

Standard Operating Procedure SL07

Please cite as:

Purpose

Revision Log

[illegible]

Contents

	Page
Purpose.....	1
Revision Log.....	1
Source Protocol.....	3
Introduction.....	3
Documenting Summary Statistics for Strata.....	3
Analyses for Lobster Surveys	5
Relative Density	6
Mean Density.....	6
Relative Frequency of Occurrence	8
Average Size in the Exploited Phase	9
Average Size in all Observed Lobsters	9
Assessing Changes to Lobster Metrics.....	9
Analyses for Demographics and Biological Condition.....	10
Changes to Map Grid and Limitations of Benthic Habitat Maps.....	15
Literature Cited	16

Source Protocol

This SOP is derived from SOP 9 in the Virgin Islands reef fish monitoring protocol:

- Bryan, D. R., A. J. Atkinson, J. S. Ault, M. E. Brandt, J. A. Bohnsack, M. W. 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. Natural Resource Report NPS/SFCN/NRR—2013/672. National Park Service, Fort Collins, Colorado.

Introduction

Data analyses first focus on relative frequency of occurrence, relative density, and average size of all observed exploited phase spiny lobsters. It is important to keep in mind that estimates of frequency of occurrence and density are *relative*. When calculating these metrics, it is assumed the entire grid cell area is hard-bottom habitat when many of the grid cells have only partial habitat coverage. This is because of map resolution and limitations in our current knowledge of benthic habitats. These relative metrics should not be treated as true estimates of frequency of occurrence and density. Estimates of relative density and relative frequency of occurrence apply to individual strata. For park-wide calculations, unit-less indices of relative density and relative frequency of occurrence are used because of the underlying uncertainty in map weights for individual strata. Also, this protocol is written with the understanding that our knowledge of benthic habitats will likely improve in the future, which could decrease the grid cell sizes that are used. If and when this occurs, historical values of the relative metrics will be re-computed. This may cause some shifts in the historical estimates of relative metrics but will not cause a shift in trends. Thus, it is important to make sure the most recent report that reflects any such changes is used for interpretation.

Other descriptive statistics apply to only lobsters that were successfully captured and assessed. These descriptive statistics concentrate on sex ratio, molt stage ratio, proportion of females bearing eggs, and proportion of females with spermatophores. Additional data analyses and reporting will be specific to management questions for each park. Other analyses include those that may refine allocation of samples across strata in future sampling.

Documenting Summary Statistics for Strata

A list including the number of sites selected within each stratum, the actual number of sites surveyed within each stratum, and the total number of grid cells per stratum is imperative for estimates of relative density and relative frequency of occurrence and should be included in each report. The strata classifications from the survey datasheet (diver team classification, not the habitat map) are used for all subsequent calculations. Tables 1, 2, 3, 4, and 5 are based on current stratification schemes and will be updated with any changes to strata or management.

Table 1. Summary statistics for strata in Biscayne NP. This is a subset of the strata that appear in Brandt et al. (2009) because some of them do not occur within Biscayne NP [m—meters].

Stratum Classification	Total # Grid Cells	# Grid Cells Selected	# Grid Cells Surveyed
Inshore Patch Reef (0–6 m)	–	–	–
Mid-Channel Patch Reef (0–6 m)	–	–	–
Offshore Patch Reef (0–6 m)	–	–	–
Forereef, Low-relief, (0–6 m)	–	–	–
Forereef, Low-relief (6–18 m)	–	–	–
Forereef, High-relief reef (0–18 m)	–	–	–

Table 2. Summary statistics for strata in Dry Tortugas NP. These strata are not separated by depth and range from 0–30 meters (0–98.4 feet [ft]).

Stratum Classification	Total # Grid Cells	# Grid Cells Selected	# Grid Cells Surveyed
Low-relief continuous reef	–	–	–
Mid-relief continuous reef	–	–	–
High-relief continuous reef	–	–	–
Low-relief isolated reef	–	–	–
Mid-relief isolated reef	–	–	–
High-relief isolated reef	–	–	–
Low-relief spur and groove	–	–	–
High-relief spur and groove	–	–	–

Table 3. Summary statistics for strata in Virgin Islands NP.

