

# Fishery Independent Data Needs for US Caribbean Fisheries Stock Assessment

## Summary

A primary goal of the Southeast Fisheries Science Center's Caribbean Strategic Planning project is to reduce gaps in fishery independent datasets used to inform management. The first step in accomplishing that goal is to collect information on existing fishery independent surveys, and identify where major fishery-independent data gaps exist to improve fisheries management decisions in the US Caribbean. A working group was established to develop fishery-independent data inventories for three survey targets (reef fish, Caribbean spiny lobster, queen conch) with respect to methodology, spatial extent, and time series, as well as identify and describe time and space coverage gaps for three survey targets, and summarize findings. This document contains those findings.



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## Acronyms

<i>Acronym</i>	<i>Definition</i>
CIMAS	Cooperative Institute for Marine and Atmospheric Studies
CSP	Caribbean Strategic Planning
DCRMP	Deep Coral Reef Monitoring Program
FI	Fishery-independent
NCRMP	National Coral Reef Monitoring Program
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PRCRMP	Puerto Rico Coral Reef Monitoring Program
PR	Puerto Rico
SEAMAP-C	Southeast Area Monitoring and Assessment Program - Caribbean
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
STTJ	St. Thomas/St. John
STX	St. Croix
TCRMP	Territorial Coral Reef Monitoring Program
UPR	University of Puerto Rico
USVI	United States Virgin Islands
UVI	University of the Virgin Islands

## Working Group

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Please contact the working group lead and coordinator with changes or suggestions.

## Introduction

Participants volunteered to join this strategic planning working group. During the initial meeting of the group, the participants developed their purpose, goals, and ideal outcomes, which are documented in the [Team Charter](#). The group met seventeen times over two years to accomplish the goals. Section A contains those goals and what was accomplished under each goal. Section B builds on the accomplished goals and contains specific data gaps identified in US Caribbean FI data.

## A. Goals & Summary of Actions to Address Goals:

1. Develop FI data inventories for the three survey targets (reef fish, Caribbean spiny lobster, queen conch) with respect to methodology, spatial extent, and time series.

Fishery-independent surveys employ standardized sampling methodology and techniques to assess changes in species abundance and other population metrics (size composition, age, etc.) through time and space. These data are generally used to assist with informing fisheries managers on the status of a given population. Based on the methodologies

employed, surveys can be classified as using extractive, non-extractive, or a combination of both methods to generate data. Extractive generally refers to removing animals from the water for biological samples to conduct age, growth, and reproductive studies. The life history information generated from these samples is often crucial to management. Non-extractive methods generally include counting (underwater or above), measuring (underwater or above), and/or weighing animals, resulting in the animals remaining alive and/or returning to the water alive. Oftentimes, surveys employ a combination of these methods to best generate data on species of interest. The type of survey methodology used (extractive vs. non-extractive) depends on the research needs and available resources. These data collected by fishery-independent surveys are used to calculate an index of abundance for target species and understand the size of the individuals in the population.

An inventory was developed to characterize current/ongoing FI data sources and the working group sought to collect information on the surveys regarding the target species group(s), methodology, and spatiotemporal range of the data collection. Programs with large-scale, long-term datasets were identified through working group member expert knowledge, input from colleagues, collaboration with other CSP working groups, and communication with relevant USVI and Puerto Rico staff. See Table 1 and the associated [spreadsheet](#) for additional information.

2. Identify and describe time/space coverage gaps for the three survey targets.

Summary tables were produced for each target species (Tables 2 – 4) to describe the survey sample frame, spatial extent, and data types related to each available and ongoing FI program. Separate meetings were held for each target species group to discuss the efficacy of each collection program for use in stock assessment, and to identify specific temporal and spatial coverage gaps (Table 5a – d and Section B). All recommendations were compiled for general data improvements (Section C).

3. Summarize findings in a written report.

This present report contains the findings of this group.

Table 1. Ongoing FI data collection programs in the US Virgin Islands and Puerto Rico.

<i>Dataset</i>	<i>Geographic Range</i>	<i>Data Points/Year</i>
SEAMAP-C Fish	USVI & PR	2017 – ongoing
SEAMAP-C Conch	USVI & PR	2017 – ongoing
SEAMAP-C Lobster	USVI & PR	2017 – ongoing
Commercial Fishers Juvenile Lobster Trap Survey	PR	2022 – ongoing
Reef Fish Survey	PR	2022 – ongoing
Reef Fish Survey Expansion**	USVI	TBD
NPS Lobster Survey	USVI National Parks	2019 – ongoing
NPS Seagrass/Conch Survey	USVI National Parks	2022 – ongoing
NCRMP	USVI & PR	2013 – ongoing
TCRMP	USVI	2003 – ongoing
PRCRMP	PR	1999 – ongoing
Conch Surveys*	USVI & PR	2023 – 2025
DCRMP*	USVI	2020 – 2022

\*Short-term study

\*\*Upcoming survey

Table 2a. Reef fish FI surveys summary table.

