U.S. Caribbean Yellowtail Snapper St. Thomas and St. John, USVI

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I. Introduction & Background

- Maps
- Current Management
- Management History
- Stock Complexes
- Assessment History

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Current Management

- Island-based fishery management plans effective as of October 2022
  - St. Thomas St.John Fishery Management Plan
  - Annual Catch Limits for Stocks and Stock Complexes
- 2022 ACL for St. Thomas and St. John Snapper 4 (Yellowtail Snapper)— 88,952 lbs
  - *2000-2010 reference; 2012-2016 ratio*
  - Based on commercial landings but applies to all harvests
  - Accountability measures apply if ACL is exceeded

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Management History

- Federal Waters
  - 1986 8-inches total length size limit; increased one inch per year
  - 1989 12-inches total length size limit
  - 1990 requirement for heads, fins, and tails to be landed intact
  - 2005 FMP comprehensive amendment
  - 2012 recreational bag limit 5 per person/day, and 15 per vessel/day
  - 2012 ACL for St. Thomas and St. John Snappers 133,775 lb *(2000-2005 reference)*

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Assessment History

- 1992 Appeldoorn et al.
  - Part of a broader reef fish assessment
  - Used length frequency analyses
  - Limited in scope and data resolution
- 2005 SEDAR 08
  - Explored CPUE trends and length frequency changes
  - Insufficient data to reliably parameterize models
  - Unable to determine stock status

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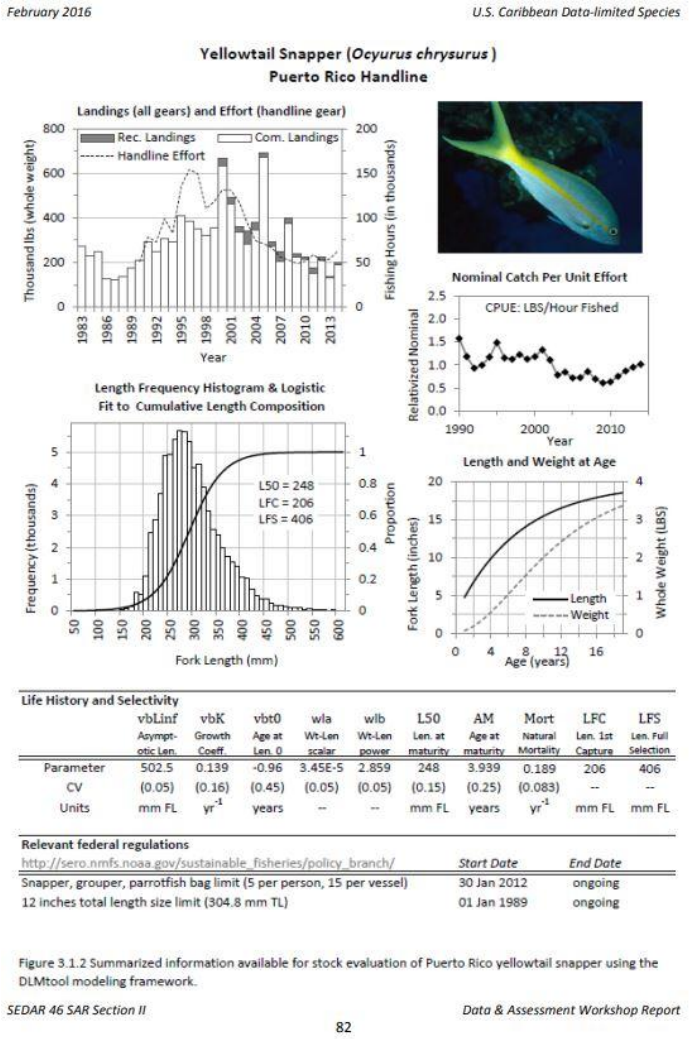
Assessment History (cont.)

- 2016 SEDAR 46
  - Applied Data-Limited Methods Toolkit (Carruthers, 2018)
  - Evaluated six species across island units
  - Included Yellowtail Snapper in Puerto Rico
  - Results ultimately not used for management advice



February 2016 *U.S. Caribbean Data-limited Species*

Yellowtail Snapper (*Ocyurus chrysurus*)
Puerto Rico Handline

Landings (all gears) and Effort (handline gear)

Nominal Catch Per Unit Effort

Length Frequency Histogram & Logistic Fit to Cumulative Length Composition

Length and Weight at Age

Life History and Selectivity	vbLinf Asympt-otic Len.	vbK Growth Coeff.	vbt0 Age at Len. 0	wla Wt-Len scalar	wlb Wt-Len power	L50 Len. at maturity	AM Age at maturity	Mort Natural Mortality	LFC Len. 1st Capture	LFS Len. Full Selection
Parameter	502.5	0.139	-0.96	3.45E-5	2.859	248	3.939	0.189	206	406
CV	(0.05)	(0.16)	(0.45)	(0.05)	(0.05)	(0.15)	(0.25)	(0.083)	--	--
Units	mm FL	yr^{-1}	years	--	--	mm FL	years	yr^{-1}	mm FL	mm FL

Relevant federal regulations http://sero.nmfs.noaa.gov/sustainable_fisheries/policy_branch/	Start Date	End Date
Snapper, grouper, parrotfish bag limit (5 per person, 15 per vessel)	30 Jan 2012	ongoing
12 inches total length size limit (304.8 mm TL)	01 Jan 1989	ongoing

Figure 3.1.2 Summarized information available for stock evaluation of Puerto Rico yellowtail snapper using the DLMtool modeling framework.

SEDAR 46 SAR Section II *Data & Assessment Workshop Report*

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II. Data & Methods

- Data Sources Overview
- Data Workshop Outcomes
- Post-Data Workshop Outcomes
- Modeling Approach
- Assessment Methodology
- Assessment Overview
- Data Sources

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Data Sources Overview

1. **Landings** from self-reported commercial fisher logbooks
2. **Length compositions** from shore-based port sampling
3. **Length compositions** from a two fishery-independent surveys of reef fish
4. **Index of abundance** from a two fishery-independent surveys of reef fish
5. **Life history information** from otolith analysis and gonad histology

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Data Workshop Outcomes

- Use life history data made available in SEDAR working papers.
- Only use commercial landings data starting in 2012.
- Consider directional bias
- Identify and flag outliers.
- Use gear groups informed by the TIP data (handline, traps, and rod and reel)
- Assume commercial discards are negligible.

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Data Workshop Outcomes (cont.)

- Utilize TIP lengths from 2012-2022 to inform selectivity and annual population trends.ity.
- Use the NCRMP Stoplight Parrotfish data for STX from 2012 to 2022.
- Do not consider the fishery-dependent information for an abundance indices.

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Post-Data Workshop Outcomes

- Assessment panel accepted landings outliers retained as valid trips
- Assessment panel accepted one combined commercial fleet configuration

Modeling Approach

- Stock Synthesis V3.30.22 was the modeling approach applied in the current SEDAR 84 assessment because of compatibility with the available data and consistency with standard practices.
- 40% SPR used as a proxy for MSY.
- Tools for working with Stock Synthesis
  - r4ss: Create plots and tables of Stock Synthesis output and functions to work with Stock Synthesis in R.
  - ss3diags: Run advanced diagnostics for Stock Synthesis models.
  - Stock Assessment Continuum Tool (previously the SS-DL-tool) a shiny app that includes Extended Simple Stock Synthesis and Simple Stock Synthesis in its functionality.