Stratum Classification	Total # Grid Cells	# Grid Cells Selected	# Grid Cells Surveyed
Scattered coral/rock	--	--	--
Pavement	--	--	--
Bedrock	--	--	--
Patch reef	--	--	--
Linear reef	--	--	--
Unknown hard-bottom	--	--	--

Table 4. Summary statistics for strata in Buck Island NM.

Stratum Classification	Total # Grid Cells	# Grid Cells Selected	# Grid Cells Surveyed
Scattered coral/rock	–	–	–
Pavement	–	–	–
Patch reef	–	–	–
Linear reef & Bedrock	–	–	–

Table 5. Summary statistics for strata in Salt River Bay NHP.

Stratum Classification	Total # Grid Cells	# Grid Cells Selected	# Grid Cells Surveyed
Pavement & Scattered coral/rock	–	–	–
Linear reef & Patch reef	–	–	–
Bedrock	–	–	–

Analyses for Lobster Surveys

The analyses for the lobster data deviate from the methods presented in the reef fish protocols. While it would be beneficial to maintain consistency between the two protocols there are several reasons why a separate approach to analysis is needed.

The analyses in the reef fish monitoring data assume normality in the data set. This is possible due to the central limit theorem, which states that survey design estimates (e.g., population means and totals) are normally distributed if sample size is large. The reef fish monitoring data include multiple species, achieve a greater number of individuals observed per survey, and attain higher sample sizes per stratum than is currently possible with lobster monitoring. We cannot assume that the lobster sample data are normally distributed. Thus, it becomes necessary to fit the lobster sample data to an underlying probability distribution (e.g. Poisson, negative binomial).

The data collected in this protocol are count data (non-negative integers) and are expected to be approximated by a Poisson, negative binomial, or similar probability distribution. Based upon the pilot data collected in 2017 in Biscayne NP and in Virgin Islands NP, it is expected that a Poisson distribution may be the most appropriate for the data set. However, if the data are over-dispersed, a negative binomial distribution may be more appropriate.

Another check to determine whether a particular regression is an appropriate fit for the data set is an examination of the summary of the model in R. This is determined by dividing the residual deviance by the degrees of freedom. A resulting value less than 2 (closer to 1 is better) indicates that the regression is acceptable. Values between 2 and 5 may be acceptable, but other regressions should be

considered. Values greater than 5 mean that the selected regression results in an unacceptable distortion of the data and another type of regression is more appropriate.

The free software, R, is used for all analyses of lobster data. Code provided in Appendix G: *R code* in the protocol narrative (Richter et al. 2018) is used to determine the appropriate distribution for the data set as well as goodness of fit.

During the pilot studies, there were several sites with non-detections. A concern with a high number of non-detections is zero-inflation of the data set and how this affects the underlying distribution. In such instances, a zero-inflated Poisson or zero-inflated negative binomial distribution could potentially better approximate the data. For a regular Poisson distribution, a minimum of three to five sites with detections is necessary. For a zero-inflated Poisson, five or more sites with detections is needed; and at least eight to ten sites are required for a zero-inflated non-binomial (Tom Philippi, personal communication, 26 November 2018). Yet, when the mean number of lobsters per site with lobster present is low (near one lobster per site), a zero-inflated model is not appropriate. If the mean number of lobsters per site is higher (e.g. greater than three lobsters per site), a zero-inflated model is more relevant. R-code provided in Appendix G can be used to determine whether a zero-inflated model is appropriate for the sample data. For the Biscayne NP and Virgin Islands NP pilot studies conducted in 2017, a Vuong test determined that an ordinary Poisson regression was more appropriate than a zero-inflated Poisson regression in both cases.

