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Caribbean Queen Triggerfish St. Thomas/St. John modeling process

28 November 2023
CFMC SSC Meeting

Overview of Data and Assessment Goals

- **Fishery-dependent** commercial trap removals, effort, and TIP observed length compositions
- **Fishery-independent** index of abundance (density) and observed length composition from diver survey by year (Reef Visual Census, RVC)
- **Cooperative** life history studies for locally informed growth, maturity, and mortality

The SEDAR 80 Caribbean Queen Triggerfish Assessment goal is to develop a stock assessment model using a data-limited approach similar to those approved for SEDAR 46 (Queen Triggerfish) or SEDAR 57 (Spiny Lobster).

[The good practices of practicable alchemy in the stock assessment continuum: fundamentals and principles of analytical methods to support science-based fisheries management under data and resource limitations \(Cope, 2023\)](#)

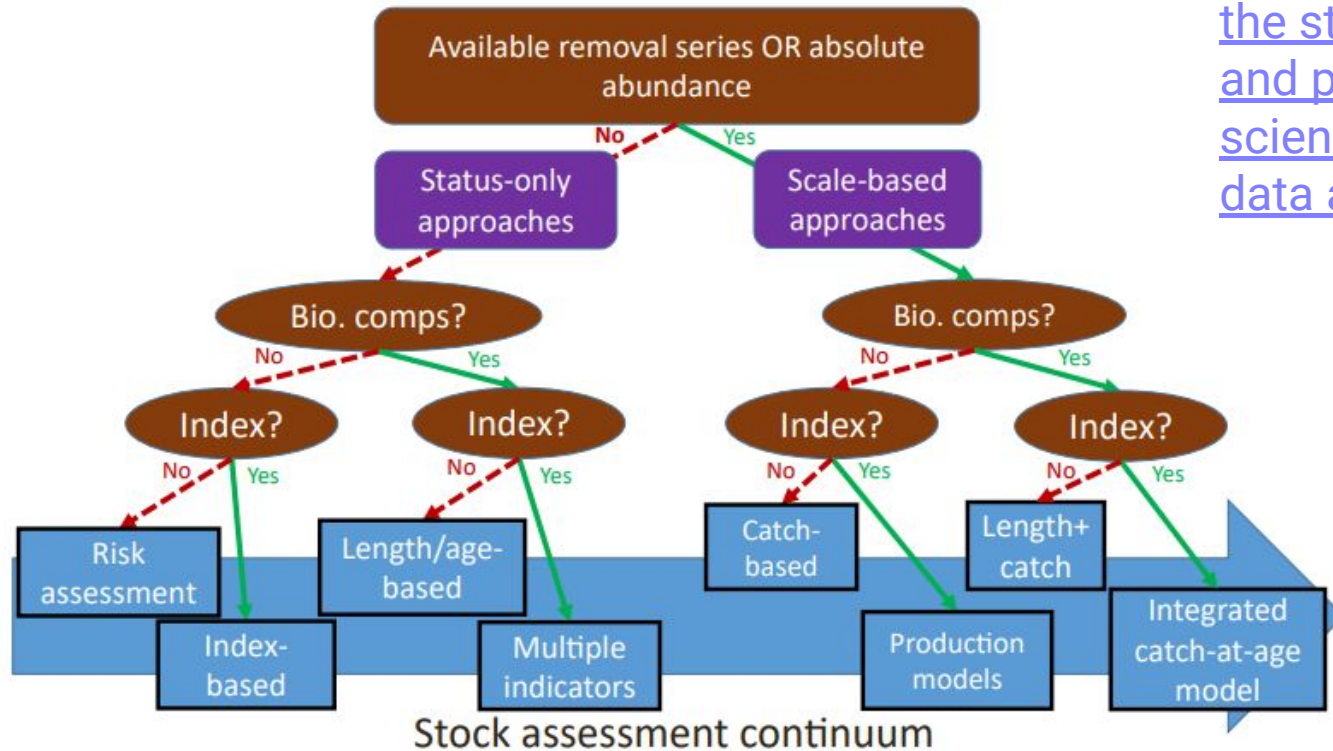


Fig. 5. Decision tree for DRL assessment options based on data availability. Two main groupings are approaches that inform status-only (left side) and those that can inform scale (right side). Status-only approaches can be used to manage fishing rates, while scale-based methods can be used to set catch limits.

Summary of Modeling Results

- Discussions with stakeholders and the SSC guided **dome-shaped selectivity and steepness inputs**
- Reference model diagnostics stable but we are unable to estimate **MSY and stock status** with confidence
 - Conflicting signals across the data sources
 - Sensitivity to inputs of growth, mortality, and data component reweighting
 - Correlated key parameters
 - There are relatively few sources of data

Data Overview

- Commercial landings (annual) and composite length composition
- RVC index and observed length composition by year

Estimated Parameters

- **Unfished recruitment (R0)**
- **Selectivity parameters**
- **Initial F (2000)**

Fixed Parameters

- Growth
- Natural Mortality
- Maturity
- **Steepness (0.99)**
- **Sigma R (0.6)**

Characterizing Uncertainty

Diagnostics

- Residual patterns
- Jitter
- Retrospective

Sensitivity

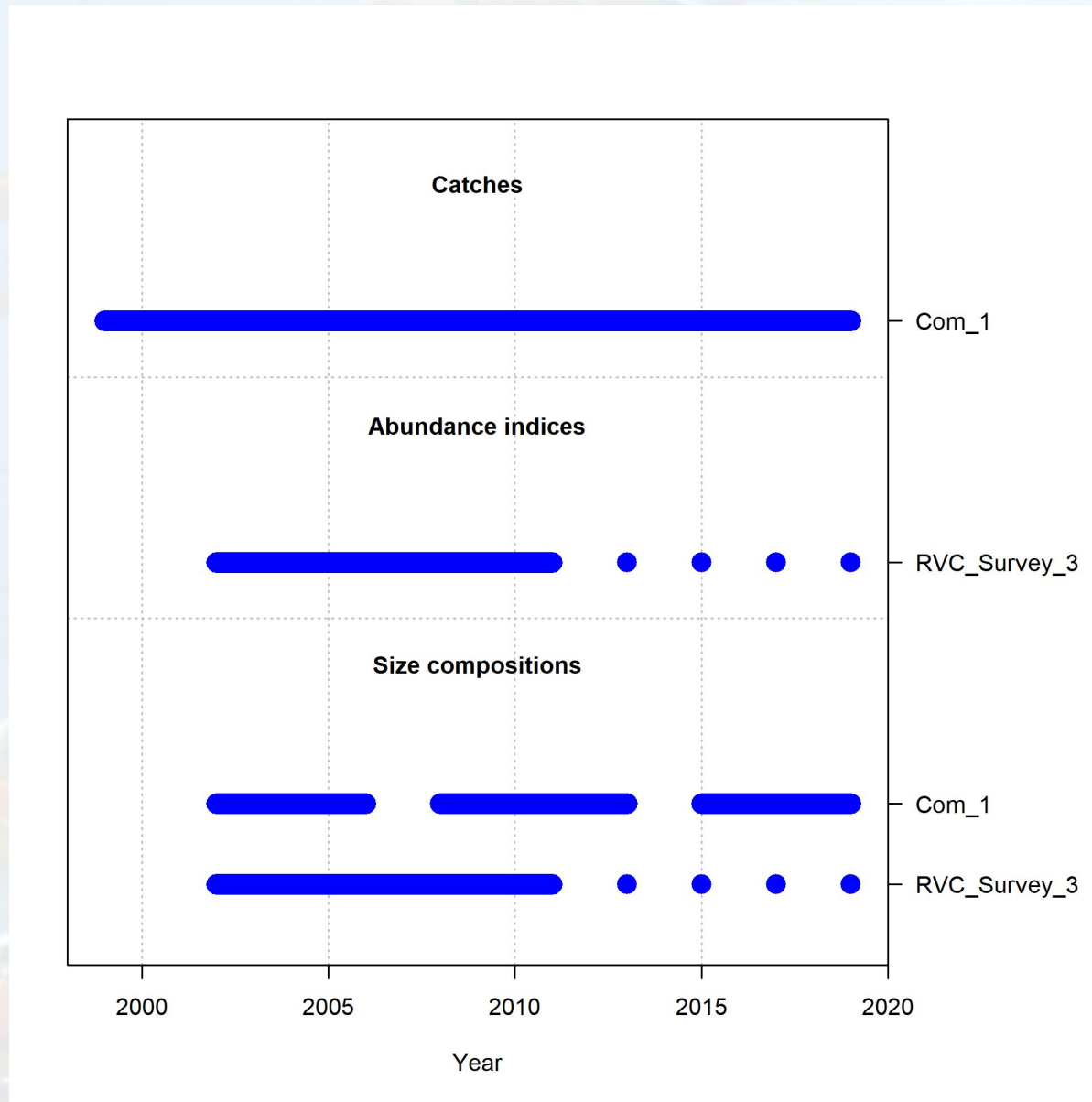
- Life history growth (higher CV)
- Run alternative growth (higher Lmax)
- Run alternative natural mortality (lower M)
- Run with reweighting (Dirichlet multinomial)
- Runs with a higher equilibrium catch (60 and 80 mt)

