SEDAR 57 Caribbean Spiny Lobster Update

CFMC SSC Meeting
November 29-Dec 1 2022

Update of the SEDAR 57 assessment benchmark for Puerto Rico, St. Thomas and St. John and St. Croix

Summary of work conducted by SEFSC

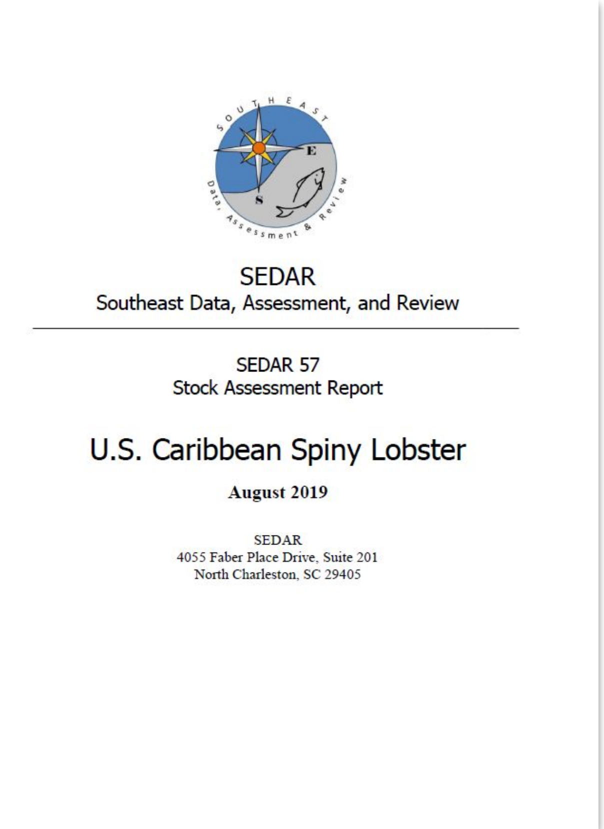
- Provided Overfishing Limit (OFL) and Acceptable Biological Catch (ABC) for 2024-2026 utilizing the already established methods from SEDAR 57 stock assessment
- Specified 2021 as the terminal year for data inputs; Made assumptions for 2022 and 2023 landings, as these are not yet known
- Prepared reports for CFMC SSC Meeting November 29-Dec 1 2022

SEDAR 57 Benchmark Methods

Stock Synthesis (SS) version 3.30 (Methot and Wetzel 2013).

The maximum sustainable yield (MSY) proxy, status determination criteria (SDC), and acceptable biological catch (ABC) were specified using the control rule's third-tier: "Data Limited: Accepted Assessment Available".

MSST was assumed to be 75% of SSPR 30% and the maximum fishing mortality threshold (MFMT) was assumed to be equal to FSPR 30%.



SEDAR
Southeast Data, Assessment, and Review

SEDAR 57
Stock Assessment Report

U.S. Caribbean Spiny Lobster

August 2019

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

Overview of SEDAR 57 Update Assessments

NOVEMBER 2022

AUGUST 2019 - SEDAR 57 Stock Assessment Report SECTION VI

Benchmark assessment with landings through 2018 and lengths through 2016

FEBRUARY 2021 - Generic Framework Amendment 1: Spiny Lobster Management Reference Points

⭐ 0. Benchmark assessment with landings through **2020** and lengths through 2016

NOVEMBER 2022 - SEDAR 57 Stock Assessment Update

1. Benchmark assessment with landings through **2021** and lengths through 2016

2. Update assessment with landings through **2021** and lengths through **2021**

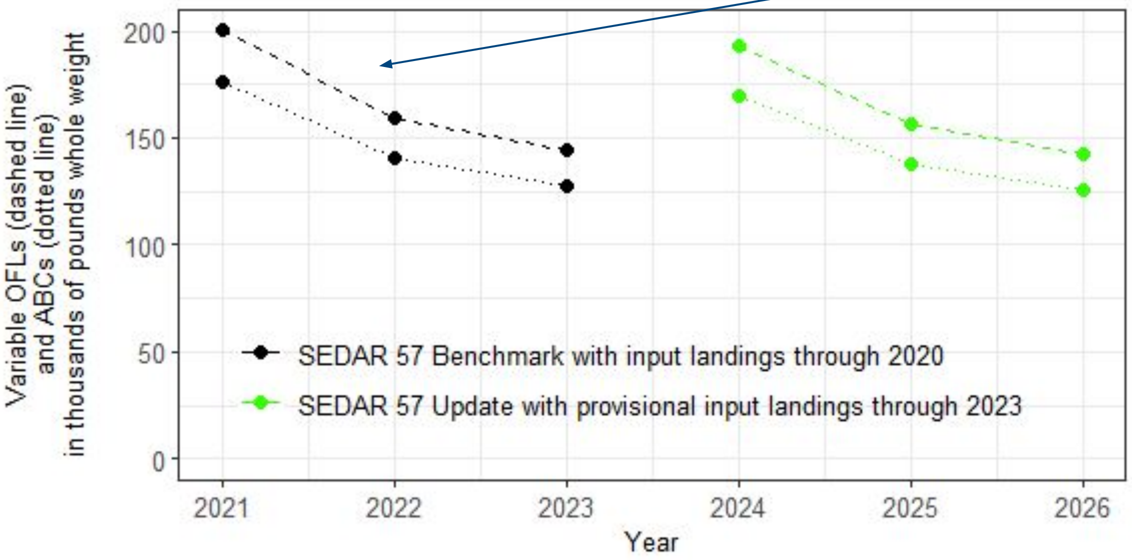
2b. Update assessment with landings through **2021** and lengths through **2021** with correction factor sensitivity [PR only]

⭐ 3. Update assessment with landings through **2023** and lengths through **2021**

St. Croix

St. Croix

Generic Framework Amendment 1: Spiny Lobster Management Reference Points



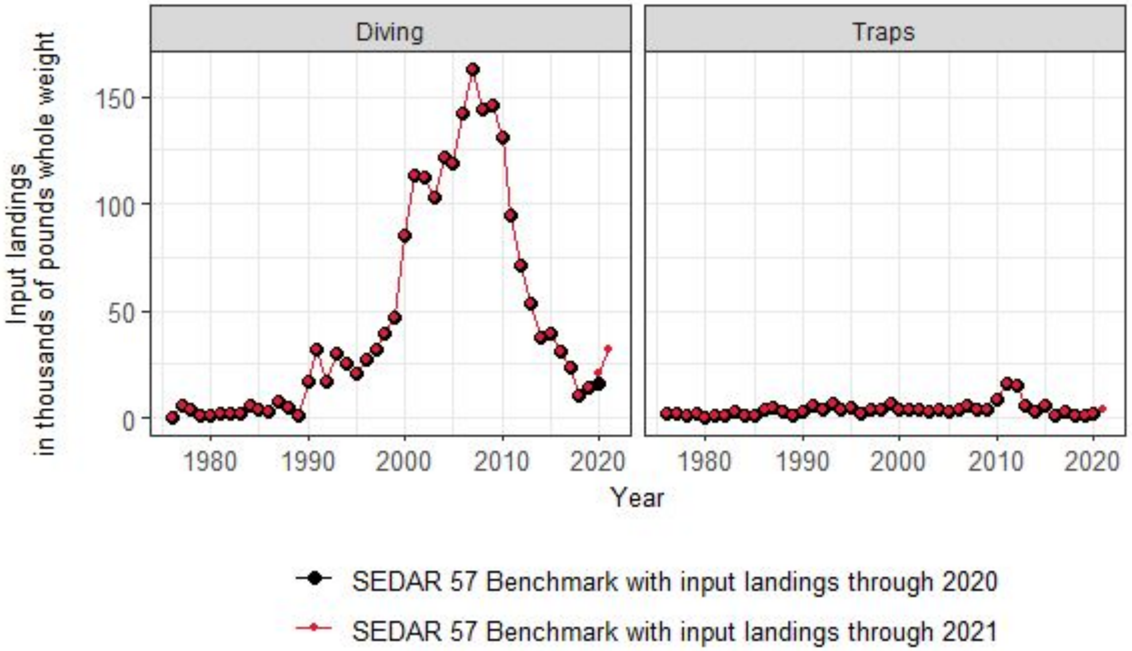
Caribbean Spiny Lobster variable-catch (annual) OFLs and ABCs for spiny lobster for St. Croix plotted in pounds whole weight. The line color relates to the source of the data. The line type refers to the forecasted values plotted from the stock assessment model projections as OFLs (dashed lines) or ABCs (dotted line).

Source	Year	OFL	Avg. OFL	ABC	Avg. ABC
SEDAR 57 Benchmark with input landings through 2020	2021	200,021	167,898	176,401	148,071
	2022	159,452		140,622	
	2023	144,220		127,189	
SEDAR 57 Update with provisional input landings through 2023	2024	192,631	163,823	169,884	144,478
	2025	156,356		137,893	
	2026	142,483		125,657	

-2.4%

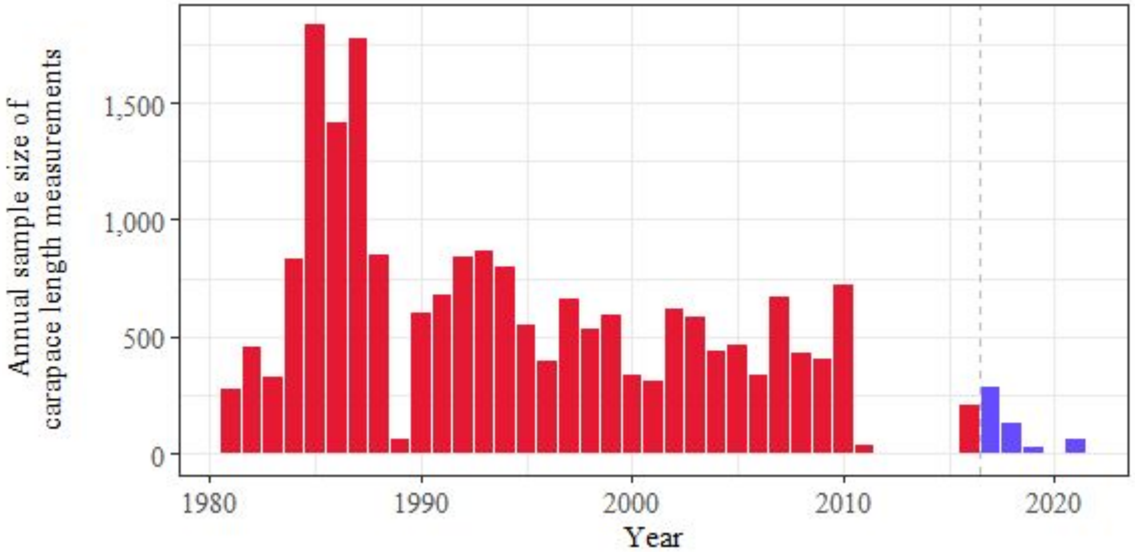
Caribbean Spiny Lobster variable-catch (annual) and constant-catch (average) OFLs and ABCs for St. Croix, based on the Tier 3 of the ABC Control Rule. The column titled "Source" indicates if the rows are associated with the SEDAR 57 Benchmark with input landings through 2020 or with the SEDAR 57 Update with input landings through 2023. All OFLs and ABCs are in pounds whole weight.

St. Croix



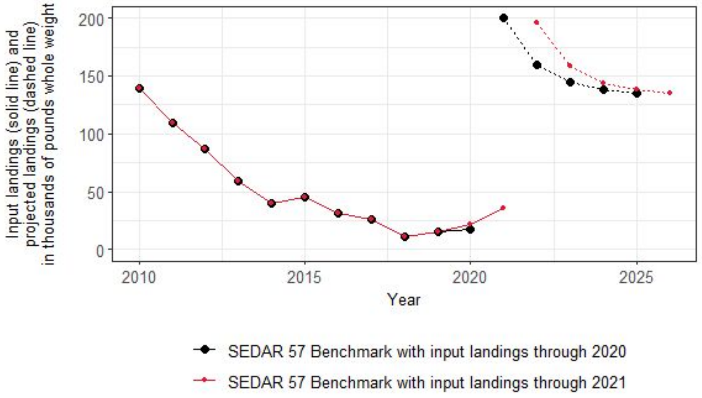
Caribbean Spiny Lobster landings from St. Croix are plotted in pounds whole weight by year and fleet. The color relates to the source of the data. The landings through 2021 are shown in red and the landings from the benchmark assessment through 2020 are shown in black. The values plotted in red overlay the values plotted in black in all years except 2019, 2020, and 2021.

