

South Florida/Caribbean Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure SEA09

Data Summaries, Analysis, and Reporting —Version 1.1

Please cite this as:

South Florida/Caribbean Network. 2022. Data summaries, analysis, and reporting —Version 1.1. South Florida/Caribbean Network Standard Operating Procedure NPS/SFCN/SOP—SEA09. South Florida/Caribbean Network, Palmetto Bay, Florida.

Source Protocol

This standard operating procedure (SOP) is derived from SOP SL07 *Data Analysis and Reporting*—Version 1.0:

South Florida/Caribbean Network. 2020. Data, analysis and reporting—Version 1.0. South Florida/Caribbean Network Standard Operating Procedure NPS/SFCN/SOP—SL07. South Florida/Caribbean Network, Palmetto Bay, Florida. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2275703> (last accessed February 2022).

Modifications have been made to reflect seagrass metrics, strata and data distributions.

Purpose

This standard operating procedure (SOP) describes basic data analysis and reporting recommended after each survey season. Suggested tables and equations for calculating variables are included.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
3/31/2021		Format update	Format update	1.1

Contents

	Page
Introduction.....	3
Creating an Initial Analysis-Ready Data Set	3
Generating Seagrass Data.....	3
Documenting Summary Statistics for Strata	3
Statistical Background	4
Summary Statistics	4
Frequency of Occurrence	4
Native Species Richness.....	5
Seagrass Cover Class Index.....	6
Change Analysis.....	7
Summary Reporting	8
Individual Seagrass and Algal Species or Genus	8
NPS Reporting Zones	8
Species Counts and Species Richness Summary.....	14
Queen Conch	14
Design Performance Analysis.....	15
Literature Cited	16

Introduction

Data analyses and reporting will be specific to management questions and resource goals that are being addressed; however, some suggested analyses should be applied to the data after each survey. This includes data for reports as well as information for the iterative approach to sample design. This SOP includes a description of these analyses.

Creating an Initial Analysis-Ready Data Set

Generating Seagrass Data

Data will be available for download after final QA/QC (see SFCN SOP SEA07 *Entering, Verifying and Performing a 100% QA/QC Check of Seagrass Data in the NPStoret Seagrass Database* — Version 1.1 [SFCN 2022a]). The standardized NPStoret export must be converted into an analysis-ready format. Table 1 lists the fields for the analysis-ready data set from which subsequent calculations described in this SOP can be made. In addition to this data set, a list of all possible strata for each region and management zone must be created along with a list of surveyed sites.

Table 1. Data fields for an analysis-ready data set.

Field	Description	Source
Site_name	discrete site name	NPStoret
Activity/Sample ID	Quadrat number	NPStoret
Sub-region	St. John/St. Thomas, St. Croix, Biscayne	Calculated from Station_name
NPS Reporting Zone	BUIS, SARI, BISC, VIIS, DRTO RNA, OutsideNPS	Calculated from Station_name
Visit Start Date	Sample Date	NPStoret
Year	Year	Calculated from Visit Start Date
Depth to Activity	average depth from divers (ft.)	NPStoret
Strat	stratification	Calculated from depth
species_cd	four letter species code	NPStoret – transposed from row to column
BB-score	Braun-Blanquet score from 0-5	NPStoret – transposed from row to column; 0's added for empty cells

Documenting Summary Statistics for Strata

Initial sampling will be proportional to stratum area, but over time sampling may shift to an optimal allocation. Optimal sampling effort for each survey requires an adjustment to the allocation of sites sampled among strata and management zone. A list including the number of sites selected within each stratum and management zone, the actual number of sites surveyed and the total area of each

stratum is imperative for population estimates and must be included with each report (Table 2). Whether or not to update the final strata classifications of sites based upon actual site depth from the survey data sheet (diver team classification, not the map) will be determined once at least one full sampling event of data has been collected and the frequency of such errors can be evaluated.

Table 2. Example of summary statistics for strata in Virgin Islands National Park.

