Glossary A. Statistical Symbols and One-Stage Computational Formulae Used in the Coral Reef Fish Sampling Surveys

Equation numbers are referenced to *Standard Operating Procedure RF01 Statistical Sampling Design—Version 2.0* (2005a) and *Standard Operating Procedure RF05 Data Analyses and Reporting—Version 1.1* (2005b).

Table 1. Relative Mean Density, Variance and Allocation.

Symbol	Definition	Computational Formula	Equation Number
h	Stratum subscript	–	–
j	Sample unit subscript	–	–
D_j	Density in sample unit *j*	–	–
A_h	Stratum area	Total units in stratum *h* * 2500 m^2	–
n_h	Number of units sampled in stratum *h*	–	–
N_h	Total possible number of secondary sample units in stratum *h*	$N_h = \frac{A_h}{177\ \mathrm{m}^2}$	SOP RF 5.22
*n**	Number of primary unit samples required to achieve a specified variance	$n^* = \frac{\left(\sum_h w_h s_h\right)^2}{V\left(\overline{D}_{st}\right) + \frac{1}{N}\sum_h w_h s_h^2}$	SOP RF 1.1
$\overline{D}_h$	Mean density in stratum *h*	$\overline{D}_h = \frac{1}{n_h}\sum_j D_{hj}$	SOP RF 1.2
s_h^2	Sample variance of density in stratum *h*	$s_h^2 = \frac{1}{n_h - 1}\sum_{j=1}^{n_h}\left(D_{hj} - \overline{D_h}\right)^2$	SOP RF 1.3
s_h	Standard deviation in stratum *h*	$s_h = \sqrt{s_h^2}$	SOP RF 1.4
w_h	Stratum *h* weighting factor	$w_h = \frac{N_h}{\sum_h N_h}$	SOP RF 1.5
$\overline{D}_{st}$	Domain-wide mean density for a stratified random survey	$\overline{D}_{st} = \sum_h \left(w_h \overline{D_h}\right)$	SOP RF 1.6
$CV[\overline{\hat{Y}}_{st}]$	Coefficient of variation of abundance	$CV[\overline{\hat{Y}}_{st}] = \frac{SE[\overline{\hat{Y}}_{st}]}{\overline{\hat{Y}}_{st}}$	SOP RF 1.7

Symbol	Definition	Computational Formula	Equation Number
$V\left[\overline{D}_{st}\right]$	Target variance for domain-wide mean density	$V\left[\overline{D}_{st}\right]=\left(CV\left[\overline{D}_{st}\right]\cdot\overline{D}_{st}\right)^2$	SOP RF 1.8

Table 1 (continued). Relative Mean Density, Variance and Allocation.

Symbol	Definition	Computational Formula	Equation Number
n_h	Optimal (Neyman) allocation of primary units among strata	$n_h = n * \bullet \left(\frac{w_h s_h}{\sum_h w_h s_h}\right)$	SOP RF 1.9
n_h	Proportional allocation of primary units among strata	$n_h = n(w_h)$	SOP RF 1.10
$\mathrm{var}\left[\overline{D}_h\right]$	Variance of mean density	$\mathrm{var}\left[\overline{D}_h\right]=\left(1-\frac{n_h}{N_h}\right)\frac{s_h^2}{n_h}$	SOP RF 5.1
$\mathrm{var}\left[\overline{D}_{st}\right]$	Variance of domain- wide mean density	$\mathrm{var}\left[\overline{D}_{st}\right]=\sum_h w_h^2\,\mathrm{var}\left[\overline{D}_h\right]$	SOP RF 5.2
$SE\left[\overline{D}_{st}\right]$	Standard error	$SE\left[\overline{D}_{st}\right]=\sqrt{\mathrm{var}\left[\overline{D}_{st}\right]}$	SOP RF 5.3
$CV\left[\overline{D}_{st}\right]$	Coefficient of variation	$CV\left[\overline{D}_{st}\right]=\frac{SE\left[\overline{D}_{st}\right]}{\overline{D}_{st}}$	SOP RF 5.4

Table 2. Abundance.

Symbol	Definition	Computational Formula	Equation Number
$\hat{Y}_h$	Stratum abundance	$\hat{Y}_{h=(\overline{D}_h)(N_h)}$	SOP RF 5.5
$\hat{Y}_{st}$	Survey wide total abundance	$\hat{Y}_{st}=\sum_h \hat{Y}_h$	SOP RF 5.6
$\mathrm{var}\left[\hat{Y}_h\right]$	Abundance variance in stratum *h*	$\mathrm{var}\left[\hat{Y}_h\right]=\mathrm{var}\left[\overline{D}_h\right](N_h)^2$	SOP RF 5.7
$\mathrm{var}\left[\hat{Y}_{st}\right]$	Sample variance of abundance	$\mathrm{var}\left[\hat{Y}_{st}\right]=\sum_h \mathrm{var}\left[\hat{Y}_h\right]$	SOP RF 5.8
$SE\left[\hat{Y}_{st}\right]$	Standard error of abundance	$SE\left[\hat{Y}_{st}\right]=\sqrt{\mathrm{var}\left[\hat{Y}_{st}\right]}$	SOP RF 5.9
$CV[\overline{\hat{Y}}_{st}]$	Coefficient of variation of abundance	$CV[\overline{\hat{Y}}_{st}]=\frac{SE[\overline{\hat{Y}}_{st}]}{\overline{\hat{Y}}_{st}}$	SOP RF 5.10

Table 3. Average Size in Exploited Phase.