Reef Fish Summary		SEAMAP-C	Deep Reef Fish Survey	Shallow Reef Fish Survey	Reef Fish Survey Expansion**	NCRMP	TCRMP	PRCRMP	DCRMP*
Sample Frame	Sample method	Video, hook & line	Video, hook & line	Video, hook & line	Hook & line	Diver	Diver	Diver	Diver
	Survey type	Combination	Combination	Combination	Combination	Non-Extractive	Non-Extractive	Non-Extractive	Non-Extractive
	Biosamples Taken	Y	Y	Y	Y	N	N	N	N
	Primary Sample Unit	100x100 m	500x500 m	500x500 m	500x500 m	50x50 m	50x50 m	50x50 m	50x50 m
	Secondary Sample Unit	NA	NA	NA	NA	15m diameter cylinder	25x4m transect	10x3m & 20x3m transect	15m diameter cylinder
	Sampling design	Random	Random	Random	Random	Random	Fixed	Fixed	Random
	Spatial stratification	Depth, habitat	Depth, rugosity	Depth, rugosity	Depth, rugosity	Depth, habitat, rugosity	TCRMP specific	Region, site, depth, habitat	Depth, habitat, rugosity
	Depth range	5 — 100 m	50 — 450 m	20 — 50 m	20 — 450 m	0 — 30 m	5 — 65 m	2 — 35 m	30 — 50 m
	Geographic coverage	W/SW & E PR, STTJ, STX	PR island-wide	PR island-wide	STTJ, STX	PR, STTJ, STX island-wide	STTJ, STX	PR	STTJ
	Sampling frequency	2 — 3 years in a 5-year cycle	Yearly	Yearly beginning 2025	Yearly beginning TBD	Every 2 years	Yearly	Every 2 years	Yearly
	Planned sites	240	200	50	TBD	250 STTJ, 250 STX, 300 PR	34	42	100
	Completed sites per year	240	200	50	TBD	250 STTJ, 250 STX, 250 PR	34	42	100
Data Type	Relative abundance	Y	Y	Y	Y	Y	Y	Y	Y
	Proportion occurrence	Y	Y	Y	Y	Y	Y	Y	Y
	Length composition	Y	Y	Y	Y	Y	Y	Y	Y
	Age composition	Y	Y	Y	Y	N	N	N	N
	Sex	Y	Y	Y	Y	N	N	N	N
	Maturity	Limited	Limited	Limited	Limited	N	N	Limited	N
	Fecundity	Limited	Limited	Limited	Limited	N	N	N	N
	Target phase	Adults, limited juveniles	Adults, limited juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	Benthic habitat	Y	N	N	N	Y	Y	Y	Y
Contact		Walt Ingram, Eric Hoffmayer	Kate Overly	Kate Overly	Kevin McCarthy	Jay Grove	Tyler Smith	Miguel Figuerola Hernandez	Tyler Smith, Jay Grove

\*Short-term study

\*\*Upcoming survey

Table 2b. Puerto Rico reef fish FI surveys summary table.

<b>Puerto Rico Reef Fish Summary</b>		<i>SEAMAP-C Est. 2017</i>	<i>Deep Reef Fish Survey Est. 2022</i>	<i>Shallow Reef Fish Survey Est. 2025</i>	<i>NCRMP Est. 2013</i>	<i>PRCRMP Est. 1999</i>
<b>Sample Frame</b>	<i>Survey type</i>	Video, hook and line	Video, hook and line	Video, Hook and line	Diver	Diver
	<i>Sample method</i>	Combination	Combination	Combination	Non-Extractive	Non-Extractive
	<i>Biosamples taken</i>	Y	Y	Y	N	N
	<i>Primary Sample Unit</i>	100x100 m	500x500 m	500x500 m	50x50 m	50x50 m
	<i>Secondary Sample Unit</i>	NA	NA	NA	15m diameter cylinder	10x3m & 20x3m transect
	<i>Sampling design</i>	Random	Random	Random	Random	Fixed
	<i>Spatial stratification</i>	Depth, habitat	Depth, rugosity	Depth, rugosity	Depth, habitat, rugosity	Region, site, depth, habitat
	<i>Depth range</i>	5 — 100 m	50 — 450 m	20 — 50 m	0 — 30 m	2 — 35 m
	<i>Geographic coverage</i>	W/SW & E	Island-wide	Island-wide	Island-wide	Island-wide
	<i>Sampling frequency</i>	2 — 3 years in a 5-year cycle	Yearly	Yearly beginning 2025	Every 2 years	Yearly in a 2-year cycle
	<i>Planned sites</i>	240	200	50	300	21
	<i>Completed sites per year</i>	240	200	50	250	21 sites each year of 42 total sites
<b>Data Type</b>	<i>Relative abundance</i>	Y	Y	Y	Y	Y
	<i>Proportion occurrence</i>	Y	Y	Y	Y	Y
	<i>Length composition</i>	Y	Y	Y	Y	Y
	<i>Age composition</i>	Y	Y	Y	N	N
	<i>Sex</i>	Y	Y	Y	N	N
	<i>Maturity</i>	Limited	Limited	Limited	N	Limited
	<i>Fecundity</i>	Limited	Limited	Limited	N	N
	<i>Target phase</i>	Adults, limited juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	N	N	Y	Y
<b>Contact</b>		Walt Ingram, Eric Hoffmayer	Kate Overly	Kate Overly	Jay Grove	Miguel Figuerola Hernandez



Table 2c. St. Thomas/St. John reef fish FI surveys summary table

<b>St. Thomas/St. John Reef Fish Summary</b>		<i>SEAMAP-C Est. 2017</i>	<i>Reef Fish Survey Expansion** TBD</i>	<i>NCRMP Est. 2013</i>	<i>TCRMP Est. 2003</i>	<i>DCRMP* 2020 - 2022</i>
<b>Sample Frame</b>	<i>Survey type</i>	Video, hook & line	Hook & line	Diver	Diver	Diver
	<i>Sample method</i>	Combination	Combination	Non-Extractive	Non-Extractive	Non-Extractive
	<i>Biosamples taken</i>	Y	Y	N	N	N
	<i>Primary Sample Unit</i>	100x100 m	500x500 m	50x50 m	50x50 m	50x50 m
	<i>Secondary Sample Unit</i>	NA	NA	15m diameter cylinder	25x4m transect	15m diameter cylinder
	<i>Sampling design</i>	Random	Random	Random	Fixed	Random
	<i>Spatial stratification</i>	Depth, habitat	Depth, rugosity	Depth, habitat, rugosity	TCRMP specific	Depth, habitat, rugosity
	<i>Depth range</i>	5 – 100 m	20 – 450 m	0 – 30 m	5 – 65 m	30 – 50 m
	<i>Geographic coverage</i>	Island wide	Island wide	Island wide	Island wide	Island wide
	<i>Sampling frequency</i>	2 – 3 years in a 5-year cycle	Yearly beginning TBD	Every 2 years	Yearly	Yearly
	<i>Planned sites</i>	120	TBD	250	34	100
	<i>Completed sites per year</i>	120	TBD	250	34	100
<b>Data Type</b>	<i>Relative abundance</i>	Y	Y	Y	Y	Y
	<i>Proportion occurrence</i>	Y	Y	Y	Y	Y
	<i>Length composition</i>	Y	Y	Y	Y	Y
	<i>Age composition</i>	Y	Y	N	N	N
	<i>Sex</i>	Y	Y	N	N	N
	<i>Maturity</i>	Limited	Limited	N	N	N
	<i>Fecundity</i>	Limited	Limited	N	N	N
	<i>Target phase</i>	Adults, limited juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	N	Y	Y	Y
<b>Contact</b>		Walt Ingram, Eric Hoffmayer	Kevin McCarthy	Jay Grove	Tyler Smith	Tyler Smith, Jay Grove