Zone	Strata	Mapped Area (hectares)	# Sites Selected	# Sites Surveyed
VIIS	< 5 meters (16.4 feet [ft]) deep	–	–	–
VIIS	5–15 meters (16.4–49.2 ft) deep	–	–	–
VIIS	> 15 meters (49.2 ft) deep	–	–	–

Statistical Background

Although the seagrass monitoring design has the appearance of a two-stage design, in practice the final placement of the quadrats would be more clustered than would be expected by a complete random sample due to the requirement that divers remain within visible sight of each other. Thus, the following calculations use the one stage statistical approach from Bryan et al. (2013) and quadrats are treated as subsamples.

All subsequent calculations use the following calculation of N_h (the total number of possible samples in stratum h) where A_h is the mapped stratum area.

$$N_h = \frac{A_h}{0.25 \text{ m}^2 \cdot \# \text{ quadrats per sample point}}$$

Note: All formulas and definitions are also provided in Table 10 at the end of this SOP.

Summary Statistics

Medians, minimums, maximums, quartiles, and proportion of points using each Braun-Blanquet (BB) score category will be generated by stratum for cover, frequency, and other metrics.

Frequency of Occurrence

An inventory of seagrass and algal species observed and their frequency of occurrence is generated by stratum for each park.

Frequency of occurrence (proportion of sites present) for each species (P_i): $P_i = \frac{N_i}{n}$; such that $0 \leq P_i \leq 1$, where P_i = proportion of occurrence or frequency of species i ; N_i = the number of quadrats at a site in which species i was present; and n = the total number of quadrats sampled at a site.

The site frequencies of occurrence are averaged by stratum: $(\bar{P}_h)$.

$$\bar{P}_h = \frac{1}{n_h} \sum_j P_{hj}$$

n_h is the total number of sites visited in each stratum. j is the individual site.

To determine the proportion of occurrence across the entire sampling domain, the stratum average frequencies of occurrence are multiplied by a weighting factor (w_h) and summed to provide an overall estimate ($\bar{P}_{st}$). This weighting factor is calculated for each stratum as:

$$w_h = \frac{N_h}{\sum_h N_h}$$

N_h is the total possible number of primary units that can be sampled in stratum h .

$$\bar{P}_{st} = \sum_h w_h \bar{P}_h$$

A non-parametric bootstrap is performed on the sample data using the `boot()` function in R. A parametric bootstrap resamples from a known distribution function and is more appropriate for continuous data sets. The non-parametric bootstrap resamples from the data that was actually collected and is more appropriate for a discrete data set. Thus, a non-parametric bootstrap is used in this protocol to calculate adjusted confidence intervals for frequency of occurrence. From the bootstrapped data, adjusted 95% confidence intervals are generated for each stratum as well as for the entire sample domain using the `boot.ci()` function in R.

Native Species Richness

In addition to proportion occurrence for all species, a total count of native species and non-native species observed throughout all surveys as well as mean native species richness (defined here as average number of species observed per site) is calculated.

The mean native species richness ($\bar{Sp}_h$) for each stratum (h) within the specified region of interest is calculated, where n_h is the number of primary units sampled in stratum h and non-native species are excluded from Sp . Sp_{hj} is the number of native seagrass species detected when pooled across the four quadrats at a site.

$$\bar{Sp}_h = \frac{1}{n_h} \sum_h Sp_{hj}$$

A non-parametric bootstrap is performed on the sample data using the `boot()` function in R to calculate adjusted confidence intervals for native species richness. From the bootstrapped data, adjusted 95% confidence intervals are generated for each stratum as well as for the entire sample domain using the `boot.ci()` function in R.

To calculate the average native species richness per site across the entire sampling domain, the stratum averages and a weighting factor are used:

$$\overline{SP}_{st} = \sum_h w_h \overline{SP}_h$$

where w_h is the stratum weighting factor

$$w_h = \frac{N_h}{\sum_h N_h}$$

N_h is the total possible number of primary units that can be sampled in stratum h .