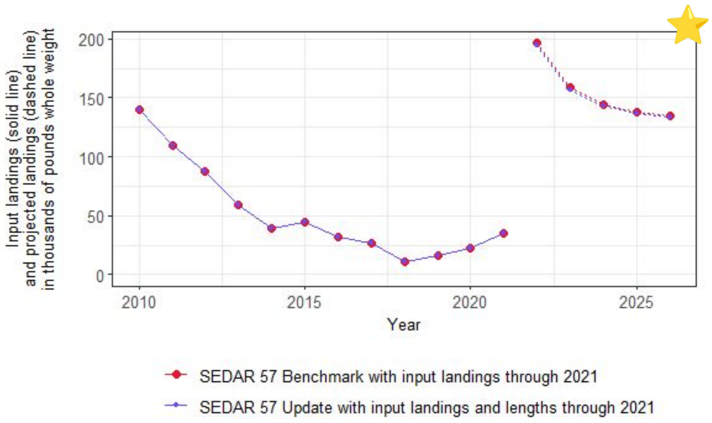
2.5% Lengths
12% Years

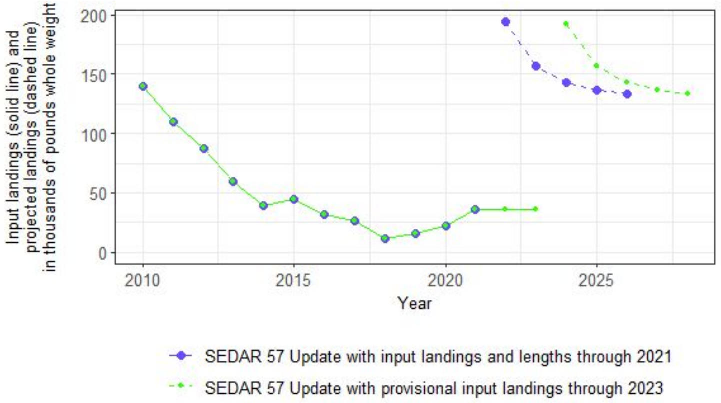


Annual counts of Caribbean Spiny Lobster carapace length samples from St. Croix used in the SEDAR 57 benchmark assessment (red) and update assessment (red and purple). The dashed vertical line denotes the terminal year of the SEDAR 57 benchmark assessment.

St. Croix







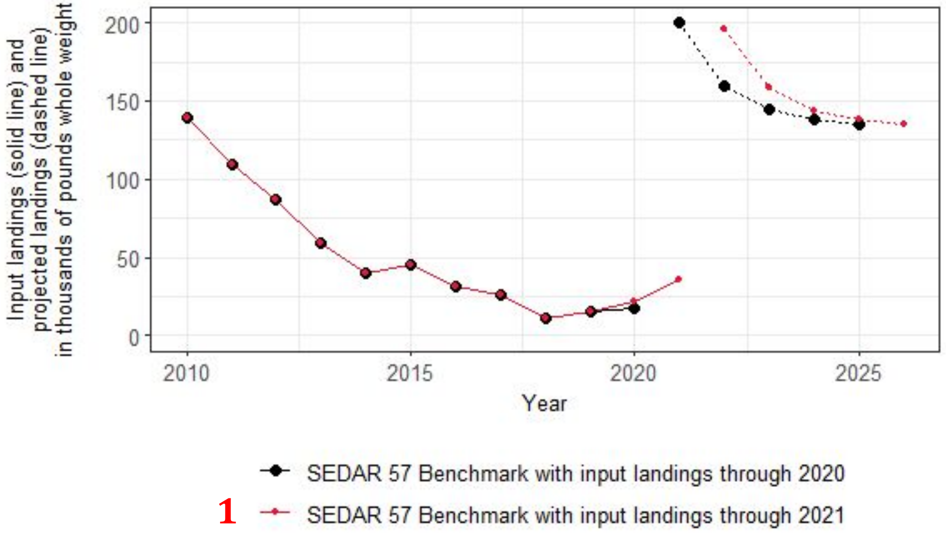
February 2021 - Generic Framework Amendment 1: Spiny Lobster Management Reference Points

Benchmark assessment with landings through **2020** and lengths through 2016

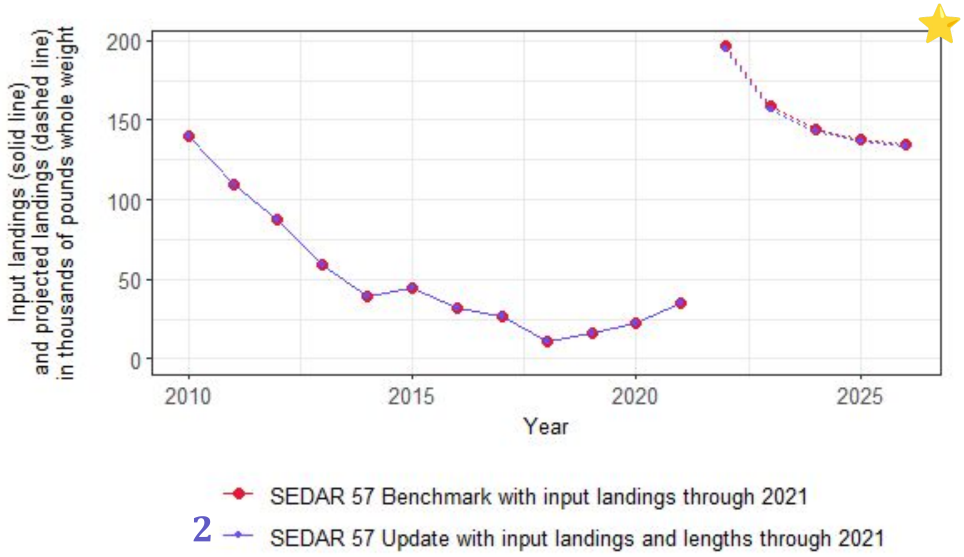
November 2022 - SEDAR 57 Stock Assessment Update

1. Benchmark assessment with landings through **2021** and lengths through 2016
2. Update assessment with landings through **2021** and lengths through **2021**
3. Update assessment with landings through **2023** and lengths through **2021**

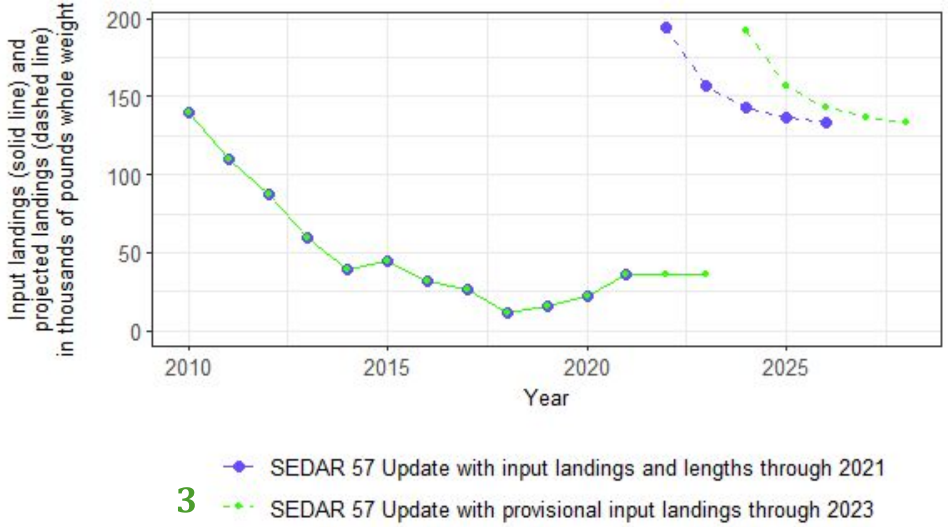
St. Croix


Input landings (solid line) and projected landings (dashed line) in thousands of pounds whole weight
200
150
100
50
0
2010
2015
2020
2025
Year
SEDAR 57 Benchmark with input landings through 2020
SEDAR 57 Benchmark with input landings through 2021

1

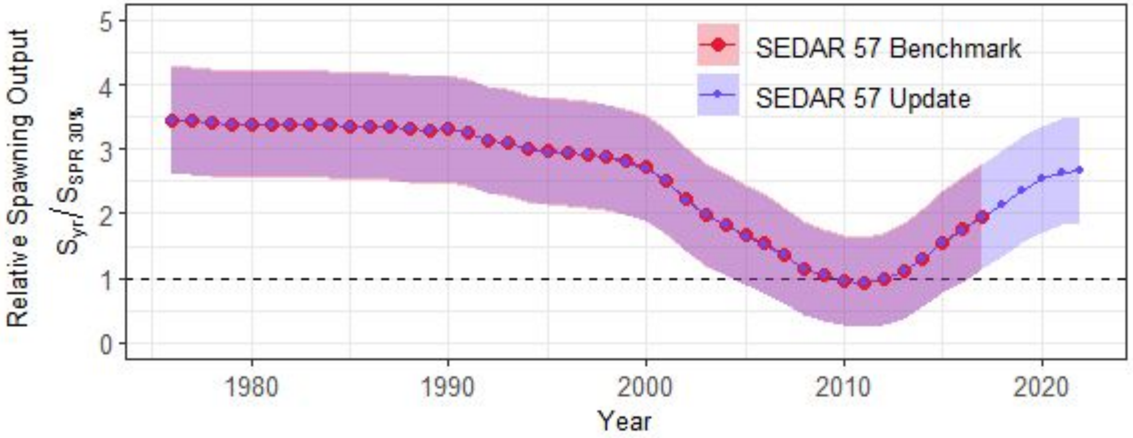

Input landings (solid line) and projected landings (dashed line) in thousands of pounds whole weight
200
150
100
50
0
2010
2015
2020
2025
Year
SEDAR 57 Benchmark with input landings through 2021
SEDAR 57 Update with input landings and lengths through 2021

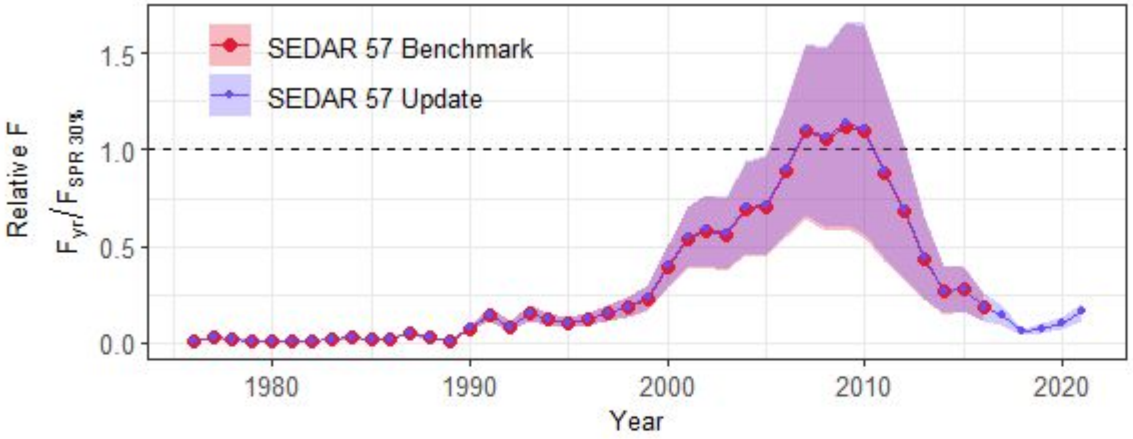
2


Input landings (solid line) and projected landings (dashed line) in thousands of pounds whole weight
200
150
100
50
0
2010
2015
2020
2025
Year
SEDAR 57 Update with input landings and lengths through 2021
SEDAR 57 Update with provisional input landings through 2023

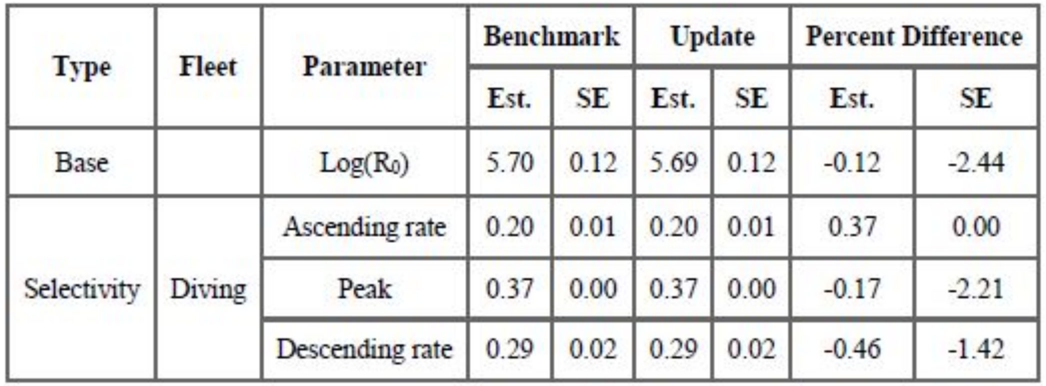
3

St. Croix





Parameter estimates compared between the SEDAR 57 benchmark assessment and the SEDAR 57 update assessment.

