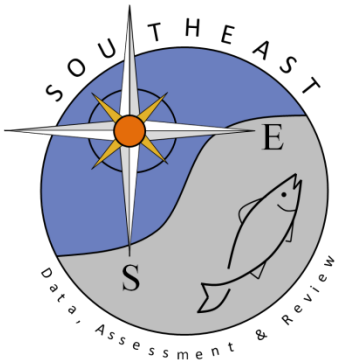
Fishery-Independent Reef Fish Visual Survey Population Density and Length Composition for Yellowtail Snapper in the Puerto Rico

Laura Jay W. Grove, Jeremiah Blondeau, and Jerald S. Ault

SEDAR84-DW-16

16 February 2024



Please cite this document as:

Grove, Laura Jay W., Jeremiah Blondeau, and Jerald S. Ault. 2024. Fishery-Independent Reef Fish Visual Survey Population Density and Length Composition for Yellowtail Snapper in St. Thomas/John SEDAR84-DW-16. SEDAR, North Charleston, SC. 15 pp.

Fishery-Independent Reef Fish Visual Survey Population Density and Length Composition for Yellowtail Snapper in St. Thomas/John

NOAA Fisheries
Southeast Fisheries Science Center
Population and Ecosystem Monitoring
Division 75 Virginia Beach Drive
Miami, FL 33149

Laura Jay W. Grove, Jeremiah Blondeau, and Jerald S. Ault

02-16-2024

Fishery-independent size-structure and density estimates for Yellowtail Snapper are compiled from the following data:

1. National Coral Reef Monitoring Program's (NCRMP) Reef fish Visual Census Metadata for the U.S. Caribbean (SEDAR80-WP-02)
    a. Historic belt-transect (BT) estimates (2001–2015)
    b. Present reef visual census stationary point count (RVC-SPC) estimates (2016–2021)

Parameters for data prepared for SEDAR84 fishery-independent reef fish visual survey data:

Species: Yellowtail Snapper

Year Range NCRMP: 2001 to 2021

Year Range Deep-NCRMP: 2020 to 2022

Geographic Range: St. Thomas and St. John

Survey Design NCRMP: Stratified-random sampling on hard-bottom coral reef habitats from 0 to 30 m.

Survey Design Deep-NCRMP: Stratified-random sampling on hard-bottom coral reef habitats

from 30 to 60 m.

Sampling Mode: Fishery-independent reef fish visual surveys.
Survey Methodology: Fully calibrated estimates that consider the change in sampling methodology from Belt Transects (BT) to RVC Stationary Points Counts (RVC-SPC) to allow for multi-decadal evaluations.

Survey Dataset Names:
St. Thomas and St. John:
YTS_dens_NCRMP_0121_20240112.xlsx
YTS_size_NCRMP_0121_20240112.xlsx

Overview

This document outlines the data and methodologies used to estimate density and abundance-at-length compositions for the SEDAR84 Yellowtail Snapper Assessment for St. Thomas and St. John.

For more background details about the reef visual survey program (historic and NCRMP), methodology, data, and sampling coverage including maps of all survey sites completed by year (2001–2019) in each U.S. Caribbean sampling domain (Puerto Rico, St. Thomas/St. John, and St. Croix) see SEDAR80-WP-02 (Grove et al. 2021). Sampling in 2021 had similar island-wide coverage for each of the island assessments as previous NCRMP surveys. Total samples were reduced in St. Thomas and St. John in 2021 to 165 as a result of weather and covid-related sampling restrictions.

Calibration

Two levels of calibration were needed to incorporate the historical transect data. First, we analyzed the regionally restricted transect data from 2001 to 2011 in Virgin Island National Park and Virgin Islands Coral Reef National Monument in St. John. We determined that similar density distributions existed within strata between the regional data and whole island-wide data, and that each strata was represented in the sampling for proper area weighting. Secondly, a robust method calibration was conducted to convert belt transect (BT) densities (2001–2015) to RVC stationary point count (RVC-SPC) densities (2017–2021). In short, paired BT and RVC-SPC sampling was conducted a number of times within each survey strata. Density and occurrence were modeled in a two-stage GLM regression using a "delta" framework for estimation of the gear correction (method calibration) factors. The method calibration factor was then applied to the BT dataset prior to any domain level estimations (Ault et al. 2020). For more details, see Grove et al. 2022 Appendix I.

