

Overcoming common challenges in fishery-independent surveys in the U.S. Caribbean

Superar los desafíos comunes en las encuestas independientes de la pesca en el Caribe de los Estados Unidos

Surmonter les défis courants dans les enquêtes indépendantes de la pêche dans les Caraïbes aux États-Unis

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EXTENDED ABSTRACT

In the U.S. Caribbean, long-term declines in reef fish populations have been attributed to overexploitation. As a result of these declines, fisheries managers have been tasked with using the few regional fisheries-dependent and fisheries-independent datasets available to provide recommendations and set sustainable fishing regulations. To further complicate matters, the few available datasets to inform management decisions have been spatially restricted, temporally limited, and/or use different gears limiting comparability among surveys. To address these issues, it was recommended that large-scale survey(s) be created and/or modified to meet the SouthEast Data, Assessment, and Review (SEDAR) stock assessment needs in the U.S. Caribbean (Cass-Calay et al. 2015).

One of the larger fishery-independent surveys in the U.S. Caribbean is NOAA's National Coral Reef Monitoring Program (NCRMP). NCRMP presently collects statistically robust, stratified-random monitoring data on hard-bottom habitats that can be used to evaluate the status and trends of ecologically and economically important reef fish species. However, NCRMP's long-term dataset was fractured due to a survey methodology change in 2016 when the diver-based survey methods changed from a belt-transect to the Reef fish Visual Census (RVC), stationary-point-count methodology (Grove et al. 2021). In addition, the NCRMP surveys have historically been limited to less than 30 m of water depth and it was unknown if estimates were representative for reef fishes from islands that had more expansive reef habitat at deeper depths. As a result, to incorporate NCRMP's reef fish data into fisheries management applications the program had to overcome two key challenges: (1) A survey methodology change, and (2) A spatial coverage limitation.

Survey methodology change: An extensive 'gear' calibration was completed to preserve the long-term time series. From 2018 to 2022, we simultaneously conducted surveys using the belt-transect and stationary-point-count 'gears' at 356 sites throughout Puerto Rico and the U.S. Virgin Islands (Figure 1). Our experimental design used a region-depth-habitat blocking scheme that targeted higher rugosity habitats with presumably greater densities of pre-determined, fishery-targeted reef fishes to facilitate the calibration process by minimizing statistical issues resulting from an excessive abundance of zeros in the dataset. The data from all islands were combined in analyses. We detected a total of 17,829 reef fishes and 146 species. Standard generalized linear models generated gear calibration factors (GCFs) for 80 individual reef fish species that had at least 15 observations in each gear type. GCFs for the remaining species are underway and will be grouped at the highest taxonomic level possible (e.g., family, genus).

Spatial coverage limitation: A three year survey expansion was completed to evaluate the abundance and length composition of reef fishes on upper mesophotic reefs located on the continuous insular shelf in St. Thomas and St. John, U.S. Virgin Islands. From 2020 to 2022, the Deep Coral Reef Monitoring Program (DCRMP) expanded NCRMP's sample frame from 0 to 30 m to conduct 345 RVC surveys from >30 to 50 m (Figure 2). An analysis of the entire sampling frame showed that 59% of the mapped hard-bottom habitat on the insular shelf occurred at deeper depths (>30 m, DCRMP) and only 41% occurred in shallower waters (0–30 m, NCRMP; Figure 2). The survey expansion was effective; DCRMP surveys yielded high quality data for a number of economically and ecologically important coral reef fishes (three survey years, 29 species \pm 5 standard deviation). For the four selected species with ongoing or upcoming stock assessments, densities were generally higher and longer lengths were more commonly observed in the DCRMP versus NCRMP surveys (for additional details see Grove et al. 2024).

