# GEORGE MASON UNIVERSITY

# Course Approval Form

For approval of new courses and deletions or modifications to an existing course.

*registrar.gmu.edu/facultystaff/curriculum*

**Action Requested:**

[x] Create new course   [ ] Inactivate existing course

[ ] Modify existing course (check all that apply)

- [ ] Title   [ ] Credits   [ ] Repeat Status   [ ] Grade Type
- [ ] Prereq/coreq   [ ] Schedule Type   [ ] Restrictions
- [ ] Other:

**Course Level:**

[ ] Undergraduate
[x] Graduate

**College/School:** COS-CHSS   **Department:** Mason Center for Conservation Studies

**Submitted by:** Joseph Kolowski   **Ext:** 540-635-0205   **Email:** kolowskij@si.edu

**Subject Code:** CONS   **Number:** 645   **Effective Term:**
[ ] Fall
[x] Spring   *Year* 2015
[ ] Summer

(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

**Title:**
Current: Estimating Animal Abundance and Occupancy
Banner (30 characters max including spaces): Animal Abundance and Occupancy
New:

**Credits:** (check one)   [x] Fixed   3   or   [ ] Variable ___ to ___

**Repeat Status:** (check one)
[x] Not Repeatable (NR)
[ ] Repeatable within degree (RD)
[ ] Repeatable within term (RT)

Maximum credits allowed: ___

**Grade Mode:** (check one)
[x] Regular (A, B, C, etc.)
[ ] Satisfactory/No Credit
[ ] Special (A, B C, etc. +IP)

**Schedule Type:** (check one)
LEC can include LAB or RCT
[x] Lecture (LEC)
[x] Lab (LAB)
[ ] Recitation (RCT)
[ ] Internship (INT)

[ ] Independent Study (IND)
[ ] Seminar (SEM)
[ ] Studio (STU)

**Prerequisite(s):**
College-level Introductory Statistics Course

**Corequisite(s):**

**Instructional Mode:**
[x] 100% face-to-face
[ ] Hybrid: ≤ 50% electronically delivered
[ ] 100% electronically delivered

**Restrictions Enforced by System:** Major, College, Degree, Program, etc. Include Code.

**Are there equivalent course(s)?**
[ ] Yes   [x] No
If yes, please list

## Catalog Copy for NEW Courses Only (Consult University Catalog for models)

| Description (No more than 60 words, use verb phrases and present tense) | Notes (List additional information for the course) |
|---|---|
| Provides a strong theoretical and analytical background to the current and accepted methods of estimating population parameters including abundance, survival, and population change. The course teaches study design, implementation and analysis of data from distance sampling, mark-recapture, and occupancy modeling techniques, with a strong focus on the practical use of field data in the programs DISTANCE, MARK and PRESENCE. | Course Format: This course is taught as an intensive, mixed-format (lectures and computer work) offering, in a residential, full-day (8:30am-6pm), **2-week** session held at the Smithsonian Conservation Biology Institute in Front Royal, VA. Students complete pre-course reading assignments, and are graded in participation, computer exercises and a final exam. Some night sessions occur throughout the two weeks as well. |

Indicate number of contact hours:   Hours of Lecture or Seminar per week: ___   Hours of Lab or Studio: ___

When Offered: (check all that apply)   [x] Fall   [x] Summer   [x] Spring

## Approval Signatures

_____   _____   _____   _____
Department Approval   Date   College/School Approval   Date

**If this course includes subject matter currently dealt with by any other units**, the originating department must circulate this proposal for review by those units and obtain the necessary signatures prior to submission. Failure to do so will delay action on this proposal.

| Unit Name | Unit Approval Name | Unit Approver's Signature | Date |
|---|---|---|---|
| | | | |
| | | | |

## For Graduate Courses Only

_____   _____   _____
Graduate Council Member   Provost Office   Graduate Council Approval Date

*For Registrar Office's Use Only:* Banner_____Catalog_____   *revised 11/8/11*

Smithsonian-Mason School for Conservation
Smithsonian Conservation Biology Institute, Front Royal, VA, USA

# *Estimating Animal Abundance and Occupancy*
## *CONS 697, Section 605*
**May 19-30, 2014**

## SYLLABUS

**Course Format:**
This Smithsonian-Mason School of Conservation course is taught as an intensive 2-week fulltime residential session, incorporating lectures, discussions and computer exercises. It is held at the new Smithsonian-Mason School of Conservation site at the Smithsonian Conservation Biology Institute's 3,200 acre facility in Front Royal, VA, USA.

**Instructor of Record:**
*Joe Kolowski*, PhD, Research Scientist, Smithsonian Conservation Biology Institute.  Email: kolowskij@si.edu; phone: 540-635-0205. Office hours, Room 203, Academic Center: by appointment.