Deep-NCRMP (DCRMP)

The National Coral Reef Monitoring Program (NCRMP) has a sampling depth limit of 30 m, and thus only represents shallow water fish populations**.** However, a majority of the fisheries areas,

particularly on the northern and southern shelf of St. Thomas and St. John, are in depths between 30 and 65 m (Kadison et al., 2017). The Coral Reef Conservation Program (CRCP) funded a pilot survey to target the upper mesophotic habitats of St. Thomas and St. John from 2020–2022. The DCRMP program used NCRMP survey design and sampling methodologies for direct comparisons. For more details about the DCRMP program, data and sampling coverage see Grove et al. (in press).

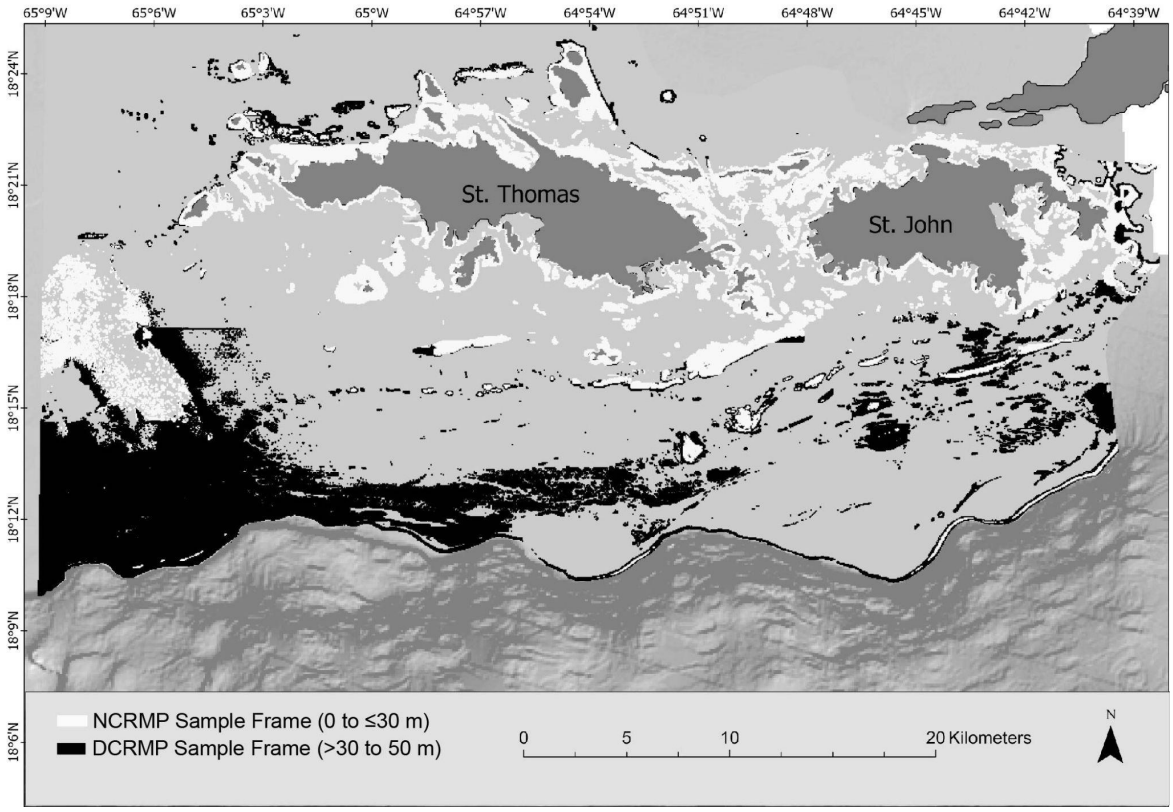


Figure 1.- St. Thomas and St. John NCRMP (white) and DCRMP (black) sampling domain.