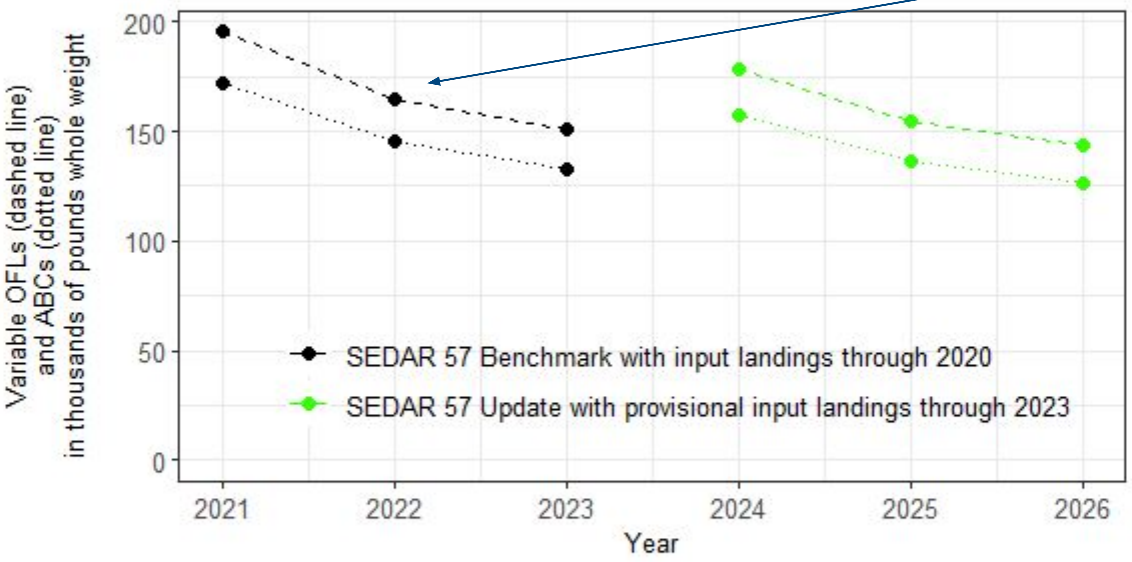


Type	Fleet	Parameter	Benchmark		Update		Percent Difference	
			Est.	SE	Est.	SE	Est.	SE
Base		Log(R_0)	5.70	0.12	5.69	0.12	-0.12	-2.44
Selectivity	Diving	Ascending rate	0.20	0.01	0.20	0.01	0.37	0.00
		Peak	0.37	0.00	0.37	0.00	-0.17	-2.21
		Descending rate	0.29	0.02	0.29	0.02	-0.46	-1.42

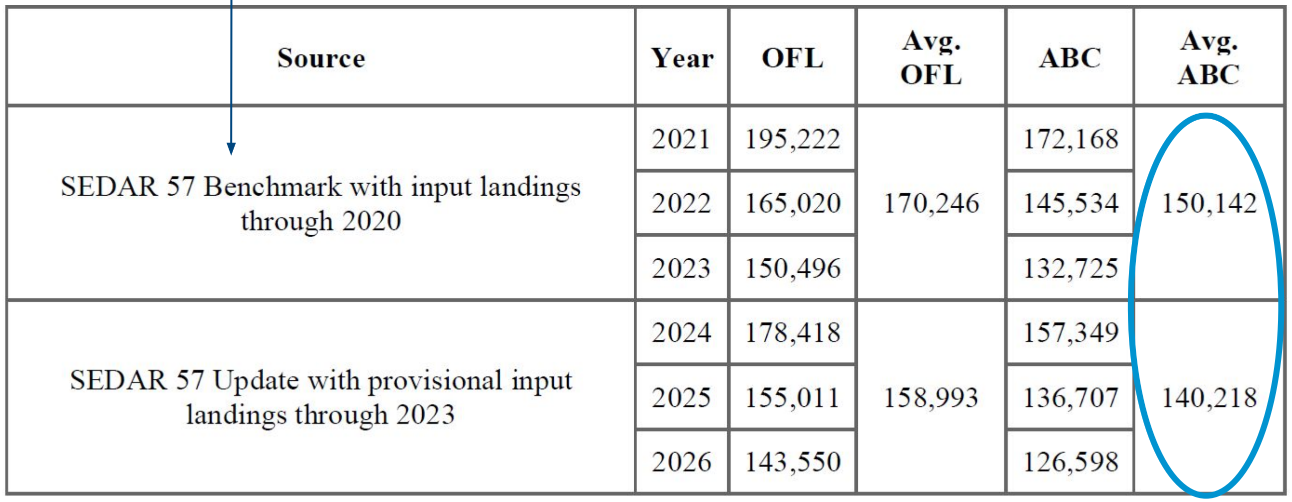
St. Thomas and St. John

St. Thomas and St. John

Generic Framework Amendment 1: Spiny Lobster Management Reference Points



Caribbean Spiny Lobster variable-catch (annual) OFLs and ABCs for spiny lobster for St. Thomas and St. John plotted in pounds whole weight. The line color relates to the source of the data. The line type refers to the forecasted values plotted from the stock assessment model projections as OFLs (dashed lines) or ABCs (dotted line).

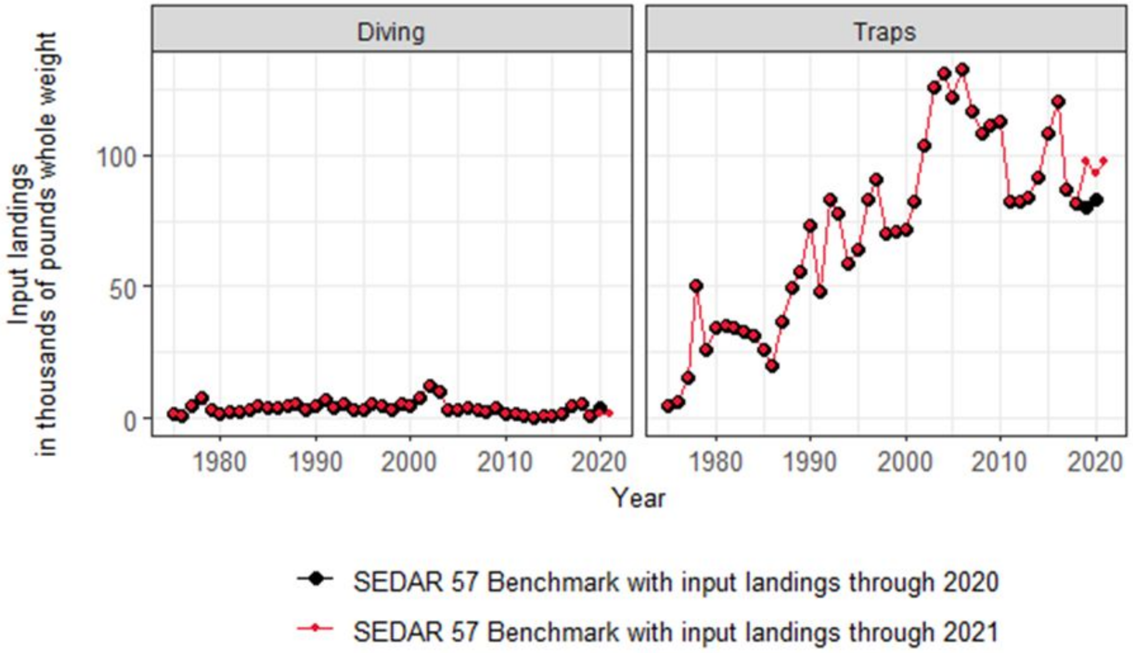


Source	Year	OFL	Avg. OFL	ABC	Avg. ABC
SEDAR 57 Benchmark with input landings through 2020	2021	195,222	170,246	172,168	150,142
	2022	165,020		145,534	
	2023	150,496		132,725	
SEDAR 57 Update with provisional input landings through 2023	2024	178,418	158,993	157,349	140,218
	2025	155,011		136,707	
	2026	143,550		126,598	

-6.6%

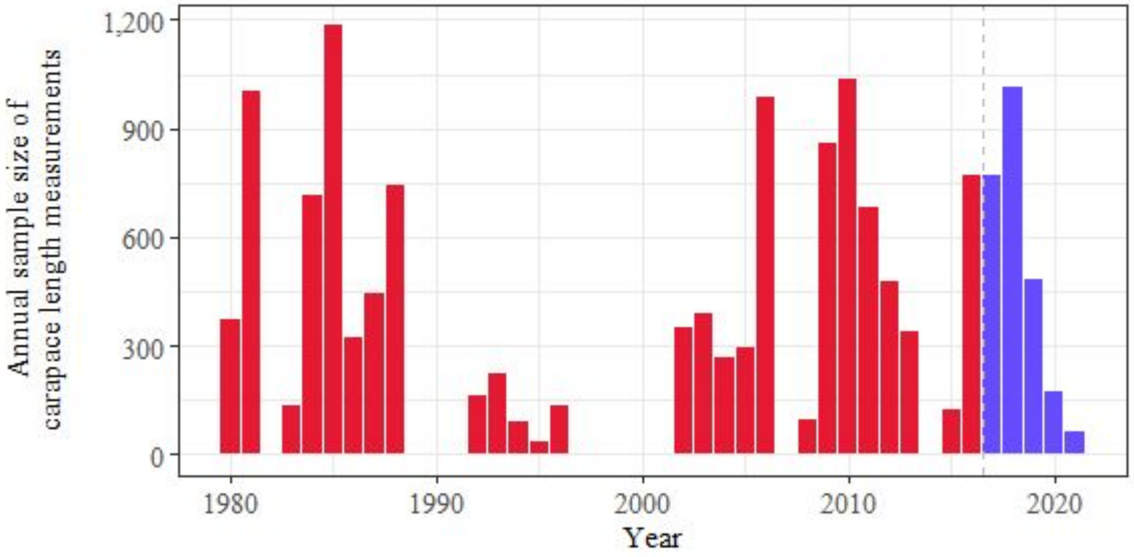
Caribbean Spiny Lobster variable-catch (annual) and constant-catch (average) OFLs and ABCs for St. Thomas and St. John, based on the Tier 3 of the ABC Control Rule. The column titled “Source” indicates if the rows are associated with the SEDAR 57 benchmark with input landings through 2020 or with the SEDAR 57 update with input landings through 2023. All OFLs and ABCs are in pounds whole weight.

St. Thomas and St. John



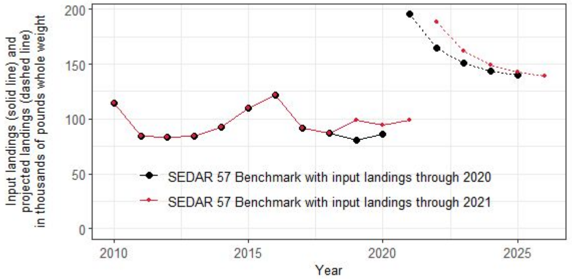
Caribbean Spiny Lobster landings from St. Thomas and St. John are plotted in pounds whole weight by year and fleet. The color relates to the source of the data. The landings through 2021 are shown in red and the landings from the benchmark assessment through 2020 are shown in black. The values plotted in red overlay the values plotted in black in all years except 2019, 2020, and 2021.

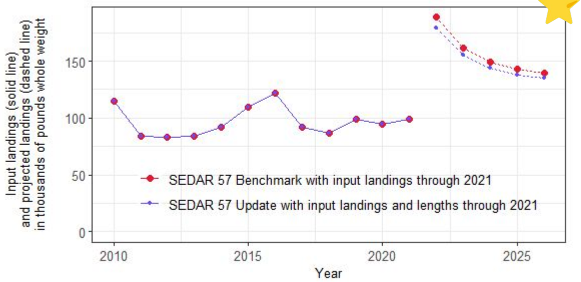
17% Lengths
12% Years

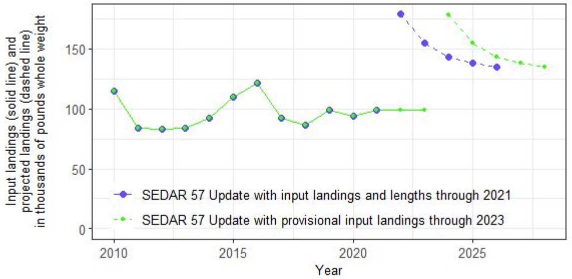


Annual counts of Caribbean Spiny Lobster carapace length samples from St. Thomas and St. John used in the SEDAR 57 benchmark assessment (red) and update assessment (red and purple). The dashed vertical line denotes the terminal year of the SEDAR 57 benchmark assessment.

