References: Estimating Population Parameters

Population Biology:

Begon, Michael, Martin Mortimer, David J. Thompson, 1996. Population ecology : a unified study of animals and plants. 3rd ed. Blackwell Science, Cambridge, Mass.

Silvertown, Jonathan W. and Jonathan Lovett Doust. 1993. Introduction to plant population biology, 3rd ed. Blackwell Scientific Publications, Cambridge, Mass.

two introductory texts, cover much more biology than what we look at.

Thompson, W. L., White, G. C. and Gowan, C. 1998. Monitoring vertebrate populations. Academic Press, San Diego.

General introduction to the biology and statistics of monitoring.

Statistical Theory (introductions for biologists):

Hilborn, R. and Mangel, M. 1997. The ecological detective: confronting models with data. Princeton Univ. Press, Princeton NJ.

Chapter 7 is a simple? introduction to maximum likelihood

White, G. C., D. R. Anderson, K. P. Burnham, D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Lab, LA-8787-NERP.

Chapter 2 is an introductory discussion of statistical concepts, including ml estimation.

Borchers, D.L., Buckland, S.T. and Zucchini, W. 2002. Estimating Animal Abundance: Closed Populations. Springer, New York.

Chapter 2 is a review of ml estimation (one of the assigned readings). Chapter 6 is an introduction to mark-recapture.

Texts / Monographs:

Amstrup, S.C., McDonald, T.L, and Manly, B.F.J. 2005. Handbook of Capture-Recapture Analysis. Princeton Univ. Press, Princeton NJ

Edited volume. source of many of this year's readings. Includes detailed presentation of using program MARK to fit models.

Otis, David, K. Burnham, G. White, and D. Anderson, 1978. Statistical inference from capture data on closed animal populations. Wildlife Monographs # 62.

Classic reference on estimation for Mt, Mh, Mb models and their generalizations. Includes complete examples; mathematical details are in the appendices.

Pollock, K. H., Nichols, J. D., Brownie, C. and Hines, J. E. 1990. Statistical inference for capture-recapture experiments. Wildlife Monographs # 107.

Comprehensive overview of Jolly-Seber and related techniques for open populations, including robust design. Includes short summary of methods for closed populations.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters, 2nd ed. Oxford Univ. Press.

Pulls together the early literature for both closed and open populations.

Thompson, D.L., Cooch, E.G., and Conroy, M.J. 2009 Modeling Demopgraphic Processes in Marked Populations. Springer.

Combining population models with mark-recapture (etc.) data.

Williams, B.K., Nichols, J.D., Conroy, M.J. 2002. Analysis and Management of Animal Populations: Modeling, Estimating, and Decision Making. Academic Press

Compendium of lots of different approaches for "quantitative wildlife management", ranging from mark-recapture to linear programming and decision making. Huge book, but treatment of individual topics is very lean "just-the-facts" style.

Closed population models:

Bailey, N.T.J. 1951. On estimating the size of mobile populations from capture-recapture data. Biometrika 38:293-306.

Properties, especially the bias, of the binomial model.

Borchers, D.L. and Efford, M.G. 2008. Spatially explicit maximum likelihood methods for capture-recapture studies. Biometrics 64:377-385.

If traps are in known locations, you can estimate density (#/area), not just population size.

Chapman, D. G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. Univ. California Publications in Statistics 1:131-160.

Derives the approximately unbiased version of the hypergeometric model estimator and its variance.

Hammond, E.L. and Anthony, R.G. 2006. Mark-recapture estiamtes of population parameters for selected species of small mammals. Journal of Mammology 87:618-627

Analyzes 1535 data sets from 33 spp of mammals using the standard models to look for general patterns across species (e.g. find heterogeneity in capture probabilities in larger data sets for any species).

Huggins, R. M. 1991. Some practical aspects of a conditional likelihood approach to capture experiments. Biometrics 47:725-732.

The second, more accessible, of two papers on how to use individual covariates to model heterogeneity. Probably the best solution to heterogeneity if you can choose the right covariates.

Jensen, A. L. 1989. Confidence intervals for nearly unbiased estimators in single-mark and single-recapture experiments. Biometrics 45:1233-1237.

ci's based on distribution of $1/\hat{N}$ under binomial and hypergeometric models. Easy to compute.

Pledger, S. 2000. Unified maximum likelihood estimates for closed captuer-recapture models for mixtures. Biometrics 56:434-442.