Analyses

Domain-wide density and variance estimates were calculated using standard stratified random design-based principles (Smith et al. 2011). Metric estimates and associated variance were computed in each strata and multiplied by the stratum weighting factor. Area weighted stratum density and variance was then summed across all strata for the final domain-wide estimate. All density data are presented as reef visual census stationary point count (RVC-SPC) estimates (number per 178 m^2, ± 1). For more details, see Grove et al. 2022 Appendix II. Three different time series estimates of density are presented in this working paper and made available as complete datasets; 1) population-level estimates include all sizes of yellowtail snapper surveyed, 2) pre-exploited density estimates filters sizes to only include those that are less than minimum size limit (12 inches TL), set by management, in federal waters and 3) exploited density estimates filters sizes to include all sizes greater than or equal to 12 inches TL

(or, 25cm FL). Time series indices and length frequency compositions were analyzed and presented separately for NCRMP and DCRMP surveys.

U.S. Caribbean

Table 1A.- Hard-bottom habitat code abbreviations and habitat names where reef fish visual surveys were collected in the U.S. Caribbean coral reef ecosystem. Shaded habitats (rows) were combined for analyses: AGRF & BDRK (dark gray) and PVMT & SCR (light gray).

Habitat Code	Habitat Name
AGRF	Aggregate Reef
BDRK	Bedrock
PTRF	Patch Reef (Aggregate and Individual)
PVMT	Pavement
SCR	Scattered Coral and Rock

Table 1B.- Depth code abbreviations, depth name, and depth range (m) where reef fish visual surveys were collected in the U.S. Caribbean coral reef ecosystem.

Depth Code	Depth Name	Range (m)
SHLW	Shallow	0 to < 12m
DEEP	Deep	≥ 12 to 30m
GTR30	Mesophotic	≥ 30 to 60m

Table 2A.- Percent of U.S. Caribbean NCRMP sampling domain area (i.e., Puerto Rico, St. Thomas/St. John, and St. Croix) within each analysis strata (strata code).

Strata Code	Puerto Rico	St. Thomas/John	St. Croix
AGRFSHLW	8.4	11.8	4.3
AGRFDEEP	9.3	25.2	3.8
PTRFSHLW	7.3	0.9	1.9
PTRFDEEP	4.4	3.4	1.2
PVMTSHLW	24.6	13.2	25.4
PVMTDEEP	46	45.5	63.4

Table 2B.- Percent of St. Thomas and St. John DCRMP sampling domain area (hardbottom habitats 30-60m) within each analysis strata (strata code).

Strata Code	St. Thomas/John
AGRFGTR30	89.2
PTRFGTR30	3.2
PVMTGTR30	7.6

St. Thomas and St. John

Table 3A.- Number of NCRMP reef fish visual survey sites (left column) and number of yellowtail snapper (*Ocyurus chrysurus*) length observations (right column) by hard-bottom strata from the reef fish visual surveys in St. Thomas and St. John coral reef ecosystem (2001–2021). Empty cells indicate zero samples (left column) or no observations (right column).

	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**	**1238**

Table 3B.- Number of DCRMP reef fish visual survey sites (left column) and number of yellowtail snapper (*Ocyurus chrysurus*) length observations (right column) by hard-bottom strata from the reef fish visual surveys in St. Thomas and St. John coral reef ecosystem (2020–2022).

