Mission: Iconic Reefs and National Coral Reef Monitoring Program Reef Fish Analyses

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1 Introduction

Mission: Iconic Reefs is a multi-institutional initiative designed to restore ecological function and biodiversity across 'iconic' reef sites in the Florida Keys. Led by NOAA in collaboration with federal, state, institutional, and non-profit partners, M:IR targets nearly three million square feet of reef at seven coral reefs in the Florida Keys National Marine Sanctuary (FKNMS): Carysfort (North and South), Cheeca Rocks, Eastern Dry Rocks, Horseshoe Reef, Looe Key, Newfound Harbor, and Sombrero Reef. The overarching M:IR goal is to restore coral cover and reef function to a self-sustaining state.

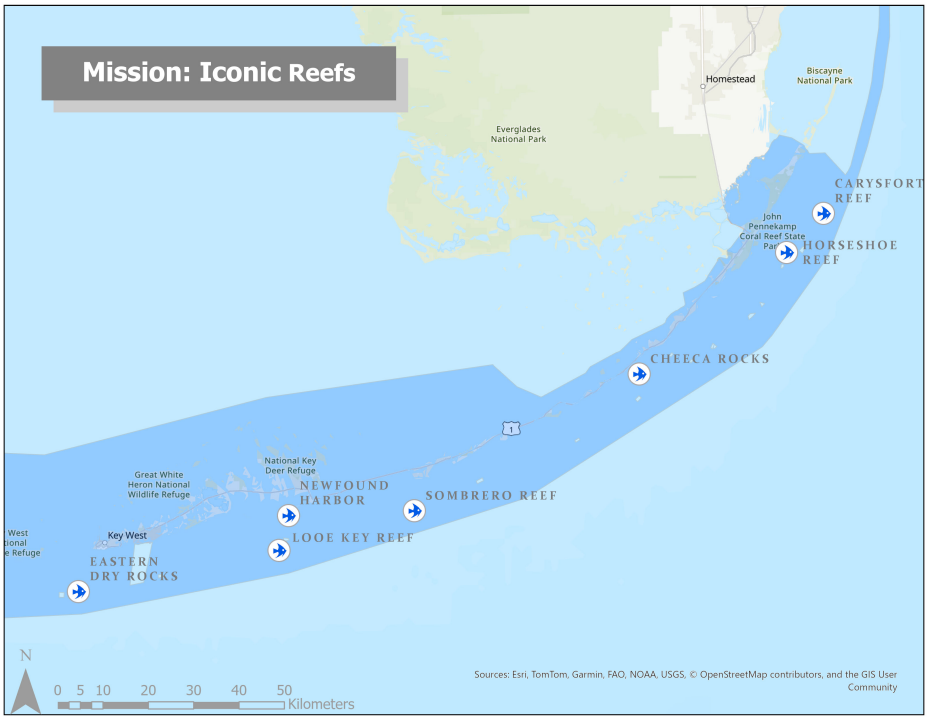
Monitoring changes in reef fish populations is one way to measure the success and broader ecological impacts of coral restoration interventions (Feeley et al. 2025). To properly interpret restoration progress at M:IR reef sites, it is important to also collect data at sites from the surrounding Florida Keys reef tract. The National Coral Reef Monitoring Program (NCRMP), which conducts standardized reef assessments across the Florida Keys, provides a solid framework for comparison and to contextualize the progress at M:IR sites.

Reef fish surveys at M:IR sites and at sites throughout the Florida Keys both used NCRMP's sampling design and survey method. Non-extractive reef fish surveys occurred on shallow (<30 m), hard-bottom reef habitats using a stratified-random, one-stage sampling design within 50 m × 50 m grid cells to ensure representative sampling across depth and rugosity strata (i.e., different habitats) (CRCP 2024; Ault et al. 2021). Surveys used a stationary-point-count method modified from Bohnsack and Bannerot (1986) where a two-diver team surveyed all fish within adjacent 15-m diameter cylinders centered on each diver. Within each cylinder, fishes were identified to the species level tallied, and fork length was estimated to the nearest centimeter (CRCP 2024).

This report shows population-level results of relative density, occurrence, and length frequency distributions for ecologically important, economically valuable, and fish species of interest to coral restoration practitioners and resource managers. This report focuses on reef fishes

within the M:IR and NCRMP sampling domains; a separate report shows results for coral population and benthic community metrics (Krampitz et al., 2025).

1.1 Map of M:IR Sites



2 Data Analyses

To allow for direct comparisons of fish populations inside the M:IR restoration areas with control, non-restored areas across the Florida Keys reefs, the NCRMP dataset was restricted to strata types and depth zones (0–12 m) found within M:IR sites (table 1). Data collected by the diver pair were averaged at the site level. Standard fish metrics, including relative density, occurrence, and length composition, were evaluated for the selected fish species (table 2). Computational formulas of standard metrics for a single-stage stratified random sampling design are modified from (Smith et al. 2011) and provided in detail in (Grove, Blondeau, and Ault 2021) and (Bryan et al. 2016)). Statistical comparisons evaluated differences in density and occurrence estimates inside M:IR areas and outside of M:IR areas (i.e., NCRMP) for each survey year. Statistical significance was accepted at p=0.05. Fish analysis scripts are open source and available through the NCRMP Fish R package (Ganz and Blondeau 2015).

