GLOSSARY

This glossary is intended for use with this primer and to help the reader interpret *Otis et al. (1978).*

Accuracy	Freedom from error or defect; correctness, usually referring to numerical computations.
α (alpha)	Probability of a Type I error; that is, of rejecting the null hypothesis (H_0) when it actually is true.
$\bar{y}$ or $\bar{x}$	The average value of the variable y or x taken over the sample. The bar indicates an average.
Behavioral response	Change in subsequent capture probability as a result of the first capture.
Bias (of an estimator)	The difference between the "expected" value of an estimator and the true value of the parameter being estimated. Bias is a measure of how much the average estimate and the true parameter value differ. Bias = $E(\hat{N}) - N$, where N is the parameter.
β (beta)	Probability of a Type II error; that is, of not rejecting the null hypothesis (H_0) when the alternative hypothesis (H_A) is true.
Census	An exact count or total enumeration of the population. A true census of an animal population would require counting each member.
Confidence coefficient	The percentage of cases in repeated sampling in which the confidence interval covers the parameter of interest. For example, a 95% confidence coefficient means that for 100 experiments the 95% confidence interval would be expected to include the true value of the parameter 95 times.
CPUE	Catch per unit effort.
c	Recapture probability (a parameter to be estimated).
$\hat{c}$	Estimator of recapture probability.
cv	Coefficient of variation, usually seen as $cv(\hat{\theta})$, or the coefficient of variation of the estimator θ. Defined as $se(\hat{\theta})/E(\hat{\theta})$.
χ^2	Chi-square, a commonly used test statistic.
Closure	The assumption that a population at risk of capture remains constant in size and composition over the period of investigation.
demographic	No changes due to population dynamics; that is, no births, deaths, emigration, or immigration during the investigation.
geographic	The assumption that the population at risk of capture occupies a distinct (but unknown) area on and around the trapping grid; that is, the assumption of something synonymous to the sides of an urn (or the assumption of boundary strip width W not large relative to the space between traps).

CAPTURE	A FORTRAN computer program for selecting a model for the data and calculating population and density estimates *(White et al. 1978).*
Darroch estimator	The estimator of population size under Model M_t.
$\frac{\partial}{\partial\theta}(\cdot)$	The partial derivative of some function $(\cdot)$ with respect to the parameter θ. This concept, taken from calculus, is useful in finding ML estimators.
D	Number of animals per area; that is, animal density (a parameter to be estimated).
df	Degrees of freedom, usually a function of the amount of data being used to test a hypothesis.
ε	Denotes stochastic, or sampling, error in a statistical model.
Errors	
Type I	Rejection of a null hypothesis that is true.
Type II	Acceptance of a null hypothesis that is not true.
Estimate	The calculated value of an estimator, given a particular sample, designated by a caret or hat ($\hat{}$) over the symbol for the parameter being estimated.
Estimator	A function of sample data that is used to estimate some parameter. An estimator is a random variable and is designated by a caret or hat ($\hat{}$) over the symbol for the parameter.
$E(\hat{N})$	The expected value of the estimator of N. If the experiment was repeated a very large number of times, the mean of all the $\hat{N}$'s would be $E(\hat{N})$. The symbol $E(\cdot)$ also can be used to express the expected value of a statistic, for example, $E(n_i)$.
Eq.	Equation, for example, Eq. (5).
!	Factorial operator. For example, $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$. In general $N! = N \times (N-1) \times (N-2) \times \ldots \times 3 \times 2 \times 1$. This odd-looking expression is frequently used as a "counting term" in probability models.
f_i	A capture frequency statistic; the number of individuals captured exactly i times in t days of trapping, $i = 1, 2, \ldots, t$. The symbol f_0 is used for the number of individuals never captured.
Generalized removal estimator	The estimator of population size under Model M_{bh}.
Histogram	A graph that presents the frequencies with which the values of a variable fall into specified numerical categories.
H_O	The null hypothesis.
H_A	The alternative hypothesis.
Inductive inference	Generalization from a single experiment to the class of all similar experiments. Reasoning from the particular to the general.