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Assessment Method

- Began with data-limited models using super-period length compositions
  - Steepness fixed at 0.99
  - Sigma R fixed at 0.7
- Model progression tracked biological/data complexities:
  - m1: Adjusted length at age zero
  - m2: Continuous recruitment
  - m3: Increased catch uncertainty
- Progressed to data-moderate models incorporating:
  - Abundance indices
  - Annual fishery-independent length compositions
  - Recruitment deviations

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Model Development

Stage	Code	Sequential modeling steps
Initial	ct	model initialized with continuum tool (ct)
Initial	m1	ct + adjusted length at age zero
Initial	m2	m1 + continuous recruitment
Initial	m3	m2 + catch uncertainty
Scenario	null	catch and super-year length data
Scenario	a	index
Scenario	v1	index + annual fishery-independent length data
Scenario	v4	index + dome-shaped selectivity
Scenario	v8	index + annual fishery-independent length data + dome-shaped selectivity
Scenario	v19	index + annual fishery-independent length data + dome-shaped selectivity + recruitment deviations
Sensitivity	s1	higher CV on growth young
Sensitivity	s2	higher age and lower m
Sensitivity	s3	higher catch uncertainty
Sensitivity	s4	s2 + s3

Model	Description
STTJ_RW_1	Single Sex, F method 2, Catch SE = 0.3, and Corrected Survey SE
STTJ_RW_2	STTJ_RW_1 + Catch SE = 2 and Estimated Growth
STTJ_RW_3	STTJ_RW_1 + 12-year Age Plus Group
PR_STTJ_RW_1	PR_RW_3 + STTJ Fleet and STJ Survey; **does not converge**
PR_STTJ_RW_2	PR_STTJ_RW_1 + Estimated Length at Maximum Age and Fixed Selectivity and 0.8 Steepness

model runs included developed under the direction of the Review Workshop Panel to explore data use and model behavior

S84 Addendum

- The models remain preliminary and sensitive to consequential assumptions (e.g., initial equilibrium catch, recruitment steepness, selectivity).
- Further work is required to address these uncertainties and develop models more robust for informing management advice.
- These models do not represent final scientific advice. They are intermediate steps in an iterative review process leading to future model development, SSC review, and eventual management consideration.

CIE Review

- Although SS3 was implemented correctly, the quality and availability of the data were not robust enough to fully support such a complex model. Diagnostics and the additional model runs revealed sensitivities to assumptions about catch uncertainty (fits to the catch vs index data) and estimation of growth.
- The RP recommended further data collection, consideration of alternative modeling approaches, and reintegration of historical information.

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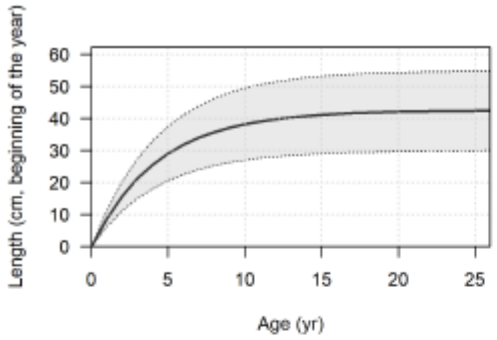
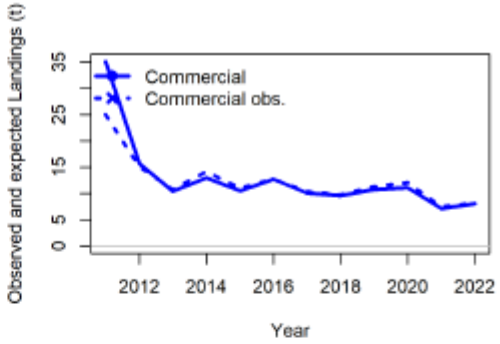
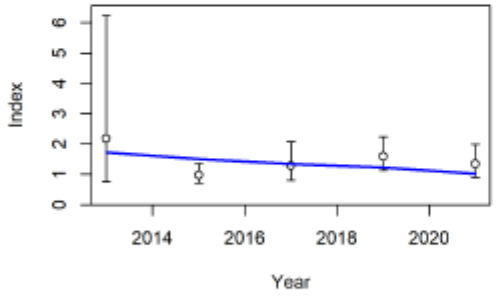
SEDAR 84 SAR SECTION VI - Addendum



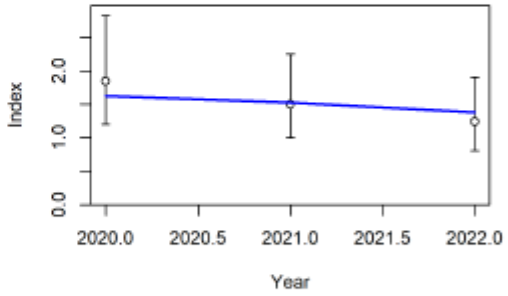
(a) Size at age



(b) Observed and expected landings

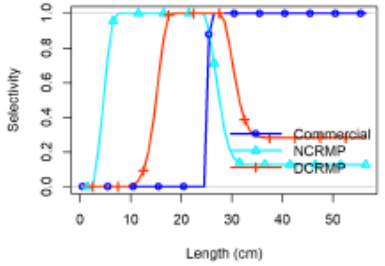


(c) Index NCRMP

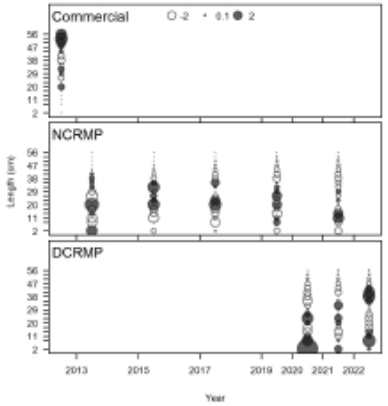


(d) Index DCRMP

Figure 1: St. Thomas and St. John Yellowtail Snapper Review Workshop Model STTJ_RW_1 (a) Length at age in the beginning of the year (or season) in the final year of the model. Shaded area indicates 95% distribution of length at age around estimated growth curve; (b) observed and expected landings; (c) Fit to index data for the NCRMP survey.; and (d) Fit to index data for the DCRMP survey.

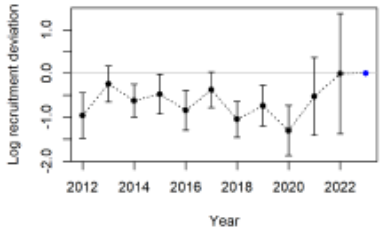


(a) Selectivity

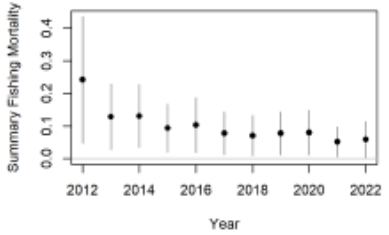


(b) Length fit

Figure 4: St. Thomas and St. John Yellowtail Snapper Review Workshop Model STTJ_RW_1. (a) selectivity at length by fleet; and (b) Pearson residuals, comparing across fleets. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).