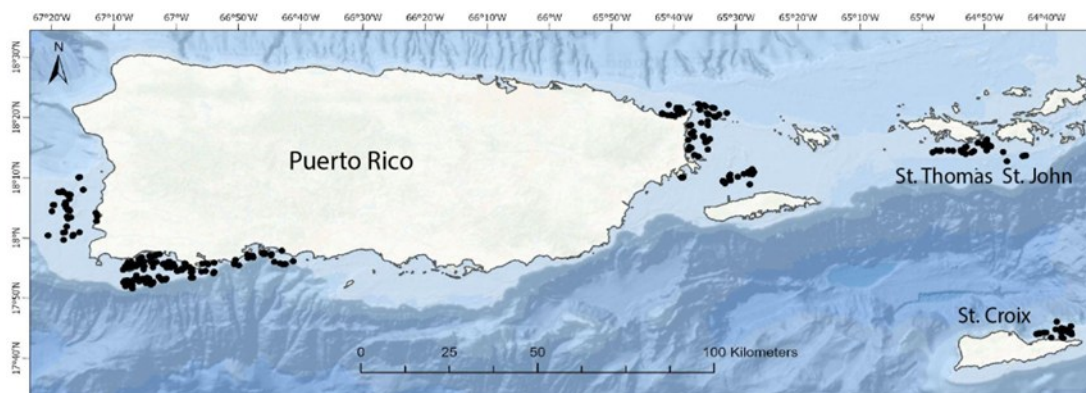


Figure 1. Location of calibration survey sites (black circles) in the U.S. Caribbean.

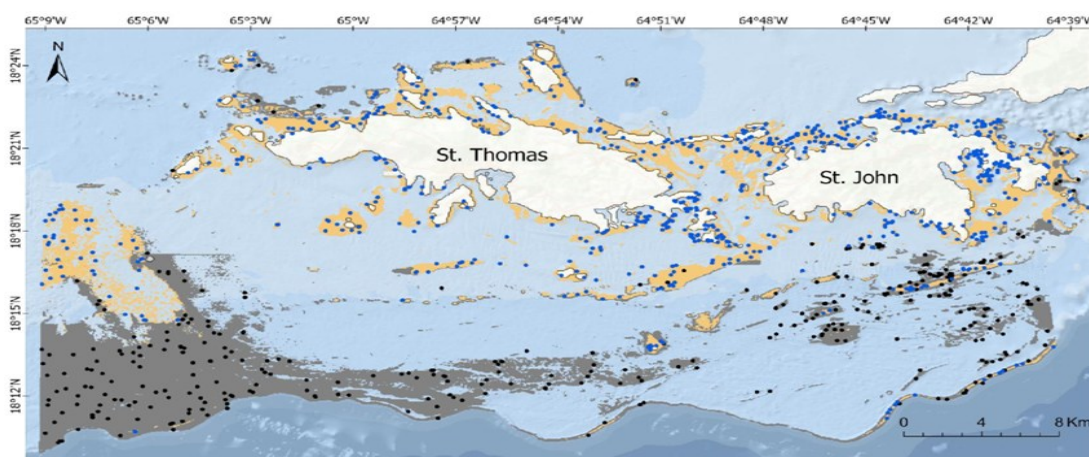


Figure 2. Location of survey sites and mapped hardbottom habitat in the National Coral Reef Monitoring Program (NCRMP, blue circles, orange habitat $\leq 30\text{m}$) and Deep Coral Reef Monitoring Program (DCRMP, black circles, gray habitat $>30\text{--}50\text{m}$) sample frames in the northern U.S. Virgin Islands.

Collectively, these efforts addressed two large fishery-independent survey challenges providing valuable insights into the status of fish populations (e.g., abundance, length composition). Species-specific GCFs allow for the historic belt-transect and stationary-point-count data to be used together as a single time series and the combined NCRMP and DCRMP efforts provide a comprehensive snapshot of reef fish populations across the overwhelming majority of insular shelf that extends to $\sim 55\text{ m}$ in the northern U.S. Virgin Islands. Successfully overcoming these two key challenges resulted in the data being considered in the two most recent data-limited stock assessments in the U.S. Caribbean (SEDAR80 and SEDAR84, <https://sedarweb.org>). Moreover, the methods described herein can be applied more broadly to different survey programs and gears within and outside of the U.S. Caribbean to create more complimentary fishery-independent datasets. Notably, these datasets have numerous ecological and management applications beyond traditional, single-species stock assessments including, but not limited to, ecosystem-based fisheries management, ecosystem status reports, endangered species act evaluations, vulnerability assessments, and community analyses.

LITERATURE CITED

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