\*Short-term study

\*\*Upcoming survey

Table 2d. St. Croix reef fish FI surveys summary table

<b>St. Croix Reef Fish Summary</b>		<i>SEAMAP-C Est. 2017</i>	<i>Reef Fish Survey Expansion** Est. 2026</i>	<i>NCRMP Est. 2013</i>	<i>TCRMP Est. 2003</i>
<b>Sample Frame</b>	<i>Survey type</i>	Video, hook & line	Hook & line	Diver	Diver
	<i>Sample method</i>	Combination	Combination	Non-Extractive	Non-Extractive
	<i>Biosamples taken</i>	Y	Y	N	N
	<i>Primary Sample Unit</i>	100x100 m	500x500 m	50x50 m	50x50 m
	<i>Secondary Sample Unit</i>	NA	NA	15m diameter cylinder	25x4m transect
	<i>Sampling design</i>	Random	Random	Random	Fixed
	<i>Spatial stratification</i>	Depth, habitat	Depth, rugosity	Depth, habitat, rugosity	TCRMP specific
	<i>Depth range</i>	5 — 100 m	20 — 450 m	0 — 30 m	5 — 65 m
	<i>Geographic coverage</i>	Island wide	Island wide	Island wide	Island wide
	<i>Sampling frequency</i>	2 — 3 years in a 5-year cycle	Yearly beginning TBD	Every 2 years	Yearly
	<i>Planned sites</i>	120	TBD	250	34
	<i>Completed sites per year</i>	120	TBD	250	34
<b>Data Type</b>	<i>Relative abundance</i>	Y	Y	Y	Y
	<i>Proportion occurrence</i>	Y	Y	Y	Y
	<i>Length composition</i>	Y	Y	Y	Y
	<i>Age composition</i>	Y	Y	N	N
	<i>Sex</i>	Y	Y	N	N
	<i>Maturity</i>	Limited	Limited	N	N
	<i>Fecundity</i>	Limited	Limited	N	N
	<i>Target phase</i>	Adults, limited juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	N	Y	Y
<b>Contact</b>		Walt Ingram, Eric Hoffmayer	Kevin McCarthy	Jay Grove	Tyler Smith

\*\*Upcoming survey

Table 3a. Spiny lobster FI surveys summary table

<b>Spiny Lobster Summary</b>		<i>NPS Lobster Survey Est. 2019</i>	<i>SEAMAP-C (USVI) Est. 2017</i>	<i>SEAMAP-C (PR) Est. 2017</i>	<i>Commercial Fishers Juvenile Lobster Trap Survey Est. 2022</i>
<b>Sample frame</b>	<i>Survey type</i>	Diver	Diver	Diver	Lobster trap
	<i>Sample method</i>	Non-Extractive	Combination	Combination	Non-Extractive
	<i>Biosamples Taken</i>	N	Y	Y	N
	<i>Primary Sample Unit</i>	353 m <sup>2</sup>	Variable	NA	50x50 m
	<i>Secondary Sample Unit</i>	NA	NA	NA	NA
	<i>Sampling design</i>	Random	Random	Haphazard; Non-standardized random swimming	Random
	<i>Spatial stratification</i>	Depth, habitat	Habitat	Depth	Depth, habitat
	<i>Depth range</i>	0 – 30 m	0 – 30 m	0 – 27 m	0 – 40 m
	<i>Geographic coverage</i>	National parks in USVI	STTJ, STX	W/SW PR	PR island-wide
	<i>Sampling frequency</i>	1 year in a 4-year cycle for each park	2 years in a 5-year cycle	1 year in a 5-year cycle	Yearly
	<i>Planned sites</i>	100	80 STTJ 80 in STX	-	TBD
	<i>Completed sites</i>	85 – 100	80 STTJ 80 in STX	-	TBD
<b>Data type</b>	<i>Relative abundance</i>	Y	Y	N	Y
	<i>Proportion occurrence</i>	Y	Y	N	Y
	<i>Length composition</i>	Y	Y	Y	Y
	<i>Age composition</i>	N	Y	Y	N
	<i>Sex</i>	Y	Y	Y	Y
	<i>Maturity</i>	Y	Limited	N	Y
	<i>Fecundity</i>	N	Limited	N	N
	<i>Target phase</i>	Adults, limited juveniles	Adults, juveniles	Adults, juveniles	Juveniles
	<i>Benthic habitat</i>	Y	Limited	Y	Limited
<b>Contact</b>		Mike Feeley	JJ Cruz-Mota	JJ Cruz-Mota	Steve Smith, Kevin McCarthy