2.1 Strata

Table 1: Table 1: Number of reef fish survey sites in each stratum inside M:IR reef sites and outside the restoration areas in the Florida Keys by survey year.

PROT	STRAT	description	2022	2024
Outside	FK01	Inshore reefs, all depths	0	15
Outside	FK02	Mid-channel patch reefs, all depths	101	100
Outside	FK03	Offshore patch, all depths	61	36
Outside	FK04	Forereef, low rugosity, <12m	95	105
Outside	FK05	Forereef, high rugosity, <12m	88	87
Inside	FK01	Inshore reefs, all depths	0	12
Inside	FK02	Mid-channel patch reefs, all depths	12	13
Inside	FK03	Offshore patch, all depths	7	8
Inside	FK04	Forereef, low rugosity, <12m	5	15
Inside	FK05	Forereef, high rugosity, <12m	61	64

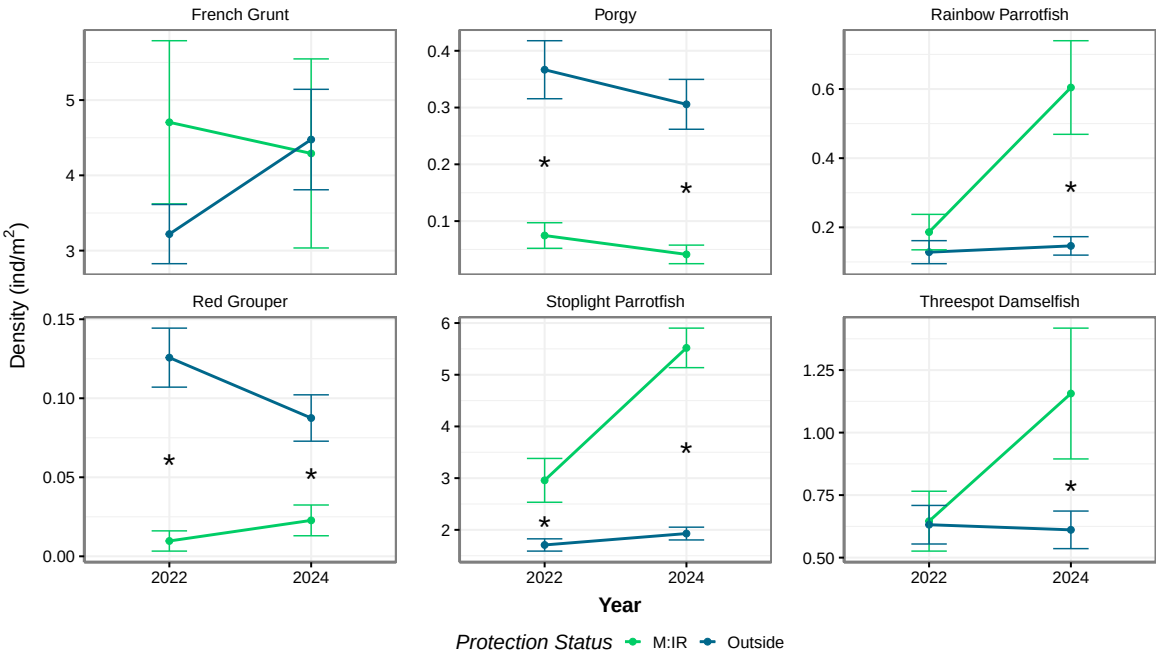
2.2 Fish Species

Table 2: Table 2: Fish species with representative photos. Difficult to distinguish species were combined for analyses (e.g., saurcereye and knobbed porgies)

Species Code	Common Name	Scientific Name	Photo
HAE FLAV	French Grunt	*Haemulon flavolineatum*	
SPA VIRI	Stoplight Parrotfish	*Sparisoma viride*	
SCA GUAC	Rainbow Parrotfish	*Scarus guacamaia*	
STE PLAN	Threespot Damselfish	*Stegastes planifrons*	
CAL CALA	Saucereye Porgy	*Calamus calamus*	
CAL NODO	Knobbed Porgy	*Calamus nodosus*	
EPI MORI	Red Grouper	*Epinephelus morio*	