Profiles

- Steepness and RVC domed selectivity
- Initial equilibrium catch
- R0



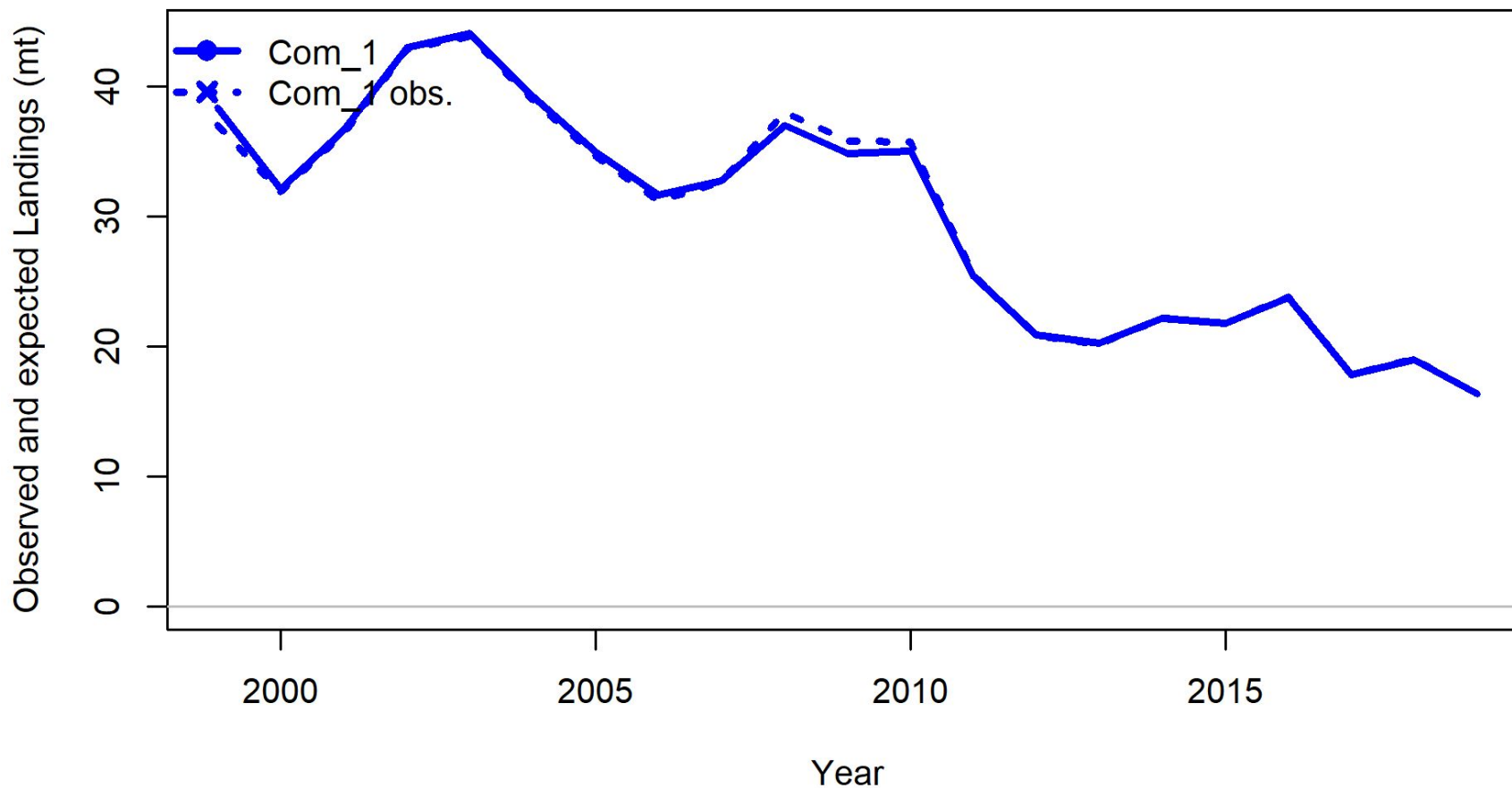
Data Overview



Commercial
Trap Fleet

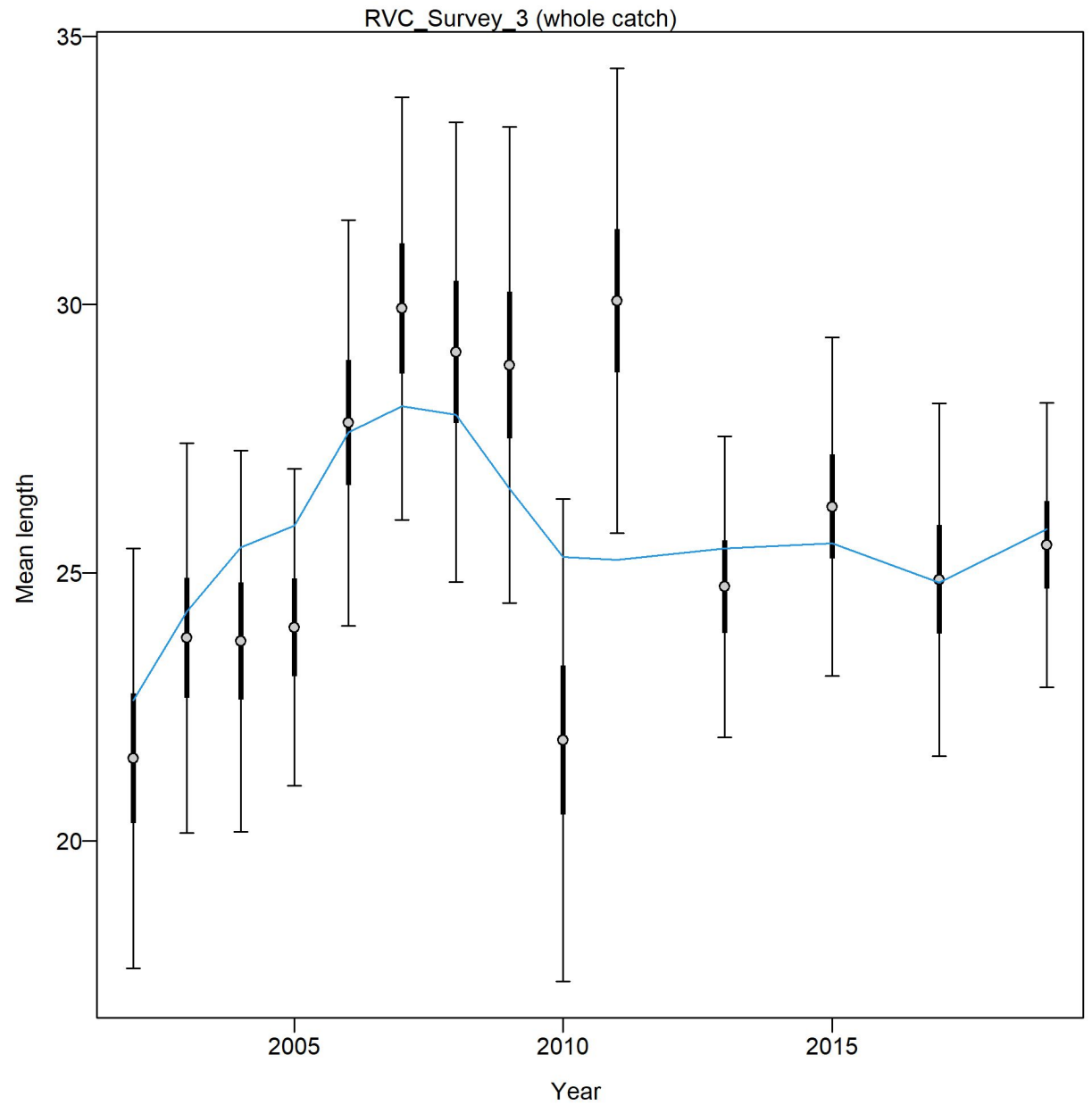
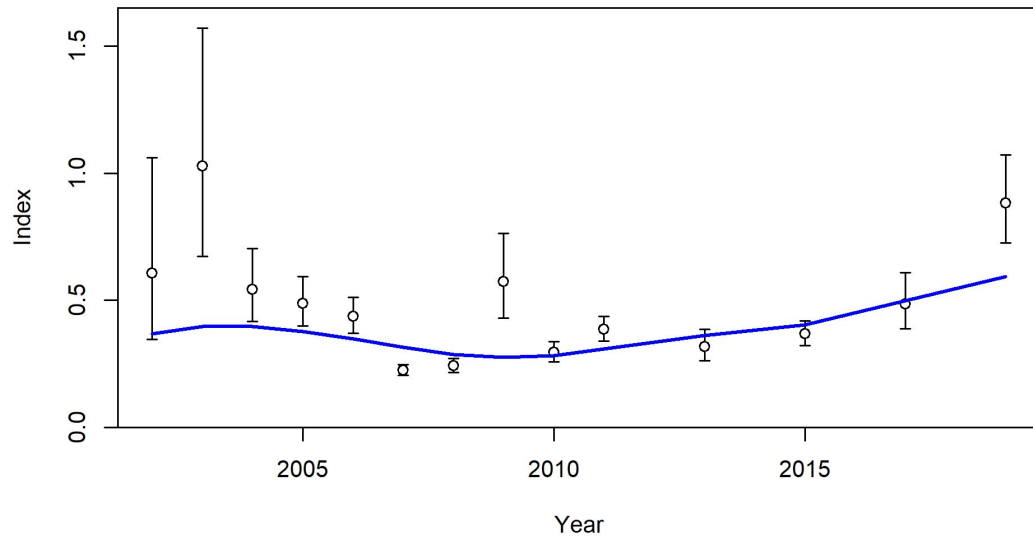
NCRMP Reef Visual
Census Survey