Table 3b. Puerto Rico spiny lobster FI surveys summary table

<b><i>Puerto Rico Spiny Lobster Summary</i></b>		<i>SEAMAP-C (PR)</i> <i>Est. 2017</i>	<i>Commercial Fishers Juvenile Lobster Trap Survey</i> <i>Est. 2022</i>
<b><i>Sample frame</i></b>	<i>Survey type</i>	Diver	Lobster trap
	<i>Sample method</i>	Combination	Non-Extractive
	<i>Biosamples Taken</i>	Y	N
	<i>Primary Sample Unit</i>	NA	50x50 m
	<i>Secondary Sample Unit</i>	NA	NA
	<i>Sampling design</i>	Haphazard selection; Non-standardized random swimming	Random
	<i>Spatial stratification</i>	Depth	Depth, habitat
	<i>Depth range</i>	0 – 27 m	0 – 40 m
	<i>Geographic coverage</i>	W/SW	Island wide
	<i>Sampling frequency</i>	1 year in a 5-year cycle	Yearly
	<i>Planned sites</i>	-	TBD
	<i>Completed sites</i>	-	TBD
<b><i>Data types</i></b>	<i>Relative abundance</i>	N	Y
	<i>Proportion occurrence</i>	N	Y
	<i>Length composition</i>	Y	Y
	<i>Age composition</i>	Y	N
	<i>Sex</i>	Y	Y
	<i>Maturity</i>	N	Y
	<i>Fecundity</i>	N	N
	<i>Target phase</i>	Adults, juveniles	Juveniles
	<i>Benthic habitat</i>	Y	Limited
<b><i>Contact</i></b>		JJ Cruz-Mota	Steve Smith, Kevin McCarthy

Table 3c. St. Thomas/St. John spiny lobster FI surveys summary table

<b>St. Thomas/St. John Spiny Lobster Summary</b>		<i>NPS Lobster Survey Est. 2019</i>	<i>SEAMAP-C (USVI) Est. 2017</i>
<i>Sample Frame</i>	<i>Survey type</i>	Diver	Diver
	<i>Sample method</i>	Non-Extractive	Combination
	<i>Biosamples Taken</i>	N	Y
	<i>Primary Sample Unit</i>	353 m <sup>2</sup>	Variable
	<i>Secondary Sample Unit</i>	NA	NA
	<i>Sampling design</i>	Random	Random
	<i>Spatial stratification</i>	Depth, habitat	Habitat
	<i>Depth range</i>	0 – 30 m	0 – 30 m
	<i>Geographic coverage</i>	Virgin Islands National Park	Island-wide
	<i>Sampling frequency</i>	1 year in a 4-year cycle for each park	1 year in a 5-year cycle
	<i>Planned sites</i>	100	80
	<i>Completed sites</i>	85 – 100	80
<i>Data Type</i>	<i>Relative abundance</i>	Y	Y
	<i>Proportion occurrence</i>	Y	Y
	<i>Length composition</i>	Y	Y
	<i>Age composition</i>	N	Y
	<i>Sex</i>	Y	Y
	<i>Maturity</i>	Y	Limited
	<i>Fecundity</i>	N	Limited
	<i>Target phase</i>	Adults, limited juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	Limited
<i>Contact</i>		Mike Feeley	JJ Cruz-Mota

Table 3d. St. Croix spiny lobster FI surveys summary table

<b>St. Croix Spiny Lobster Summary</b>		<i>NPS Lobster Survey Est. 2019</i>	<i>SEAMAP-C (USVI) Est. 2017</i>
<i>Sample Frame</i>	<i>Survey type</i>	Diver	Diver
	<i>Sample method</i>	Non-Extractive	Combination
	<i>Biosamples Taken</i>	N	Y
	<i>Primary Sample Unit</i>	353 m <sup>2</sup>	Variable
	<i>Secondary Sample Unit</i>	NA	NA
	<i>Sampling design</i>	Random	Random
	<i>Spatial stratification</i>	Depth, habitat	Habitat
	<i>Depth range</i>	0 – 30 m	0 – 30 m
	<i>Geographic coverage</i>	Buck Island Reef National Monument/Salt River Bay Historical Park and Ecological Reserve	Island wide
	<i>Sampling frequency</i>	1 year in a 4-year cycle for each park	1 year in a 5-year cycle
	<i>Planned sites</i>	100	80
	<i>Completed sites</i>	85 – 100	80
<i>Data Type</i>	<i>Relative abundance</i>	Y	Y
	<i>Proportion occurrence</i>	Y	Y
	<i>Length composition</i>	Y	Y
	<i>Age composition</i>	N	Y
	<i>Sex</i>	Y	Y
	<i>Maturity</i>	Y	Limited
	<i>Fecundity</i>	N	Limited
	<i>Target phase</i>	Adults, limited juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	Limited
<i>Contact</i>		Mike Feeley	JJ Cruz-Mota

Table 4a. Queen conch FI surveys summary table

<i>Queen Conch Summary</i>		<i>SEAMAP-C Est. 2017</i>	<i>NPS Lobster Survey*** Est. 2019</i>	<i>NPS Seagrass Survey*** Est. 2022</i>	<i>Conch Surveys* 2023 – 2025</i>
Sample Frame	Survey type	Diver	Diver	Diver	Diver
	Sample method	Non-extractive; Belt transect to radial survey	Non-extractive	Non-extractive	Non-extractive; Radial survey
	Biosamples Taken	N	N	N	N
	Primary Sample Unit	NA	2500 m <sup>2</sup>	NA	NA
	Secondary Sample Unit	NA	353 m <sup>2</sup>	177 m <sup>2</sup>	314 m <sup>2</sup>
	Sampling design	Random	Random	Random	Random
	Spatial stratification	Depth, habitat	Depth, habitat	Depth	Depth, habitat
	Depth range	0 – 30 m	0 – 30 m	0 – 25 m	0 – 30 m
	Geographic coverage	E & W PR, USVI	National parks in USVI	National parks in USVI	STTJ, STX, PR
	Sampling frequency	1 year in a 5-year cycle (PR), infrequent in USVI	One park per year in a 4-year cycle	One park per year in a 3-year cycle	One island per year
	Planned sites	-	100	100	-
	Completed sites	-	85 – 100	100	-
Data Type	Relative abundance	Y	Y	Y	Y
	Proportion occurrence	Y	Y	Y	Y
	Length composition	Limited	N	N	Y
	Age composition	Limited	N	N	Limited
	Sex	N	N	N	N
	Maturity	N	Y	Y	Limited
	Fecundity	N	N	N	N
	Target phase	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	Benthic habitat	Y	Y	Y	Y
Contact		JJ Cruz-Mota	Mike Feeley	Mike Feeley	Jennifer Doerr