3 Density

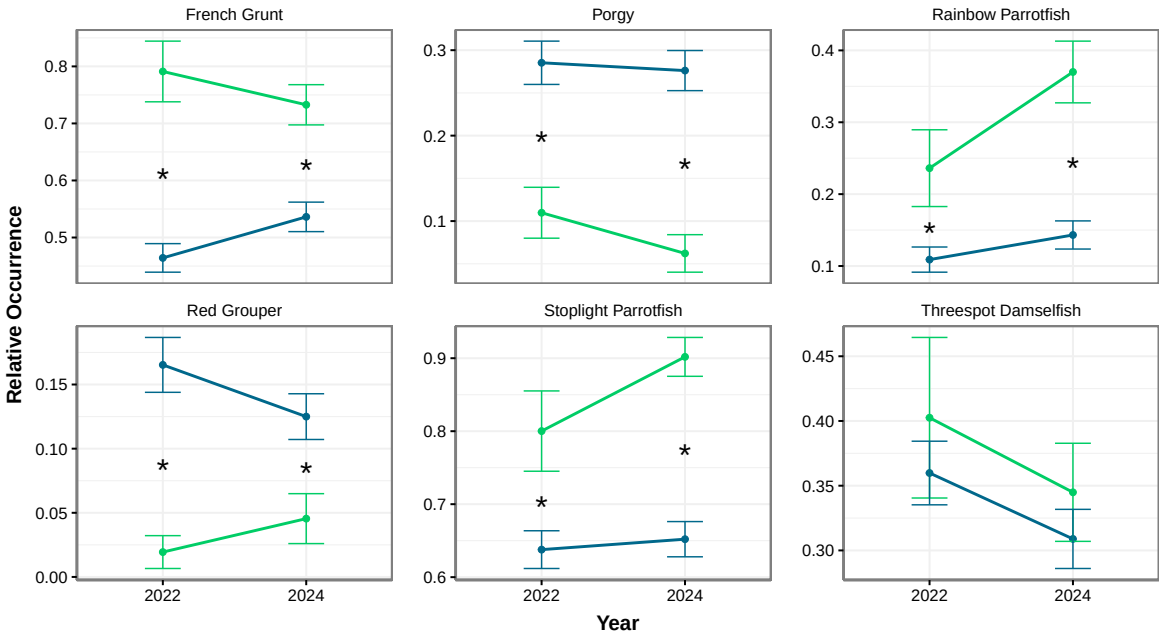
Each survey year, M:IR and NCRMP surveys capture a snapshot of coral reef fish populations. It is common for fish populations to fluctuate annually due to a number of factors including, but not limited to, recruitment success, predator-prey dynamics, fishing pressure, and natural events (e.g., hurricanes, marine heat waves). Whenever possible, resource managers should evaluate multiple years of fish density data to inform and assess management efforts, including the success of habitat restoration. Consistently higher or increasing densities over time within restored areas suggests these areas are providing high-quality habitat for reef fishes.



Relative density results are shown as the number of individuals per survey area 177 m^{2} ± standard error within the M:IR reef sites (M:IR, green) and outside the restoration areas in the Florida Keys (outside, blue). Significant differences between M:IR and open densities are denoted with an asterick (*) within each survey year.

4 Occurrence

Monitoring species occurrence, or how often a species is detected in surveys, offers valuable insight into its distribution. This metric provides presence data regardless of abundance, which helps to identify whether a species is widespread or rare. For resource managers, species occurrence can be used as a bioindicator of overall ecosystem health and to evaluate the success of restoration projects. A consistently higher occurrence of a fish species, especially of a rare species or an obligate coral dweller, within coral restoration areas serves as an indicator of high-quality habitat.



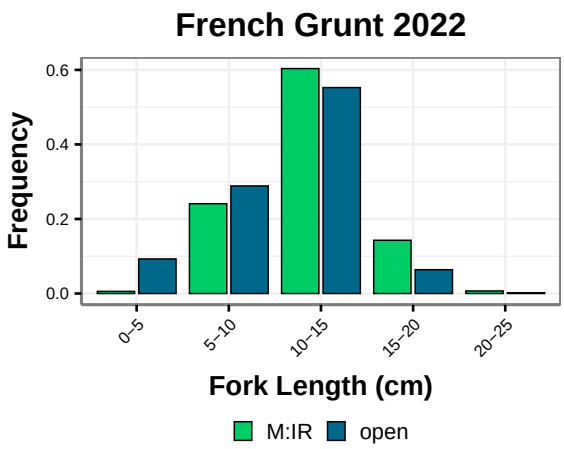
Relative occurrence ± standard error is shown within the M:IR reef sites (M:IR, green) and outside the restoration areas in the Florida Keys (outside, blue). Significant differences between M:IR and open densities are denoted with an asterick (*) within each survey year.