	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**

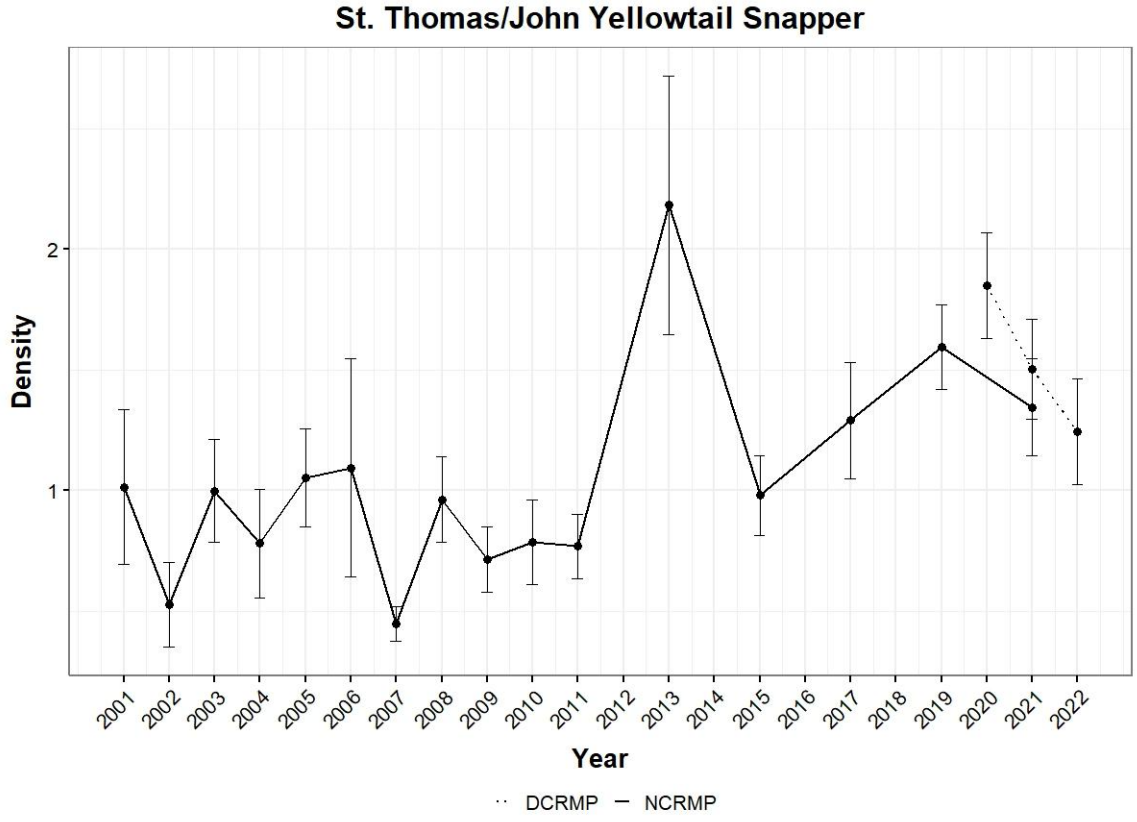


Figure 2.- Time series (2001–2021) of yellowtail snapper (*Ocyurus chrysurus*) mean population density (number per 178 m^2, $\pm$ SE) from the NCRMP (solid line) and DCRMP (dotted line) reef fish visual surveys in the St. Thomas and St. John coral reef ecosystem.