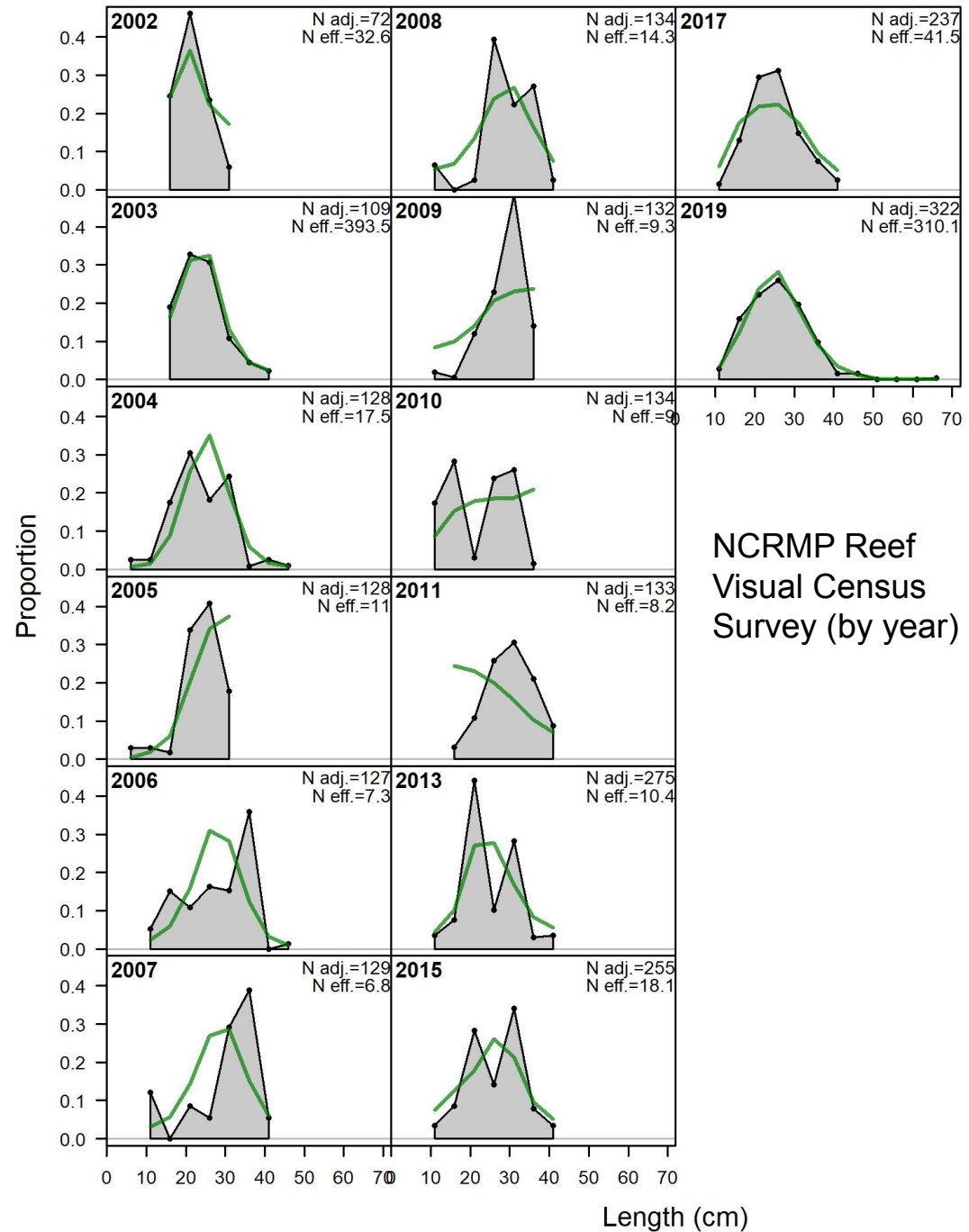
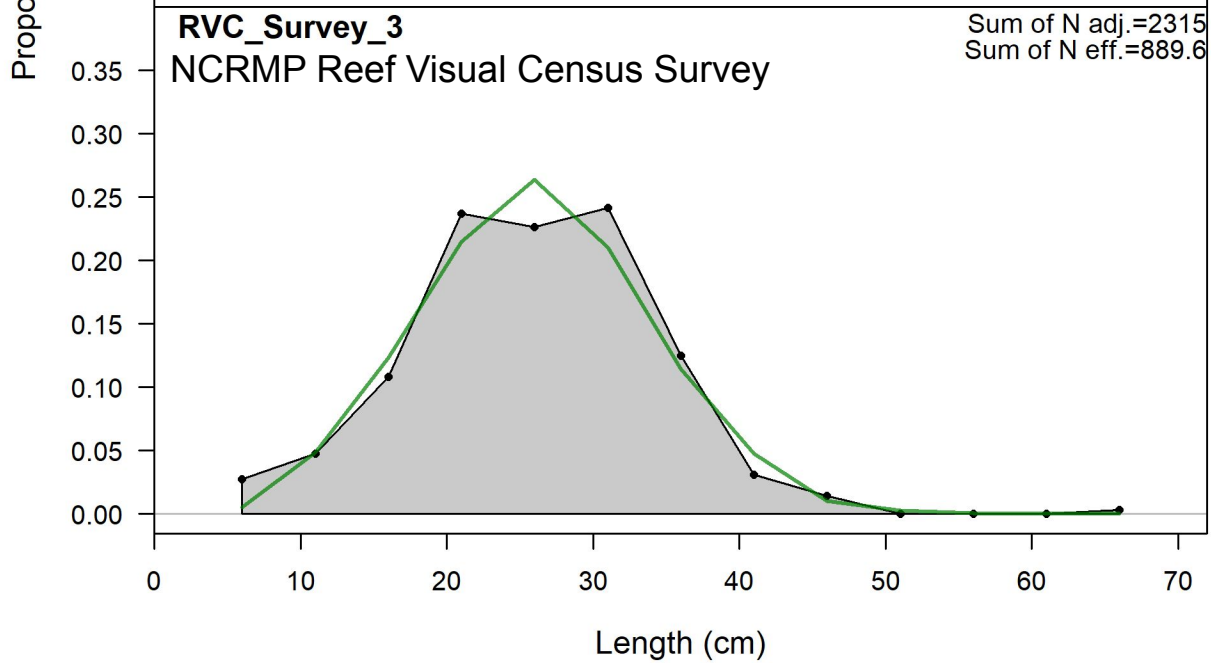
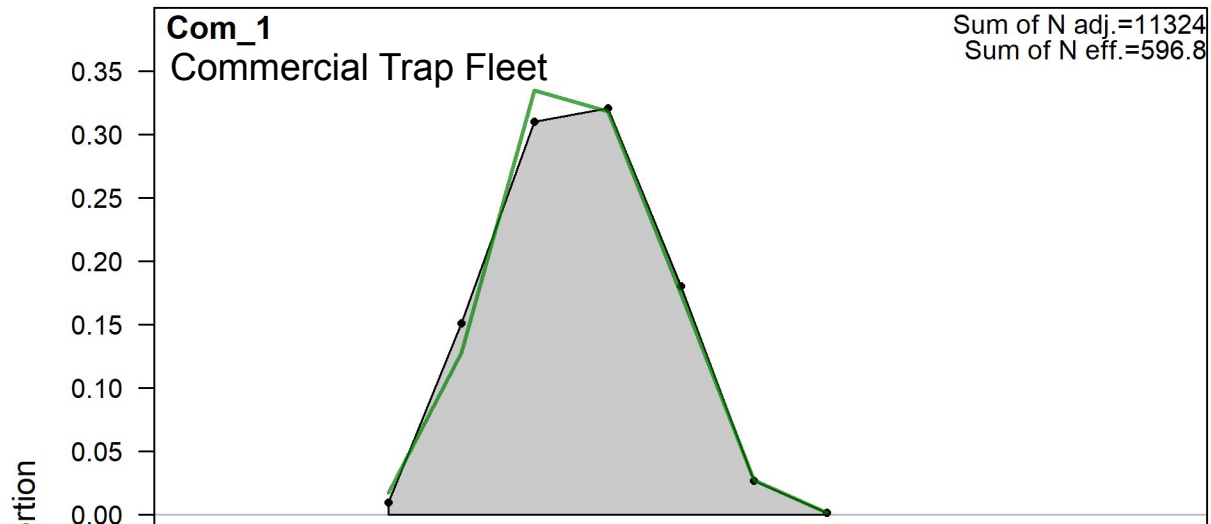
Commercial Trap Fleet Landings