\*Short-term study

\*\*\*Conch as incidental

Table 4b. Puerto Rico queen conch FI surveys summary table

<b>Puerto Rico Queen Conch Summary</b>		<b>SEAMAP-C (PR) Est. 2017</b>	<b>Conch Surveys* 2023 – 2025</b>
<b>Sample Frame</b>	<i>Survey type</i>	Diver	Diver
	<i>Sample method</i>	Non-extractive; Belt transect to radial survey	Non-extractive; Radial survey
	<i>Biosamples Taken</i>	N	N
	<i>Primary Sample Unit</i>	Circular transect of 10 m radius	NA
	<i>Secondary Sample Unit</i>	NA	314 m <sup>2</sup>
	<i>Sampling design</i>	Random	Random
	<i>Spatial stratification</i>	Depth, habitat	Depth, habitat
	<i>Depth range</i>	0 – 30 m	0 – 30 m
	<i>Geographic coverage</i>	E & W	Island wide
	<i>Sampling frequency</i>	1 year in a 5-year cycle	1 year in a 3-year cycle
	<i>Planned sites</i>	-	-
	<i>Completed sites</i>	-	-
<b>Data Type</b>	<i>Relative abundance</i>	Y	Y
	<i>Proportion occurrence</i>	Y	Y
	<i>Length composition</i>	Limited	Y
	<i>Age composition</i>	Limited	Limited
	<i>Sex</i>	N	N
	<i>Maturity</i>	N	Limited
	<i>Fecundity</i>	N	N
	<i>Target phase</i>	Adults, juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	Y
<b>Contact</b>		JJ Cruz-Mota	Jennifer Doerr

\*Short-term study



Table 4c. St. Thomas/St. John queen conch FI surveys summary table

<b>St. Thomas/St. John Queen Conch Summary</b>		<b>SEAMAP-C (USVI) Est. 2017</b>	<b>NPS Lobster Survey*** Est. 2019</b>	<b>NPS Seagrass Survey*** Est. 2022</b>	<b>Conch Surveys* 2023 – 2025</b>
<b>Sample Frame</b>	<i>Survey type</i>	Diver	Diver	Diver	Diver
	<i>Sample method</i>	Non-extractive; Belt transect to radial survey	Non-extractive	Non-extractive	Non-extractive; radial survey
	<i>Biosamples Taken</i>	N	N	N	N
	<i>Primary Sample Unit</i>	NA	2500 m <sup>2</sup>	NA	NA
	<i>Secondary Sample Unit</i>	NA	353 m <sup>2</sup>	177 m <sup>2</sup>	314 m <sup>2</sup>
	<i>Sampling design</i>	Random	Random	Random	Random
	<i>Spatial stratification</i>	Depth, habitat	Depth, habitat	Depth	Depth, habitat
	<i>Depth range</i>	0 – 30 m	0 – 30 m	0 – 25 m	0 – 30 m
	<i>Geographic coverage</i>	Island-wide	Virgin Islands National Park	Virgin Islands National Park	Island-wide
	<i>Sampling frequency</i>	1 year in a 5-year cycle	1 year in a 4-year cycle	1 year in a 3-year cycle	1 year in a 3 year cycle
	<i>Planned sites</i>	-	100	100	-
	<i>Completed sites</i>	-	85–100	100	-
<b>Data Type</b>	<i>Relative abundance</i>	Y	Y	Y	Y
	<i>Proportion occurrence</i>	Y	Y	Y	Y
	<i>Length composition</i>	Limited	N	N	Y
	<i>Age composition</i>	Limited	N	N	Limited
	<i>Sex</i>	N	N	N	N
	<i>Maturity</i>	N	Y	Y	Limited
	<i>Fecundity</i>	N	N	N	N
	<i>Target phase</i>	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	Y	Y	Y
<b>Contact</b>		JJ Cruz-Mota	Mike Feeley	Mike Feeley	Jennifer Doerr

\*Short-term study

\*\*\*Conch as incidental

Table 4d. St. Croix queen conch FI surveys summary table

<b>St. Croix Queen Conch Summary</b>		<b>SEAMAP-C Est. 2017</b>	<b>NPS Lobster Survey*** Est. 2019</b>	<b>NPS Seagrass Survey*** Est. 2022</b>	<b>Conch Surveys* 2023 – 2025</b>
<b>Sample Frame</b>	<i>Survey type</i>	Diver	Diver	Diver	Diver
	<i>Sample method</i>	Non-Extractive	Non-Extractive	Non-Extractive	Non-Extractive; radial survey
	<i>Biosamples Taken</i>	N	N	N	N
	<i>Primary Sample Unit</i>	NA	2500 m <sup>2</sup>	NA	NA
	<i>Secondary Sample Unit</i>	NA	353 m <sup>2</sup>	177 m <sup>2</sup>	314 m <sup>2</sup>
	<i>Sampling design</i>	Random	Random	Random	Random
	<i>Spatial stratification</i>	Depth, habitat	Depth, habitat	Depth	Depth, habitat
	<i>Depth range</i>	0 – 30 m	0 – 30 m	0 – 25 m	0 – 30 m
	<i>Geographic coverage</i>	Island wide	Buck Island Reef National Monument/Salt River Bay Historical Park and Ecological Reserve	Buck Island Reef National Monument/Salt River Bay Historical Park and Ecological Reserve	Island-wide
	<i>Sampling frequency</i>	1 year in a 5-year cycle	1 year in a 4-year cycle	1 year in a 3-year cycle	1 year in a 3 year cycle
	<i>Planned sites</i>	-	100	100	-
	<i>Completed sites</i>	-	85 – 100	100	-
<b>Data Type</b>	<i>Relative abundance</i>	Y	Y	Y	Y
	<i>Proportion occurrence</i>	Y	Y	Y	Y
	<i>Length composition</i>	Limited	N	N	Y
	<i>Age composition</i>	Limited	N	N	Limited
	<i>Sex</i>	N	N	N	N
	<i>Maturity</i>	N	Y	Y	Limited
	<i>Fecundity</i>	N	N	N	N
	<i>Target phase</i>	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
	<i>Benthic habitat</i>	Y	Y	Y	Y
<b>Contact</b>		JJ Cruz-Mota	Mike Feeley	Mike Feeley	Jennifer Doerr