j	Sampling occasion; $j = 1, 2, \ldots, t$.
Jackknife estimator	The estimator of population size under Model M_h.
L_r	Length of a row in a grid of traps.
L_c	Length of a column in a grid of traps.
$\mathcal{L}(N,p \mid \underline{X})$	Read as "the likelihood function of the parameters N and p, given the data matrix $\underline{X}$." This particular example is for Model M_o. The likelihood function is essential to the technique of deriving ML estimators.
$\ell n(\cdot)$	The natural logarithm of a number or expression.
$\ell n(\mathcal{L}(N,\underline{p} \mid \underline{X}))$	Read as "the logarithm of the likelihood function of the parameter N and the vector of parameters $\underline{p}$, given the data matrix $\underline{X}$." This is for Model M_t because of the vector of capture probabilities, $\underline{p}$.
ML	Maximum likelihood.
MLE	Maximum likelihood estimator.
Model M_o	Model in which capture probabilities are constant.
Model M_t	Model in which capture probabilities vary by time.
Model M_b	Model in which capture probabilities vary due to behavioral response.
Model M_h	Model in which capture probabilities vary by individual animal.
Model M_{tb}	Model in which capture probabilities vary due to time and behavioral response.
Model M_{th}	Model in which capture probabilities vary by time and individual animal.
Model M_{bh}	Model in which capture probabilities vary due to behavioral response and differences between individual animals.
Model M_{tbh}	Model in which capture probabilities vary due to time, behavioral response, and differences between individual animals.
Model M_{Rj}	A particular generalized removal model in which j ($j = 1, \ldots, t-2$) different average capture probabilities are used.
M_{t+1}	The number of different individuals caught during the trapping experiment (a statistic).
M_j	The number of marked animals in a population at the time of j^{th} sample (a statistic).
M.	The sum of the M_j, $j = 1, \ldots, t$ (a statistic).
m_j	The number of marked animals captured in the j^{th} sample (a statistic).
m.	The sum of the m_j, $j = 1, \ldots, t$ (a statistic).
μ	Population mean.
N(0,1)	Shorthand for a normal distribution having a mean of 0 and variance of 1; called a "standard normal."
N	True population size; the number of animals (parameter to be estimated).

$\hat{N}$	Estimator of population size; estimator of the number of animals in the population. A particular value of the estimator (the estimate) is also designated as $\hat{N}$ = value.
n_j	The number of animals captured in the jth sample, j = 1, . . ., t (a statistic).
n.	The total number of captures and recaptures during the study (a statistic).
Nonparametric	Refers to a statistical technique that does not depend on any distributional assumptions concerning the variables involved in the technique.
Null estimator	The estimator of population size under Model M_o.
p	Capture probability (a parameter that we estimate to obtain an estimate of N).
$\hat{p}$	Estimator of capture probability.
$P(\cdot)$ or $Pr(\cdot)$	Probability of $(\cdot)$.
$\bar{p}$	Average capture probability of animals in the population on a given occasion (parameter). The bar denotes an average or mean.
$\underline{p}$	An array or "vector" of several capture probabilities. For example, the row vector $(p_1, p_2, p_3, \ldots, p_t)$ is often written $\underline{p}$.
Parameter	A fixed quantity in a given population.
Parametric	Refers to a statistical technique that depends on at least one assumption that the variables involved in the technique have a specified distribution, such as chi-square or normal.
PRB	Percent relative bias, for example $100(E(\hat{N}) - N)/N$ is the PRB of $\hat{N}$.
Precision	A property of an estimator related to the amount of variation among estimates from repeated samples.
$\pi(\cdot)$	Used as a short notation for a complicated probability expression; π alone stands for 3.14159+ .
$\prod_{i=1}^{n}(\cdot)$	Product operator for multiplication. Same idea as using $\sum_{i=1}^{n}$ for summation. For example, 10! can be written $\prod_{i=1}^{10} i$.
POPAN-2	A FORTRAN computer program for the maintenance and analysis of open-population capture-recapture data. *(Arnason and Baniuk 1978).*
ρ	Rho, the correlation coefficient. This parameter has values between -1 and 1; it measures the strength of the linear relationship between two variables.
Robustness (of an estimator to an assumption)	A robust estimator is one that is not sensitive to the breakdown of a particular assumption on which it is based. An estimator is more or less robust depending on the extent to which the validity of the assumption affects its performance.

$se(\hat{N})$	The standard error of the estimator of N; $se(\hat{N}) = \sqrt{var(\hat{N})}$.
σ^2	Population variance.
Statistic	A function of the sample data.
$\sum_{i=1}^{n}(\cdot)$	Summation operator; a shorthand notation to indicate the addition of a number of terms. For example, $\sum_{j=1}^{t} n_j = n_\cdot = n_1 + n_2 + n_3 + \ldots + n_t$.
Survey	A study of a portion of a population. In the context here, the portion is selected or "sampled" from the total population.
t	Number of capture occasions; also a common test statistic that has a Student's t distribution.
Test statistic	A value, to be computed from the experimental data, that will determine the decision concerning a null hypothesis.
Type I and Type II errors	See error.
u_j	The number of new (unmarked) animals captured on the jth sample (a statistic).
UMVUE	Uniform minimum variance unbiased estimator.
$Var(\cdot)$	Variance of the quantity in the parenthesis.
$\mathbf{\Sigma}$	A matrix called the variance-covariance matrix of a vector of estimators. The variances are on the main diagonal and the covariances appear symmetrically throughout the rest of the matrix.
$var(\hat{N})$	The sampling variance of the estimator of N; $var(\hat{N}) = (se(\hat{N}))^2$.
$\underline{X}$ or $[X_{ij}]$	The matrix of data composed of zeros (not captured) and ones (captured). All statistics used to calculate parameter estimates are obtained from the X_{ij} matrix.
W	Strip width for nested grids in density estimation procedure.
z	A test statistic that is distributed N(0,1).
Zippin estimator	The estimator of population size under Model M_b.