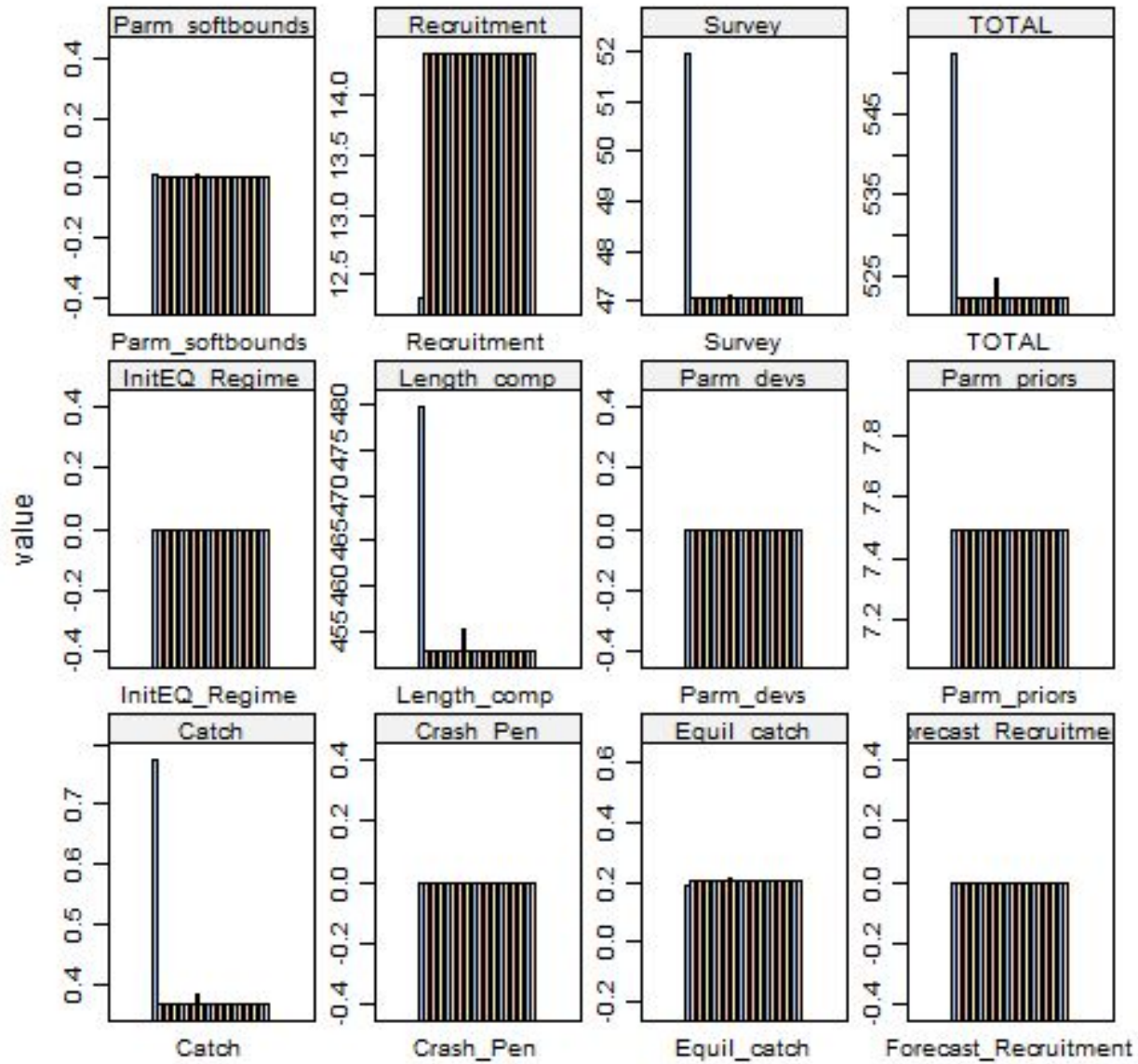


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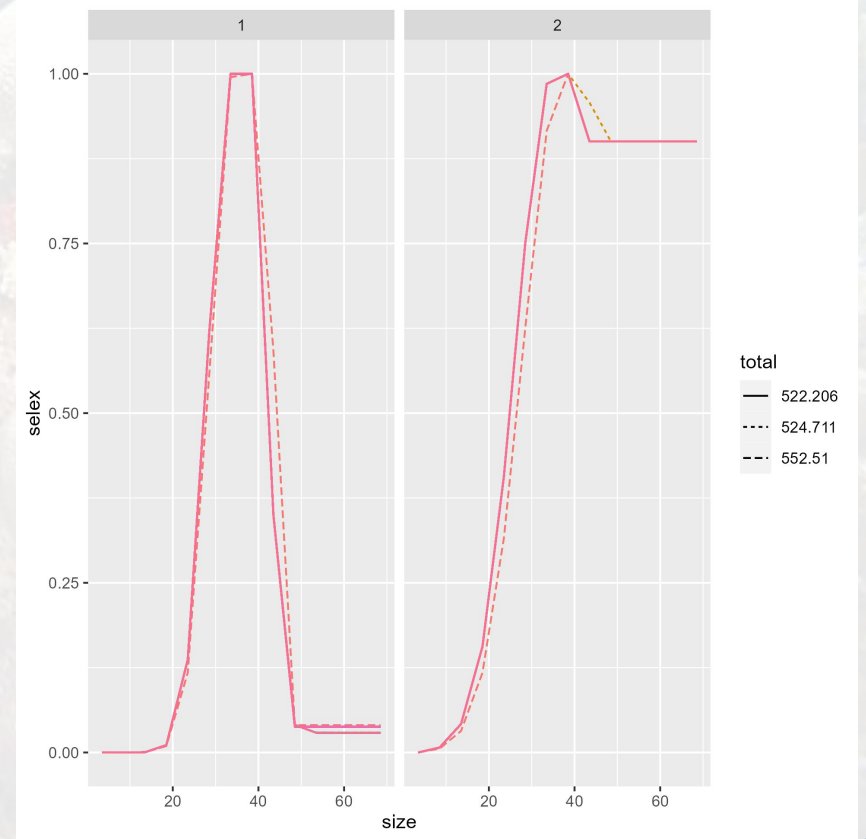
NCRMP Reef Visual Census Survey Index (left) and average length (right)