\*Short-term study

\*\*\*Conch as incidental

Table 5a. Coverage gaps for FI survey targets in the US Virgin Islands and Puerto Rico. An 'X' indicates there is no gap in data coverage.

<b>Coverage Gaps</b>		<i>Reef Fish</i>	<i>Spiny Lobster</i>	<i>Queen Conch</i>
<i>Sample Frame</i>	<i>Geographic coverage</i>	X	X	X (High density/low density as well as stratified random sampling but need continued support)
	<i>Depth coverage</i>	X	No surveys beyond 40 m	X
	<i>Time coverage</i>	Seasonality missing or not adequately sampled	Unclear if survey frequency is adequate	Not adequately sampled
<i>Data Type</i>	<i>Relative abundance</i>	X	X	X
	<i>Proportion occurrence</i>	X	X	X
	<i>Length composition</i>	X	X	X
	<i>Age composition</i>	X	X	Cannot currently age
	<i>Sex</i>	X	X	Missing or not adequately sampled
	<i>Maturity</i>	Missing or not adequately sampled	Missing or not adequately sampled	Missing or not adequately sampled
	<i>Fecundity</i>	Missing or not adequately sampled	Missing or not adequately sampled	Missing or not adequately sampled
	<i>Juveniles sampled</i>	Missing or not adequately sampled	Missing or not adequately sampled	0 - 1 year old missing or not adequately sampled; 5 - 6 cm sampled
	<i>Benthic habitat</i>	Missing or not adequately sampled	X	X

Table 5b. Coverage gaps for Reef Fish across Island Platforms. An 'X' indicates there is no gap in data coverage.

Coverage Gaps for Reef Fish		Puerto Rico		STTJ		STX	
		Note	Coverage =X	Note	Coverage=X	Note	Coverage=X
Sampling frame	Geographic coverage	Island-wide	X	Island-wide	X	Island-wide	X
	Depth coverage	0 – 450 m	X	0 – 100 m	–	0 – 100 m	–
	Time coverage	20 – 450 m yearly ; < 20 m ~every 2 years	–	0 – 100 m ~every 3 – 5 years; 0 – 450 m yearly TBD	–	0 – 100 m ~every 3 – 5 years; 0 – 450 m yearly TBD	–
Data types	Relative abundance	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Proportion occurrence	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Length composition	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Age composition	Data collected via extractive surveys	X	Data collected via extractive surveys	X	Data collected via extractive surveys	X
	Sex	Data collected via extractive surveys	X	Data collected via extractive surveys	X	Data collected via extractive surveys	X
	Maturity	Limited data	–	Limited data	–	Limited data	–
	Fecundity	Limited data	–	Limited data	–	Limited data	–
	Target phase	Data collected on all phases	X	Data collected on all phases	X	Data collected on all phases	X
	Benthic habitat	Data collected via visual surveys	X	Data collected via visual surveys	X	Data collected via visual surveys	X

Table 5c. Coverage gaps for Spiny Lobster across Island Platforms. An 'X' indicates there is no gap in data coverage.

Coverage Gaps for Spiny Lobster		Puerto Rico		STTJ		STX	
		Note	Coverage=X	Note	Coverage=X	Note	Coverage=X
Sample Frame	Geographic coverage	Island-wide by one survey	X	Island-wide by one survey	–	Island-wide by one survey	–
	Depth coverage	0 – 40 m	–	0 – 30 m	–	0 – 30 m	–
	Time coverage	0 – 27 m ~ every 5 years; 0 – 40 m yearly	–	0 – 30 m 2 years in a 5-year cycle island-wide; 0 – 30 m yearly in national parks	–	0 – 30 m 2 years in a 5-year cycle island-wide; 0 – 30 m yearly in national parks	–
Data Type	Relative abundance	Data collected by one survey	–	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Proportion occurrence	Data collected by one survey	–	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Length composition	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Age composition	Data collected via visual survey every 5 years	–	Data collected via extractive survey	X	Data collected via extractive survey	X
	Sex	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X	Data collected via visual & extractive surveys	X
	Maturity	Data collected via visual survey every 5 years	–	Limited data	–	Limited data	–
	Fecundity	Data not collected	–	Limited data	–	Limited data	–
	Target phase	Data on adults collected every 5 years	–	Limited data	–	Limited data	–
	Benthic habitat	Limited data	–	Limited data	–	Limited data	–

Table 5d. Coverage gaps for Queen Conch across Island Platforms. An 'X' indicates there is no gap in data coverage.