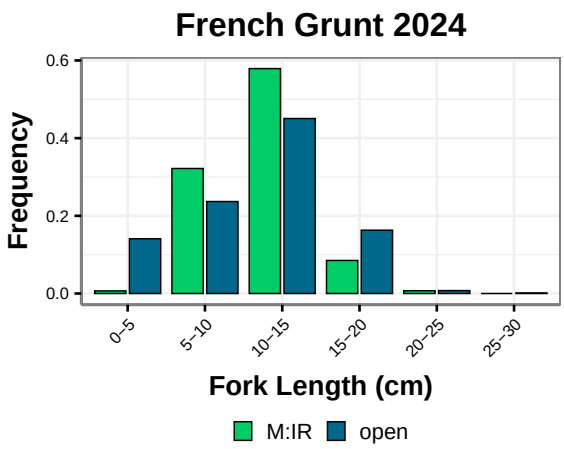
5 Length Frequency

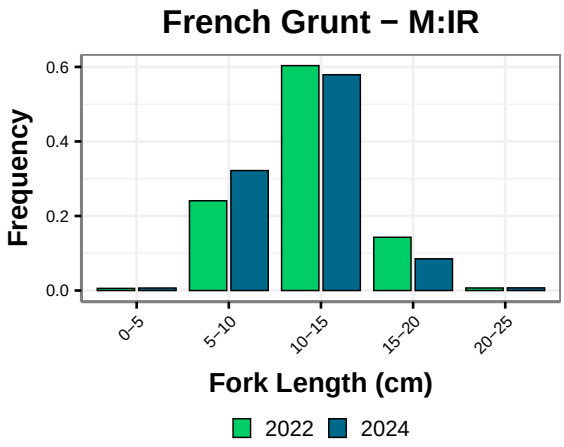
Length compositions provide a detailed description of a fish's population structure. These highly informative figures can show the length at which a species recruits to the coral reef from their nursery habitat, the length classes that are selected by local recreational and commercial fisheries, the effectiveness of fisheries management regulations, and the success of habitat restoration efforts. Successful coral restoration improves habitat quality and reef complexity, which provides structural protection for smaller size classes and foraging opportunities for larger sizes classes.

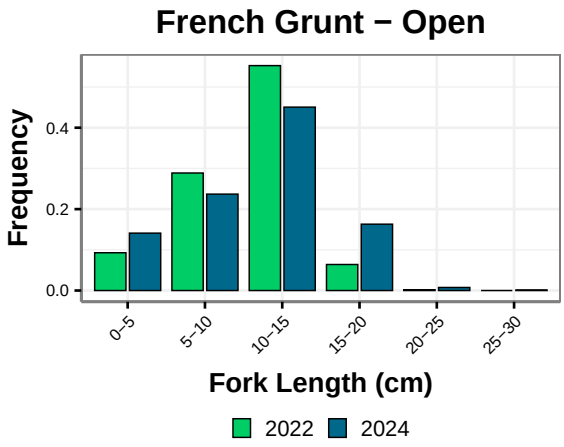
Relative length frequency by fork length (cm) bin is shown for each species within each sampling domain (i.e., M:IR restoration areas and NCRMP outside restoration areas) and between each sampling domain by survey year.