St. Thomas and St. John







February 2021 - Generic Framework Amendment 1: Spiny Lobster Management Reference Points

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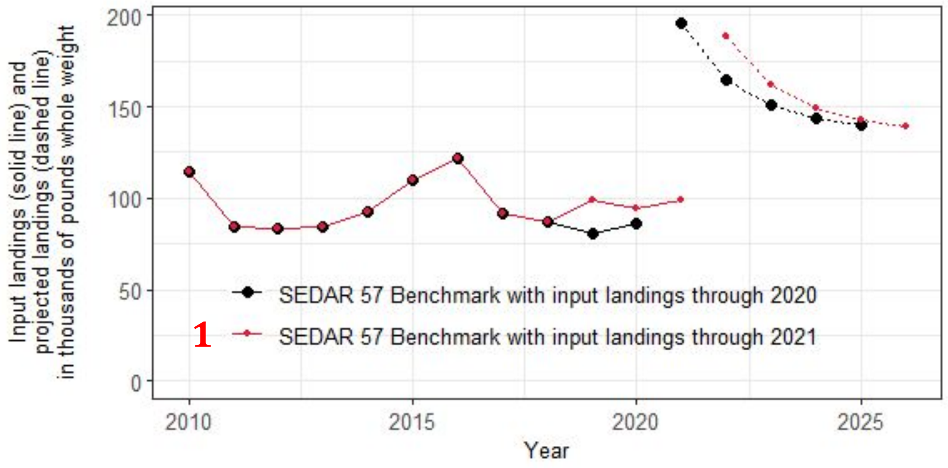
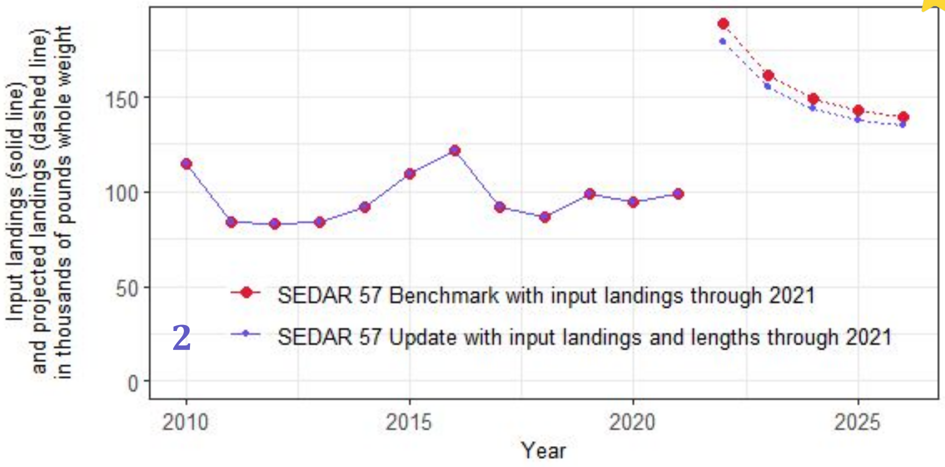
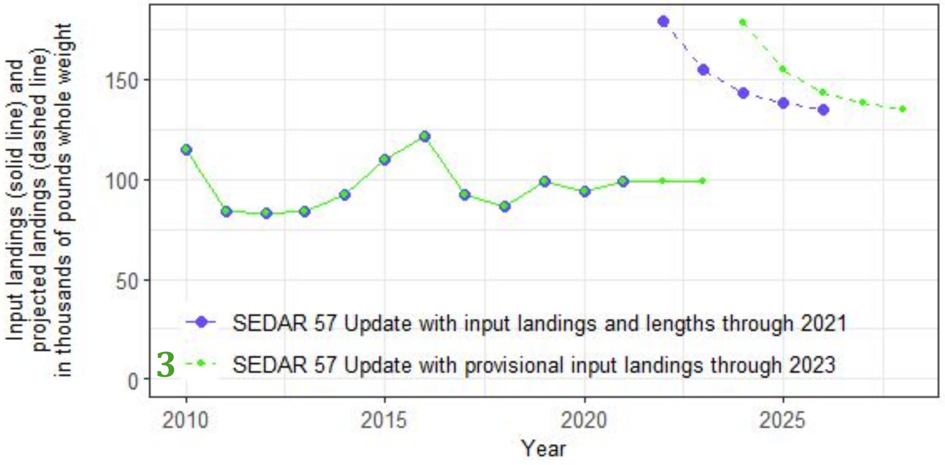
St. Thomas and St. John

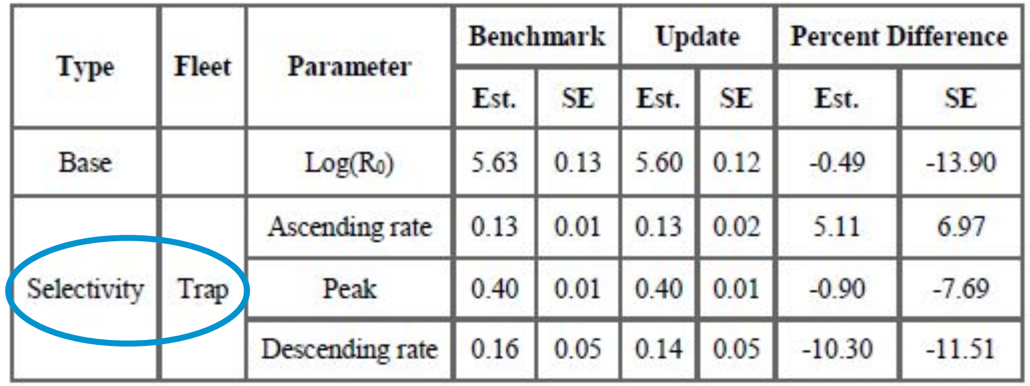




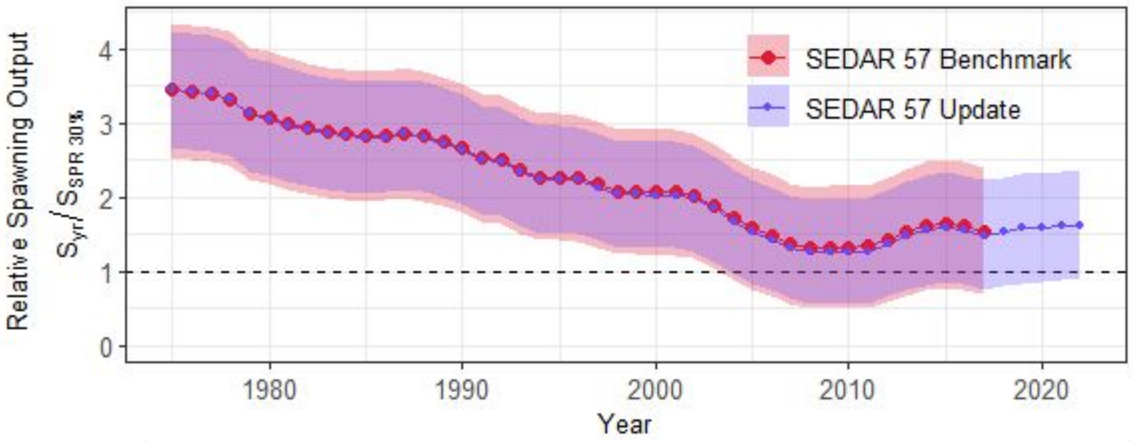


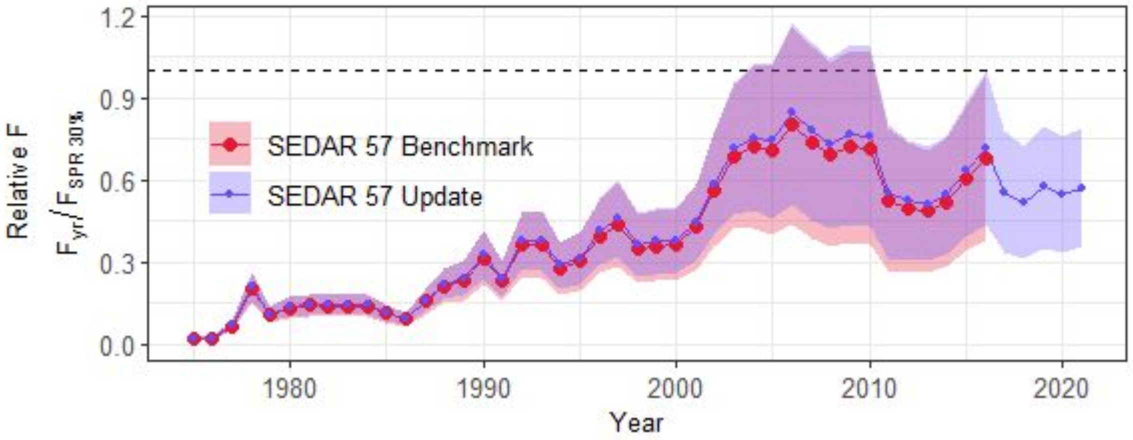
St. Thomas and St. John

Parameter estimates compared between the SEDAR 57 benchmark assessment and the SEDAR 57 update assessment.



Type	Fleet	Parameter	Benchmark		Update		Percent Difference	
			Est.	SE	Est.	SE	Est.	SE
Base		Log(R_0)	5.63	0.13	5.60	0.12	-0.49	-13.90
Selectivity	Trap	Ascending rate	0.13	0.01	0.13	0.02	5.11	6.97
		Peak	0.40	0.01	0.40	0.01	-0.90	-7.69
		Descending rate	0.16	0.05	0.14	0.05	-10.30	-11.51





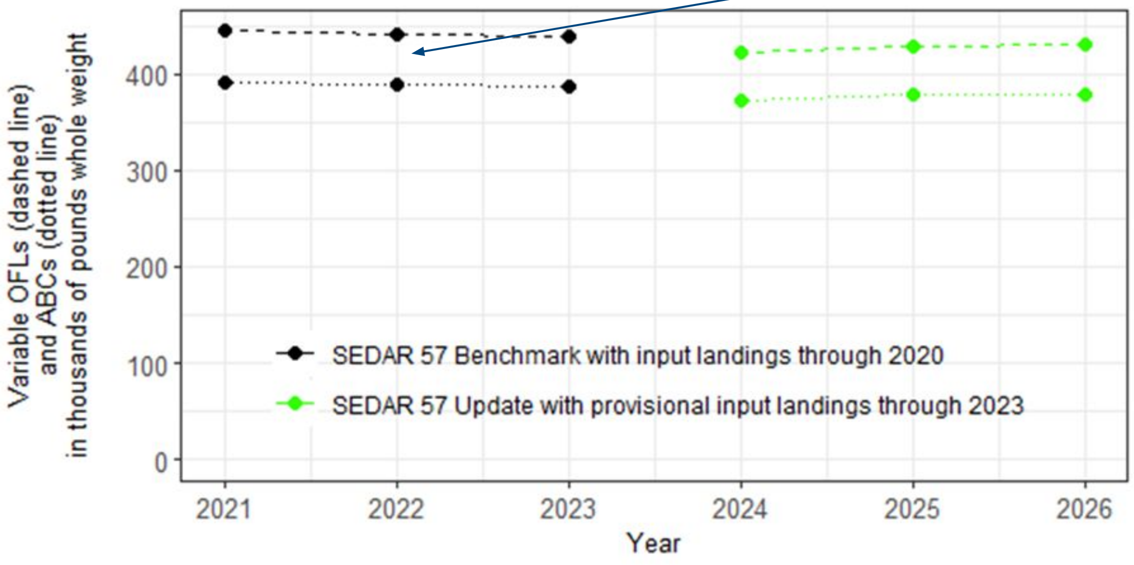
Puerto Rico

Revised on 05 December, 2022

Sensitivity model results reported in Section 2 and Section 5 were updated with correction factor inputs utilized as intended by the methods described. Compared to the landings with the original 2020 correction factor, the alternative correction factors resulted in changes whereby the trap fleet landings increased by 10.8 and 13.9 percent, while the dive fleet landings decreased by 21.4 and 20.8, for 2020 and 2021 respectively. Previously, this was incorrectly reported as "trap fleet landings increased by 1 and 0.7 percent, while the dive fleet landings decreased by 19 and 16.4, for 2020 and 2021 respectively."