(a) Recruitment deviations



(b) Fishing Mortality

Figure 5: St. Thomas and St. John Yellowtail Snapper Review Workshop Model STTJ_RW_1 (a) Recruitment deviations with 95% intervals; and (b) fishing mortality (total biomass killed / total biomass).

Assessment Overview

- Stock Assessment Continuum Tool used to build initial models
- Models configured with 1 area, 1 fleet, and 2 surveys; 2012—2022
- Sensitivities tested using:
  - Longevity-based natural mortality
  - Growth variability (CV on growth)
  - Uncertainty in initial equilibrium catch
- Diagnostics included:
  - Gradients, residuals, likelihood profiles
  - Retrospectives and jitter analyses

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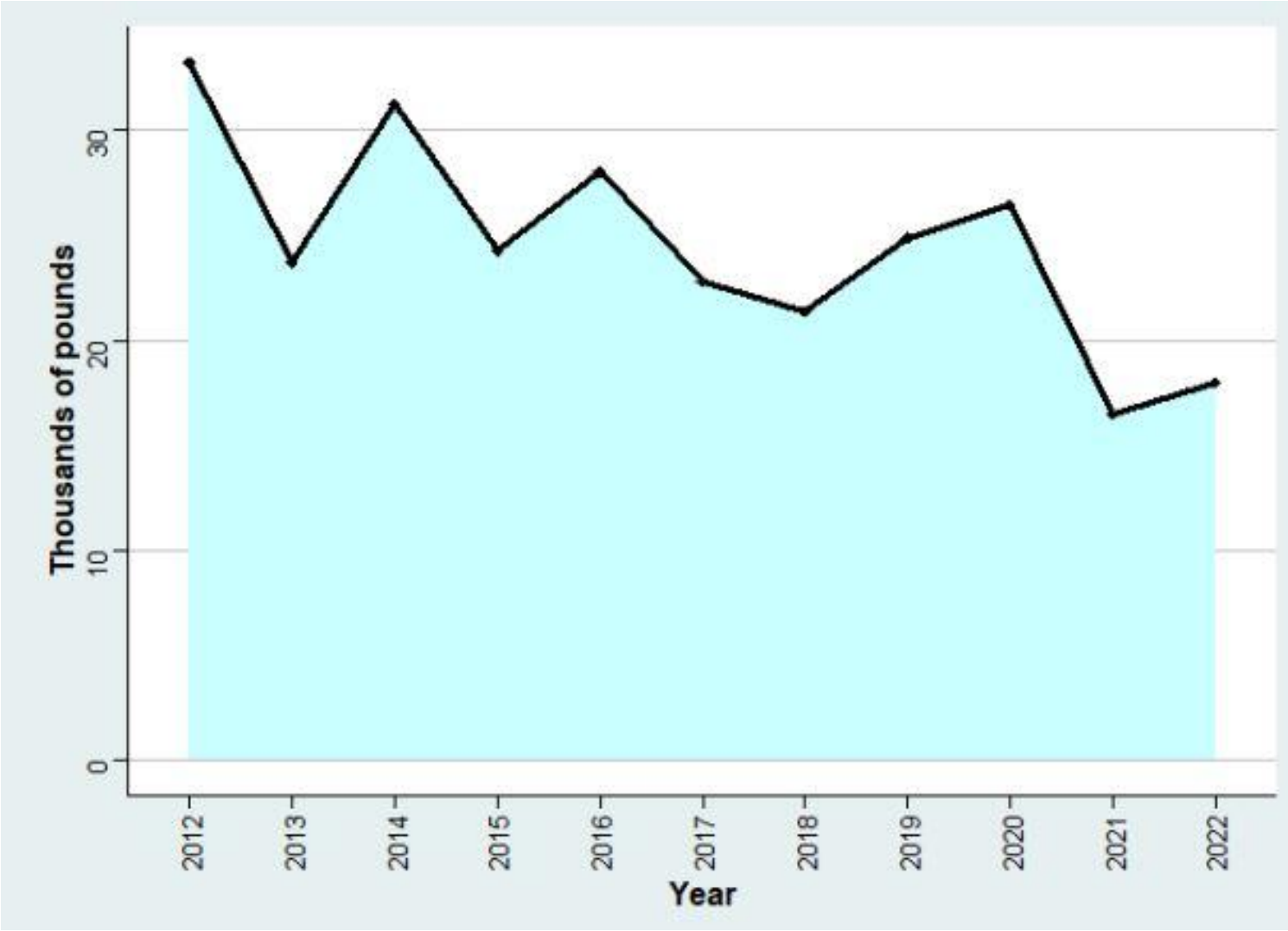
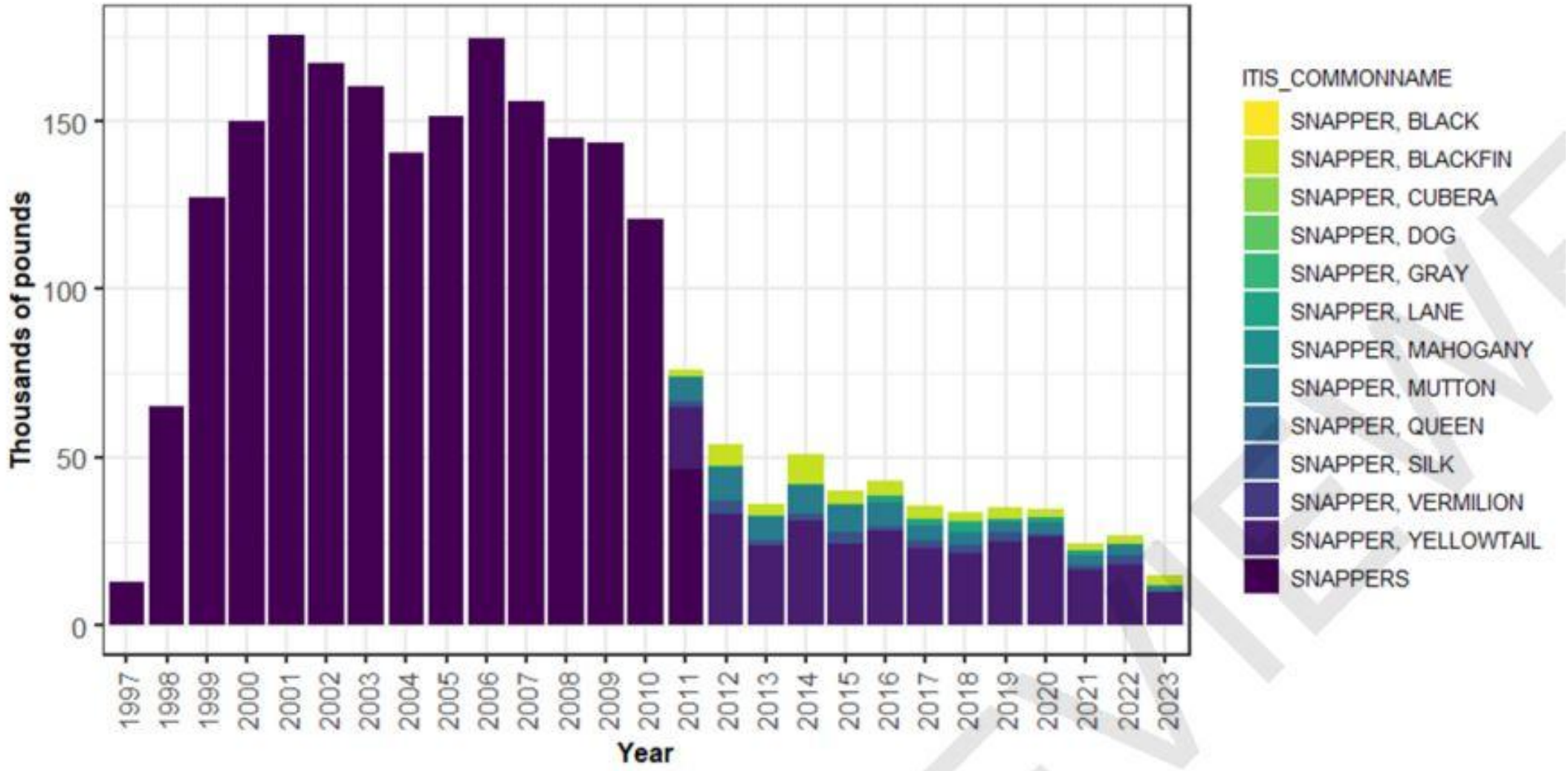
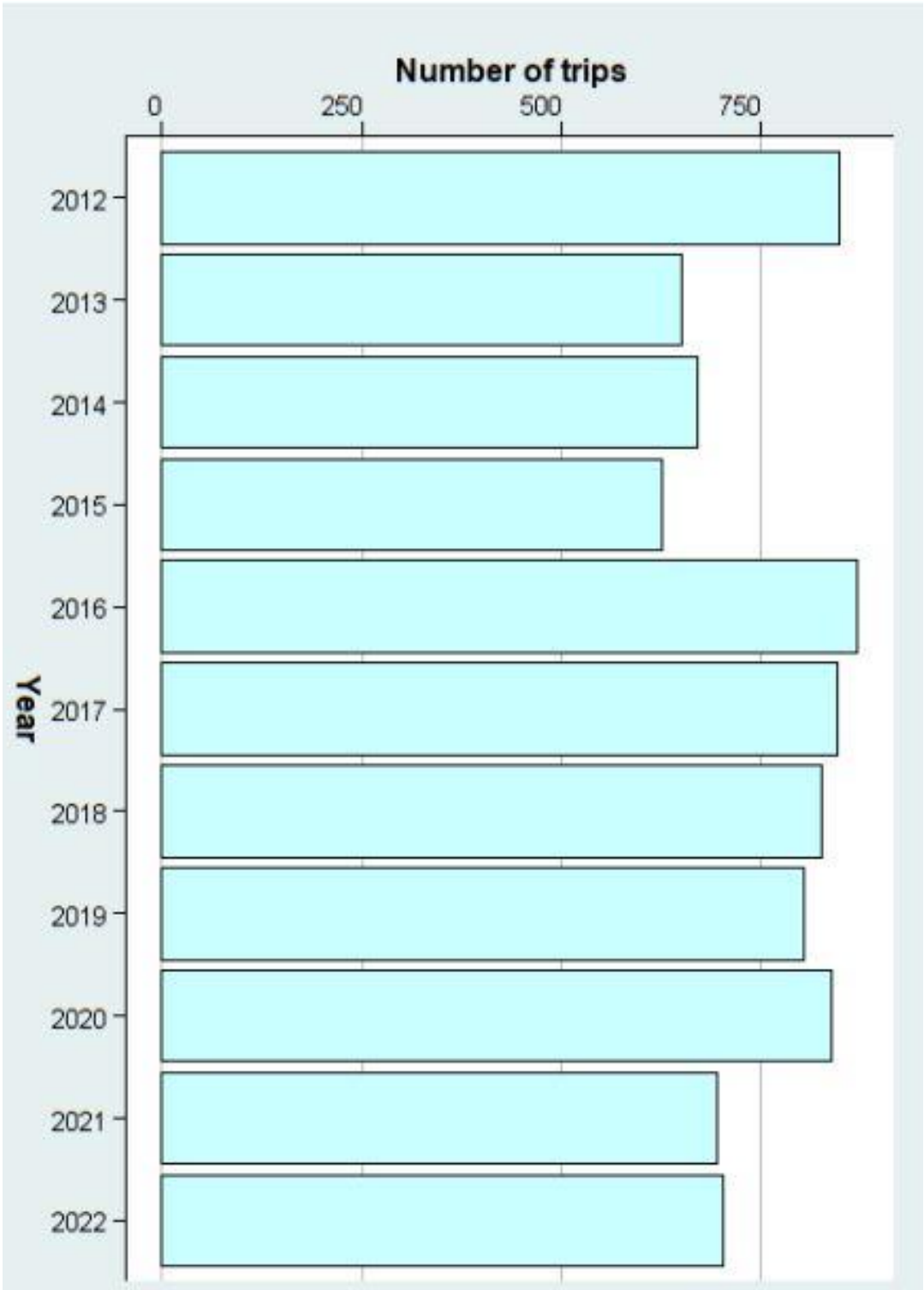
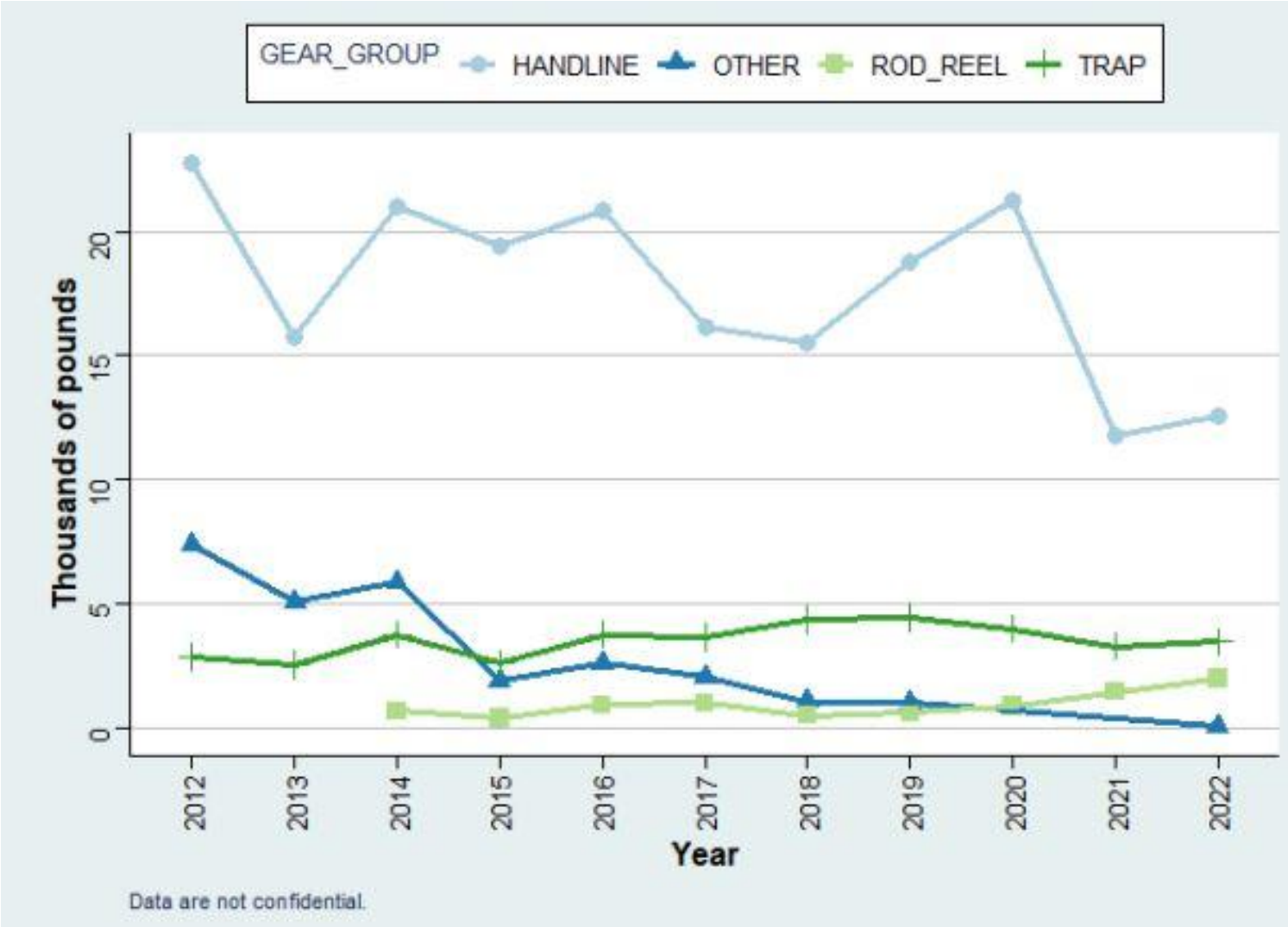
1. Landings from self-reported commercial logbooks