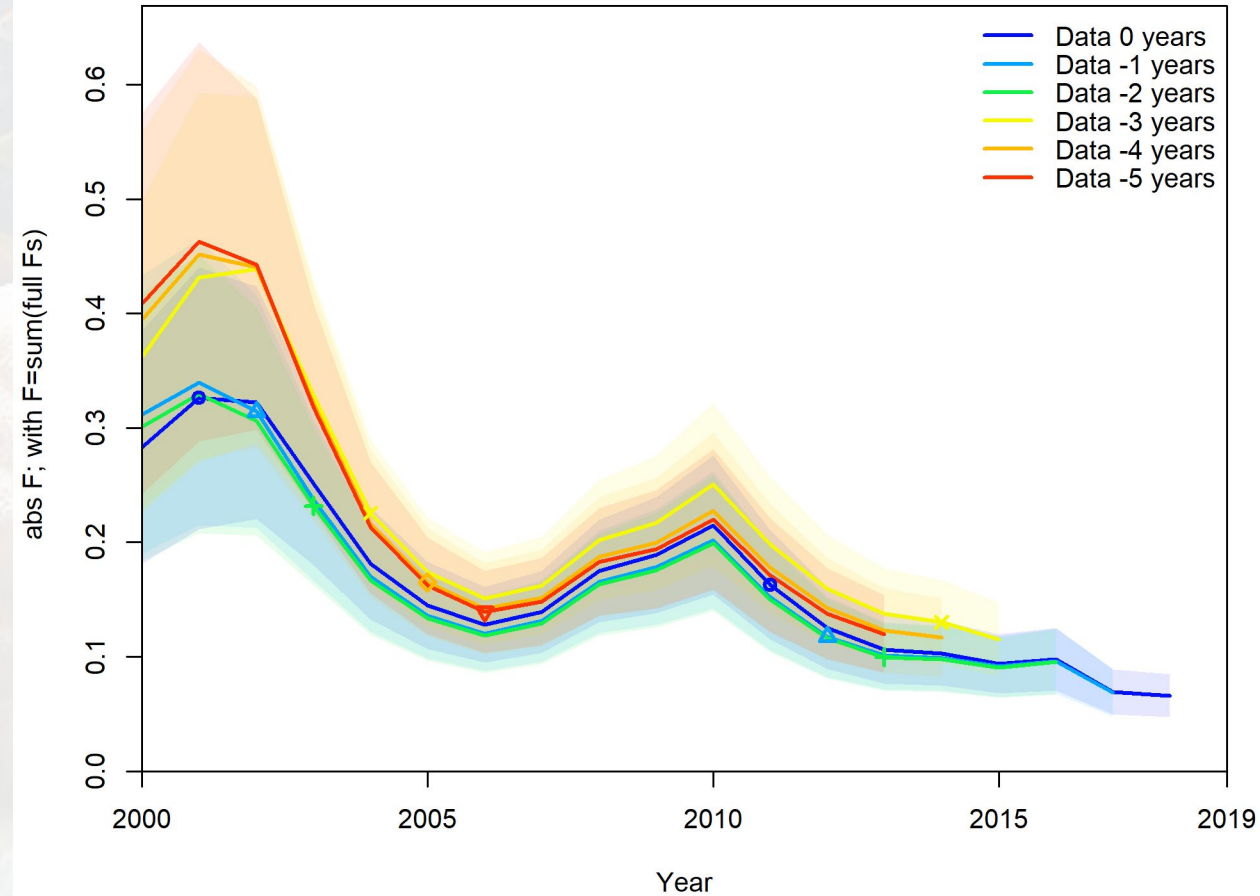
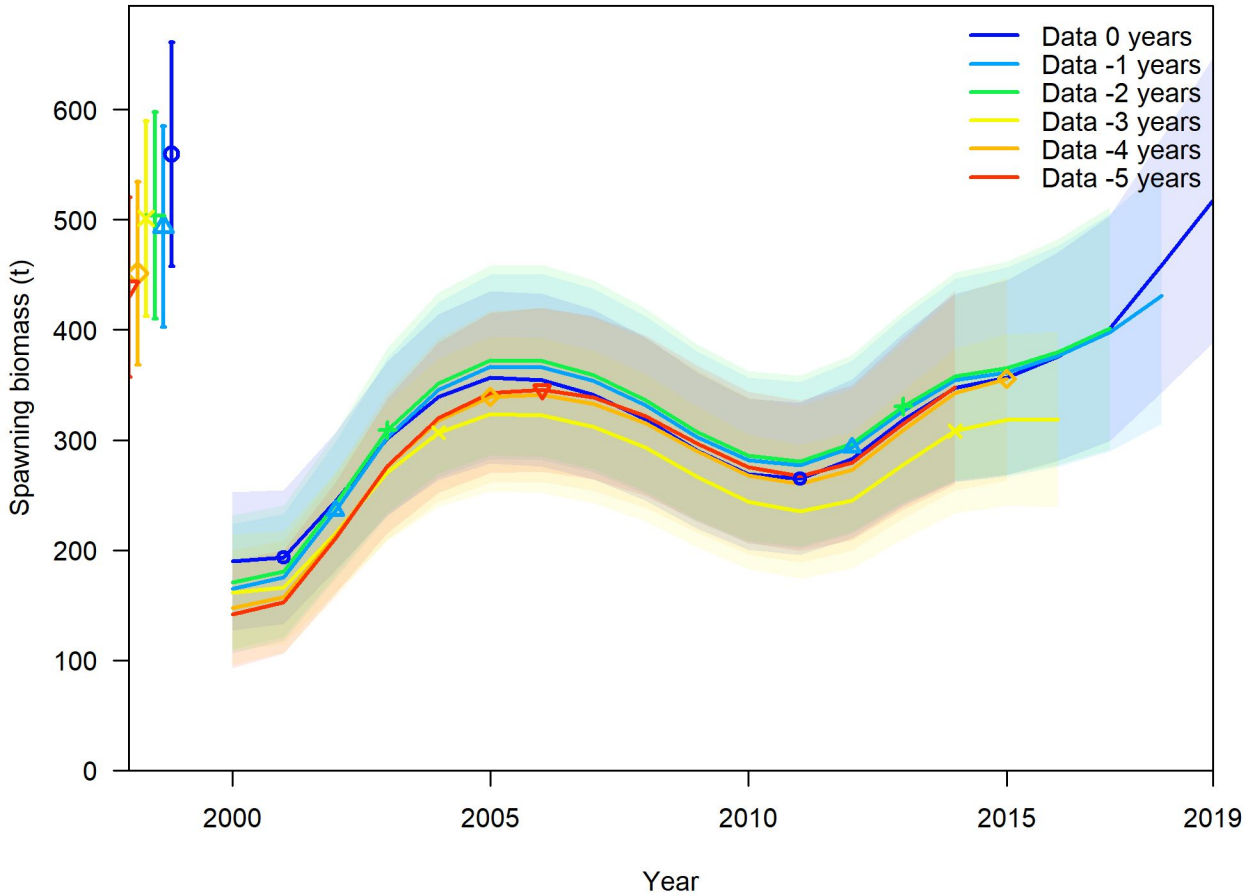




Jitter



Retrospective



Profile Result	Total Likelihood	Final selectivity parameter NCRMP Reef Visual Census Survey				
		0.97	0.93	0.88	0.83	0.79
Steepness	0.4	528.286	525.386	522.537	519.749	517.04
	0.5	524.44	521.65	518.912	516.24	513.649
	0.6	522.18	519.465	516.804	514.21	511.7
	0.7	520.961	518.297	515.689	513.149	510.694
	0.8	520.579	517.95	515.378	512.876	510.458
	0.9	521.262	518.658	516.112	513.636	511.245
	0.99	526.252	523.665	521.136	518.677	516.304

Profile Result	Survey Likelihood	Final selectivity parameter NCRMP Reef Visual Census Survey				
		0.97	0.93	0.88	0.83	0.79
Steepness	0.4	46.5911	46.5735	46.5596	46.5495	46.5434
	0.5	46.7585	46.7325	46.7089	46.6888	46.6724
	0.6	46.8602	46.8307	46.8038	46.7802	46.76
	0.7	46.9381	46.908	46.8802	46.8553	46.8335
	0.8	47.0051	46.9738	46.9458	46.9199	46.8977
	0.9	47.0622	47.0311	47.0025	46.9768	46.9536
	0.99	47.1073	47.0764	47.0475	47.0211	46.9975

Profile Result	R0	Final selectivity parameter NCRMP Reef Visual Census Survey				
		0.97	0.93	0.88	0.83	0.79
Steepness	0.4	6.8609	6.88022	6.9011	6.92363	6.94798
	0.5	6.84883	6.86686	6.88606	6.90688	6.9294
	0.6	6.83288	6.85003	6.86841	6.88834	6.90993
	0.7	6.81676	6.83366	6.85176	6.87132	6.8925
	0.8	6.80247	6.81907	6.83716	6.8565	6.87765
	0.9	6.79	6.80672	6.82473	6.84427	6.86534
	0.99	6.78049	6.79737	6.81545	6.83496	6.8561

Profile Result	Composition Likelihood	Final selectivity parameter NCRMP Reef Visual Census Survey				
		0.97	0.93	0.88	0.83	0.79
Steepness	0.4	456.771	454.243	451.775	449.381	447.076
	0.5	456.789	454.273	451.818	449.436	447.144
	0.6	456.81	454.295	451.841	449.461	447.17
	0.7	456.801	454.282	451.826	449.444	447.151
	0.8	456.765	454.245	451.786	449.403	447.108
	0.9	456.719	454.197	451.737	449.351	447.057
	0.99	456.676	454.152	451.69	449.304	447.01

Profile Result	Initial F	Final selectivity parameter NCRMP Reef Visual Census Survey				
		0.97	0.93	0.88	0.83	0.79
Steepness	0.4	0.20	0.20	0.19	0.18	0.17
	0.5	0.21	0.20	0.19	0.19	0.18
	0.6	0.22	0.21	0.20	0.19	0.19
	0.7	0.22	0.22	0.21	0.20	0.19
	0.8	0.23	0.22	0.21	0.21	0.20
	0.9	0.24	0.23	0.22	0.21	0.20
	0.99	0.24	0.23	0.22	0.21	0.20

Profile Result	Recruitment Likelihood	Final selectivity parameter NCRMP Reef Visual Census Survey				
		0.97	0.93	0.88	0.83	0.79
Steepness	0.4	23.65	23.32	22.99	22.64	22.27
	0.5	20.10	19.89	19.66	19.43	19.18
	0.6	17.85	17.72	17.57	17.42	17.26
	0.7	16.40	16.32	16.24	16.14	16.03
	0.8	15.44	15.40	15.35	15.29	15.23
	0.9	14.78	14.76	14.74	14.71	14.67
	0.99	14.35	14.35	14.35	14.33	14.31

