Advanced Topics Population Dynamics and Estimation – FiW 6004

T 8:00 – 10:00 am 132 Cheatham
W 2:00 - 4:00 pm 213 Cheatham

Spring 2008

Instructor(s):

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Office Hours: By appt.

Dean Stauffer (Instructor for first part of class)

There are no required textbook for this course. However some good background readings that are used in my undergraduate course are:

Mills, L. S. 2007 Conservation of wildlife populations: Demography, genetics, and management. Blackwell Publishing, Massachusetts.

Gotelli, N.J. 2001. A primer of ecology. Third Edition. Sinauer Associates, Inc. Sunderland, Massachusetts

Additionally, I post numerous other background readings on Blackboard including chapters of: Akçakaya, H.R.; Burgman, M.A.; and L.R. Ginzburg. 1999. Applied population ecology: principles and computer exercises using RAMAS EcoLab. Second edition. Sinauer Associates, Inc.; Sunderland Massachusetts. Finally – I have also posted a review of calculus from my *Idiots Guide to Calculus*. This will serve as a reminder of how to do things – like take a derivative.

Topics:

This class covers two main topic areas. These areas are 1) Parameter Estimation and 2) Population Projection or Population Viability. Parameter estimation includes: estimating abundance and density of wildlife species through techniques such as distance estimation and capture- mark-recapture; methods of determining area surveyed. It also covers survival analysis and occupancy estimation techniques. After Spring break the course transitions from parameter estimation to population projection focusing on matrix modeling, sensitivity/elasticity analyses, and determining rates of increase and extinctions risks faced by species. The course follows my undergraduate course (FiW 4414) closely, but goes into much more depth. For those who have never had a population dynamics course before, please consider taking the undergraduate course before, or con-currently, with this course.

This course uses problem based learning. All homework assignments given are real data sets that student must analyze and interpret. A computer is a must and laptop computers with wireless capability, are required for the course.

Final projects will be described in more detail later, but final projects should apply at least one of the concepts and techniques to a real world data set, preferably the student's own data, or data related to the student's graduate project.

DISABILITY STATEMENT: Any student who feels that s/he may need an accommodation because of a disability (learning disability, attention deficit disorder, psychological, physical, etc.), please see the instructor.

Method of Evaluation:

Assignment	pts
Analysis of Point count data and impact of detectability on Density estimates	50
Analysis of mark-recapture data using program CAPTURE and determination of animal density and use of correlates of home range	50
Survival analysis in Program Mark. Sage Grouse or American Dipper data set.	50
Analysis of presence/non-detection data for estimating proportion of area occupied	50
Analysis of Grizzly Bear and Checkerspot Butterfly to determine growth rates and influence of density dependence	50
Extinction risk write up from VORTEX/RAMAS on Grizzly Bear data set	50
Final Presentation	50
Final Paper	100
Total Points	**450**

Course Schedule - FiW 5984 Advanced Topics in Applied Population Dynamics - Spring 2008

Date	Lecture(s)	Lab	Assignment due	Readings
Jan 14-18	Introduction: Course Overview, term project, etc.; Distance Estimation	Program DISTANCE		Selected Readings from Buckland et al. 2001
Jan 21-25	More on Distance Estimation and Review Mark-recpature: Cormack-Jolly-Seber (CJS) - back to basics	More work with DISTANCE	Program DISTANCE Assignment	
Jan 28- Feb 1	Mark-recapture. Probability of capture. Models in CAPTURE: variation in time, behavior, individual heterogeneity, etc.	Program CAPTURE. Puma/jaguar data set: estimate pop. size (and density) and choose most appropriate model.		Karanth and Nichols 1998; Wilson and Anderson 1985; DICE 1934; Rexstad and Burnham 1991; Braun 2005
Feb 4-8	More on CAPTURE; Begin Program MARK. Linear models in MARK. Survival Estimation. Logit function etc.	European Dipper Data Set - Live Recaptures (Cormack Jolly Seber - CJS)	CAPTURE write-up: jaguar/puma pop size and density	Cooch, E. 2000; White and Burnham 1999; Cooch and White 2001: Chapter 7
Feb 11-15	Program MARK. Akaike's Information Criterion (AIC) and Goodness of Fit (GOF)	Continue European Dipper: Use AIC to choose from *apriori* models including: sex, age, time, Flood conditions, linear trends, and potential interactions between these variables		Handouts provided from MARK workshop 2002; Williams et al. 2002; Cooch and White 2001.
Feb18-22	Patch occupancy models and proportion of area occupied	Work with program PRESENCE	MARK write-up: Mus musculus survival and capture probability	McKenzie et al. 2002, 2003, 2004
Feb 25-29	Adding co-variates to p and psi	More work with PRESENCE; Use AIC to choose best model for 4 bat species		
March 3-7	Spring Break = No Class			
March 10-14	Exponential Growth Expanded: arithmetic mean versus geometric mean; Extinction risk from time searies data: cummulative distribution function and population projections; Density dependent growth: Theta logistic model	Grizzly bear and butterfly data sets provided. Use linear regression to determine growth rate and confidence intervals. Use regression on grizzly bear and butterfly data to examine for presence of density dependent regulation		Morris and Doak 2002: chapter 3; Morris and Doak 2002: Chapter 4: pages 99-118
March 17-21	Properties of the Leslie Matrix and stable age distribution; dominant eigenvalue; right and left eigenvectors; components of fecundity; intro to sensitivity analysis. Weighted averages for Leslie Matrix		Program Presence 4 bats on ot Picket assignment due	Readings complied from various sources: Akcakaya et al. 1999; Caswell 2001; Case 2000; Gotelli 2001
March 24-28	Sensitivity/elasticity analysis: manual perturbation; analytical solutions; Life Table Response Experiments; LTRE; Life stage simulation analysis (LSA);	Formulas for calculating sensitivities and elasticities		Beissinger and McCullough 2002 Chapter 16; Hoekman et al. 2002.
March 31- April 4	Marcella gone - no class - but assignment due		Regression write up: Grizzly Bear/ butterfly growth rates and density dependence	