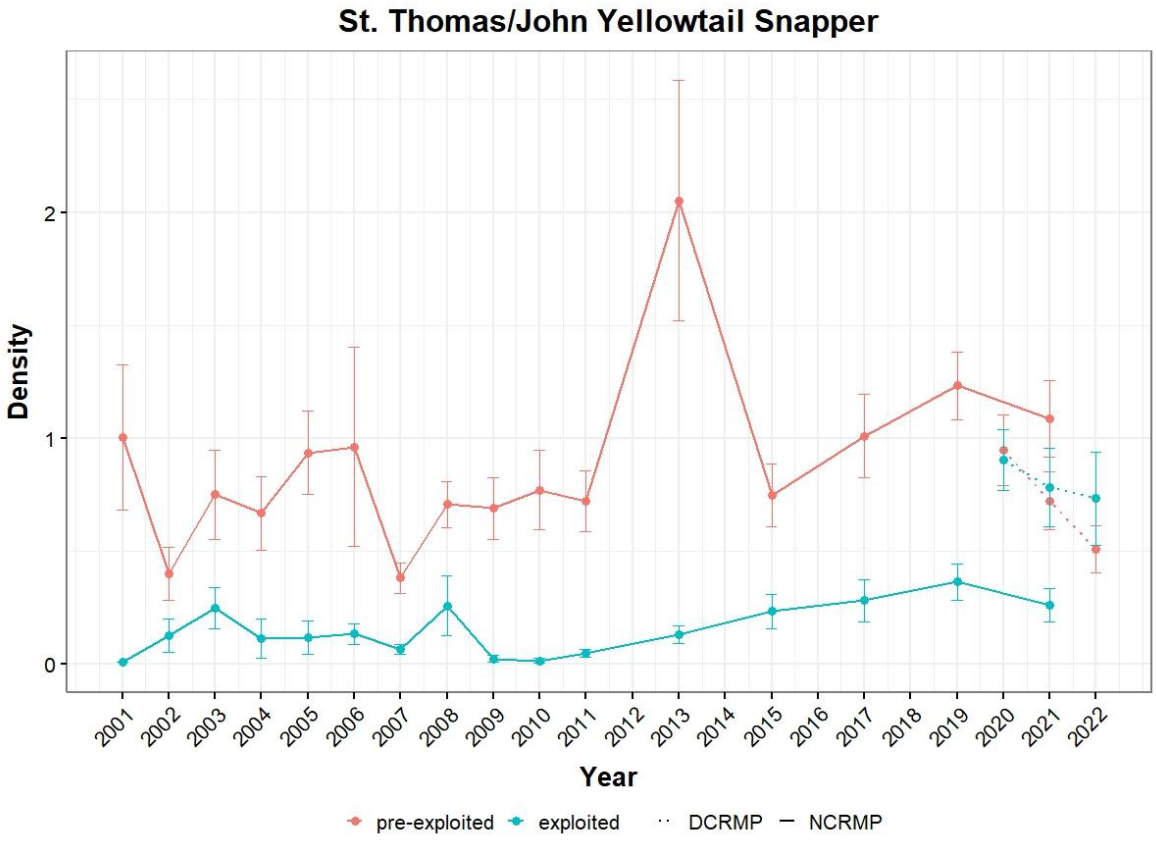


Figure 3.- Time series (2001–2022) of yellowtail snapper (*Ocyurus chrysurus*) mean population density (number per 178 m^2, $\pm$ SE) from the NCRMP (solid line) and DCRMP (dotted line) in the pre-exploited (blue, < 25 cm) and exploited (red, ≥ 25 cm) reef fish visual surveys in the St. Thomas and St. John coral reef ecosystem.