Seagrass Cover Class Index

Note: *Calculation of averages of BB scores will only be used for summary tables or graphs. Statistical analyses for change will use analyses appropriate for ordinal data as described further below.*

A seagrass cover class BB score index can be estimated for each stratum within the area of interest. Seagrass cover, D , is the average of the BB score per site for a species or species group. The mean cover ($\overline{D}_h$) for each stratum (h) within the entire domain or specified region of interest is calculated where n_h is the number of primary units (j) sampled in stratum h .

$$\overline{D}_h = \frac{1}{n_h} \sum_j D_{hj}$$

To calculate the Seagrass Cover Class Index for the domain, the stratum cover class index averages and a weighting factor are used:

$$\overline{D}_{st} = \sum_h (w_h \overline{D}_h)$$

where w_h is the stratum weighting factor

$$w_h = \frac{N_h}{\sum_h N_h}$$

N_h is the total possible number of primary units that can be sampled in stratum h .

A hierarchical non-parametric bootstrap is performed on the sample data using the `boot()` function in the R statistical analysis package (R Foundation for Statistical Computing, Vienna, Austria, [The R Project](#)) to calculate adjusted confidence intervals for average cover BB score for each seagrass species, total seagrass cover, and each algal species category. Unlike the other metrics above which have a single value per site, cover class will involve a hierarchical bootstrap in which the 4 quadrats

are bootstrapped and then sites are bootstrapped. From the bootstrapped data, adjusted 95% confidence intervals are generated for each stratum as well as for the entire sample domain using the `boot.ci()` function in R.

Change Analysis

Change in the average cover class index and frequency of occurrence will be calculated within each stratum and across strata. For seagrass cover metrics based on BB scores, the South Florida/Caribbean Network will use statistical methods designed for ordinal data such as ordinal regression (Guisan and Harrell 2000; Irvine and Rodhouse 2010; Damgaard 2014) or Kruskal-Wallis test (multiple years) or Mann-Whitney U-test (between years). Recent development of ordinal beta models that link category probabilities to continuous variables such as percent cover (Irvine and Rodhouse 2010; Irvine et al. 2016) and use ordinal regression are appropriate for interpretation of trends in hierarchical cover classes, such as Braun-Blanquet (Guisan and Harrell 2000; Irvine and Rodhouse 2010; Damgaard 2014). Cumulative logit models and ordinal beta models are applicable for trend analysis on ordered categorical variables used to visually estimate cover classes using areal plots. Logistic regression models, particularly with unequal cover class intervals, can effectively summarize changes in ranked data and are considered mathematically more appropriate than least squares linear regression modeling using cover class midpoints (Yeo et al. 2009). A logit model may also be referred to as proportional odds models (POM):

$$\text{logit} [\Pr(C_i \leq j | \mathbf{X})] = \theta_j - \mathbf{X}\boldsymbol{\beta}$$

where C_i is the assigned category for observation i with $j + 1$ observed categories, and $\boldsymbol{\theta}$ is the set of ordered cutpoints (threshold parameters) with $-\infty = \theta_0 < \theta_1 < \dots < \theta_J < \theta_{J+1} = \infty$ and $\{\boldsymbol{\beta}, \theta_1, \dots, \theta_J\}$ (Irvine et al. 2016). The model can account for a latent variable distribution function but assumes that a shift to the next higher category is uniform across all classes; which is not the case with Braun-Blanquet data (Irvine et al. 2016). Recent development of ordinal beta models show promise as a way to link category probabilities to continuous variables such as percent cover (Irvine and Rodhouse 2010; Irvine et al. 2016). R and JAG code for implementation of the ordinal beta hurdle model and POM is available on the NPS Integrated Resource Management Applications (IRMA) portal at: [DataStore - Journal Article - \(Code: 2231866\) \(nps.gov\)](#). Analyses that involve all three depth strata with stratum as a factor or “block” variable will also be conducted for BB scores using ordinal regression.

The following approach can be used with frequency of occurrence and native species richness metrics to determine whether a significant difference between two time periods exists. The differences between two time periods are bootstrapped to create a 95% confidence interval of the differences. These time periods can be individual sample events or grouped sample events from consecutive years. In this approach, a sample is taken from the first time period (T_1) and a sample from the second time period (T_2) is subtracted from it. This value is stored and the process repeated 10,000 times (the bootstrap). From this distribution, the 2.5 and 97.5 percentiles are identified (two-tailed test for $\alpha = 0.05$). If the value 0 falls outside of these percentiles, then the two time periods are significantly different. This process should be completed for sampling domain-wide estimates and for each stratum individually.