Steepness and Domed Selectivity Profile

Fixed Parameters in Reference Model
 Steepness = 0.99
 RVC Sel Final = 0.90

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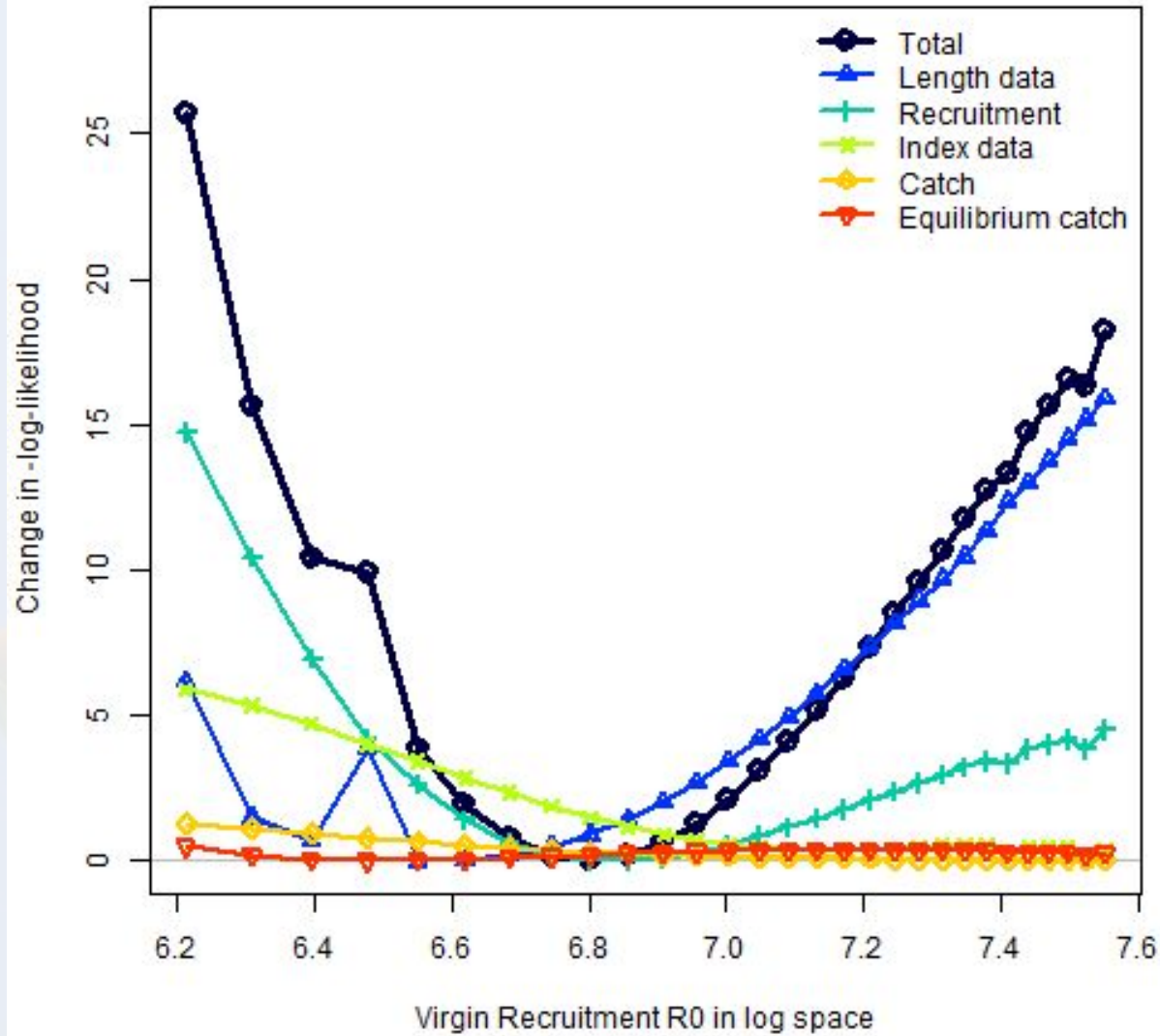
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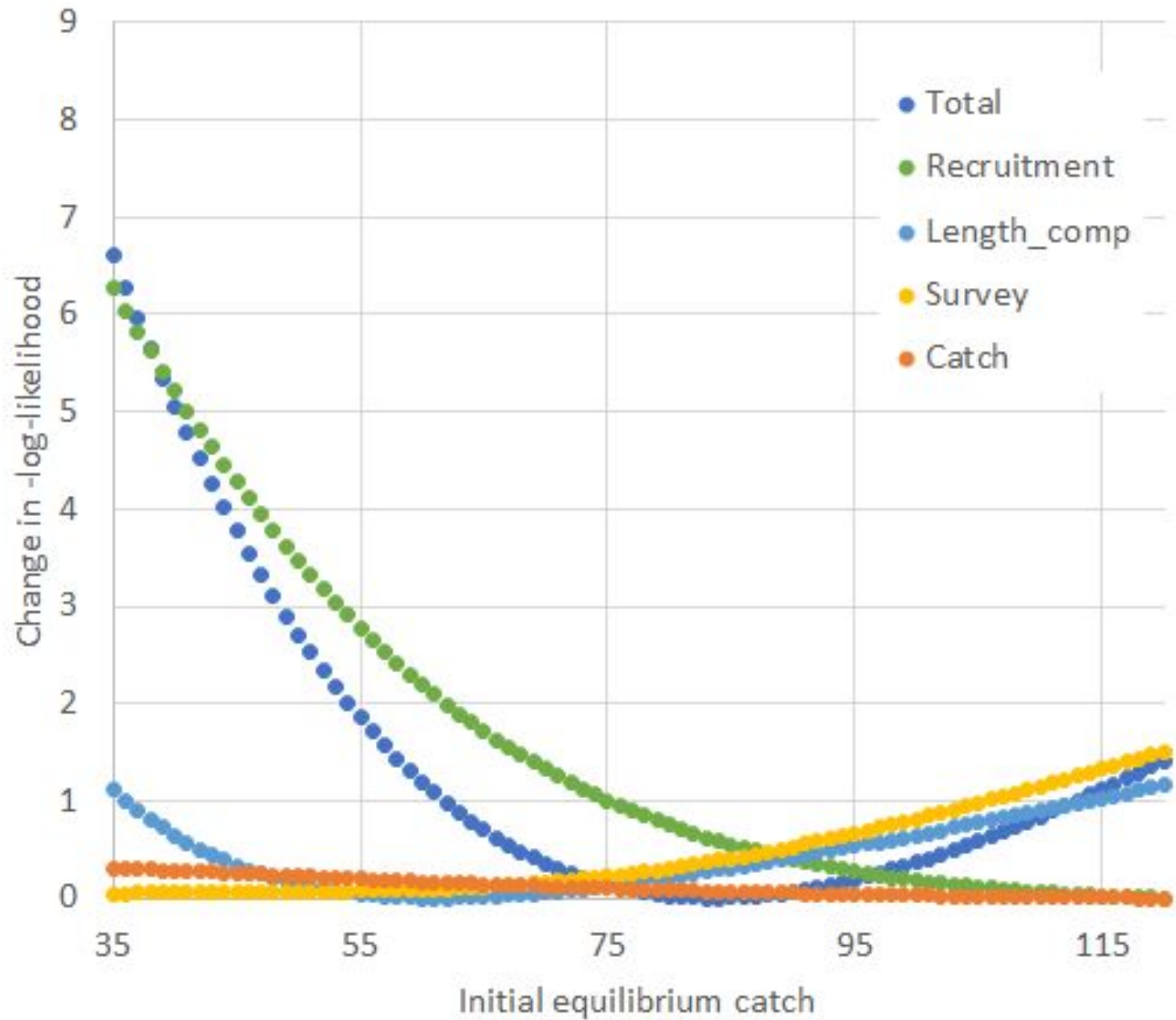
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Steepness and Domed Selectivity Profile