Coverage Gaps for Queen Conch		Puerto Rico		STTJ		STX	
		Note	Coverage=X	Note	Coverage=X	Note	Coverage=X
Sample Frame	Geographic coverage	Island-wide by one survey	–	Island-wide	X	Island-wide	X
	Depth coverage	0 – 30 m		0 – 30 m	X	0 – 30 m	X
	Time coverage	0 – 30 m ~ every 3 & 5 years		0 – 30 m ~ every 3, 4, & 5 years; 0 – 25 m every 4 years	X	0 – 30 m ~ every 3, 4, & 5 years; 0 – 25 m every 4 years	X
Data Type	Relative abundance	Data collected via visual surveys	X	Data collected via visual surveys	X	Data collected via visual surveys	X
	Proportion occurrence	Data collected via visual surveys	X	Data collected via visual surveys	X	Data collected via visual surveys	X
	Length composition	Limited data	–	Limited data	–	Limited data	–
	Age composition	Limited data	–	Limited data	–	Limited data	–
	Sex	No data collected	–	No data collected	–	No data collected	–
	Maturity	Limited data	–	Limited data	–	Limited data	–
	Fecundity	No data collected	–	No data collected	–	No data collected	–
	Target phase	Data collected on all phases	X	Data collected on all phases	X	Data collected on all phases	X
	Benthic habitat	Data collected via visual surveys	X	Data collected via visual surveys	X	Data collected via visual surveys	X

## B. Summary of Fishery Independent Data Gaps:

### 1. Reef Fish

#### a. Puerto Rico

When all five reef fish sampling programs in Puerto Rico are considered, sampling has occurred at least every two years, island-wide since 2013 with at least one survey type (Table 2b). Other programs which sample fewer sites every two to three years have been in operation since 1999 and 2013 (Table 2b). Starting in 2025, one program began sampling yearly, island-wide and that project is ongoing (Table 2b). As such, the planned geographic coverage for shallower depths (0 – 100 m) appears to be adequate, pending funding. Another program focused on deeper reef fish habitat (50 – 450 m) has sampled island-wide annually since 2022 (Table 2b).

The sampling frequency of the survey types may be missing or inadequate. Specifically, information regarding the seasonality of species cannot always be obtained due to the sampling schedules. Among the surveys, the following data types are sampled annually, island-wide, with at least one survey type from 20 – 450 m: relative abundance, proportion occurrence, length composition, age composition, and sex ratio. Among the surveys, the following data types are missing or not adequately sampled: maturity, fecundity, juvenile life phase, and benthic habitat. Although the programs survey juveniles, no program samples the full extent of juvenile habitats.

b. St. Thomas/St. John

When all five reef fish sampling programs in the St. Thomas/St. John island platform are considered, sampling appears to be island-wide i.e., the geographic coverage is adequate (Table 2c). Combined, the surveys cover depths from 0 – 65 m. SEAMAP-C samples depths up to 100 m for three years in a five-year cycle (Table 2c). Presently, no surveys consistently sample depths greater than 40 m. The planned Reef Fish Survey Expansion pilot study would annually survey to 450 m (Table 2c); however, the funding for this project was rescinded and the start date is to be determined. It is unclear if the sampling frequency is adequate, likely due to logistical concerns, including cancellations during hurricane season and delayed arrival of funds. Among the surveys, the following data types are sampled annually island-wide from 5 – 65 m: relative abundance, proportion occurrence, length composition, and benthic habitat (Table 2c). Age composition and sex ratio are sampled island-wide from 5 – 100 m every 2 – 3 years in a 5-year cycle (Table 2c). Among the surveys, the following data types are missing or not adequately sampled: maturity, fecundity, and juvenile life phase. Although the programs survey juveniles, no program samples the full extent of juvenile habitats.

c. St. Croix

When all four reef fish sampling programs in St. Croix are considered, sampling appears to be island-wide and includes areas of high density, low density, and stratified random sampling; however, continued support is needed on this island platform (Table 2d). Combined, the surveys cover depths of 0 – 65 m. Additionally, SEAMAP-C samples depths up to 100 m for three years in a five-year cycle. The planned Reef Fish Survey Expansion pilot study would annually survey to 450 m (Table 2d); however, the funding for this project was rescinded and the start date is to be determined. Temporal coverage for FI surveys in St. Croix have historically been inadequate. Among the surveys, the following data types are sampled annually island-wide from 0 – 65 m: relative abundance, proportion occurrence, length composition, and benthic habitat. Age composition and sex ratio are sampled island-wide from 5 – 100 m every 2 – 3 years in a 5-year cycle. Among the surveys, the following data types are missing or not adequately sampled: maturity, fecundity, and juvenile life phase. Although the programs survey juveniles, no program samples the full extent of juvenile habitats, specifically the 0 – 1 year old life phase.

d. Overall

Specific needs to ensure adequate data for reef fish are collected for stock assessment include (in no particular order):

- i. Coordination/Calibration of current sampling efforts and standardized survey methods
- ii. Ensure the frequency of sampling is adequate to capture seasonality and periodicity. Input from assessment scientists on frequency of sampling is necessary.
- iii. Continued funding of current programs with developed time series.
- iv. Continued funding of bio-sampling for fishery-independent surveys, some of which is external to “fishery-independent”.

While adult life stages and some juvenile life stages of reef fishes in the US Caribbean are adequately sampled, potential areas for improvement in the current sampling efforts or new sampling efforts may include (in no particular order):

- v. A review of the location and timing of larval fish sampling to identify where additional surveys are needed to properly assess the populations.
- vi. A survey of juvenile habitats e.g. mangroves and shallow seagrass beds (0 – 30 m).
- vii. Establishment of long-term spawning aggregation surveys as most historical projects are short-term.

Beyond the surveys, the development and adoption of standardized maturity assigning protocols to develop size-at-maturity estimates for targeted reef fish species and standardized protocols for fecundity estimation in targeted reef fish species would be useful for stock assessment and potentially help to determine the periodicity of sampling efforts.