Puerto Rico

Generic Framework Amendment 1: Spiny Lobster Management Reference Points



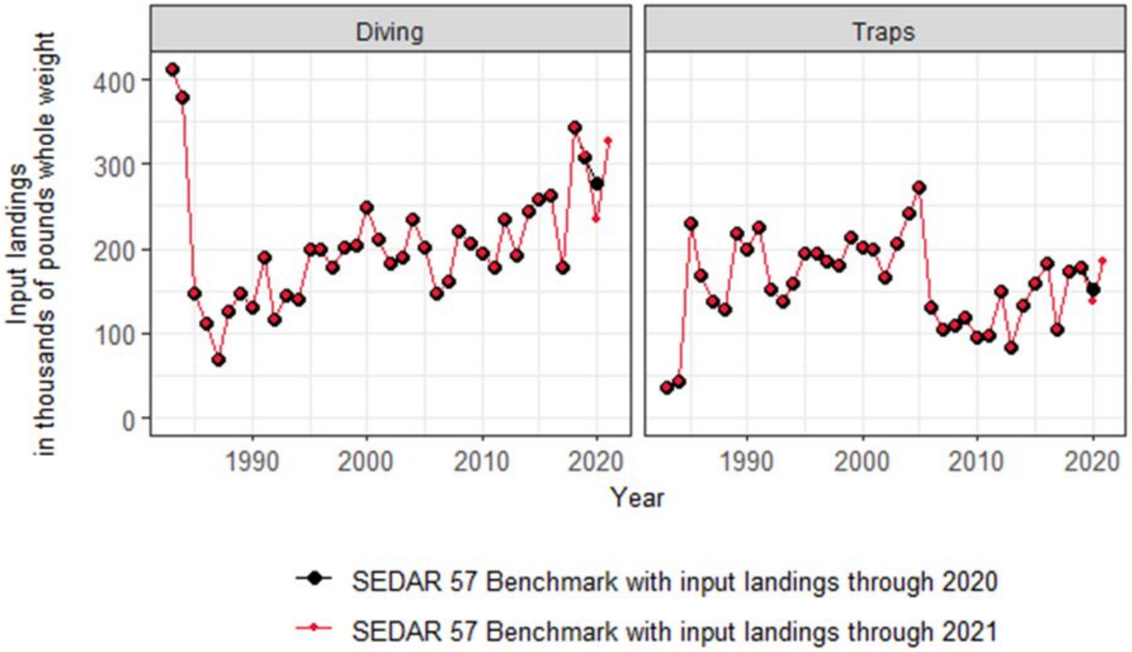
Caribbean Spiny Lobster variable-catch (annual) OFLs and ABCs for spiny lobster for Puerto Rico plotted in pounds whole weight. The line color relates to the source of the data. The line type refers to the forecasted values plotted from the stock assessment model projections as OFLs (dashed lines) or ABCs (dotted line).

Source	Year	OFL	Avg. OFL	ABC	Avg. ABC
SEDAR 57 Benchmark with input landings through 2020	2021	444,020	440,803	391,587	388,750
	2022	440,387		388,383	
	2023	438,001		386,279	
SEDAR 57 Update with provisional input landings through 2023	2024	422,004	426,858	372,171	376,452
	2025	428,523		377,921	
	2026	430,047		379,264	

-3.2%

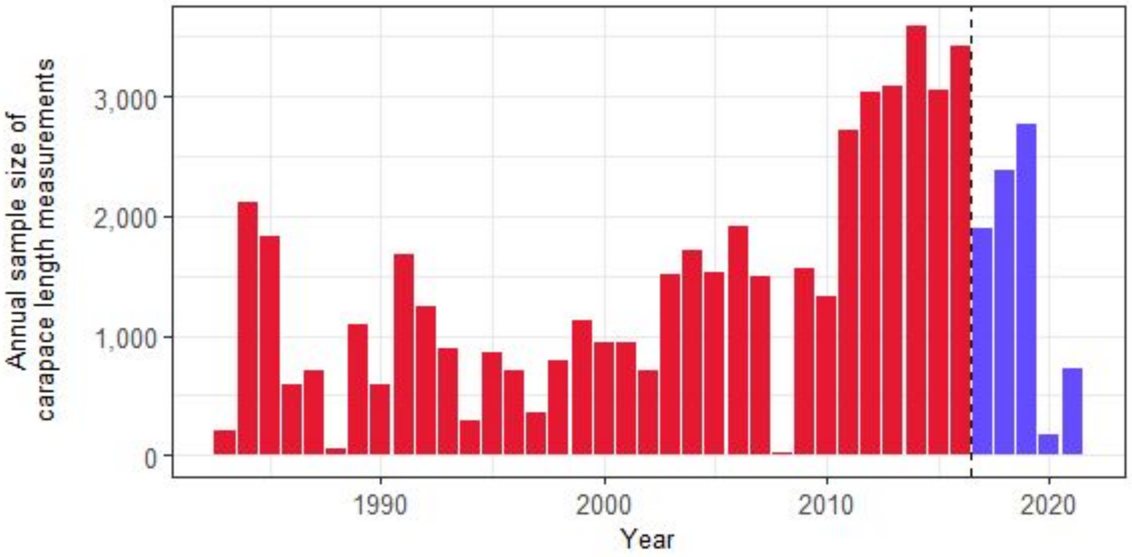
Caribbean Spiny Lobster variable-catch (annual) and constant-catch (average) OFLs and ABCs for Puerto Rico, based on the Tier 3 of the ABC Control Rule. The column titled "Source" indicates if the rows are associated with the SEDAR 57 benchmark with input landings through 2020 or with the SEDAR 57 update with input landings through 2023. All OFLs and ABCs are in pounds whole weight.

Puerto Rico



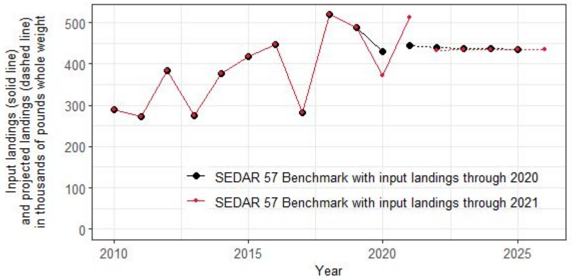
Caribbean Spiny Lobster landings and forecast OFLs for Puerto Rico plotted in pounds whole weight by year. The line color relates to the source of the data. The line type refers to the status of the values plotted either as data inputs (solid lines) or as forecasted values from the stock assessment model projections (dashed lines). The values plotted in red exactly or nearly overlay the values plotted in black in most years, except 2020, 2021, and 2022.

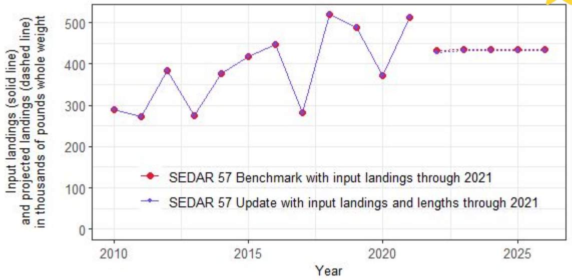
14% Lengths
13% years

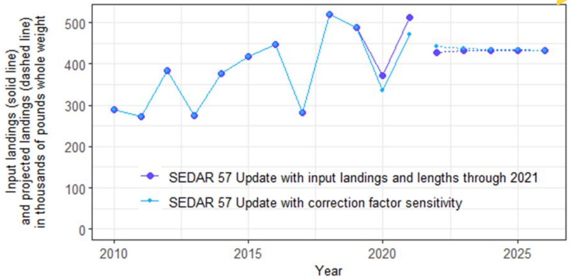


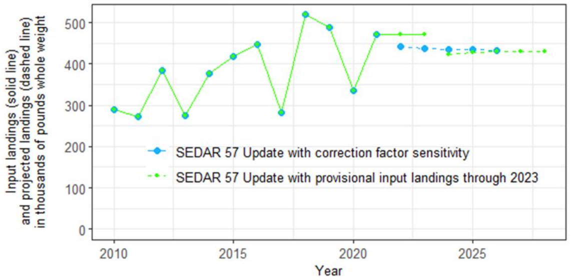
Annual counts of Caribbean Spiny Lobster carapace length samples from Puerto Rico used in the SEDAR 57 benchmark assessment (red) and update assessment (red and purple). The dashed vertical line denotes the terminal year of the SEDAR 57 benchmark assessment.

Puerto Rico









February 2021 - Generic Framework Amendment 1: Spiny Lobster Management Reference Points

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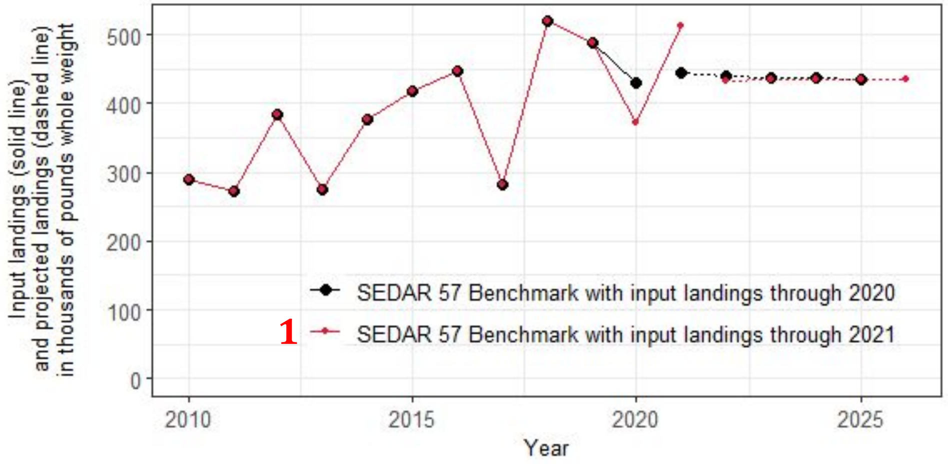
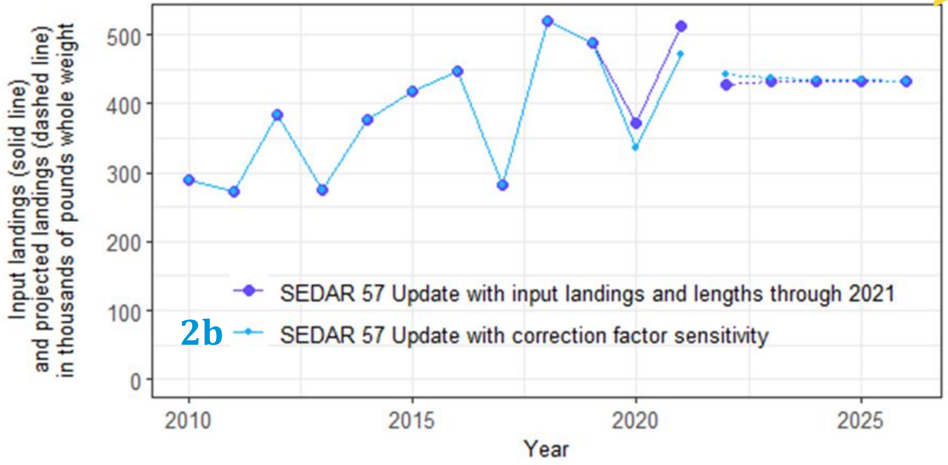
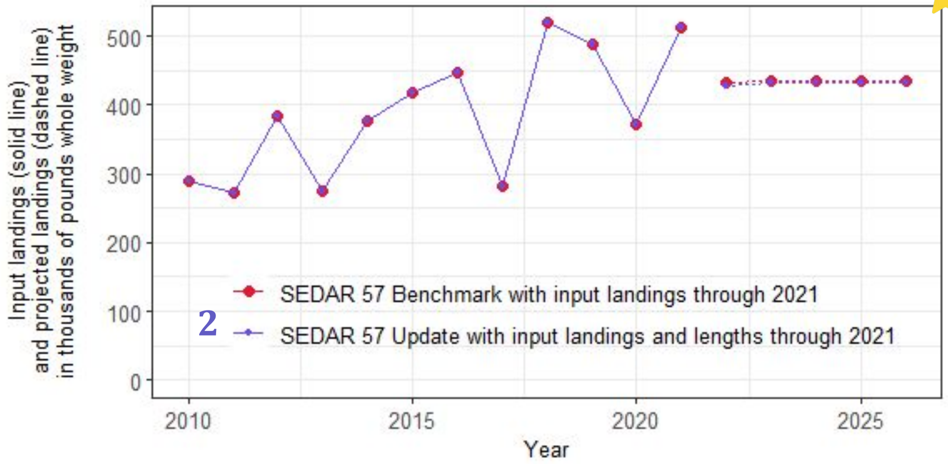
2b. Update assessment with landings through **2021** and lengths through **2021** with correction factor sensitivity (PR only)