R0 Profile

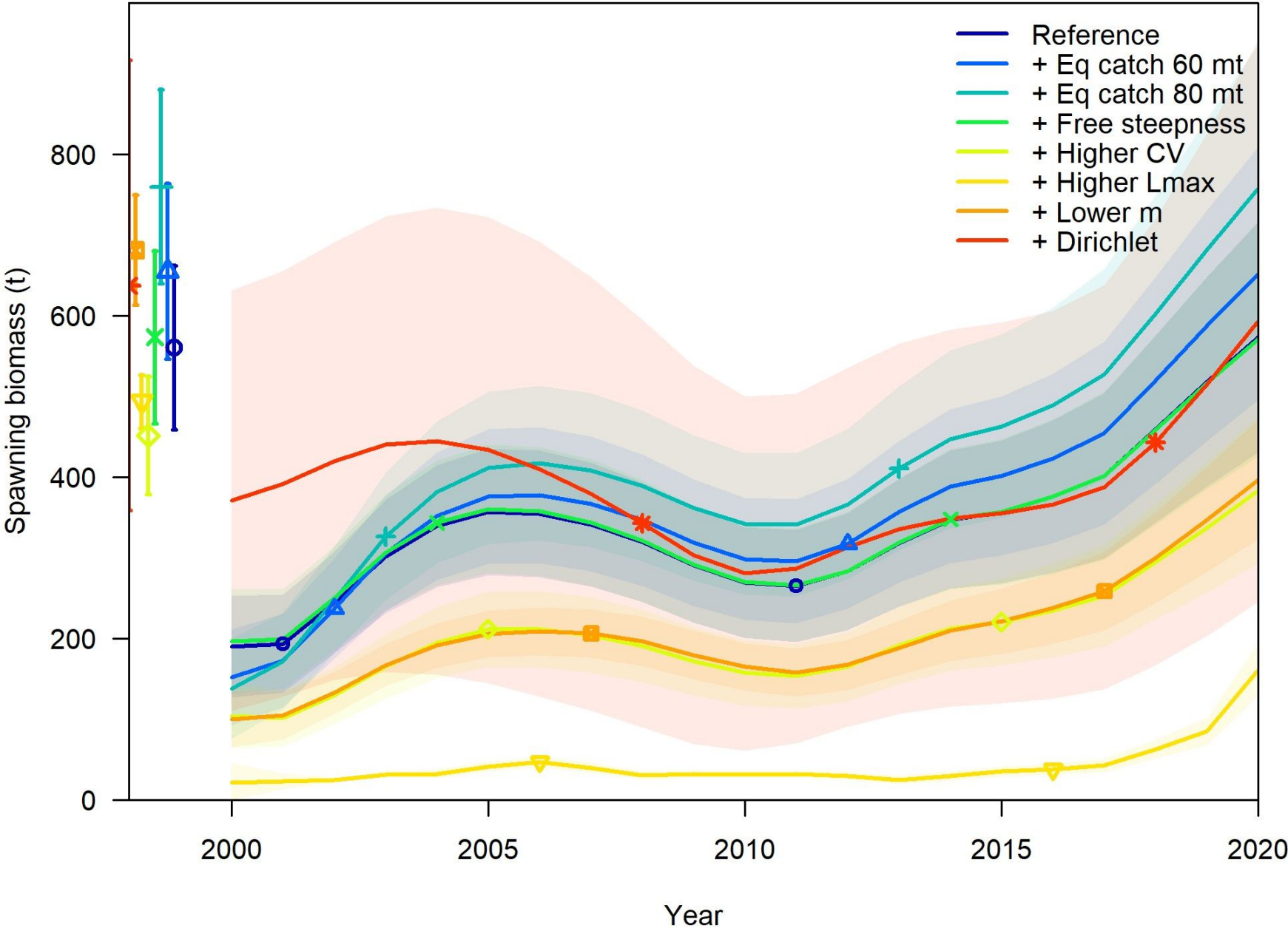




Initial equilibrium catch Profile

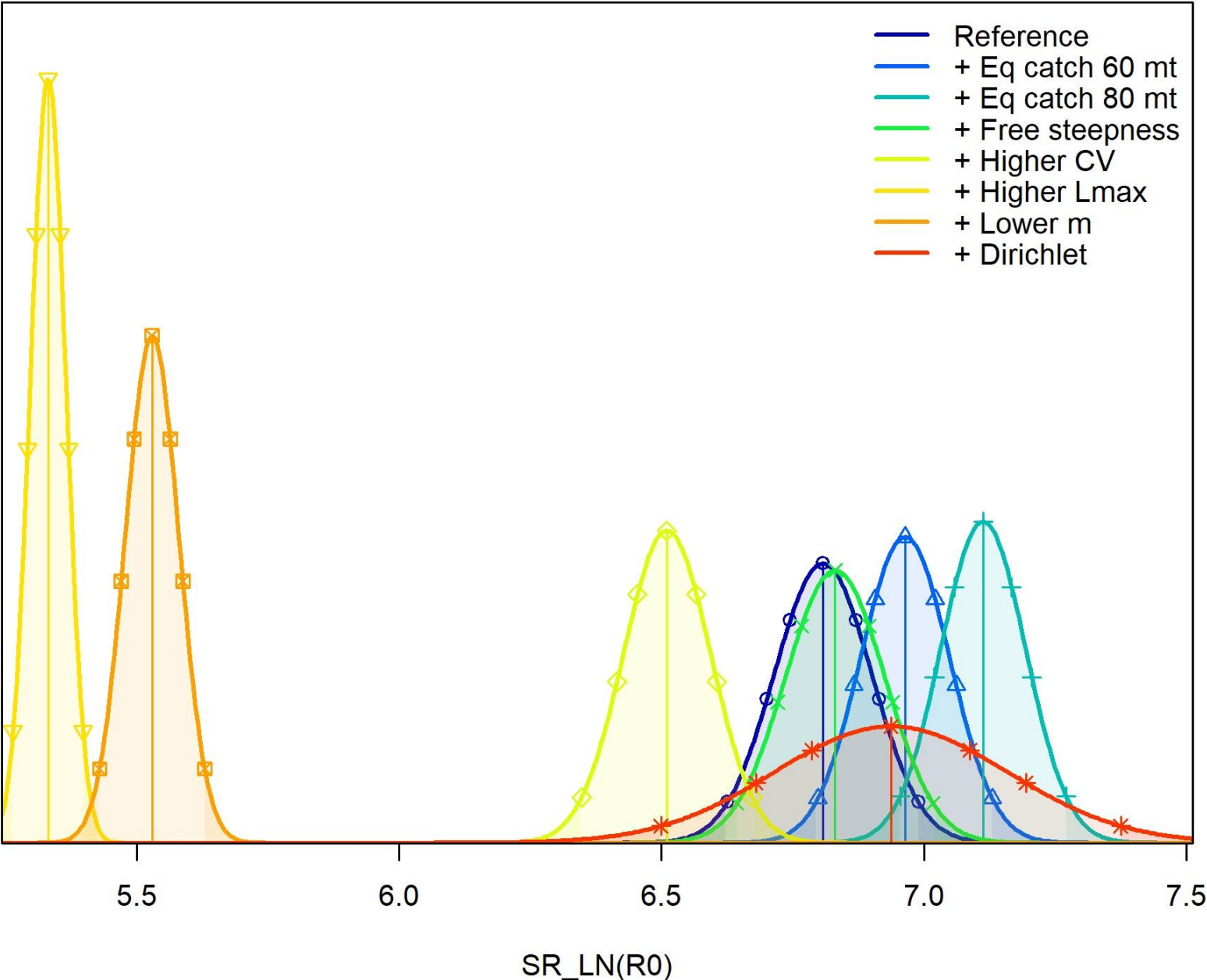
- The reference model uses the 2000-2003 three-year average of 37 mt (79,724 lbs)

Sensitivities



Sensitivities

Density



Summary of Modeling Results

- Discussions with stakeholders and the SSC guided **dome-shaped selectivity and steepness inputs**
- Reference model diagnostics stable but we are unable to estimate **MSY and stock status** with confidence
 - Conflicting signals across the data sources
 - Sensitivity to inputs of growth, mortality, and data component reweighting
 - Correlated key parameters
 - There are relatively few sources of data
 - **Abundance is increasing (FI-index)**
 - **Current catches sustainable**

Data Overview

- Commercial landings (annual) and composite length composition
- RVC index and observed length composition by year

Estimated Parameters

- **Unfished recruitment (R0)**
- **Selectivity parameters**
- **Initial F (2000)**

Fixed Parameters

- Growth
- Natural Mortality
- Maturity
- **Steepness (0.99)**
- **Sigma R (0.6)**

Are we in Tier 3?

Tier 2: Data Moderate	
Condition for Use, MSY, SDC	Data-moderate approaches where two of the three time series (catch, stage composition, and index of abundance) are deemed informative by the assessment process, and the assessment can provide MSST, MFMT, and PDF of OFL.
ABC	Same as Tier 1, but variation of the PDF of OFL (σ) must be greater than $1.5 \sigma_{\min}$ (in principle there should be more uncertainty with data-moderate approaches than data-rich approaches).
Tier 3: Data Limited: Accepted Assessment Available	
Condition for Use	Relatively data-limited or out-of-date assessments
MSY	MSY proxy = long-term yield at proxy for F_{MSY}
SDC	MFMT = F_{MSY} proxy MSST = $0.75 * \text{SSB}_{\text{MFMT}}$ or proxy OFL = Catch at MFMT
ABC	ABC determined from OFL as reduced (buffered) by scientific uncertainty ⁴ and reflecting the acceptable probability of overfishing ² <ul style="list-style-type: none"> a. Where the buffer is applied to the PDF of OFL when the PDF is determined from the assessment (with $\sigma \geq 2\sigma_{\min}$) <p>OR</p> <ul style="list-style-type: none"> b. Where ABC = buffer * OFL, where buffer must be ≤ 0.9



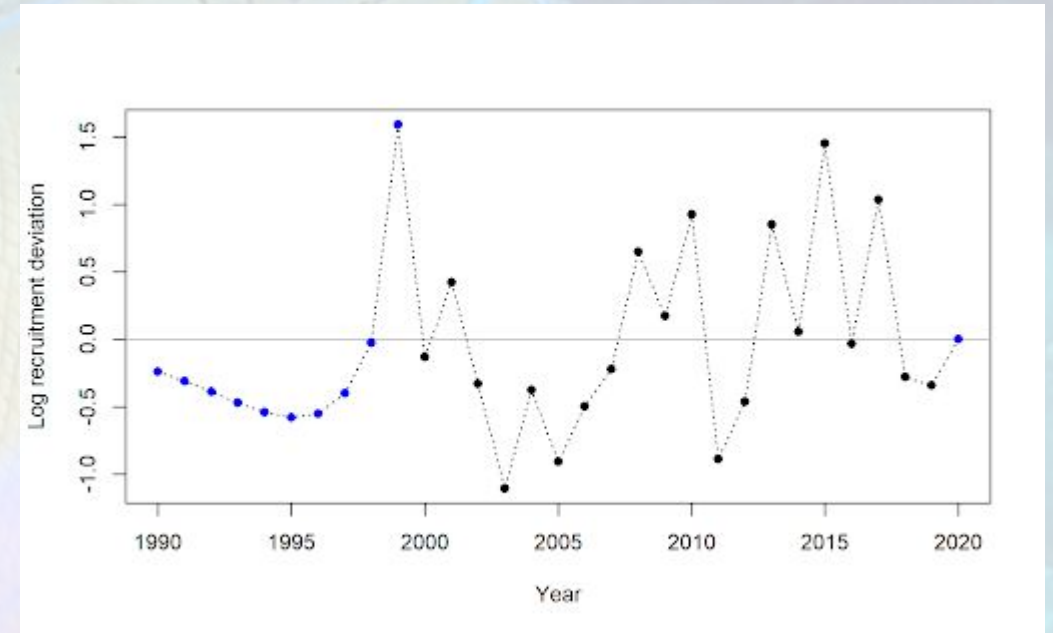
Management Summary

- Current catch limits for St. Thomas and St. John Queen Triggerfish
 - SYL 205,621 lbs
 - ABC 102,810 lbs
 - ACL 97,670 lbs
- Recent years of catch:
 - 2019 35,971 lbs
 - 2020 38,152 lbs
 - 2021 39,740 lbs
- While the results across the model runs suggest that catch could increase above current levels, it is unclear by how much.