A second concern about a data set with many non-detections is the ability to calculate accurate and useful confidence intervals. Increasing the sample size per stratum or increasing samples with detections are two methods to improve the variance. By combining some of the strata, we have reduced the overall number of strata for each park unit, which in turn allows us to allocate more samples per stratum. Initially, an even allocation of samples across strata also keeps the number of samples per stratum high. We will also use a non-parametric bootstrap (R code provided in Appendix G) to calculate adjusted 95% confidence intervals.

The following methods are used in analyses to calculate relative frequency of occurrence, relative density, and average size. All lobster observed in plots, including those that have evaded capture but have visual size estimates, will be included in these analyses. The methods presented below are used to calculate the metrics for all observed lobsters. These analyses should also be conducted separately for exploited phase and unexploited phase lobsters. The exception is for average size, where only calculations for exploited phase and all observed lobsters are conducted.

Relative Density

Mean Density

A primary motivation of monitoring lobster is to evaluate changes in population structure which may fluctuate in response to environmental changes or fishing pressure. Robust estimators of population condition for focal species include average relative density of lobster at different life stages (all observed, exploited phase, unexploited phase) and average length of exploited phase (or “legal”) individuals (Ault et al. 2001; Ault et al. 2005). These two biological indicators must be calculated

and compared to previous years and between strata, with consideration to habitat. Mean density of life stages must also be considered spatially across the domain.

Mean lobster relative density can be estimated for each individual stratum (e.g. bedrock) in a park unit. An index of relative density is generated for the whole park unit by combining the means of relative density in each stratum, weighted by the proportional coverage of the stratum in the entire park unit. At the time of this writing, uncertainty in the underlying benthic coverage and associated map weights means that the index of relative density calculated for a park unit is unit-less. This value is not intended to represent the true density of lobsters within the park unit but may be tracked through time to determine whether the relative density is increasing or decreasing.

A Poisson distribution is expected to approximate the sample data the best, though this can be confirmed with R-code provided in Appendix G: *R code* in the protocol narrative (Richter et al. 2018). The methods below describe how to determine mean relative density and calculate 95% confidence intervals per stratum using the Poisson distribution and a non-parametric bootstrap. Lobster relative density, D_{hj} , is the number of individuals observed per site or pair of circular plots (e.g., individuals observed / 353 square meters [3,804 square feet {ft²}]). It is assumed the data collected at the survey sample is representative of the whole primary unit in which it was collected. Therefore, the mean relative density ($\bar{D}_h$) for each stratum h is estimated as:

$$\bar{D}_h = \frac{1}{n_h} \sum_j D_{hj} \quad (\text{SOP 7.1})$$

Where n_h is the number of primary units sampled in stratum h .

The Poisson distribution is approximated by the equation

$$P(x; \lambda) = \frac{(e^{-\lambda})(\lambda^x)}{x!} \quad (\text{SOP 7.2})$$

Where x represents the number of successes that result from the experiment, λ is the mean of the distribution, and e is a mathematical constant equal to approximately 2.718.

To create a Poisson distribution for the sample data in each stratum, only the stratum mean, λ_h , is needed. This is approximated by ($\bar{D}_h$) in Equation SOP 3.2.

$$\bar{D}_h = \lambda_h \quad (\text{SOP 7.3})$$

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 datasets. The non-parametric bootstrap resamples from the data that was actually

collected and is more appropriate for a discrete dataset. Thus, a non-parametric bootstrap is used in this protocol to calculate adjusted confidence intervals for relative density. 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 index of relative mean density for the domain, the stratum relative densities and a weighting factor are used:

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

(SOP 7.4)

where w_h is the stratum weighting factor

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

(SOP 7.5)

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

Relative Frequency of Occurrence

The relative frequency of occurrence for lobster is generated for each stratum in each park. Lobster relative frequency of occurrence, P , is the proportion of sites (paired circular plots) where at least one lobster was observed to the total number of sites visited. Relative frequency of occurrence is

calculated first by stratum ($\bar{P}_h$). Calculations of relative frequency of occurrence are similar to that of relative density, where a non-parametric bootstrap is used to determine 95% confidence intervals.