Symbol	Definition	Computational Formula	Equation Number
$\overline{L}$	Average size in the exploited phase	$\overline{L} = \frac{1}{n_{exp}} \sum L$	SOP RF 5.11
$\bar{L}_{st}$	Ratio of means estimator	$\bar{L}_{st} = \frac{\bar{Y}_{st}}{\bar{X}_{st}}$	SOP RF 5.12
$\bar{X}_h$	Stratum estimate of density of exploited phase fish	$\bar{X}_h = \frac{1}{n_h} \sum_j X_{hj}$	SOP RF 5.13
$\bar{Y}_h$	Stratum estimate of sum of the lengths of exploited phase fish	$\bar{Y}_h = \frac{1}{n_h} \sum_j Y_{hj}$	SOP RF 5.14
$\bar{X}_{st}$	Domain estimate of density of exploited phase fish	$\bar{X}_{st} = \sum_h w_h \bar{X}_h$	SOP RF 5.15
$\bar{Y}_{st}$	Domain estimate of sum of the lengths of exploited phase fish	$\bar{Y}_{st} = \sum_h w_h \bar{Y}_h$	SOP RF 5.16
$\bar{L}_{st}$	Domain wide estimate of the average size in the exploited phase	$\bar{L}_{st} = \frac{\bar{Y}_{st}}{\bar{X}_{st}}$	SOP RF 5.17
s_h^2	Sample variance in stratum *h*	$s_h^2 = \frac{\sum_j (Y_{hj} - \bar{L}_{st} X_{hj})^2}{\bar{n}_h - 1}$	SOP RF 5.18
$var[\bar{L}_h]$	Variance of the average size in the exploited phase	$var[\bar{L}_h] = \left(1 - \frac{n_h}{N_h}\right) \frac{s_h^2}{n_h \bar{X}_h}$	SOP RF 5.19
$var[\bar{L}_{st}]$	Variance of the survey domain	$var[\bar{L}_{st}] = \sum_h w_h^2 var[\bar{L}_h]$	SOP RF 5.20
$SE[\bar{L}_{st}]$	Standard error of the survey domain	$SE[\bar{L}_{st}] = \sqrt{var[\bar{L}_{st}]}$	SOP RF 5.21

Table 4. Relative Proportion of Occurrence.

Symbol	Definition	Computational Formula	Equation Number
P_j	Occurrence in sample unit *j*	–	–
$\bar{P}_h$	Proportion occurrence by strata	$\bar{P}_h = \frac{1}{n_h}\sum_j P_{hj}$	SOP RF 5.23
$\bar{P}_{st}$	Domain-wide proportion occurrence	$\bar{P}_{st} = \sum_h w_h \bar{p}_h$	SOP RF 5.24
$\mathrm{var}\left[\overline{P}_h\right]$	Strata variance for proportion occurrence	$var[\bar{P}_h] = \left(1 - \frac{n_h}{N_h}\right) \times \frac{\left(\frac{n_h}{(n_h-1)}\right) \times \bar{p}_h \times (1-\bar{p}_h)}{n_h}$	SOP RF 5.25
$\mathrm{var}\left[\overline{P}_{st}\right]$	Domain-wide proportion occurrence variance	$\mathrm{var}[\bar{P}_{st}] = \sum_h var[\bar{P}_h]\, w_h^2$	SOP RF 5.26
$SE\left[\overline{P}_{st}\right]$	Standard error for domain-wide proportion occurrence	$SE\left[\overline{P}_{st}\right] = \sqrt{var[\bar{P}_{st}]}$	SOP RF 5.27

Table 5. Species Richness.

Symbol	Definition	Computational Formula	Equation Number
Sp_j	Species richness per site *j*	–	–
$\overline{Sp}_h$	Mean strata species richness	$\overline{Sp}_h = \frac{1}{n_h}\sum_h sp_{hj}$	SOP RF 5.28
$\overline{Sp}_{st}$	Mean domain wide species richness	$\overline{Sp}_{st} = \sum_h w_h \overline{Sp}_h$	SOP RF 5.29
$\overline{Sp}_h^2$	Sample variance of species richness in stratum *h*	$\overline{Sp}_h^2 = \frac{1}{n_h - 1}\sum_i \left(\overline{Sp}_{hi} - \overline{Sp}_h\right)^2$	SOP RF 5.30
$\mathrm{var}\left[\overline{Sp}_h\right]$	Variance of mean species richness in stratum *h*	$\mathrm{var}\left[\overline{Sp}_h\right] = \left(1 - \frac{n_h}{N_h}\right)\frac{\overline{Sp}_h^2}{n_h}$	SOP RF 5.31
$\mathrm{var}\left[\overline{Sp}_{st}\right]$	Domain wide variance of species richness	$\mathrm{var}\left[\overline{Sp}_{st}\right] = \sum w_h^2\, \mathrm{var}\left[\overline{Sp}_h\right]$	SOP RF 5.32

Literature Cited

South Florida/Caribbean Network (SFCN). 2025a. Statistical Sampling Design—Version 2.0. South Florida/Caribbean Network Standard Operating Procedure NPS/SFCN/SOP—RF01. South Florida/Caribbean Network, Palmetto Bay, Florida. Available at: https://irma.nps.gov/DataStore/Reference/Profile/2309696 (last accessed March 2025).

South Florida/Caribbean Network. 2025b. Data Analyses and Reporting—Version 1.1. South Florida/Caribbean Network Standard Operating Procedure NPS/SFCN/SOP—RF05. South Florida/Caribbean Network, Palmetto Bay, Florida. Available at: https://irma.nps.gov/DataStore/Reference/Profile/2309701 (last accessed March 2025)