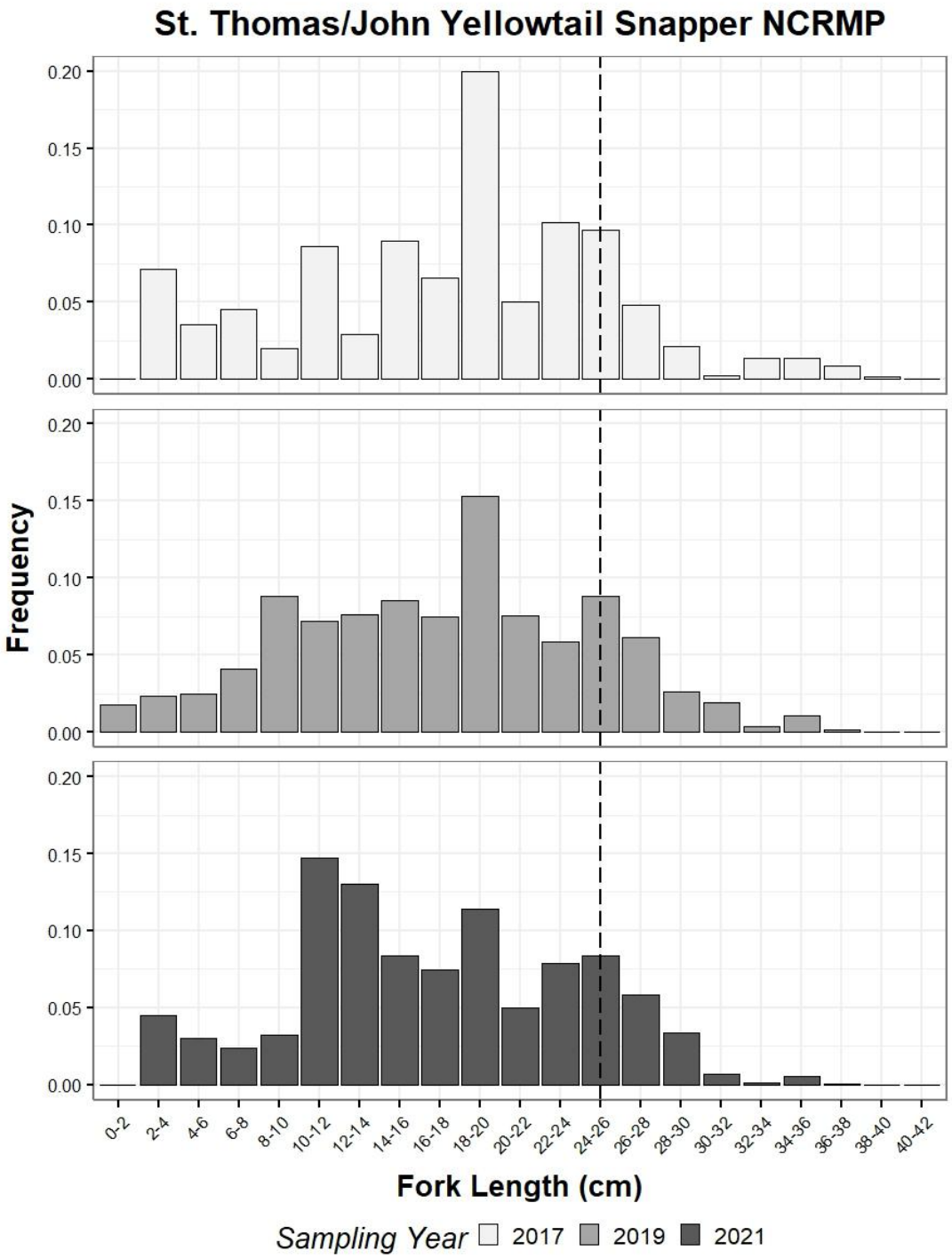


Figure 4.- Yellowtail snapper population size-frequency distribution at 2-cm bins from the 2017 - 2021 NCRMP RVC-SPC St. Thomas and St. John surveys. Vertical dashed line is length at capture (25.0 cm fork length).