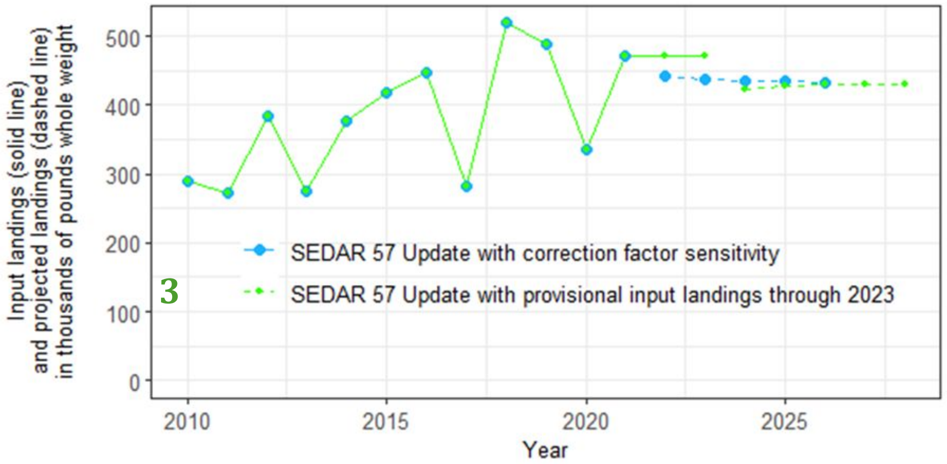
3. Update assessment with landings through **2023** and lengths through **2021**

Puerto Rico

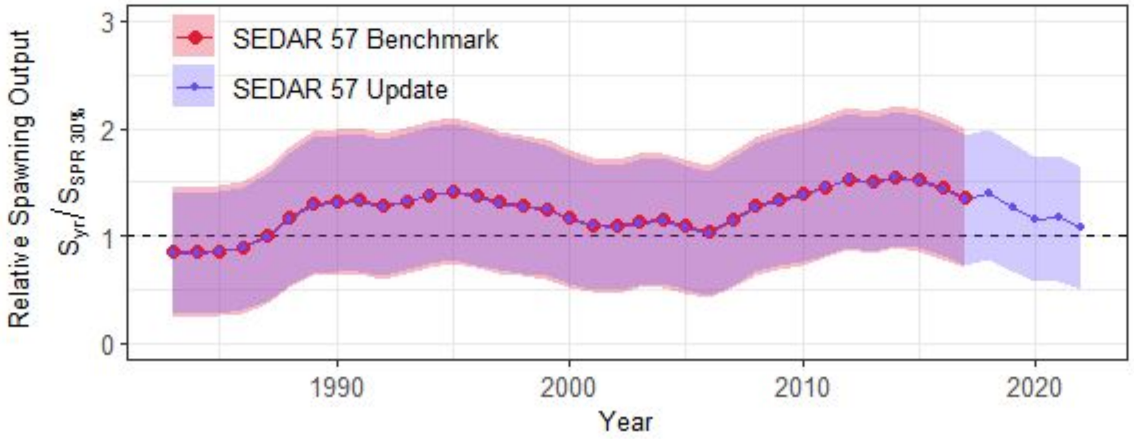

Input landings (solid line)
and projected landings (dashed line)
in thousands of pounds whole weight
0
100
200
300
400
500
2010
2015
2020
2025
Year
SEDAR 57 Benchmark with input landings through 2020
1
SEDAR 57 Benchmark with input landings through 2021

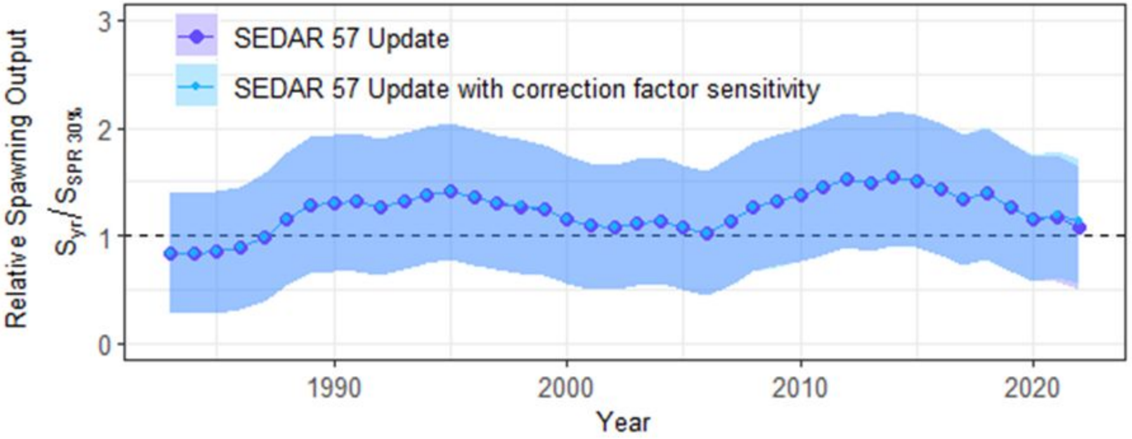

Input landings (solid line)
and projected landings (dashed line)
in thousands of pounds whole weight
0
100
200
300
400
500
2010
2015
2020
2025
Year
SEDAR 57 Update with input landings and lengths through 2021
2b
SEDAR 57 Update with correction factor sensitivity

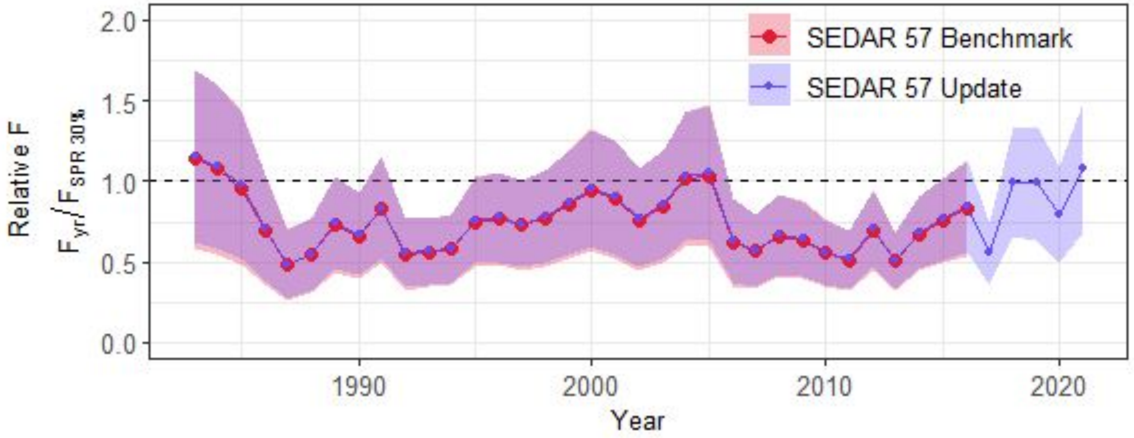

Input landings (solid line)
and projected landings (dashed line)
in thousands of pounds whole weight
0
100
200
300
400
500
2010
2015
2020
2025
Year
SEDAR 57 Benchmark with input landings through 2021
2
SEDAR 57 Update with input landings and lengths through 2021

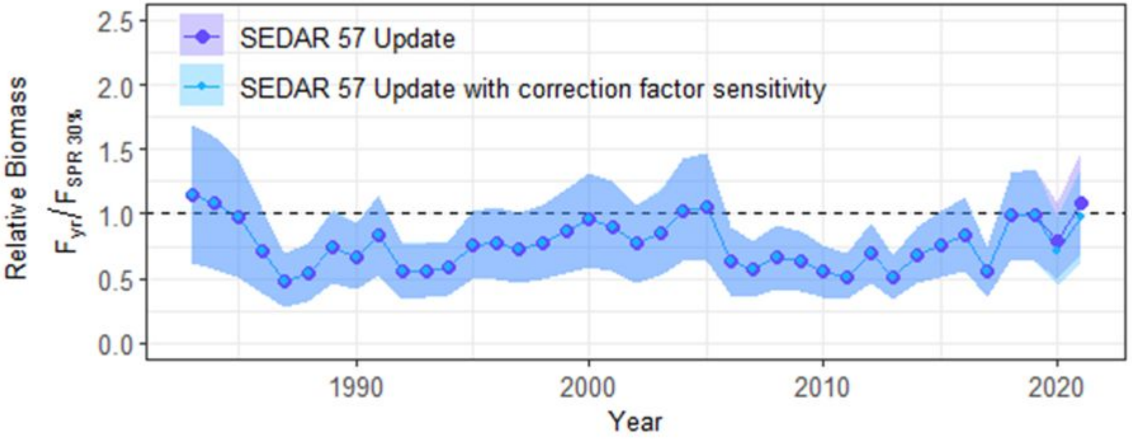

Input landings (solid line)
and projected landings (dashed line)
in thousands of pounds whole weight
0
100
200
300
400
500
2010
2015
2020
2025
Year
SEDAR 57 Update with correction factor sensitivity
3
SEDAR 57 Update with provisional input landings through 2023

Puerto Rico


SEDAR 57 Benchmark
SEDAR 57 Update
Relative Spawning Output
$S_{yr}/S_{SPR\ 30\%}$
0
1
2
3
1990
2000
2010
2020
Year

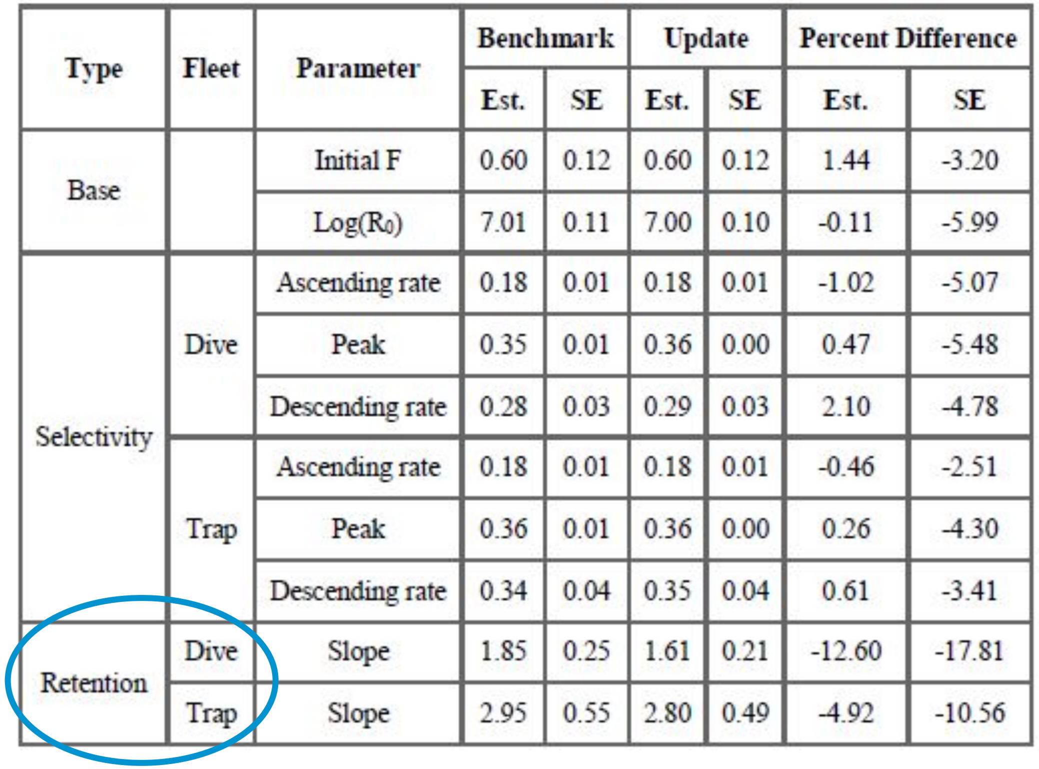

SEDAR 57 Update
SEDAR 57 Update with correction factor sensitivity
Relative Spawning Output
$S_{yr}/S_{SPR\ 30\%}$
0
1
2
3
1990
2000
2010
2020
Year