To test for trends in frequency of occurrence and native species richness that occur over three or more time periods, a generalized linear model (GLM) is used. Time, stratum, and time by stratum interactions are included. Time is included as a linear regression variable where possible, but if change appears to be non-linear, then time must be included as a categorical variable. For the metric in question, the GLM uses the distribution that is most appropriate for the data set. The GLM for native species richness (count data) may require a Poisson or other distribution. For frequency of occurrence data, a binomial distribution may be required, but for frequencies less than 5%, a logistic regression may be most appropriate.

Analyses will be conducted in R. Code will be developed subsequent to publication of this protocol, but procedures are available for conducting these analyses in R. The R and JAG code for implementation of the ordinal beta hurdle model and POM is available on the NPS IRMA portal at: [DataStore - Journal Article - \(Code: 2231866\) \(nps.gov\)](#) (Irvine and Rodhouse 2010; Irvine et al. 2016). R code associated with bootstrapping routines for similar analyses of spiny lobster is found in Appendix G of the Caribbean spiny lobster protocol (Richter et al. 2018).

Trend analysis methods will be further refined after several years of data collection from a single park unit.

Summary Reporting

At the end of each survey season, the National Park Service will prepare a report containing analyses described in the section above. This report will provide managers and interested parties a single document from which to evaluate spatial and temporal trends of population level metrics. Specifics of this report are described below.

Individual Seagrass and Algal Species or Genus

A basic summary report will be created for all species using the metrics described in Table 3. Summaries will be created for 33 variables listed in Table 4.

NPS Reporting Zones

Data reports include several metrics that are broken down by reporting zone. In some cases these are the same as management zone and in other cases a park may be a single reporting zone or outside parks may be a reporting zone. A description is included below:

St. Croix

BUIS = Buck Island Reef National Monument

SARI = Salt River Bay National Historical Park and Ecological Preserve

St. John

VIIS = Virgin Islands National Park

VICR = Virgin Islands Coral Reef National Monument

Florida

BISC = Biscayne National Park

In addition to reporting data combined across reporting zones, data are reported by stratum within a reporting zone. Once several sampling events have occurred, example tables and figures will be provided as in Figure 1. However, the first year of reporting would benefit from simpler tables showing multiple species at once.

Table 3. Individual species metrics reported by stratum for summary report. Canopy cover index and frequency of occurrence are also reported as combined weighted multi-strata metrics.

Metric	Descriptive statistic
Frequency	Mean 95% Confidence Interval
Canopy Cover Index	Mean 95% Confidence Interval
Canopy Height (centimeters [cm])	Mean Standard Deviation Standard Error Median Minimum Maximum
Sediment Depth (centimeters [cm])	Mean Standard Deviation Standard Error Median Minimum Maximum
Water Depth (feet [ft])	Mean Standard Deviation Standard Error Median Minimum Maximum

Table 4. Focal species list for reporting.

Taxonomic Group	Name	Exotic	Potential Optimization Taxon	Taxon Code
Seagrasses	<i>Thalassia testudinum</i>	–	X	TTES
	<i>Syringodium filiforme</i>	–	X	SFIL
	<i>Halodule wrightii</i>	–	–	HWRI
	<i>Halophila decipiens</i>	–	–	HDEC
	<i>Halophila engelmannii</i>	–	–	HENG
	<i>Halophila stipulacea</i>	X	X	HSTI
	<i>Ruppia maritima</i>	–	–	RMAR
	Seagrass total	–	X	STOT
Calcareous Green Alga	<i>Halimeda</i> sp.	–	–	HALI
	<i>Udotea</i> sp.	–	–	UDOT
	<i>Penicillus</i> sp.	–	–	PENI
	<i>Rhipocephalus</i> sp.	–	–	RHIP
	<i>Acetabularia</i> sp.	–	–	ACET
	<i>Neomeris</i> sp.	–	–	NEOM
	<i>Cymopolia</i> sp.	–	–	CYMO
	Calcareous green total	–	–	CGTO
Green Alga	<i>Caulerpa</i> sp.	–	–	CAUL
	<i>Batophora</i> sp.	–	–	BATO
	<i>Avrainvillea</i> sp.	–	–	AVRA
	<i>Dasycladus</i> sp.	–	–	DASY
	Green other	–	–	GOTH
	Green total	–	–	GTOT
Red Alga	<i>Laurencia</i> sp.	–	–	LAUR
	Red other	–	–	ROTH
	Calcareous red other	–	–	CROT
	Red total	–	–	RTOT
Brown Alga	<i>Sargassum</i> sp.	–	–	SARG