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April 7-11	Incorporating demographic, environmental, and genetic stochasticity into population models; Incorporating density dependence. Stochastic vs. chaotic models; Population	Programs VORTEX and RAMAS simulation models. Calculate extinction risks etc.		Akcakaya et al. 1999; Lacy 1993; Mills et. al. 1996; Ralls et al. 1988; Miller and Lacy 1993: Chapter 3
April 14-18	More VORTEX and RAMAS - sensitivity, elasticity, RV, EXT risk, etc	Programs VORTEX and RAMAS simulation models. Calculate extinction risks etc.		
April 21-25	Review effective population size. Review Mills genetic chapter	Calculate Ne various ways	Extinction risk write up from VORTEX/RAMAS	Provided
April 28 - April 30	Project presentations	Presentations of individual projects/models/simulations of research using any of the above techniques	Submit Final paper of project by May 5	

Readings (partial list)

Cooch, E. 2000. First steps with program MARK: linear models. Dept. of Natural Resources; Cornell University.

Hoekman, S. T., L. S. Mills, D. W. Howerter, J. H. Devries, and I. J. Ball. 2002. Sensitivity analysis of the life cycle of mid-continent mallards. *Journal of Wildlife Management*. 66: 883-900.

Karanth, K.U. and J.D. Nichols. 1998 Estimation of tiger densities in India using photographic captures and recaptures. *Ecology* 79: 2852–2862.

Lacy, R.C. 1993. VORTEX: a computer simulation model for population viability analysis. *Wildlife Research* 20: 45-65.

MacKenzie D.I., Bailey L.L. & Nichols J.D. (2004) Investigating species co-occurrence patterns when species are detected imperfectly. J Anim Ecology, 73, 546-555

MacKenzie D.I., Nichols J.D., Hines J.E., Knutson M.G. & Franklin A.B. (2003). Estimating site occupancy, colonization and local extinction when a species is detected imperfectly. Ecology, 84, 2200-2207

MacKenzie D.I., Nichols J.D., Lachman G.B., Droege S., Royle J.A. & Langtimm C.A. (2002) Estimating site occupancy rates when detection probabilities are less than one. Ecology, 83, 2248-2255

Miller, P.S. and R.C. Lacy. 1993. VORTEX: a stochastic simulation of the extinction process. Version 8 User's Manual. Apple Valley MN.

Mills, L.S.; Hayes, S.G.; Baldwin, C.; Wisdom,M.J.; Citta, J.; Mattson, D.J. and K. Murphy. 1996. Factors leading to different viability prediations for a grizzly bear data set. *Conservation Biology* 10: 863-873.

Ralls, K.; Ballou, J.D. and A. Templeton. 1988. Estimate of lethal equivalents and cost of inbreeding in mammals. *Conservation Biology* 2: 185-193.

Rexstad, E. and K.P. Burnham. 1991. *User's guide for interactive program CAPTURE. Abundance estimation of closed populations*. Colorado State University, Fort Collins, Colorado, USA.

White, G.C. and K.P. Burnham. 1999. Program MARK: survival estimation from populations of Marked animals. Bird Study: 46 (suppl.), S120-139

Wilson, K.R. and D.R. Anderson. 1985. Evaluation of two density estimators of small mammal population size. *Journal of Mammalogy* **66,** 13–21.