5.1 French Grunt

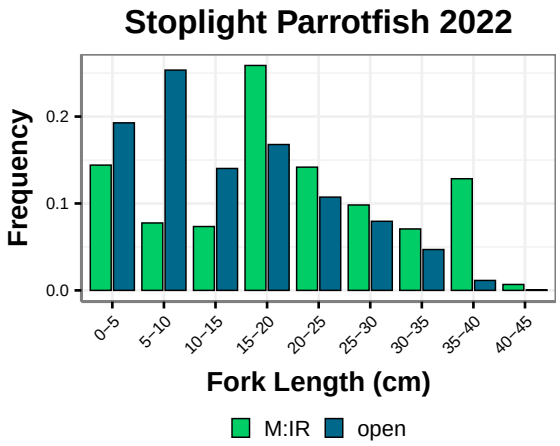


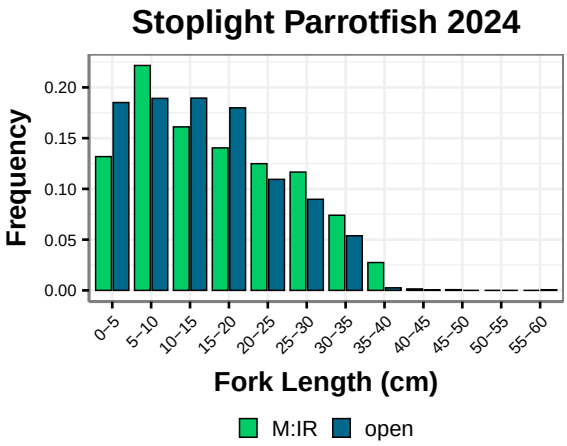


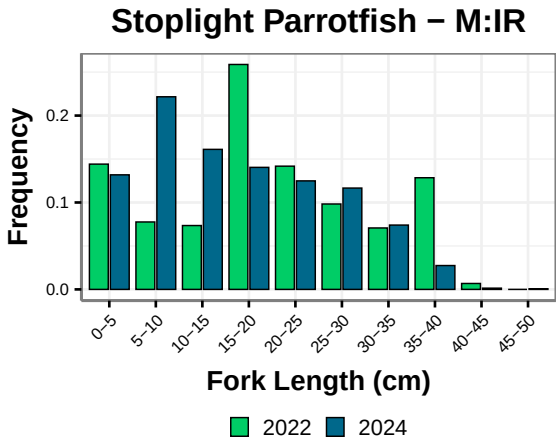


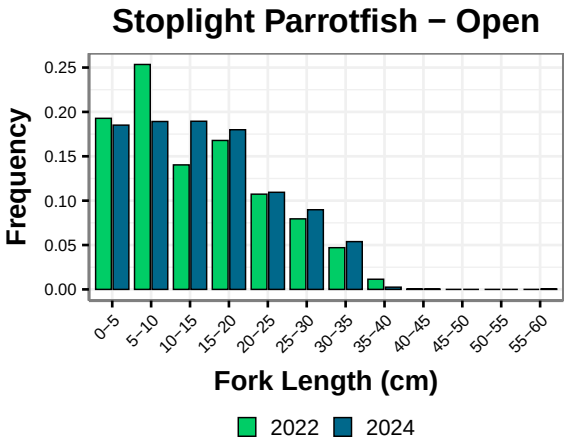


5.2 Stoplight Parrotfish

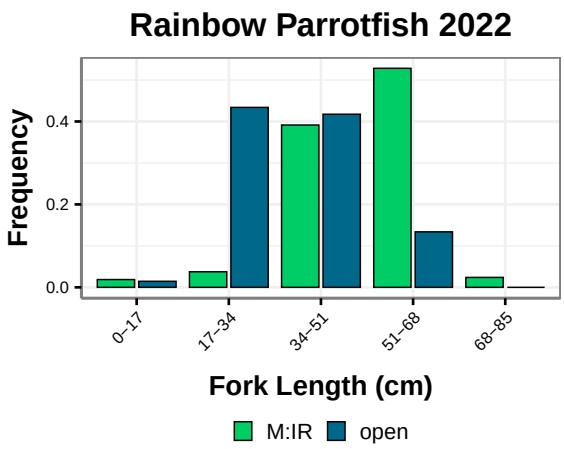


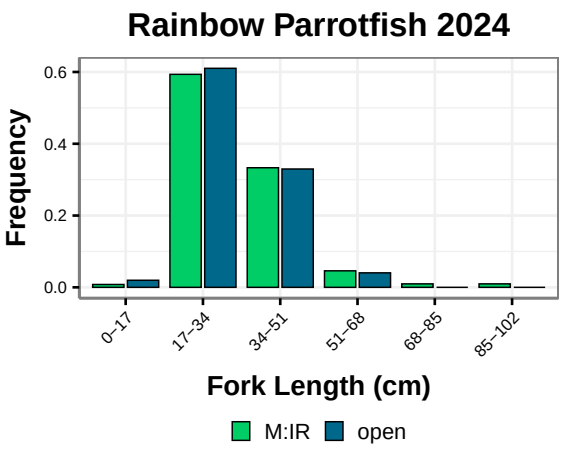