Caribbean Commercial Logbook Program




Thousands of pounds
150
100
50
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
ITIS_COMMONNAME
SNAPPER, BLACK
SNAPPER, BLACKFIN
SNAPPER, CUBERA
SNAPPER, DOG
SNAPPER, GRAY
SNAPPER, LANE
SNAPPER, MAHOGANY
SNAPPER, MUTTON
SNAPPER, QUEEN
SNAPPER, SILK
SNAPPER, VERMILION
SNAPPER, YELLOWTAIL
SNAPPERS


Number of trips
0
250
500
750
Year
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


GEAR_GROUP
HANDLINE
OTHER
ROD_REEL
TRAP
Thousands of pounds
0
5
10
15
20
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Data are not confidential.

2. Length compositions from shore-based port sampling

Trip Interview Program

- 85% of TIP length data (2012–2022) came from hand lines.
  - 7,351 length measurements from 208 trips.
- Used to inform length-based selectivity for the commercial fleet.
- Multiple lengths per trip; non-independent observations.
- Model weighting based on number of sampled trips.

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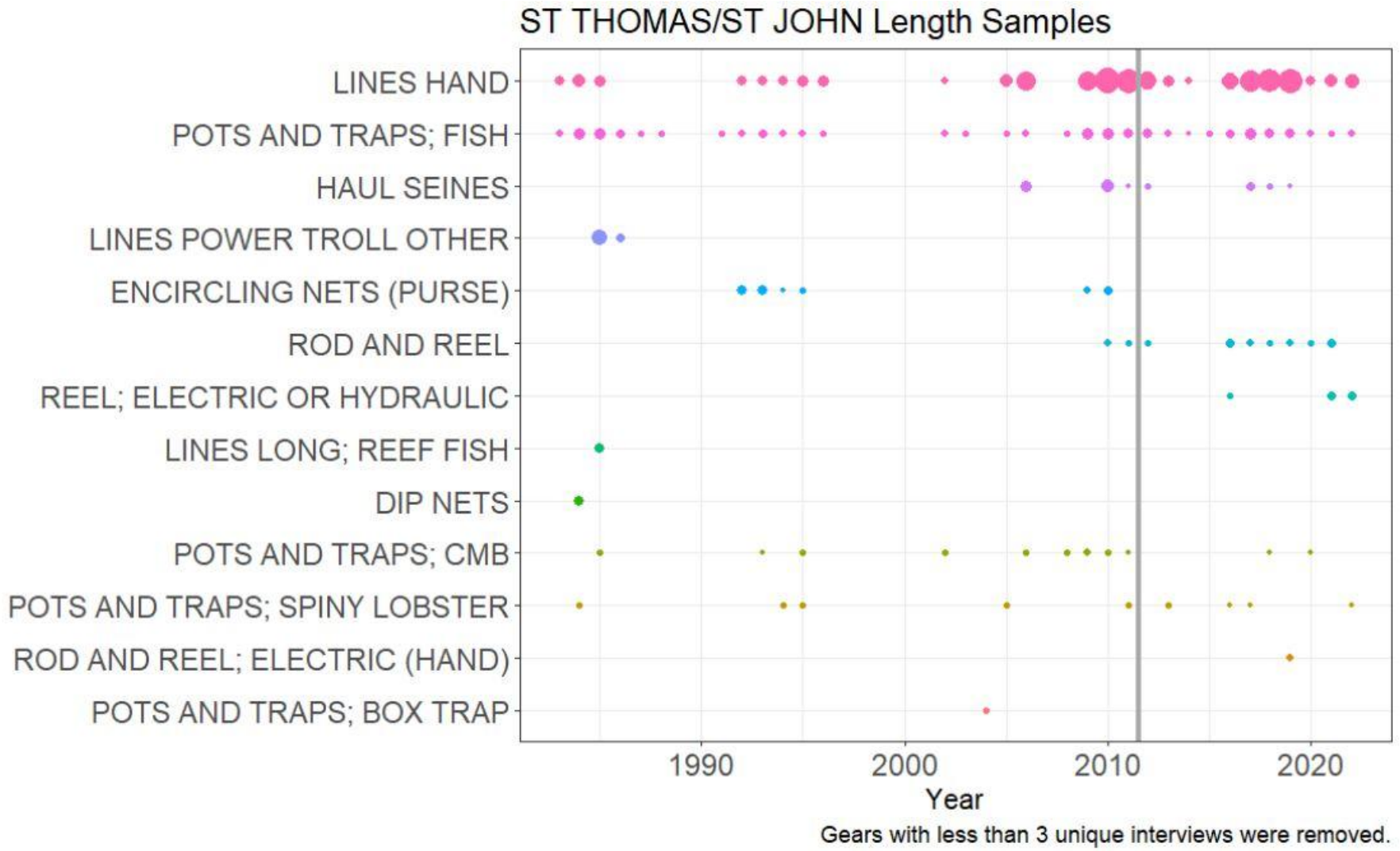