SEDAR 57 Benchmark
SEDAR 57 Update
Relative F
$F_{yr}/F_{SPR\ 30\%}$
0.0
0.5
1.0
1.5
2.0
1990
2000
2010
2020
Year


SEDAR 57 Update
SEDAR 57 Update with correction factor sensitivity
Relative Biomass
$F_{yr}/F_{SPR\ 30\%}$
0.0
0.5
1.0
1.5
2.0
2.5
1990
2000
2010
2020
Year

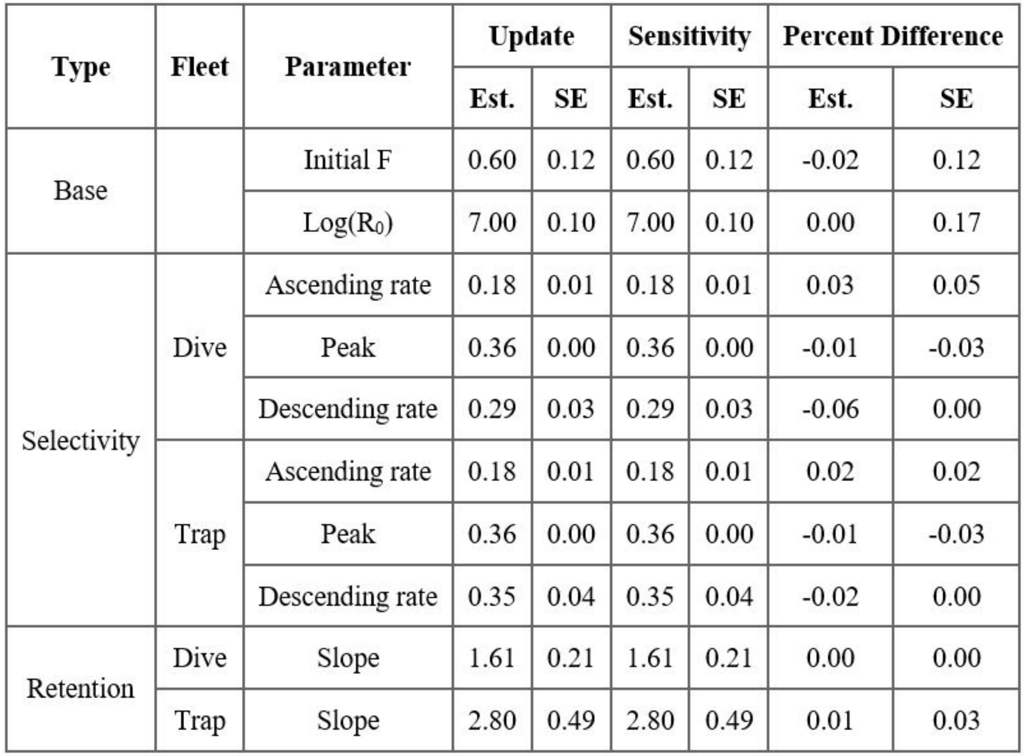
Puerto Rico

Parameter estimates compared between the SEDAR 57 benchmark assessment and the SEDAR 57 update assessment.



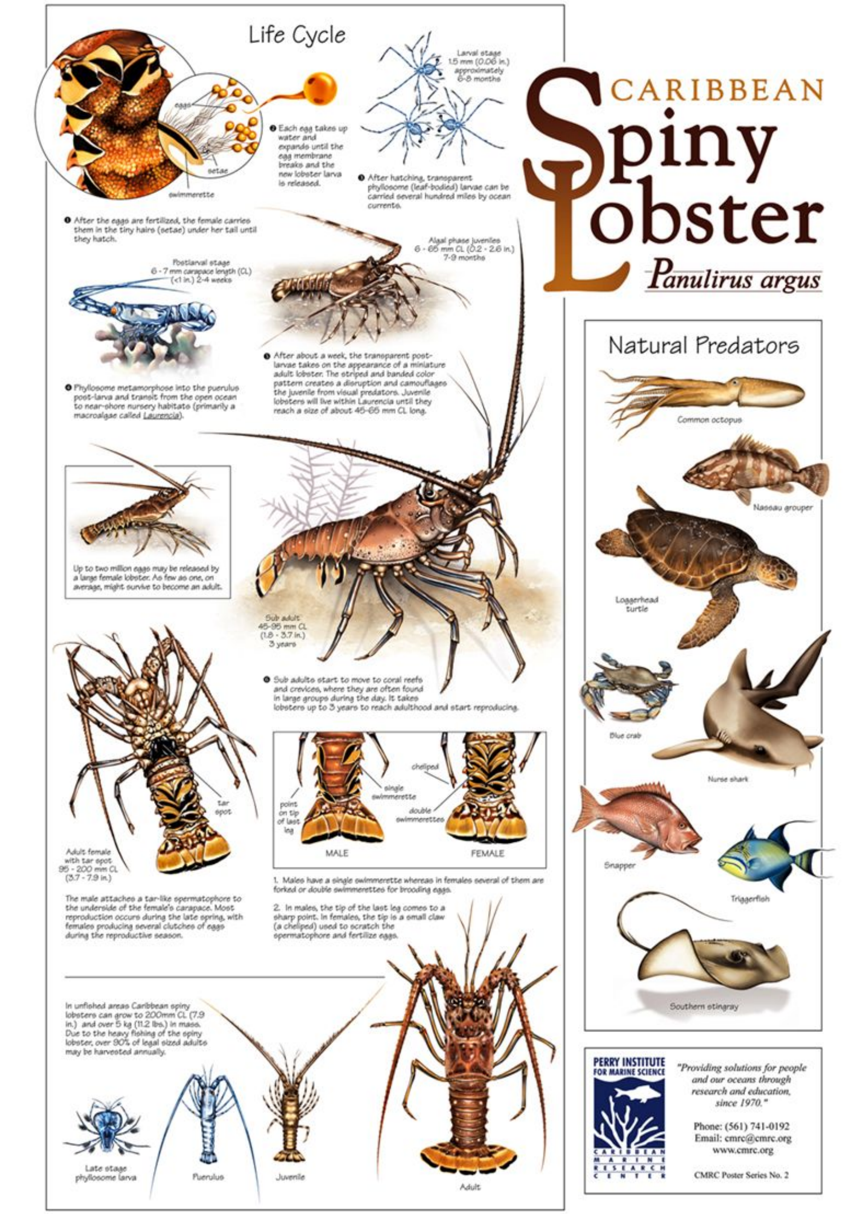
Type	Fleet	Parameter	Benchmark		Update		Percent Difference	
			Est.	SE	Est.	SE	Est.	SE
Base		Initial F	0.60	0.12	0.60	0.12	1.44	-3.20
		Log(R_0)	7.01	0.11	7.00	0.10	-0.11	-5.99
Selectivity	Dive	Ascending rate	0.18	0.01	0.18	0.01	-1.02	-5.07
		Peak	0.35	0.01	0.36	0.00	0.47	-5.48
		Descending rate	0.28	0.03	0.29	0.03	2.10	-4.78
	Trap	Ascending rate	0.18	0.01	0.18	0.01	-0.46	-2.51
		Peak	0.36	0.01	0.36	0.00	0.26	-4.30
		Descending rate	0.34	0.04	0.35	0.04	0.61	-3.41
Retention	Dive	Slope	1.85	0.25	1.61	0.21	-12.60	-17.81
	Trap	Slope	2.95	0.55	2.80	0.49	-4.92	-10.56

Parameter estimates compared between the SEDAR 57 update assessment and the SEDAR 57 update sensitivity assessment with alternative correction factors for 2020 and 2021.



Type	Fleet	Parameter	Update		Sensitivity		Percent Difference	
			Est.	SE	Est.	SE	Est.	SE
Base		Initial F	0.60	0.12	0.60	0.12	-0.02	0.12
		Log(R_0)	7.00	0.10	7.00	0.10	0.00	0.17
Selectivity	Dive	Ascending rate	0.18	0.01	0.18	0.01	0.03	0.05
		Peak	0.36	0.00	0.36	0.00	-0.01	-0.03
		Descending rate	0.29	0.03	0.29	0.03	-0.06	0.00
	Trap	Ascending rate	0.18	0.01	0.18	0.01	0.02	0.02
		Peak	0.36	0.00	0.36	0.00	-0.01	-0.03
		Descending rate	0.35	0.04	0.35	0.04	-0.02	0.00
Retention	Dive	Slope	1.61	0.21	1.61	0.21	0.00	0.00
	Trap	Slope	2.80	0.49	2.80	0.49	0.01	0.03

Questions



eggs
setae
swimmerette
Larval stage
1.5 mm (0.06 in.)
approximately
6-8 months
Postlarval stage
6 - 7 mm carapace length (CL)
(<1 in.) 2-4 weeks
Algal phase juveniles
6 - 65 mm CL (0.2 - 2.6 in.)
7-9 months
Sub adult
45-95 mm CL
(1.8 - 3.7 in.)
3 years
tar spot
Adult female
with tar spot
95 - 200 mm CL
(3.7 - 7.9 in.)
cheliped
single swimmerette
point on tip of last leg
double swimmerettes
MALE
FEMALE
Common octopus
Nassau grouper
Loggerhead turtle
Blue crab
Nurse shark
Snapper
Triggerfish
Southern stingray
Late stage phyllosome larva
Puerulus
Juvenile
Adult

Life Cycle

CARIBBEAN Spiny Lobster

Panulirus argus

❶ After the eggs are fertilized, the female carries them in the tiny hairs (setae) under her tail until they hatch.

❷ Each egg takes up water and expands until the egg membrane breaks and the new lobster larva is released.

❸ After hatching, transparent phyllosome (leaf-bodied) larvae can be carried several hundred miles by ocean currents.

❹ Phyllosome metamorphose into the puerulus post-larva and transit from the open ocean to near-shore nursery habitats (primarily a macroalgae called Laurencia).

❺ After about a week, the transparent post-larvae takes on the appearance of a miniature adult lobster. The striped and banded color pattern creates a disruption and camouflages the juvenile from visual predators. Juvenile lobsters will live within Laurencia until they reach a size of about 45-65 mm CL long.

Up to two million eggs may be released by a large female lobster. As few as one, on average, might survive to become an adult.

❻ Sub adults start to move to coral reefs and crevices, where they are often found in large groups during the day. It takes lobsters up to 3 years to reach adulthood and start reproducing.

1. Males have a single swimmerette whereas in females several of them are forked or double swimmerettes for brooding eggs.

2. In males, the tip of the last leg comes to a sharp point. In females, the tip is a small claw (a cheliped) used to scratch the spermatophore and fertilize eggs.

The male attaches a tar-like spermatophore to the underside of the female's carapace. Most reproduction occurs during the late spring, with females producing several clutches of eggs during the reproductive season.

In unfished areas Caribbean spiny lobsters can grow to 200mm CL (7.9 in.) and over 5 kg (11.2 lbs.) in mass. Due to the heavy fishing of the spiny lobster, over 90% of legal sized adults may be harvested annually.

Natural Predators

PERRY INSTITUTE FOR MARINE SCIENCE

CARIBBEAN MARINE RESEARCH CENTER

"Providing solutions for people and our oceans through research and education, since 1970."