Central paper in a sequence by Pledger on mixtures to model between individual heterogeneity in capture probability

Open population models:

Brooks, S.P., Catchpole, E. A. and Morgan, B. J. T. 2000. Bayesian animal survival estimation. Statistical Science. 15:357-376.

Review and summary of Bayesian approaches to estimation for open populations.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration stochastic model. Biometrika 52:225-247.

Seber, G. A. F. 1965. A note on the multiple recapture census. Biometrika 52:249-259.

The two original papers on the Jolly-Seber model

Kendall, W. L., K. H. Pollock, and C. Brownie. 1995. A likelihood-based approach to capture-recapture estimation of demographic parameters under the robust design. Biometrics 51:293-308.

A full likelihood analysis of data from a robust design

Pollock, K.H. 1982. A capture-recapture design robust to unequal probability of capture. J. Wildlife Management 46:757-760.

The robust design is a way of combining open and closed population models to get the best of both. This is the most accessible early paper. Estimation is a combination of ml and ad-hoc.

White, G.C., Kendall, W.L., and Barker, R.J. 2006. Multistate survival models and the extensions in program MARK. J. Wildlife Management 70:1521-1529

Multistate models add another dimension to an individual. The state could be breeder/nonbreeder, or spatial area, or something else. This is a nice review of multistate models.

Model Averaging:

Burnham, K. P. and D. R. Anderson, 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York.

Section 4.2.6 presents the AIC approach to model averaging. Section 2.2 and 2.4 discuss AIC and refinements.

Specialized Computer Programs:

Program Mark: see its web page: http://www.cnr.colostate.edu/∼gwhite/mark/mark.htm

Appendix G in Williams et al. is a tabulation of software and download sites.

Other approaches:

Burnham, K. P. and Overton, W. S. 1978. Estimation of the size of a closed population when capture probabilities vary among animals. Biometrika 65:625-633.

Burnham, K. P. and Overton, W. S. 1979. Robust estimation of population size when capture probabilities vary among animals. Ecology 60:927-936.

Two papers describing the jacknife estimator for Mh model.

Conn, P.B., Kendall, W.L. and Samuel, M.D. 2004. A General Model for the Analysis of Mark-Resight, Mark-Recapture, and Band-Recovery Data under Tag Loss Biometrics 60:900-909.

One entry into a current research topic: how to account for tag loss.

Gazey, W. J. and Staley, M. J. 1986. Population estimation from mark-recapture experiments using a sequential Bayes algorithm. Ecology 67:941-951.

Develops a Bayesian approach to combine information from many sampling periods, each with a small number of recaptures. Haven't checked all the details, but I believe the 'sequential Bayes algorithm' is similar to what is now known as the Gibbs sampler.

Lebreton, J.-D., K. P. Burnham, J. Clobert, and D. R. Anderson. 1992. Modeling survival and testing biological hypotheses using marked animals: case studies and recent advances. Ecological Monographs 62:67-118.

Uses linear models to relate covariates (e.g. time or experimental treatments) to model parameters (e.g. survival probability or capture probability).

Lee, S. and Chao, A. 1994. Estimating population size via sample coverage for closed capture-recapture models. Biometrics 50:88-97.

Various papers by Chao describe the coverage approach. This one is a relatively accessible treatment of all closed models; a 1992 paper by Chao gives more details on a subset of models.

Lukacs, P. and Burnham, K.P. 2005. Review of capture-recapture methods applicable to noninvasive genetic sampling. Molecular Ecology 14:3909-3919

Introduction to another current research area - use of genetic markers (e.g. RFLP's from dung) to identify individuals.

McClintock, B.T., White, G.C., Antolin, M.F, and Tripp, D.W. 2008. Estimating abundance using mark-resight when sampling is with replacement or the number of marked individuals is unknown. Biometrics 65:237-246.

Mark-resight data are where individuals are captured to be marked, but the marks are sufficiently visible that individuals just need to be resighted to be identified. This sort of data requires more complicated models.

Petit, E. and Valiere, N. 2006. Estimating Population Size with Noninvasive Capture-Mark-Recapture Data. Conservation Biology 20:1062-1073.

Evaluation of non-invasive methods.

Pradel, R. 1996. Utilization of capture-mark-recapture for the study of recruitment and population growth rate. Biometrics 52:703-709.

Pradel, R., Johnson, A.R., Viallefont, A., Hager, R.G., and Cezilly, F. 1997. Local recruitment in the Greater Flamingo: a new approach using capture-recapture data. Ecology 78:1431-1445.

Theory and an example of Pradel's temporal symmetry model to estimate recruitment and population growth rate directly from capture-recapture data.