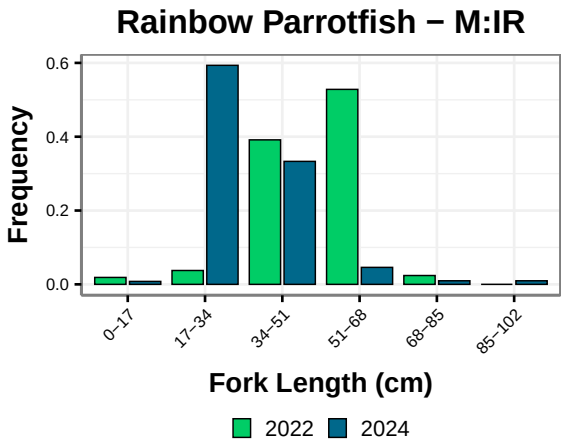


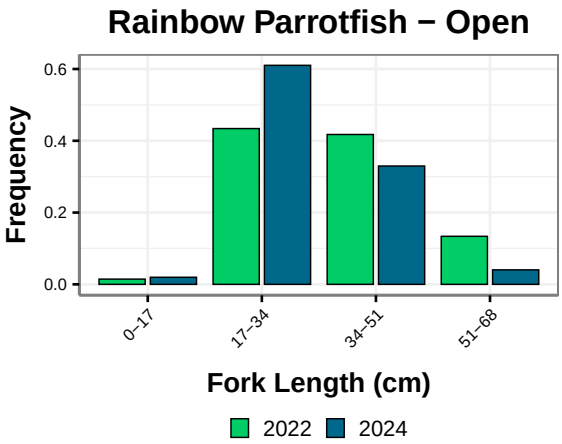


5.3 Rainbow Parrotfish

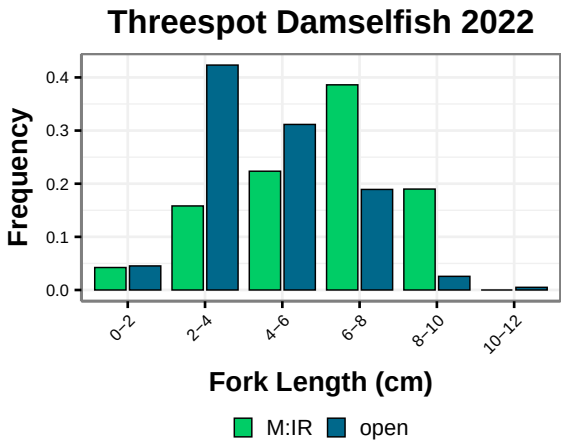


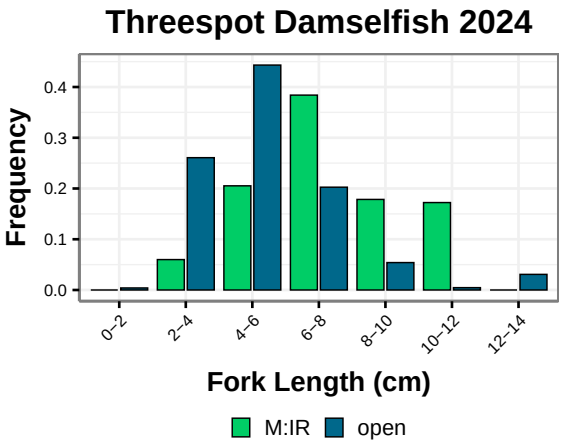


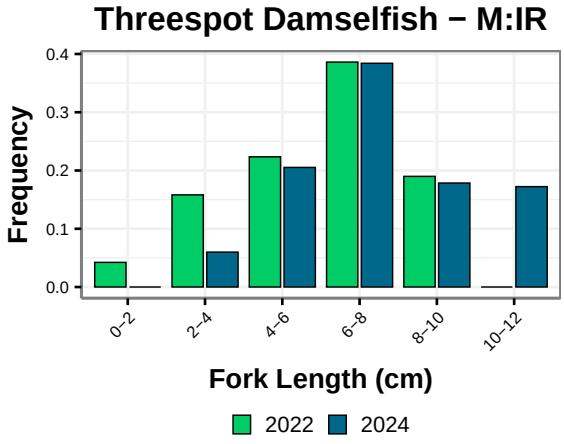


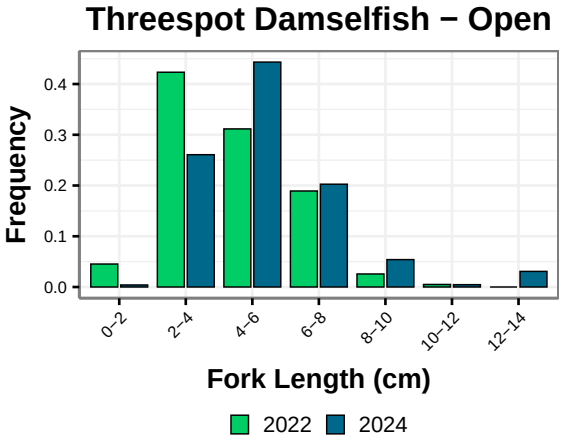


5.4 Threespot Damselfish

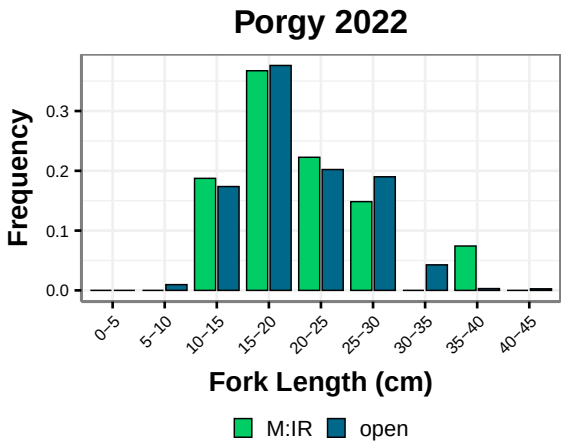