Unlike the relative density dataset however, frequency of occurrence follows a binomial distribution.

n_h is the total number of primary units visited in each stratum. j is the individual sample.

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

(SOP 7.6)

To determine the index of relative frequency of occurrence across the entire park domain, the stratum relative 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:

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

(SOP 7.5)

The total number of primary units (grid cells) in a stratum, N_h , is dependent on stratum area, so values for N_h are derived directly from GIS habitat maps.

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

(SOP 7.7)

The R-code for calculating relative frequency of occurrence and the 95% confidence intervals for each stratum and across the entire park domain can be found in Appendix G: *R code* in the protocol narrative (Richter et al. 2018).

Average Size in the Exploited Phase ($\bar{L}_{exp}$)

Average size in the exploited phase should be calculated at the end of each survey season. This metric is calculated by averaging the size of all lobster that are already greater than or equal to the exploited phase size limit. In Florida any lobster with a carapace length greater than 3 inches (76 millimeters [mm]) is considered in the exploited phase. In the Virgin Islands, any lobster with a carapace length greater than 3.5 inches (89 mm) is considered in the exploited phase. At this time, lengths are not weighted by strata.

$\bar{L}_{exp}$ is defined as the average length of lobsters in the exploited phase:

$$\bar{L}_{exp} = \frac{1}{n_{exp}} \sum L_{exp}$$

(SOP 7.8)

where n_{exp} is defined as the number of lobster in the exploited phase and L_{exp} is the carapace length of an exploited phase lobster.

Average Size in all Observed Lobsters

Average size in the exploited phase is the most important size metric to track over time. However, average size of all observed lobsters should also be tracked. This can be done, using the same equation SOP 7.8, but by replacing n_{exp} with n_{all} and L_{exp} with L_{all} where n_{all} is the number of all observed lobster and L_{all} is the carapace length of an observed lobster.

$$\bar{L}_{all} = \frac{1}{n_{all}} \sum L_{all}$$

(SOP 7.9)

Assessing Changes to Lobster Metrics

There are two approaches we will use to detect change to lobster metrics over time: determining whether a significant difference between two time periods exists and determining whether a trend exists over multiple (more than two) sampling events. In the first scenario, the differences between two time periods are bootstrapped to create a 95% confidence intervals 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. The R-code for this process is found in Appendix G: *R code* in the protocol narrative (code forthcoming; Richter et al. 2018). This process should be completed for park-wide estimates and for each stratum individually.

Second, to test for trends 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 relative density (count data) should use a Poisson or other distribution (e.g., negative binomial). The distribution of best fit is determined by methods previously discussed in this section using R-code provided in Appendix G: *R code*. For frequency of occurrence data, a logistic regression (for binary variables) is most appropriate, especially if numbers in some strata are less than 5%. The results of the GLM are examined in R to determine whether sample events are significantly different for the metric of interest and whether a time by strata interaction is occurring. If a time by stratum interaction is occurring, reporting and graphing results by individual strata is advised. With sufficient data, additional factors such as distance from edge will be explored to determine if fit of the models are improved.

Analyses for Demographics and Biological Condition

The following analyses should only include lobsters that were successfully captured with biological characteristics recorded. There are several assumptions when analyzing these lobster data:

1. The sample of captured lobsters accurately represents the lobster population in the domain.
2. The capture method does not select for particular types of lobster (e.g., larger lobster are not easier to catch, or when lobsters are in groups they are captured irrespective of size or condition).
3. The skill of catching lobster (success rate) is similar among observers.
4. The timing of surveys is consistent.

It is important to note lobsters exhibit seasonality in reproductive characteristics. For example, in Florida, late May is peak egg-bearing time for lobsters (Bertelsen and Matthews 2001). When lobsters release eggs, they also tend to migrate to deeper water (Crawford 1921; Butler and Herrnkind 1997). Because of this, consistency in timing of surveys is extremely important when trying to establish trends of lobster conditions affected by reproduction. Sampling will occur in a single sampling pulse in May to reduce any issues caused by migration of female lobsters.