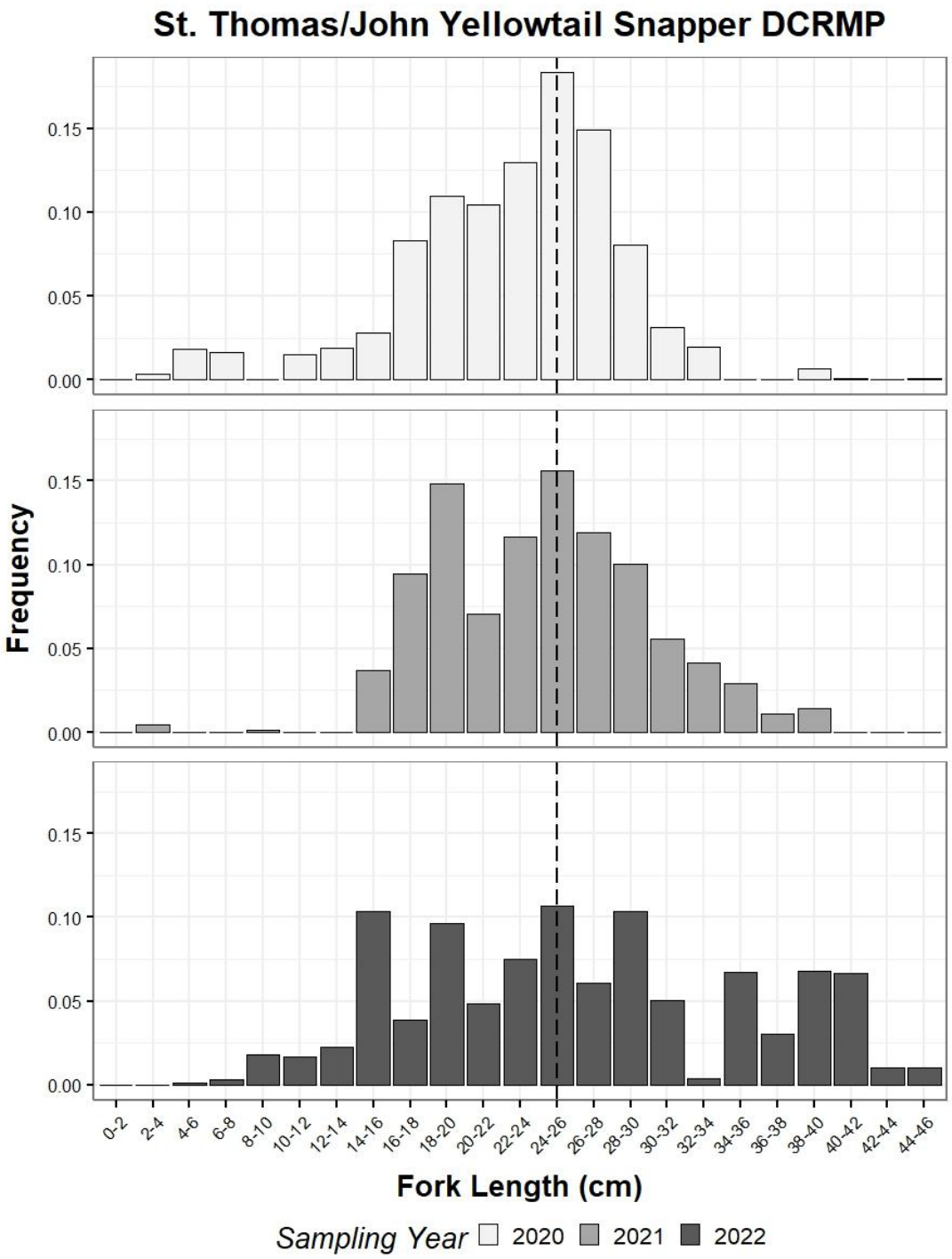


Figure 5.- Yellowtail snapper population size-frequency distribution at 2-cm bins from the 2020 - 2022 DCRMP RVC-SPC St. Thomas and St. John surveys. Vertical dashed line is length at capture (25.0 cm fork length).