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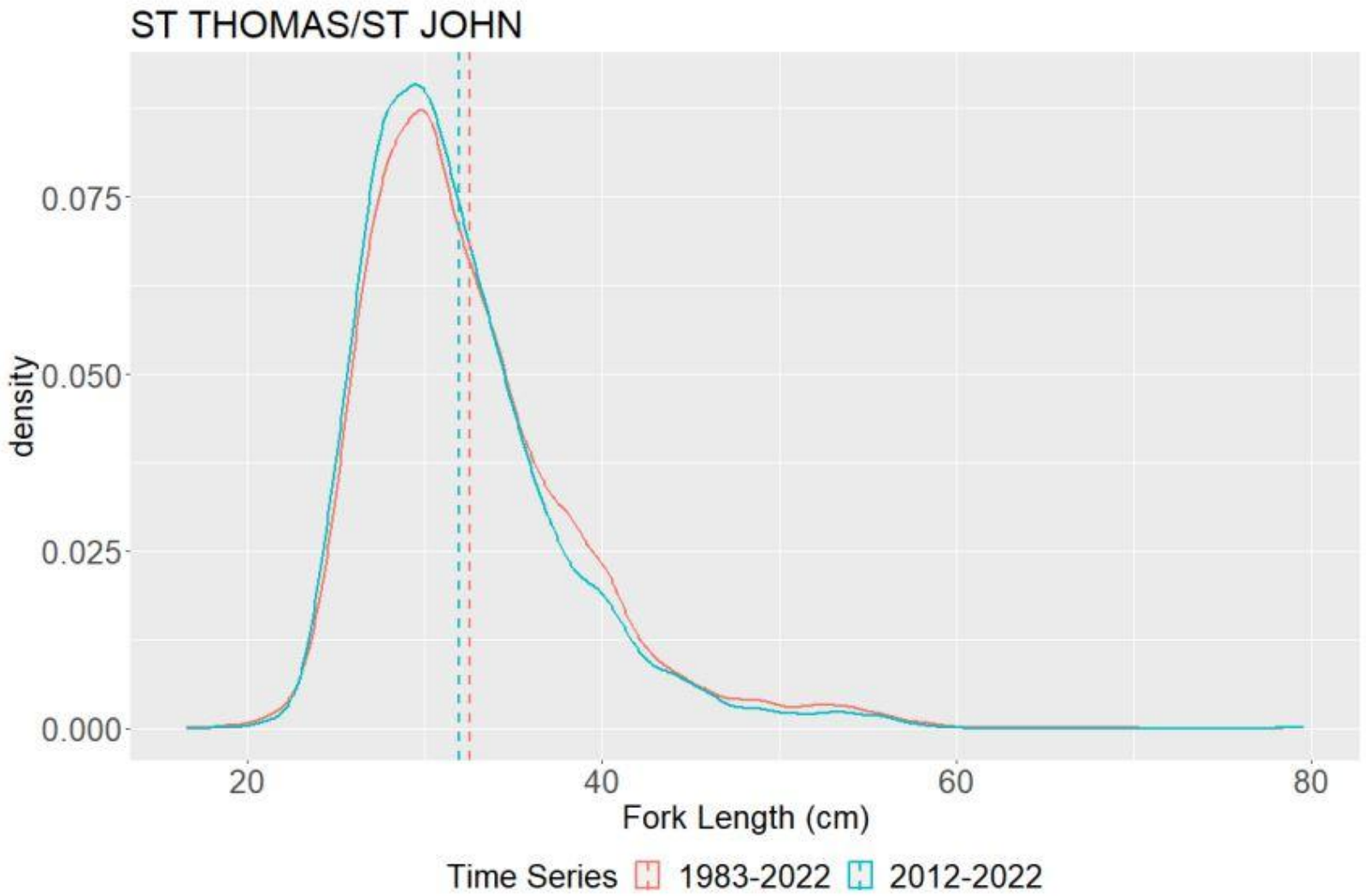
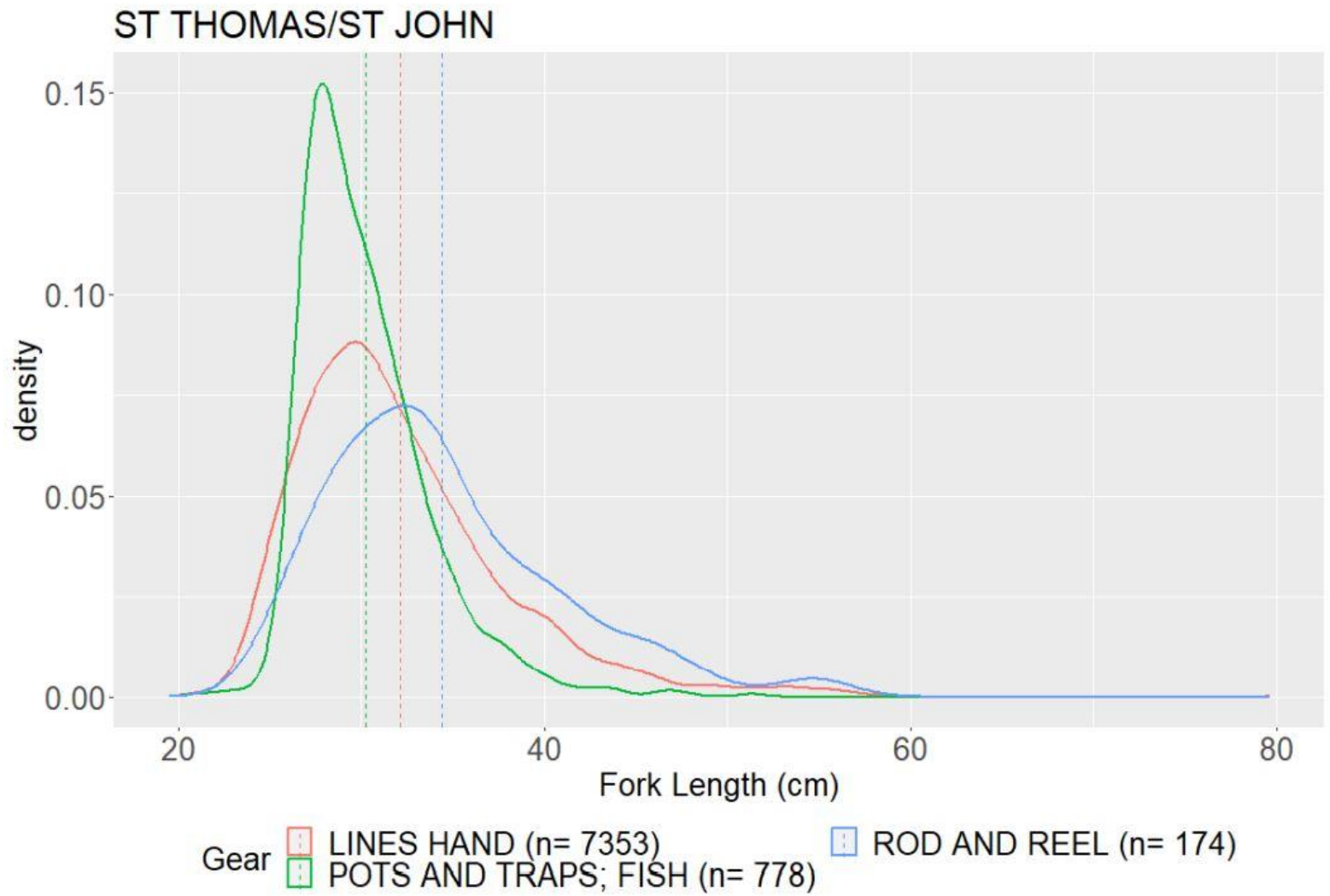

ST THOMAS/ST JOHN
density
0.075
0.050
0.025
0.000
20
40
60
80
Fork Length (cm)
Time Series
1983-2022
2012-2022



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3. Length compositions from a fishery-independent survey of reef fish

Survey Data

- National Coral Reef Monitoring Program
- Sampling depth limit of 30 m
- Regionally restricted transect data from 2001 to 2011.
- Belt transect (2001–2015); Stationary point count (2017–2021).
- Multiple lengths per dive; non-independent observations.
- The relative model weighting based on the number of paired dives.
- Deep-NCRMP
- Sampling depth limit of 60 m
- 2020-2022 Pilot survey of upper mesophotic habitats
- Multiple lengths per dive; non-independent observations.
- The relative model weighting based on the number of paired dives.