Taxonomic Group	Name	Exotic	Potential Optimization Taxon	Taxon Code
	<i>Dictyota</i> sp.	–	–	DICT
	Brown other	–	–	BOTH
	Brown total	–	–	BTOT
Other Taxa	Sponges	–	–	SPO
	Corals	–	–	CORALU
	Gorgonians	–	–	GO

Hypothetical individual species data summary for Virgin Islands NP.

Table 5. Average Braun Blanquet Score by Stratum and Combined Across Strata. CI=Confidence Interval.

Strata	Variable	2018	2021	2023	2025
> 15 meters	Avg	0.00	0.00	0.00	0.00
	95% CI	(0.00, 0.00)	(0.00, 0.00)	(0.00, 0.00)	(0.00, 0.00)
5–15 meters	Avg	0.27	0.30	0.27	0.28
	95% CI	(0.00, 0.58)	(0.00, 0.60)	(0.00, 0.56)	(0.00, 0.57)
< 5 meters	Avg	0.92	1.10	1.30	2.00
	95% CI	(0.48, 1.36)	(0.70, 1.50)	(0.88, 1.72)	(1.59, 2.41)
Combined	Avg	0.31	0.35	0.37	0.40
	95% CI	(0.15, 0.47)	(0.18, 0.52)	(0.22, 0.52)	(0.25, 0.55)



Figure 1. Graph showing Average Braun Blanquet Score by Stratum and Combined Across Strata. CI=Confidence Interval.

Table 6. Average Frequency of Occurrence (%quadrats/site) by Stratum and Combined Across Strata. CI=Confidence Interval.

Strata	Variable	2018	2021	2023	2025
> 15 meters	Avg	0.00	0.00	0.00	0.00
	95% CI	(0.00, 0.00)	(0.00, 0.00)	(0.00, 0.00)	(0.00, 0.00)
5–15 meters	Avg	0.21	0.25	0.24	0.27
	95% CI	(0.08, 0.34)	(0.15, 0.35)	(0.14, 0.34)	(0.18, 0.36)
< 5 meters	Avg	0.45	0.60	0.65	0.70
	95% CI	(0.24, 0.66)	(0.35, 0.85)	(0.39, 0.91)	(0.45, 0.95)
Combined	Avg	0.11	0.20	0.21	0.22
	95% CI	(0.06, 0.16)	(0.14, 0.26)	(0.15, 0.27)	(0.15, 0.29)