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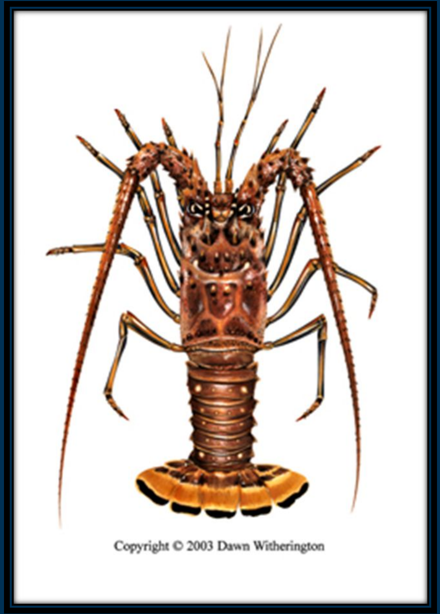
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Decapoda
An Arthopoda
Panuliridae
An ancient line
Goes back in time
3-60 million years away

- *Kingfish Trio 2022*

Additional Slides

Additional information

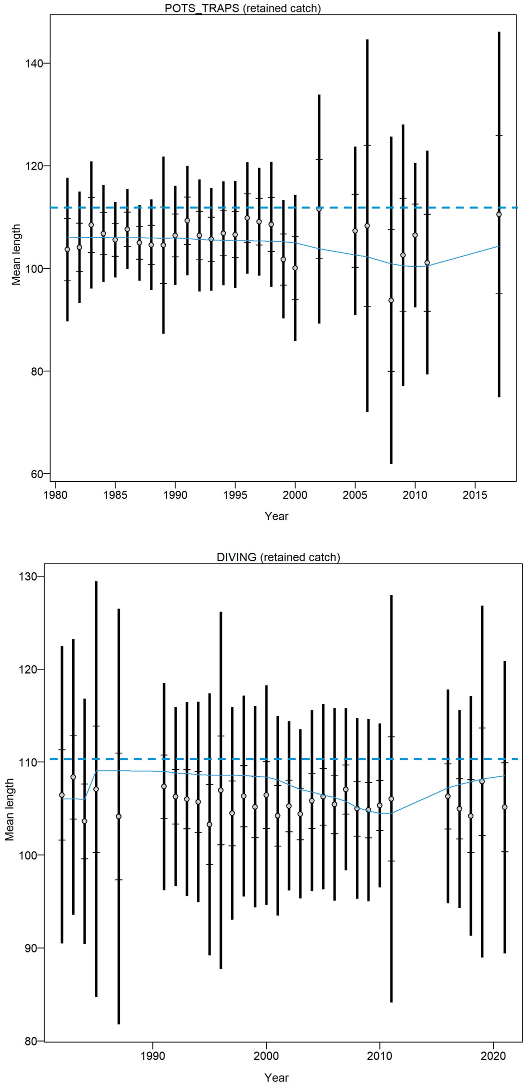
Requested by SSC 11/29

- Mean length by island over time
- 2020 correction factor values
- PR landings time series without correction factors

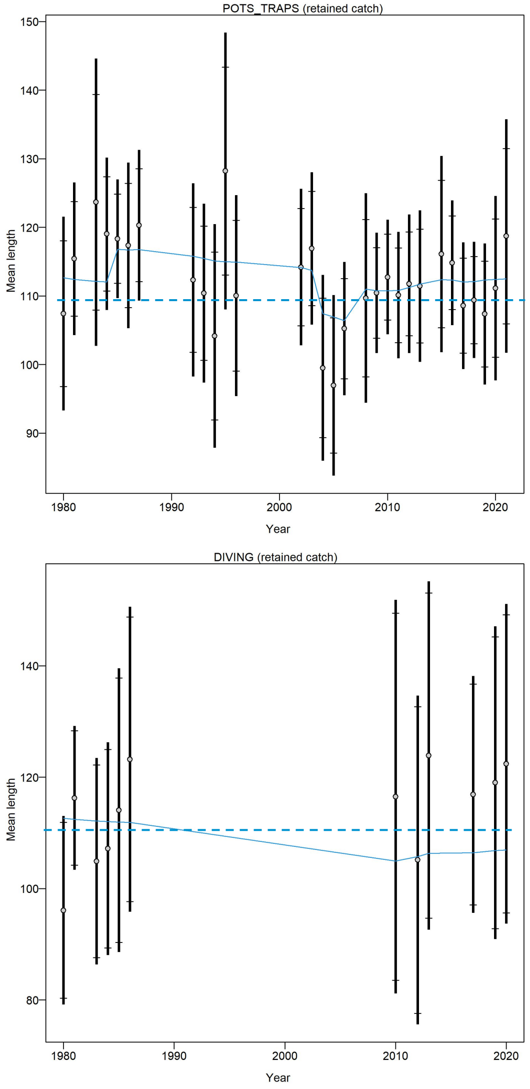
Update SSC determinations/decisions

- Include length (TIP) and landings (Logbooks) through 2021
- Start projections in 2024 (2022 and 2023 assumed equal to 2021]
- Use original 2020 correction factor or averages 2014-2019

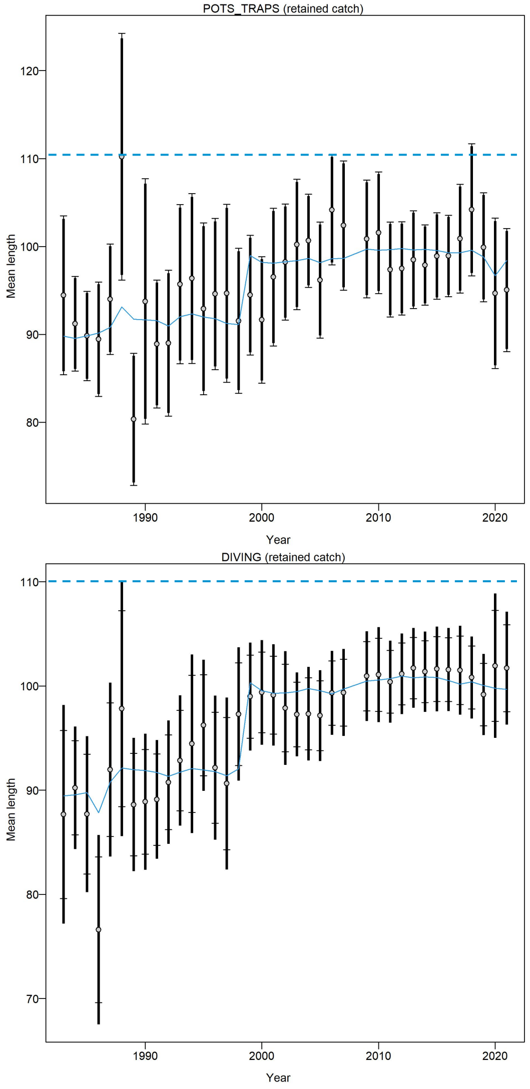
St. Croix

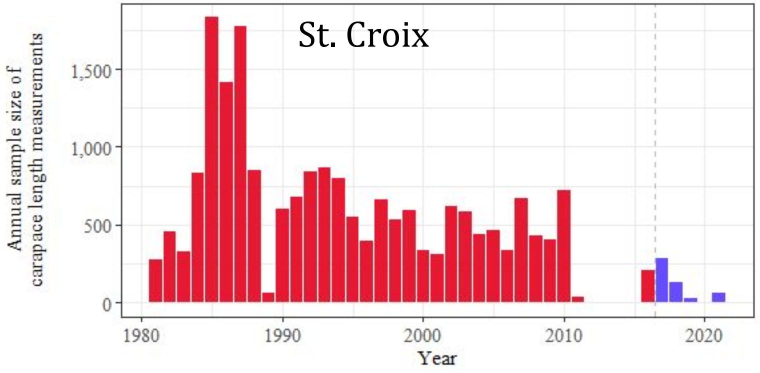


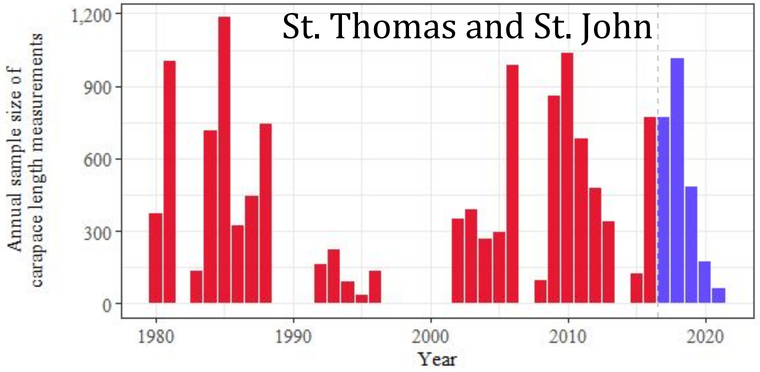
St. Thomas and St. John

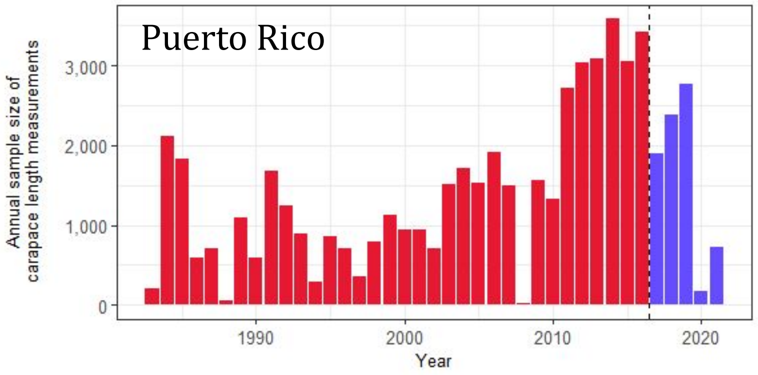


Puerto Rico

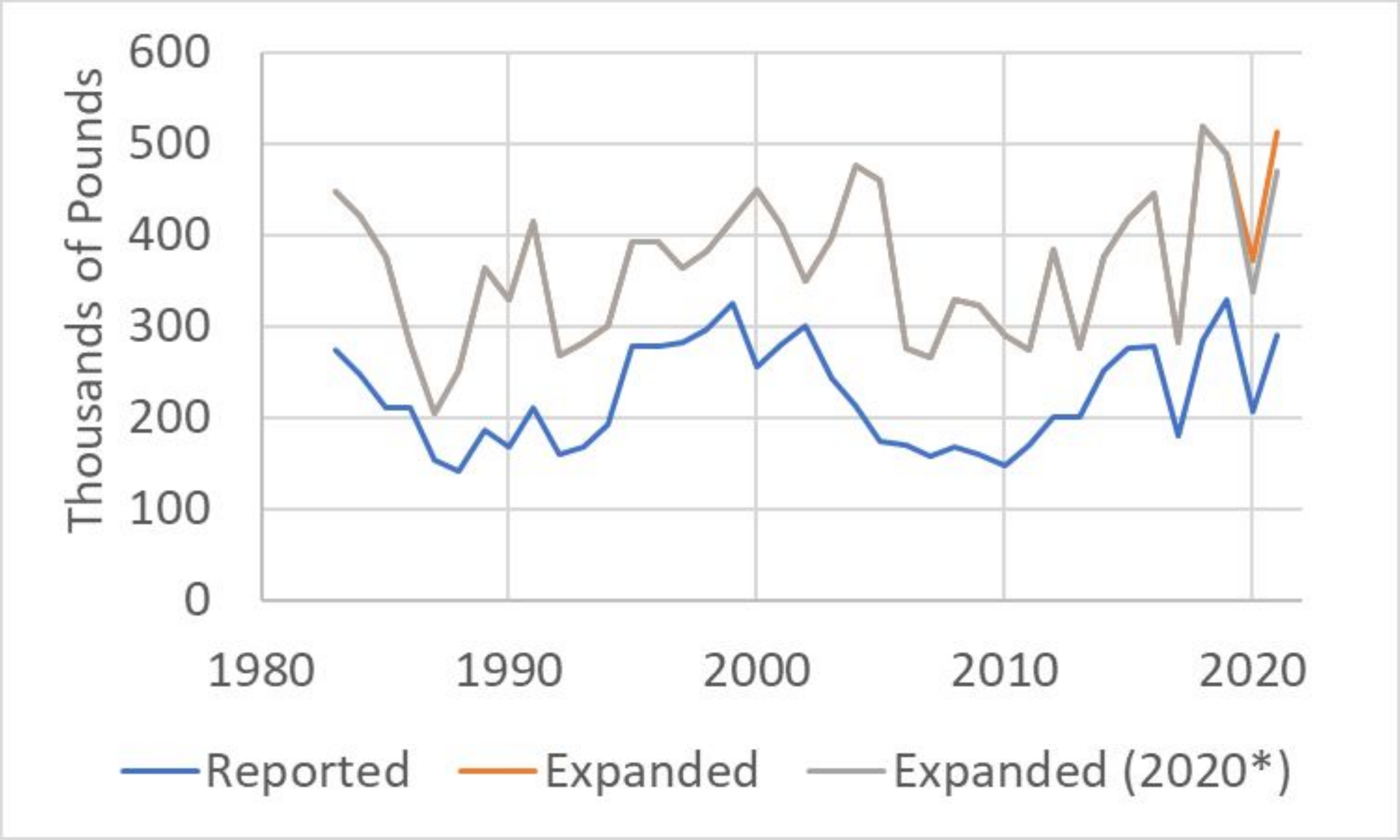








Puerto Rico landings time series without correction factors



2020 Reported Landings by Coast

	DIVING	TRAPS
EAST	27%	58%
INLAND	0%	0%
NORTH	9%	1%
SOUTH	20%	29%
WEST	44%	12%

2020 Correction Factor

	1/(2020 CF)	1/(Sen. CF)*	Change
EAST	1.50	2.02	35%
INLAND	1.00	1.37	37%
NORTH	5.96	1.67	-72%
SOUTH	1.66	1.50	-10%
WEST	1.57	1.24	-21%