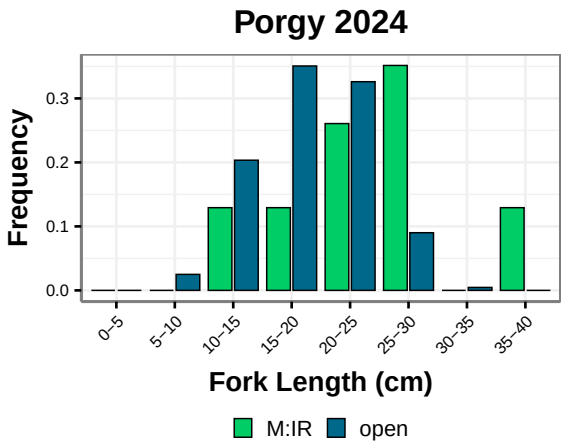


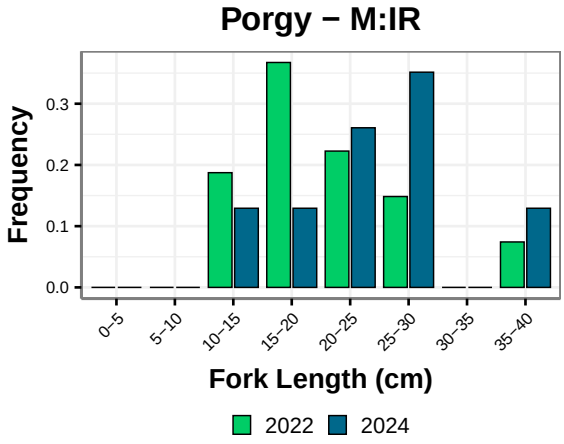


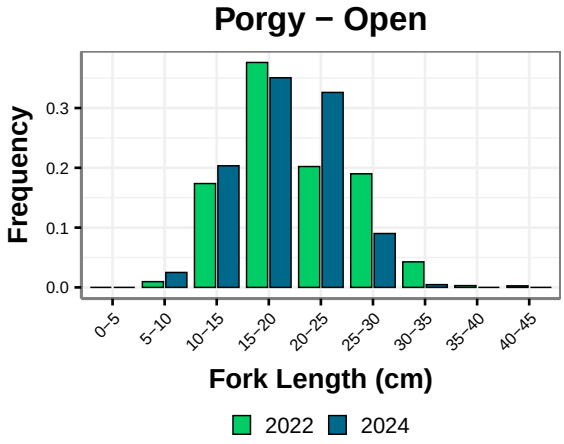


5.5 Porgy

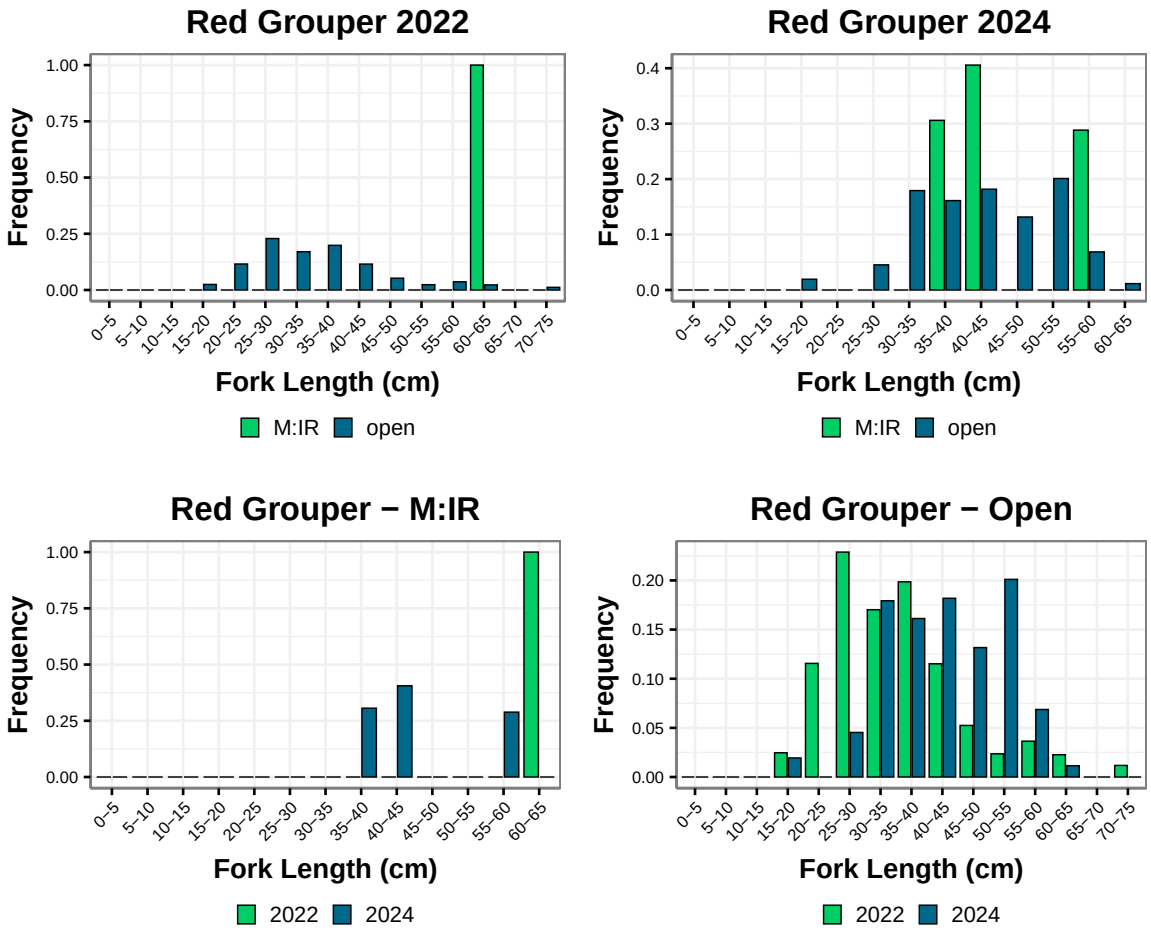

Porgy 2022
Frequency
0.0
0.1
0.2
0.3
0–5
5–10
10–15
15–20
20–25
25–30
30–35
35–40
40–45
Fork Length (cm)
M:IR
open