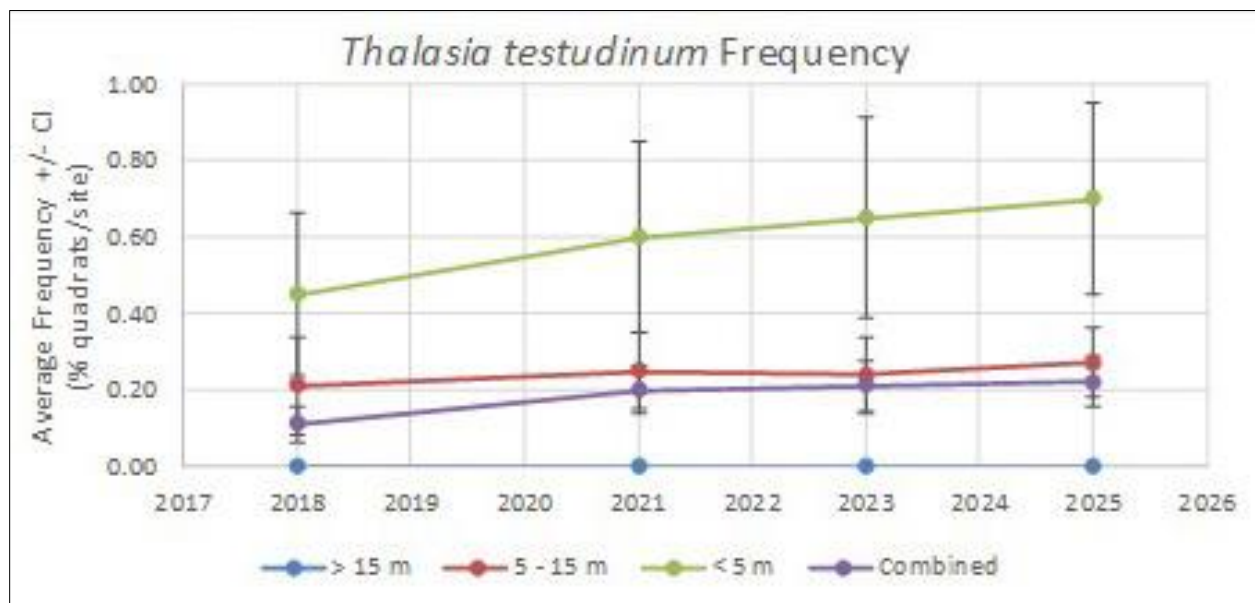


Figure 2. Graph showing Average Frequency of Occurrence (%quadrats/site) by Stratum and Combined Across Strata. CI=Confidence Interval.

Species Counts and Species Richness Summary

In addition to individual species reports a few community metrics will be reported. A running list of total number of species and new species observed by park will be reported in Table 7. Mean native species richness of seagrass by strata and park over time will also be reported (Table 8).

Table 7. Summary of species counts for current sampling period.

Park	Total Species	Total New Species
Buck Island Reef National Monument (BUIS)	–	–
Salt River Bay National Historical Park and Ecological Preserve (SARI)	–	–

Table 8. Seagrass species richness (average # detected per site) for Virgin Islands National Park (CI=Confidence Interval).

Stratum	Variable	2020	2023	2026
< 15 meters (49.2 ft)	Avg	–	–	–
	95% CI	–	–	–
5–15 meters (16.4–49.2 ft)	Avg	–	–	–
	95% CI	–	–	–
> 5 meters (16.4 ft)	Avg	–	–	–
	95% CI	–	–	–
Combined strata	Avg	–	–	–
	95% CI	–	–	–

Queen Conch

Within the national parks, Queen Conch occurrence based on field observations will also be included in reports as shown in Table 9.

Table 9. Queen Conch recorded (St. Croix).

Species	# Sites Present (BUIS)	% Occurrence (SARI)	# Sites Present (SARI)	% Occurrence (SARI)
Queen Conch	–	–	–	–

Design Performance Analysis

An examination of sampling size and allocation performance will be completed after each season. This analysis aids in determining sampling allocation for the subsequent year as described in SOP SEA04 *Sample Allocation*—Version 1.1 (SFCN 2022b). Sampling design performance is ultimately the result of trade-offs between surveying cost (usually measured by the number of samples) and population estimate precision. A performance measure typically used is the coefficient of variation (CV) of density as shown in both the reef fish protocol for Virgin Islands SOP 2 *Stratification* and SOP 3 *Sample Allocation* (Bryan et al. 2013); and SOP A *Statistical Sampling Design* in (A *Cooperative Multi-Agency Reef Fish Monitoring Protocol for the Florida Keys Coral Reef Ecosystem* (Brandt et al. 2009). Additional data helps define the variance structure for each stratum which can change the allocation of sampling effort.

The sample allocation will start out as a proportional allocation (conservative) and then develop a more aggressive approach (adaptive) over time to reduce the variance of the estimates in the survey. Most likely densities of two or three key species important to management will be selected for optimization of the adaptive design (i.e., *Thalassia testudinum*, *Syringodium filiforme*, *Halophila stipulacea*).

Table 10. Statistical symbol definitions.