## 2. Spiny Lobster

### a. Puerto Rico

There are two main spiny lobster sampling programs in Puerto Rico. One survey has sampled island-wide to depths of 40 meters annually since 2022, and one survey has sampled every five years to depths of 27 m since 2017 (Table 3b). The time series of data for spiny lobster in Puerto Rico is minimal, and the surveys may not cover the entire depth range of the species. As such, it is unclear if the sampling frequency adequately captures population dynamics accurately. From one survey, the following data types are sampled annually island-wide from 0 – 40 m: relative abundance, proportion occurrence, length composition, sex, and maturity (Table 3b). The following data types are missing or not adequately sampled: age composition, fecundity, and benthic habitat. Additionally, pertinent information on adult lobsters has been collected every five years since 2017, while information on juveniles has been collected annually since 2022 (Table 3b).

### b. St. Thomas/St. John and St. Croix

The two spiny lobster surveys in the USVI sample both STTJ and STX, with the same sampling frame (Table 3c, 3d). When both spiny lobster sampling programs in the USVI are considered for both island platforms, one survey has sampled island-wide for one year in a five-year cycle since 2017, while the other has sampled on a 4-year cycle in national parks since 2019 (Table 3c, 3d), i.e., the geographic coverage may not be



adequate. Both surveys sample depths up to 30 meters (Table 3c, 3d). The time series of data for spiny lobster in the USVI is minimal, and the surveys may not cover the entire depth range of the species (Table 3c, 3d). As such, it is unclear if the sampling frequency adequately captures population dynamics accurately. From 0 – 30 m island-wide, the following data types are sampled once in a five-year cycle: relative abundance, proportion occurrence, length composition, age composition, and sex ( Table 3c, 3d). The following data types are missing or not adequately sampled: maturity, fecundity, and benthic habitat. Pertinent data on the target phases of adults and juveniles are limited.

c. Overall

Specific needs to ensure adequate data for spiny lobster are collected for stock assessment include (in no particular order):

- i. Creation of additional surveys to identify potential deeper habitats for lobster and, if found, implementation of surveys to adequately assess the deeper populations that are not inhibited by diving limitations.
- ii. Periodic review of survey frequency to understand if time coverage is adequate, as many programs have only performed pilot studies thus far.
- iii. Incorporation of photographs into current surveys to efficiently estimate fecundity, especially when eggs are present.
- iv. Identification and proper surveillance of juvenile populations and the documentation of lobster virus presence/absence in current surveys to understand population impacts.
- v. Documentation of molt status (in molt, about to molt, or recently molted) island-wide.

3. Queen Conch

a. Puerto Rico

There is one continuous queen conch sampling program in Puerto Rico and one short-term study that began in 2023. Historically, sampling has not been island-wide, and the geographic coverage has not been adequate. The continuous survey has sampled portions of Puerto Rico every five years since 2017, while the other will sample island-wide one time between 2023 – 2025. Combined, the surveys cover 0 – 30 meters of water depth, where queen conch appears to be most abundant. The sampling frequency is inadequate as the time series is minimal. From 0 – 30 m on the east and west coast of the island, the following data types are sampled once in a five-year cycle: relative abundance, proportion occurrence, and benthic habitat. From 0 – 30 m island-wide, length composition data was collected in a short-term pilot study. The following data types are missing or not adequately sampled: length composition, age composition, sex, maturity, and fecundity. Historically, information on 0 – 1 year old queen conch is missing or not adequately sampled.

b. St. Thomas/St. John and St. Croix

The four queen conch surveys in the USVI sample both St. Thomas/St. John and St. Croix with the same sampling frame. When all queen conch sampling programs in the USVI are considered, sampling has occurred island-wide by one survey every five years since 2017 and in national parks every four years since 2019. A short-term study will sample island-wide one time between 2023 – 2025, and another queen conch study

plans to incidentally sample every four years from 2022. Historically, the geographic coverage has not been adequate. Combined, the surveys cover 0 – 30 meters of water depth, where queen conch appears to be most abundant. The sampling frequency may be missing or inadequate. Specifically, seasonality cannot be obtained due to the sampling schedules. From 0 – 30 m island-wide, the following data types are sampled once in a five-year cycle: relative abundance, proportion occurrence, and benthic habitat. From 0 – 30 m and 0 – 25 m in national parks, maturity data are collected once in a 4-year and 3-year cycle, respectively. Among the surveys, the following data types are missing or not sampled island-wide: length composition, age composition, sex, maturity, fecundity, and juvenile life phase. Historically, information on 0 – 1 year old queen conch is missing or not adequately sampled.

c. Overall

Specific needs to ensure adequate data for queen conch are collected for stock assessment include (in no particular order):

- i. Implementation of additional surveys to quantify sex ratios and fecundity
- ii. Identification surveys to quantify the abundance of 0 – 1 year olds, which are typically buried in the sediment
- iii. Implementation of more continuous sampling to increase the frequency and temporal coverage of conch surveys
- iv. Consideration of AI or autonomous vehicles to identify high and low-density areas of interest
- v. Restructured survey approaches and designs such that high and low-density areas are surveyed continuously and repeatedly over time, including consideration of stratified random sampling for low-density areas and targeted surveys in known high-density areas

## C. General Recommendations to Improve US Caribbean Stock Assessment

1. Collaborate with data collection program managers to discuss survey methodology, coverage, overlap, and efficient use of resources to adequately sample target species populations.
  - a. Consider hosting workshops for each survey target with relevant NOAA, SEFSC, and partner staff in attendance
2. Prioritize filling of data gaps based on feasibility given current funding resources and personnel capacity.
  - a. Identify additional funding sources and personnel required to adequately and efficiently fill remaining data gaps
3. Consult with the funding governance CSP group to coordinate additional data collection needs and funding sources.
4. Consult with the toolbox CSP group to understand what additional FI data are required for multi-species or ecosystem-based approaches to fishery management.
5. Coordinate with the US Caribbean stock assessment team to better understand additional gaps regarding the seasonality of sampling as well as target species of interest while taking into consideration constraints of resource allocation and weather conditions.
6. Identify efficient ways to study the role of the species groups in ecosystem health and facilitate Ecosystem Based Fisheries Management.

7. Coordinate with the life history CSP group and stock assessment to ensure surveys are collecting relevant biological samples