Possible Management Options

- Interim determination
 - Set ABC at sustainable current level of catch
 - Use ABC control rule and retain it in Tier 4
 - Use tier 3 (further discussions to define proxy and recent recruitment, to obtain short-term catch advice)
 - Determine catch advice from projection of X% of F_{SPR40}
 - determine period of assumed recruitment
 - Can be justified outside of tier control rule
- Focus future assessment on MSE tested management procedures and other alternative approaches

- Years of recruitment
 - (2000-2019)
 - Projecting with steepness of 1 (test)
- F SPR Proxy (initially 40%)
 - levels of F proxy for computing catch levels; e.g., 100% FSPR, 75% FSPR
- Decision table to characterize uncertainty
 - Reference model
 - Flexible Variations (high and low values)
 - M; initial catch (initial f); steepness
 - Low M, High F, low steepness
 - High M, Low F, high steepness
 - Set R0 (high and low); see how wide the parameter estimates



We can't reliably estimate scale.
 "Understanding the scale of the stock allows for the specification of abundance-based management measures such as catch limits." - Jason Cope

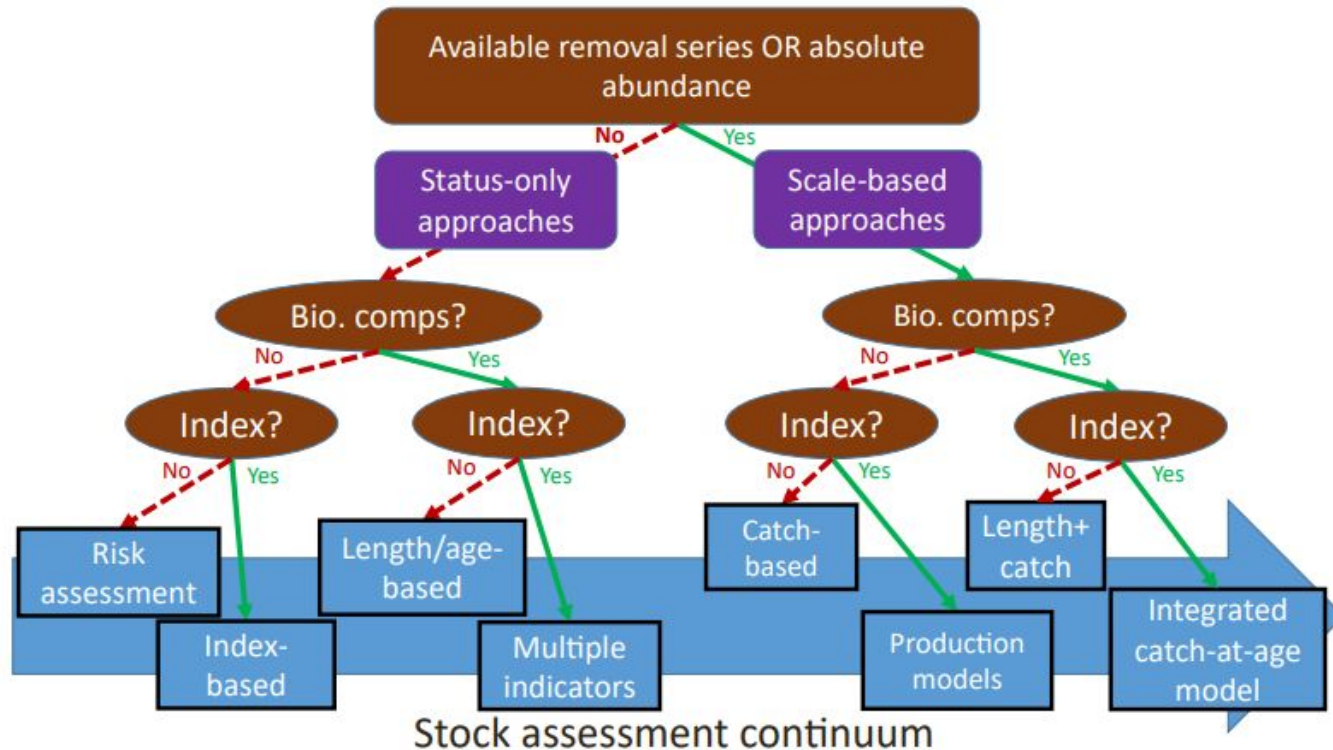
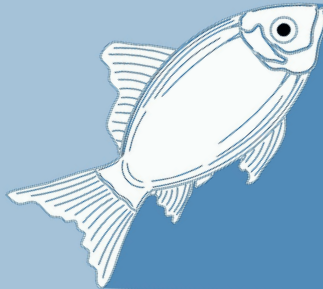


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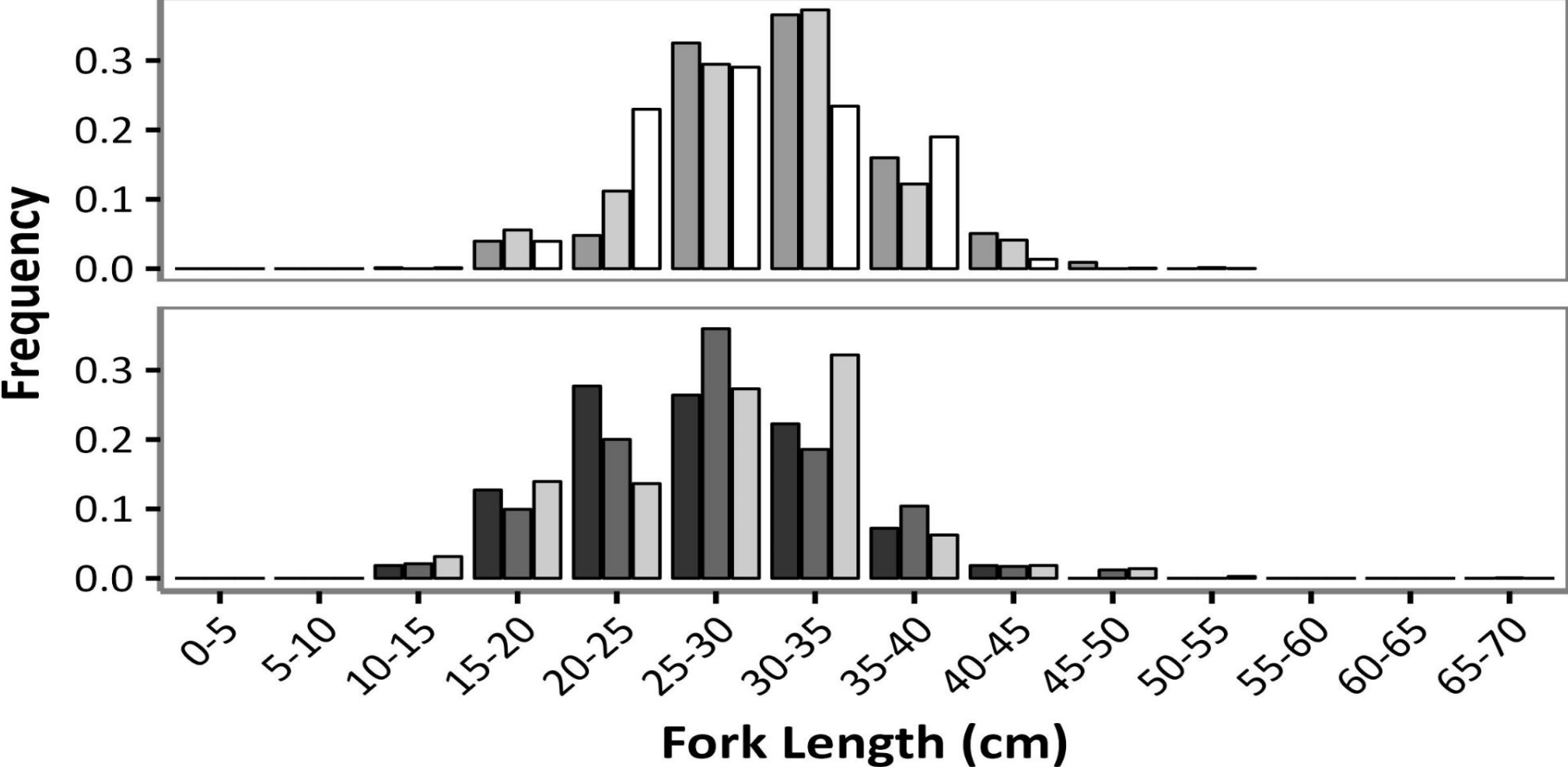


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Questions?
¿Preguntas?

NCRMP (RVC) and DCRMP size comps



DCRMP

NCRMP (RVC)

Sampling Year 2017 2019 2020 2021 2022



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St. Croix Overview