Sex ratio and molt stage ratio are included on summary reports. These should be presented as the number of males to females (males : females) and as number of pre-molt to intermolt to post-molt (pre : inter : post) when reported (Table 4).

Proportion of egg-bearing females is calculated by dividing the number of egg-bearing females by the total number of females captured in the survey. Proportion of females with a spermatophore is calculated by dividing the number of females with a spermatophore by the total number of females captured in the survey (Table 4).

The following are possible descriptive statistics of a lobster population that a park may be interested in:

1. Size distribution of all observed lobsters;
2. Size distributions by sex; and
3. Size distribution of egg-bearing females;
4. Spatial distribution of lobsters during a sample event

Size distributions may be presented in tables or histograms (see Figures 1 and 2 for examples).

A park unit may also request specific analyses not listed here. These will be assessed upon request by a park unit.

Summary Reporting

At the end of each survey season a report shall be prepared containing the analyses described in the above sections. This report will provide park 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.

The data calculations used to generate these reports are dependent on the map grid product used. Updates in the map grid require recalculation of metrics in all previous years of sampling. This may cause shifts in the relative metrics (density, frequency of occurrence) but not in the direction of trends. This will be made explicitly clear in any published report released to the parks and/or public.

Table 6. Lobster metrics to include in summary report [mm—millimeters].

Variable	Specific Metrics
Index of relative frequency of occurrence	Exploited Phase (Mean, SE) Unexploited Phase (Mean, SE) Total (Mean, SE)
Index of relative density	Exploited Phase (Mean, SE, CV) Unexploited Phase (Mean, SE, CV) Total (Mean, SE, CV)
Carapace Length	Average Exploited Length (mm) Average Overall Length (mm)
Length Frequency	Number of lobster in 10 mm carapace length bins Number of males in 10 mm carapace length bins Number of females in 10 mm carapace length bins
Descriptive Statistics	
Total sites completed	Total sites completed
Total lobster observed	Total lobster observed
Total lobster captured	Total lobster captured
Maximum length	Max. carapace length (mm) observed
Minimum length	Min. carapace length (mm) observed
Sex Ratio	Males : Females
Molt Stage Ratio	Pre-molt : Intermolt : Post-molt
Proportion of egg-bearing females	% of females that are egg-bearing
Proportion of females with spermatophore	% of females with spermatophore

Caribbean spiny lobster (*Panulirus argus*)

SAMPLE report

*All data presented here are fictional

Table A. Average size of lobsters (carapace length, mm)

Life Stage	Variable	2018	2022	2026
Exploited Phase	Avg $\pm$ SE	107 $\pm$ 8	105 $\pm$ 6	112 $\pm$ 10
Total Observed Lobsters	Avg $\pm$ SE	80 $\pm$ 10	78 $\pm$ 9	70 $\pm$ 11

Table B. Descriptive statistics

Metric	2018	2022	2026
Total sites completed	51	49	53
Total lobster observed	22	22	26
Total lobster captured	18	15	20
Max carapace length	190 mm	165 mm	182 mm
Sex Ratio (Males/Females)	0.9	1.1	1.0
Molt Stage Ratio (Pre : Inter : Post)	0 : 3 : 1	0 : 3 : 1	0 : 3 : 1
Proportion of females with eggs	80.00%	50.00%	60.00%
Proportion of females with spermatophore	80.00%	70.00%	65.00%
Prevalence of PaV1	0.00%	0.00%	0.00%

Note:

Indices of relative density and relative frequency of occurrence are intentionally presented without units. They should not be interpreted as true density or true frequency of occurrence because of uncertainty in map weights.

Data calculations used to generate this report depend on the map grid product used. Updates to the grid require recalculation of relative density and relative frequency of occurrence for ALL sample years. Thus results presented here may not exactly match data in previously published reports, but being based on a more accurate map grid, should provide the best estimates available.