Porgy 2024
Frequency
0.0
0.1
0.2
0.3
0–5
5–10
10–15
15–20
20–25
25–30
30–35
35–40
Fork Length (cm)
M:IR
open


Porgy − M:IR
Frequency
0.0
0.1
0.2
0.3
0–5
5–10
10–15
15–20
20–25
25–30
30–35
35–40
Fork Length (cm)
2022
2024


Porgy − Open
Frequency
0.0
0.1
0.2
0.3
0–5
5–10
10–15
15–20
20–25
25–30
30–35
35–40
40–45
Fork Length (cm)
2022
2024

5.6 Red Grouper



6 Points of Contact

NCRMP Atlantic Fish Team Lead: **Jay Grove** (jay.grove@noaa.gov)

NCRMP Atlantic and Caribbean Fish Data Manager: **Jeremiah Blondeau** (jeremiah.blondeau@noaa.gov)

7 References

Ault, S. Jerald, G. Steven Smith, Jiangang Luo, J. Laura Grove, W. Matthew Johnson, and Jeremiah Blondeau. 2021. “Refinement of the Southern Florida Reef Tract Benthic Habitat Map with Habitat Use Patterns of Reef Fish Species.” NOAA National Centers for Environmental Information. https://www.ncei.noaa.gov/archive/accession/0224176.

Bryan, David R., Steven G. Smith, Jerald S. Ault, Michael W. Feeley, and Charles W. Menza. 2016. “Feasibility of a Regionwide Probability Survey for Coral Reef Fish in Puerto Rico and the u.s. Virgin Islands.” *Marine and Coastal Fisheries* 8 (1): 135–46. https://doi.org/10.1080/19425120.2015.1082520.

CRCP, NOAA. 2024. “National Coral Reef Monitoring Program (NCRMP) Reef Visual Census (RVC) Fish Survey Protocols u.s. Atlantic: Florida, Flower Garden Banks, Puerto Rico, and u.s. Virgin Islands.” NOAA Coral Reef Conservation Program. https://doi.org/10.25923/1y7h-cf65.

Feeley, M. W., M. E. Brandt, D. R. Bryan, N. Zurcher, A. Acosta, J. S. Ault, J. Blondeau, et al. 2025. “A Cooperative Multiagency Reef Fish Monitoring Protocol for the Florida and US Virgin Islands Coral Reef Ecosystems: Protocol Narrative Version—2.0.” Science Report NPS/SR—2025/327. Fort Collins, Colorado: National Park Service. https://doi.org/10.36967/2310167.

Ganz, H., and J. Blondeau. 2015. “Reef Visual Census Statistical Package in r.” R package. https://github.com/jeremiaheb/rvc.

Grove, Laura Jay W., Jeremiah Blondeau, and Jerald S. Ault. 2021. “National Coral Reef Monitoring Program’s Reef Fish Visual Census Metadata for the u.s. Caribbean.” NOAA Southeast Fisheries Science Center. https://doi.org/10.25923/39r6-9578.

Smith, Steven G., Jerald S. Ault, James A. Bohnsack, Douglas E. Harper, Jiangang Luo, and David B. McClellan. 2011. “Multispecies Survey Design for Assessing Reef□fish Stocks, Spatially Explicit Management Performance, and Ecosystem Condition.” *Fisheries Research* 109 (1): 25–41. https://doi.org/10.1016/j.fishres.2011.01.012.

Data Sources:

National Centers for Coastal Ocean Science (NCCOS) and Southeast Fisheries Science Center (SEFSC) (2022). National Coral Reef Monitoring Program: Assessment of coral reef fish communities in Florida from 2022-06-01 to 2022-12-16 (NCEI Accession 0282183). [indicate subset used]. NOAA National Centers for Environmental Information. Dataset. https://www.ncei.noaa.gov/archive/accession/0282183

2024 Florida Fish Data: National Centers for Coastal Ocean Science (NCCOS); NOAA Southeast Fisheries Science Center (SEFSC) (2024). National Coral Reef Monitoring Program: Assessment of fish communities in the Florida Reef Tract from 2024-05-29 to 2024-11-26 (NCEI Accession 0306184). [indicate subset used]. NOAA National Centers for Environmental Information. Dataset. https://www.ncei.noaa.gov/archive/accession/0306184