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	0 - 12 meters					12 - 30 meters						
Year	Aggregate	Bedrock	Patch	Pavement	Coral/Rock	Aggregate	Bedrock	Patch	Pavement	Coral/Rock	Site Total	Length Total
2001	15		6	5		2		5	3		**36**	**42**
2002	21		11	9	1	5		8	15	1	**71**	**93**
2003	18		16	3	2	8		15	20		**82**	**90**
2004	16		12	7	5	17		13	11	2	**83**	**66**
2005	17		7	5	1	20		14	24	7	**95**	**72**
2006	10		5	10		42		9	21	3	**100**	**155**
2007	21		18	28	1	46		14	36	9	**173**	**288**
2008	7		4	8		30		7	25	5	**86**	**92**
2009	18		12	8		42		5	24	7	**116**	**244**
2010	13		1	14		12		10	16	8	**74**	**116**
2011	6		3	9	1	3		5	19	5	**51**	**138**
2012	1		1	8		11		2	12		**35**	**165**
2014	31	14	19	36	6	42	4	20	37	14	**223**	**522**
2016	24	7	14	38	8	48	2	27	57	15	**240**	**670**
2019	38	10	16	28	9	42	1	16	27	16	**203**	**872**
2021	29	8	14	46	4	48	2	28	43	12	**234**	**1,238**

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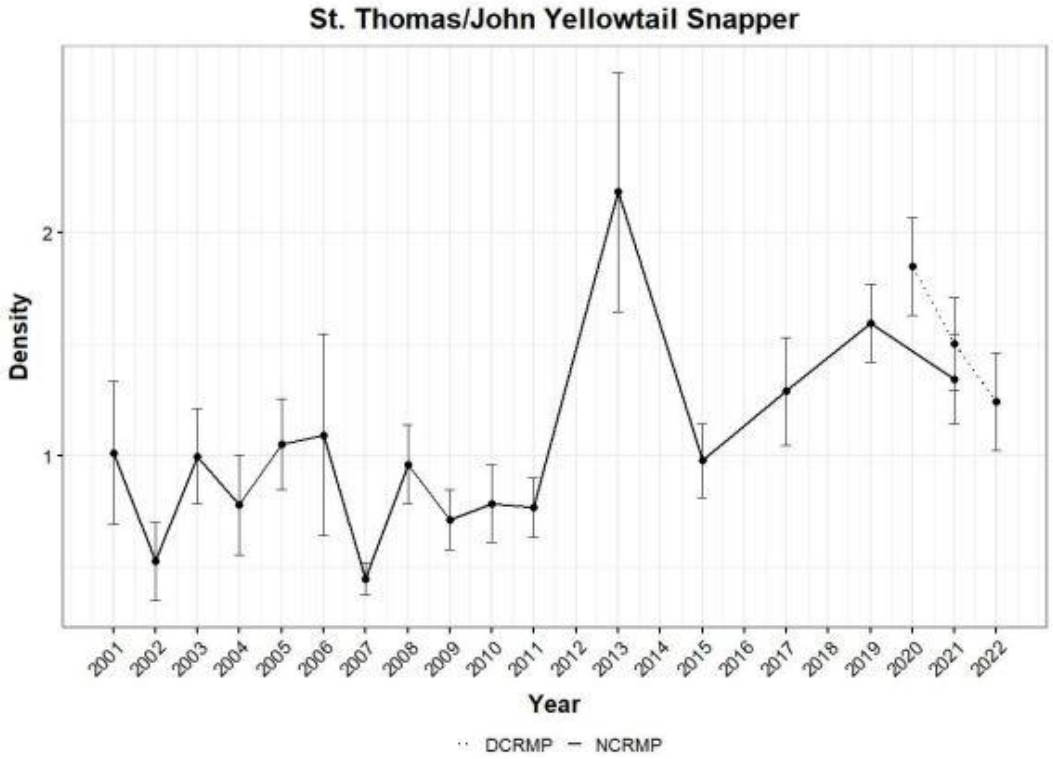
	30 - 60 meters				
Year	Aggregate	Patch	Pavement	Site Total	Length Total
2020	75	48	39	**162**	**376**
2021	59	23	16	**98**	**258**
2022	33	21	35	**89**	**160**



5. Life history information

- Lengths
  - 1,554 samples from 2013-2023 and across the U.S. Caribbean
  - Length frequency distributions did not differ significantly by sex
  - Maximum length 572 mm FL
- Ages
  - 1,437 aged fish
  - Oldest fish 26

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5. Life history information

- Sexual maturity
  - Gonad histology was obtained for 765 females and 675 males
  - Year-round spawning with peak spawning from March-April
  - M:F sex ratio 1:1.04

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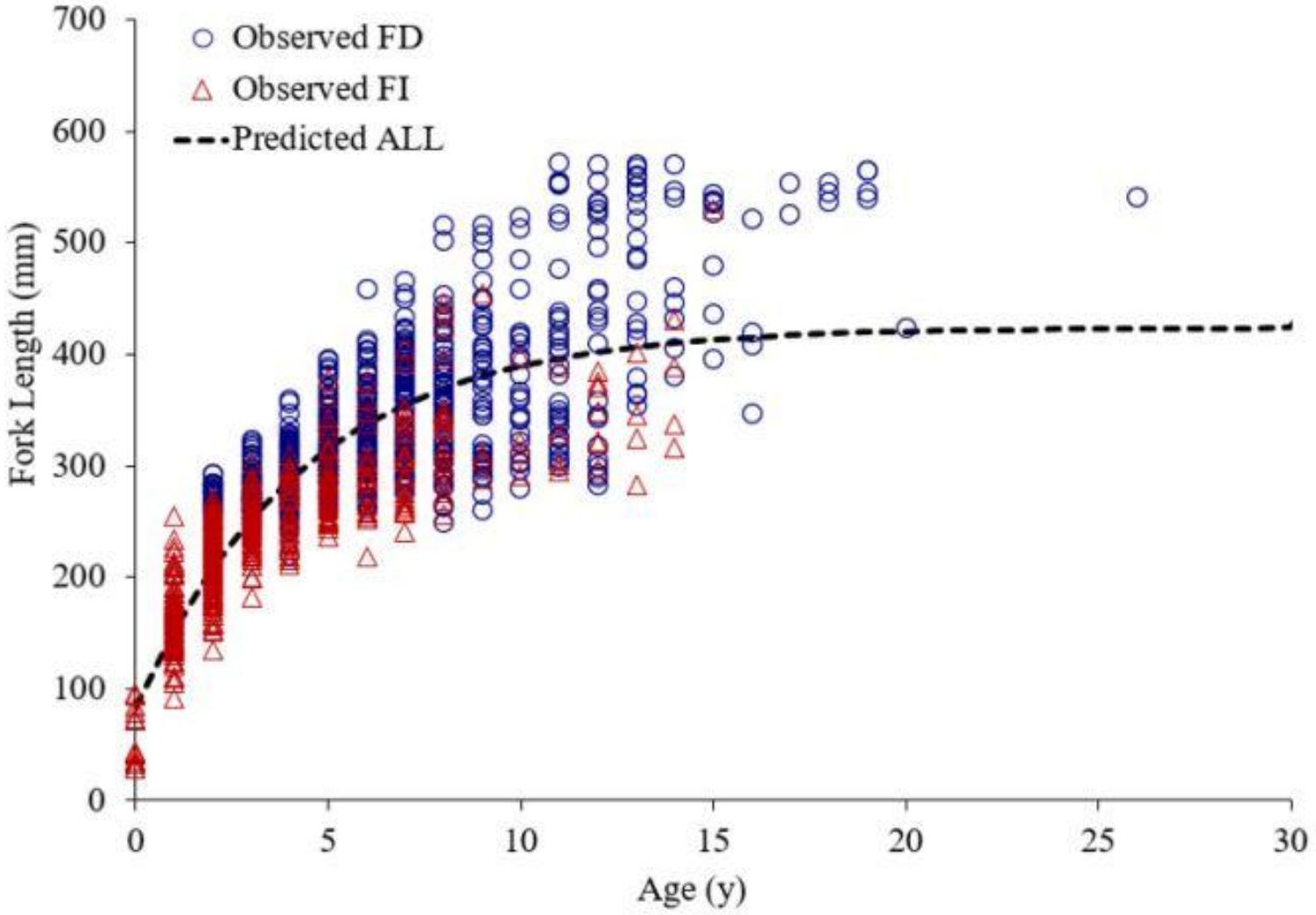
Growth