Table C. Calculated metrics

Metric	Life Stage	Variable	2018	2022	2026
Index of relative density	Exploited Phase	Avg $\pm$ SE	7.2 $\pm$ 1.9	8.0 $\pm$ 2.1	8.5 $\pm$ 2.1
		CV (%)	24.2	23.3	22.1
	Unexploited Phase	Avg $\pm$ SE	5.1 $\pm$ 1.2	4.2 $\pm$ 0.9	4.1 $\pm$ 1.1
		CV (%)	26.1	24.3	21.6
	Total Observed Lobsters	Avg $\pm$ SE	12.3 $\pm$ 3.1	12.2 $\pm$ 3.0	12.6 $\pm$ 3.2
		CV (%)	19.5	18.6	18.4
Index of relative frequency of occurrence	Exploited Phase	Avg $\pm$ SE	0.5 $\pm$ 0.2	0.5 $\pm$ 0.2	0.6 $\pm$ 0.2
	Unexploited Phase	Avg $\pm$ SE	0.2 $\pm$ 0.1	0.1 $\pm$ 0.1	0.2 $\pm$ 0.1
	Total Observed Lobsters	Avg $\pm$ SE	0.6 $\pm$ 0.2	0.6 $\pm$ 0.2	0.8 $\pm$ 0.3

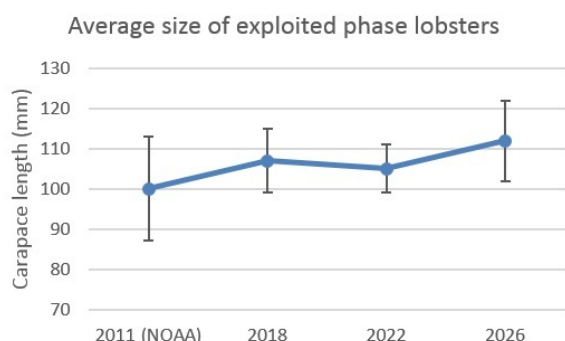
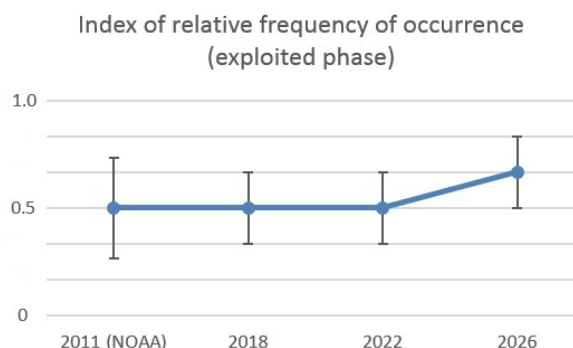
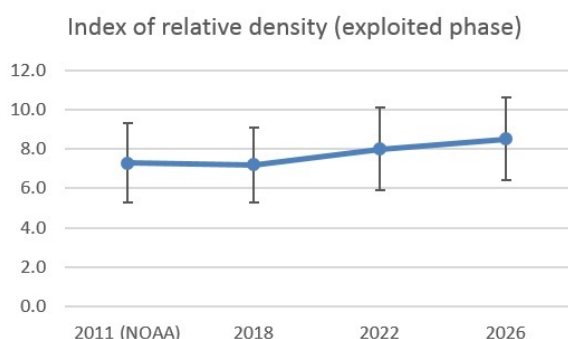
Table D. Size class distribution of all observed lobster (carapace length, mm)

Year	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180+
2018	1	0	2	2	4	1	4	3	1	0	0	1	2	0	1
2022	2	1	2	2	1	3	4	1	1	3	1	0	1	0	0
2026	0	2	2	3	0	2	4	3	4	2	0	2	0	1	1

Figure 1. Microsoft Excel spreadsheet illustrating summary tables of a hypothetical data summary report.