Category	Symbol	Definition	Computational Formula
Mean	h	Stratum subscript	—
Cover	j	Sample unit subscript	—
Class and Allocation	D_j	Average density in sample unit j across i quadrats	—
	A_h	Stratum area	Total mapped area in stratum h
	n_h	Number of units sampled in stratum h	—
	N_h	Total possible number of sample units in stratum h	$N_h = \frac{A_h}{0.25 \text{ m}^2 \cdot \# \text{ quadrats per sample point}}$
	$\bar{D}_h$	Mean cover in stratum h	$\bar{D}_h = \frac{1}{n_h} \sum_j D_{hj}$
Frequency of Occurrence	P_j	Occurrence in sample unit j	—
	$\bar{P}_h$	Proportion occurrence by strata	$\bar{P}_h = \frac{1}{n_h} \sum_j P_{hj}$
Native Species Richness ¹	Sp_j	Species richness per site j	—
	$\bar{Sp}_h$	Mean strata species richness	$\bar{Sp}_h = \frac{1}{n_h} \sum_h sp_{hj}$

¹ The number of species pooled across the quadrats at a site.

Literature Cited

- Brandt, M. E., N. Zurcher, A. Acosta, J. S. Ault, J. A. Bohnsack, M. W. Feeley, D. E. Harper, J. H. Hunt, T. Kellison, D. B. McClellan, M. E. Patterson, and S. G. Smith. 2009. A cooperative multi-agency reef fish monitoring protocol for the Florida Keys coral reef ecosystem. Natural Resource Report NPS/SFCN/NRR—2009/150. National Park Service, Fort Collins, Colorado. Available at: https://data.nodc.noaa.gov/coris/library/NOAA/CRCP/NMFS/SEFSC/Other/fl_keys_reef_fish_monitor_protocol_2009.pdf (last accessed February 2022).
- Bryan, D. R., A. J. Atkinson, J.S. Ault, M. E. Brandt, J. A. Bohnsack, M. J. Feeley, M. E. Patterson, B. I. Ruttenberg, S. G. Smith, and B. D. Witcher. 2013. A cooperative multiagency reef fish monitoring protocol for the U.S. Virgin Islands coral reef ecosystem, V. 1.00. Natural Resource Report NPS/SFCN/NRR-2013/672. National Park Service, Fort Collins, Colorado. Available at: [DataStore - Published Report - \(Code: 2195859\) \(nps.gov\)](#) (last accessed February 2022).
- Guisan, A. and F. E. Harrell. 2000. Ordinal response regression models in ecology. *Journal of Vegetation Science*, 11(5), pp.617–626.
- Irvine, K.M. and T. J. Rodhouse. 2010. Power analysis for trend in ordinal cover classes: implications for long-term vegetation monitoring. *J. Veg. Sci.* 21(6):1152–1161.
- Irvine, K.M., T. J. Rodhouse, and I. N. Keren. 2016. Extending ordinal regression with a latent zero-augmented beta distribution. *Journal of Agricultural, Biological, and Environmental Statistics* 21(4): 619–640.
- Richter, L. J., M. W. Feeley, A. J. Atkinson, J. M. Patterson, A. D. Davis, and J. Miller. 2018. Long-term monitoring protocol of Caribbean spiny lobster (*Panulirus argus*): Protocol narrative. Natural Resource Report NPS/SFCN/NRR—2018/1850. National Park Service, Fort Collins, Colorado. Available at: [DataStore - Published Report - \(Code: 2279134\) \(nps.gov\)](#) (last accessed February 2022).
- South Florida/Caribbean Network. 2022a. Entering, verifying and performing a 100% QA/QC check of seagrass data in the NPStoret seagrass database —Version 1.1. South Florida/Caribbean Network Standard Operating Procedure NPS/SFCN/SOP—SEA07. South Florida/Caribbean Network, Palmetto Bay, Florida. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2285065> (last accessed February 2022).
- South Florida/Caribbean Network. 2022b. Sample allocation—Version 1.1. South Florida/Caribbean Network Standard Operating Procedure NPS/SFCN/SOP—SEA04. South Florida/Caribbean Network, Palmetto Bay, Florida. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2285062> (last accessed February 2022).

Yeo, J. J., T. J. Rodhouse, G. H. Dicus, K. M. Irvine, and L. K. Garrett. 2009. Upper Columbia Basin Network sagebrush steppe vegetation monitoring protocol: Standard operating procedures version 1.0. Natural Resource Report NPS/UCBN/NRR—2009/142. National Park Service, Fort Collins, Colorado. Available at: [DataStore - Published Report - \(Code: 662446\) \(nps.gov\)](#) (last accessed February 2022).