Observed FD
Observed FI
Predicted ALL
Fork Length (mm)
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Age (y)

Growth

Model	L_∞ (mm)	K	t_0	R^2
FL mm	508 (479-547)	0.12 (0.10-0.14)	-2.73 (-3.29- -2.26)	0.70
TL mm	653 (635-648)	0.11 (0.10-0.13)	-2.67 (-3.18- -2.18)	0.70
FL mm t_0-fixed Carib	424 (415-434)	0.23 (0.22-0.24)	-0.96	0.68
FL mm t_0-fixed Fla	467 (454-481)	0.16 (0.15-0.18)	-1.93	0.70

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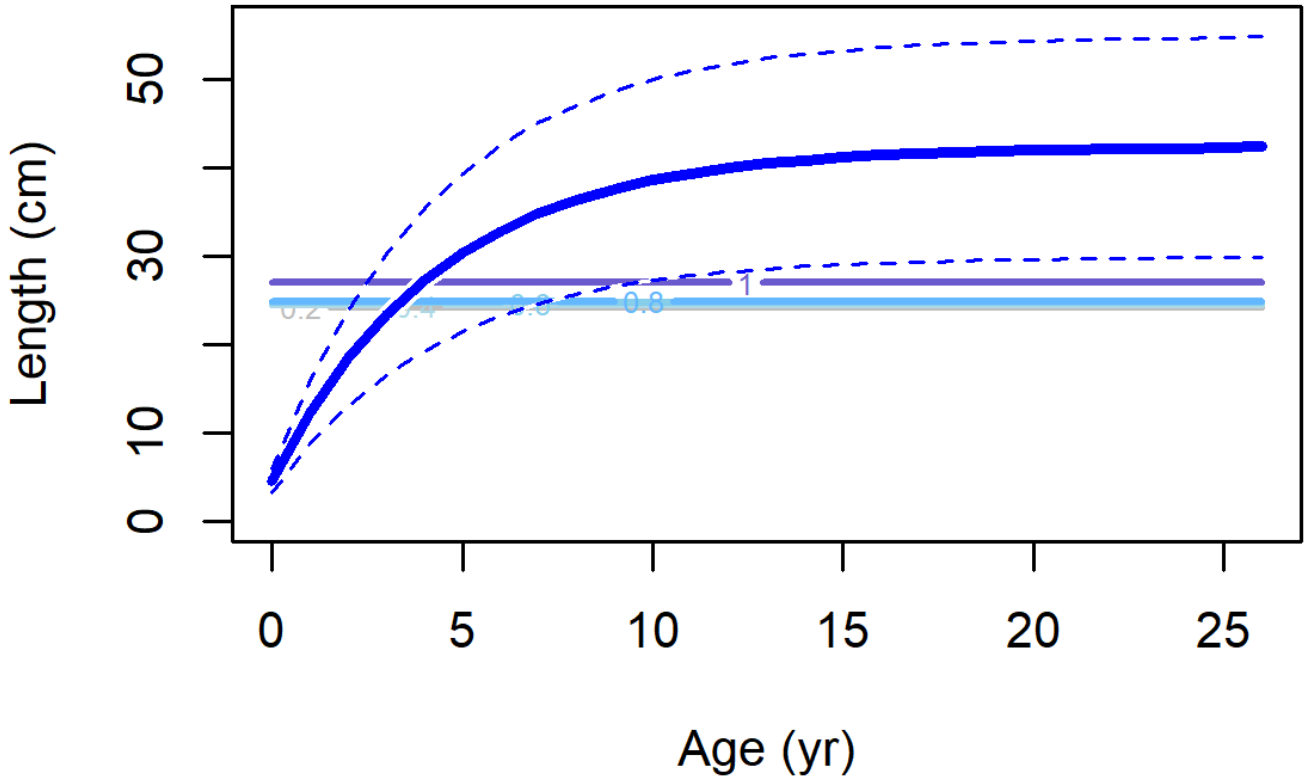
Growth



Maturity

Table 9. U.S. Caribbean yellowtail snapper length (mm FL) at sexual maturity (95% prediction intervals).

Variable	Sexes Combined	Female	Male
Number of samples	1876	922	954
L_{50}	194 (189 - 199)	207 (202 - 211)	182 (174 - 190)
L_{90}	238 (233 - 242)	244 (238 - 249)	229 (221 - 235)
L_{95}	253 (246 - 258)	256 (248 - 264)	245 (235 - 253)

Table 10. U.S. Caribbean yellowtail snapper age (y) at sexual maturity (95% prediction intervals).

Variable	Sexes Combined	Female	Male
Number of samples	949	482	464
A_{50}	1.5 (1.4 - 1.6)	1.5 (1.3 - 1.9)	1.6 (1.4 - 1.7)
A_{90}	2.2 (2.0 - 2.3)	2.1 (1.9 - 2.3)	2.3 (2.0 - 2.6)
A_{95}	2.4 (2.2 - 2.6)	2.3 (2.0 - 2.6)	2.5 (2.2 - 2.9)

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Natural Mortality

Input Source	Input Type	Input	M	Method
SEDAR (2020)	Maximum age	28	**0.193**	Hamel_Amax
Shervette, Rivera Hernández, & Peña Alvarado (2024)	Maximum age	26	**0.208**	Hamel_Amax
Meta-analysis	Scientific name	*Ocyurus chrysurus*	0.348	FishLife