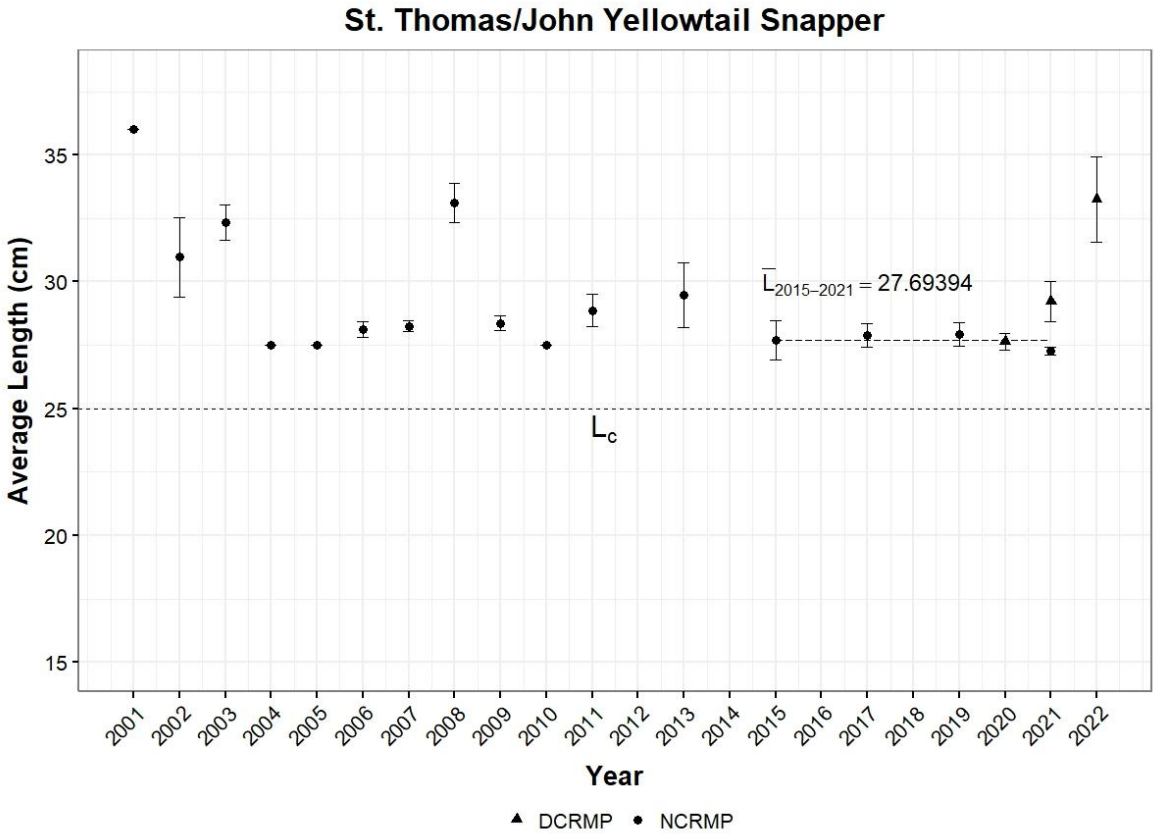


Figure 6.- Time series (2001–2022) of exploited phase (L_c >= 25 cm) yellowtail snapper average size (cm ± SE) from the NCRMP (solid circle) and DCRMP (solid triangle) reef fish visual surveys in the St. Thomas and St. John coral reef ecosystem. Long dashed line segment represents the mean of island-wide (2015-2021) average lengths.

References

Ault, JS, GA Diaz, SG Smith, J Luo, and JE Serafy. 1999. An efficient sampling survey design to estimate pink shrimp population abundance in Biscayne Bay, Florida. North American Journal of Fisheries Management 19: 696–712.

Ault, J.S., Smith, S.G., Richards, B.L., Yau, A.J., Langseth, B.J., O'Malley, J.M., Boggs, C.H., Seki, M.P., DiNardo. G.T. 2018. Towards fishery-independent biomass estimation for Hawaiian Islands deepwater snappers. Fisheries Research 208: 321-328.

Ault, JS, SG Smith, MW Johnson, and LJ Grove. 2020. Gear calibration factors for U.S. Caribbean coral reef fish visual surveys. Final Technical Report on NOAA Grant No. NA15OAR4320064 SEFSC CREU. 56 p.

Bryan, DR, AJ Atkinson, JS Ault, ME Brandt, JA Bohnsack, MW Feeley, ME Patterson, BI Ruttenberg, SG Smith, and BD Witcher. 2013. A cooperative multi-agency reef fish monitoring protocol for the U.S. Virgin Islands coral reef ecosystem. Natural Resource Report NPS/SFCN/NRR—2013/672. National Park Service, Fort Collins, Colorado.

Bryan, DR, SG Smith, JS Ault, MW Feeley, and CW Menza. 2016. Feasibility of a region-wide probability survey for coral reef fish in Puerto Rico and the U.S. Virgin Islands. Marine and Coastal Fisheries 8(1): 135–146.

Cochran, WG. 1977. Sampling Techniques. Third edition, John Wiley and Sons, New York.

Grove, LJW, J Blondeau, D Swanson, S Heidmann, SG Smith, M Johnson, V Brandtneris, S Sagarese and TB Smith. (in press). Expansion of an established fishery-independent survey into the US Virgin Islands' upper mesophotic zone: feasibility and management implications. Bulletin of Marine Science.

Grove, LJW, J Blondeau, and JS Ault. 2022. Fishery-Independent Reef Fish Visual Survey Population Density and Length Composition for Queen Triggerfish in the U.S. Caribbean. SEDAR80-WP-08. SEDAR, North Charleston, SC. 32 pp.

Grove, LJW, J Blondeau, and JS Ault. 2021. National Coral Reef Monitoring Program's Reef fish Visual Census Metadata for the U.S. Caribbean. SEDAR80-WP-02. SEDAR80, North Charleston, SC. 55 p.

Kadison, E, M Brandt., R Nemeth, J Martens, J Blondeau, and T Smith. (2017). Abundance of commercially important reef fish indicates different levels of over-exploitation across shelves of the U.S. Virgin Islands. PLOS ONE 12(7)

Law, AM. 2007. Simulation modeling and analysis. Fourth edition, McGraw Hill, New York.

Lohr, SL. 2010. Sampling: Design and Analysis. Second edition, Brooks/Cole, Boston.

Robson, DS. 1966. Estimation of the relative fishing power of individual ships. ICNAF Research Bulletin 3: 5–15.

Smith, SG, JS Ault, JA Bohnsack, DE Harper, J Luo, and DB McClellan. 2011. Multispecies survey design for assessing reef-fish stocks, spatially explicit management performance, and ecosystem condition. Fisheries Research 109:25–41.