Caribbean spiny lobster (*Panulirus argus*) SAMPLE report

*All data presented here are fictional



Note:

Indices of relative density and relative frequency of occurrence are intentionally presented without units. They should not be interpreted as true density or true frequency of occurrence because of uncertainty in map weights.

Data calculations used to generate this report depend on the map grid product used. Updates to the grid require recalculation of relative density and relative frequency of occurrence for ALL sample years. Thus results presented here may not exactly match data in previously published reports, but being based on a more accurate map grid, should provide the best estimates available.

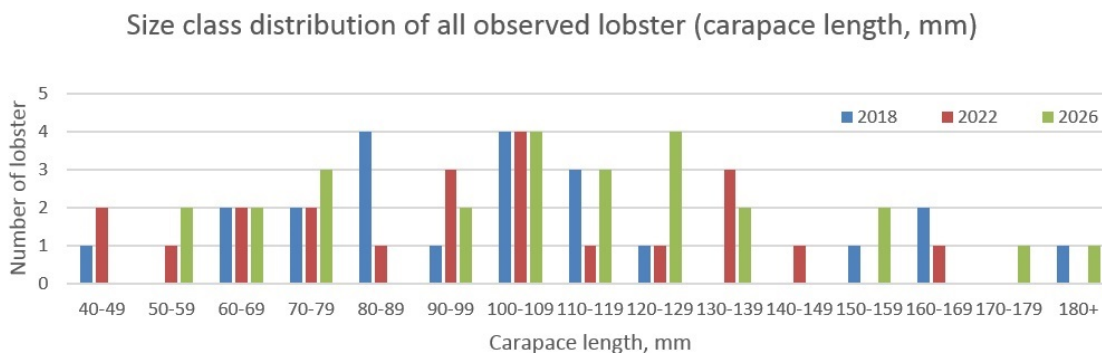


Figure 2. Microsoft Excel spreadsheet illustrating summary figures of a hypothetical data summary report.

Changes to Map Grid and Limitations of Benthic Habitat Maps

At present, the sample frame in Florida uses a grid made of 100×100 -meter (328×328 -ft) cells and the sample frame in the Virgin Islands uses a grid made of 50×50 -meter (164×164 -ft) cells. The cell sizes are due to limitations in map resolution and/or accuracy. Because of the limitations, we do not have the ability to apply a correction for the proportion of hard-bottom habitat within each mapped grid cell during the selection draw, during the field visit, or during the final calculation of strata weights. Using currently available benthic habitat maps to influence selection probabilities of the sample draw or final calculation of strata weights is inadvisable due to the inaccuracies of the maps at this time. This problem will be reduced over time as maps get more accurate, grid cell size gets smaller, and as additional methods are developed (e.g., LiDAR, multi-beam sonar) to better map benthic habitats.

In the coming years, we do expect better mapping technology and coverage to become available. The grid cells have the potential to be reduced in size in order to reflect the more accurate benthic habitat maps. Specifically, we expect the grid cell size in Florida may be reduced to 50×50 meters (164×164 ft) by as soon as 2020 (Steve Smith, pers. comm.). If and when this happens, the stratum designation of each grid cell will be re-classified in order to reflect the more accurate benthic habitat. This will change the strata weights used for calculations in analysis. It is imperative that when these changes occur, the new strata weights are applied to the data in all previous sample years. This avoids the appearance of artificial trends but may change the values of historical relative metrics. The justification of doing this is that the newer map grid is a truer estimate of strata weights during all years, because the geologic structural features that define the habitats change very little through in the biological time frame of monitoring. It is important to remember that the density and frequency of occurrence metrics are *relative* and should not be interpreted as true estimates. These metrics should first be calculated for each individual stratum in a park. For park-wide estimates, indices of relative density and relative frequency of occurrence should be used. The unit-less indices are presented because of the uncertain map weights used to calculate park-wide estimates.

If strata definitions change in the future (e.g., establishment of a management zone within a park unit), the strata weights for the older years will be calculated with the new grid by using the original strata definitions.

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