**Additional Instructors**:
*Sarah Converse,* PhD, Research Ecologist, USGS Patuxent Wildlife Research Center
*Evan Grant*, PhD, Wildlife Biologist USGS Patuxent Wildlife Research Center
*Jim Hines*, Computer Specialist, USGS Patuxent Wildlife Research Center
*Jim Nichols, PhD,* Wildlife Biologist / Senior Scientist, USGS Patuxent Wildlife Research Center
*Gary C. White,* PhD, Professor Emeritus Department of Fish, Wildlife and Conservation Biology Colorado State University

**Brief Course Description:**
Currently in the field of wildlife ecology and conservation, the estimation of animal densities based on field data is most commonly conducted using either the program DISTANCE using line-transect data, or the program MARK using mark-encounter data. When animal densities are too low to be estimated explicitly, occupancy modeling is commonly used to associate ecological, anthropogenic, or biotic variables to the probability of presence of a species. This technique has become increasingly common in ecological studies over the last 5-7 years and uses a program called PRESENCE (and also MARK).  Significant interest exists for intensive training in these programs among wildlife ecologists. Although individual courses are available that focus on each of these programs separately, very few teach all three jointly, despite the fact that similar statistical concepts underlie all three types of analysis and many conservation biologists and managers rely on all three methods. All three programs are freely available for download online, and are therefore used widely on an international scale.

The course is designed to provide a strong theoretical and analytical background to graduate students in distance sampling, mark-encounter, and occupancy modeling techniques, with a strong focus on the practical use of field data in the programs DISTANCE, MARK and PRESENCE. In the intensive 2-week program, a day of broad introduction to the course and the statistical concepts that underlie all three analytical techniques will be followed by approximately 3 days

of focus on each type of analysis. Each 3-day module will begin with a detailed treatment of theoretical concepts and case studies, followed by computer work with each respective program. Computer work will include work with real field data, and focus on identifying problems with one's dataset, selecting appropriate models, and interpreting analysis results. Case studies will focus on vertebrate studies, primarily involving birds and terrestrial mammals. After each module, students will be allowed time to work on their own data in consultation with the instructors, or identify advanced topics of interest for additional lectures.

## Course Goals:

This course aims to provide a solid grounding to students in all phases of research focused on estimating animal abundance and occupancy, starting with the framing of objectives and study design, moving into basic model types, and reviewing program design and structure. The focused use of relevant real-world case studies, and extensive time for one-on-one work with instructors will demonstrate clearly how these techniques are applied to field studies, and how flaws and challenges in data analysis can be identified and remedied. By the end of the course, students will be comfortable identifying the scientific questions that can be addressed with each technique and implementing basic analyses in all 3 programs. More advanced techniques in each program will be demonstrated, indicating when they are appropriate and how results can be interpreted. Finally, students will leave the course with a detailed list of available resources, in both print and online, to assist in the use of more advanced techniques.

## Learning Outcomes:

By the end of this course, students will be able to:
- Associate a given scientific question or objective related to estimation of a population dynamics parameter or abundance or occupancy with the appropriate field method and analytical technique
- Import raw data into each of the course's computer programs
- Perform basic analyses in all three programs without supervision including the use of covariates, model selection and testing of model fit
- Identify digital and printed resources to assist in study design, field implementation and data analysis and interpretation for all three analytical frameworks
- Identify circumstances under which advanced techniques are necessary and properly identify those techniques
- Accurately troubleshoot field studies during stages of design, data collection, data import and analysis in all 3 programs
- Properly identify all components of analysis outputs from each of the three programs and interpret their relevance to the scientific question at hand

## Readings and Course Structure:

Assigned readings are integral to the course learning experience. A required reading list is provided below. Registered students will have access to these readings through the E-reserve system at George Mason University. Additional readings may be added throughout the course. The timing of the various course modules are indicated below in the course schedule. With the exception of a few readings below noted as optional, students are expected to complete these readings before the material is covered in the course.

*Textbook*

No textbook is required for this course and participants will receive the two texts below as part of their course material free of charge. A manual of assignments and other materials will be distributed either in hard copy or digital format.

Buckland, S. T. 2001. *Introduction to distance sampling: estimating abundance of biological populations,* Oxford University Press, Oxford ; New York.

MacKenzie, D. I., J. A. Royle, J. D. Nichols, K. H. Pollock, L. L. Bailey, and J. E. Hines. 2006. *Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence*. Academic Press, New York, USA.

*Required Readings*

Readings should be completed before the relevant course module.

Capture-Mark Recapture/Encounter (CMR) and the Program MARK

Cooch, E. G., and G. C. White (eds.) 2012. Program MARK – a Gentle Introduction. http://www.phidot.org/software/mark/docs/book/.  Chapters 1–7, other chapters of interest to student.

White, G. C., and K. P. Burnham.  1999.  Program MARK: survival estimation from populations of marked animals.  Bird Study 46 Supplement:120–138. (E-reserve)

White, G. C., K. P. Burnham, and D. R. Anderson.  2001.  Advanced features of Program Mark.  Pages 368–377 in R. Field, R. J. Warren, H. Okarma, and P. R. Sievert, editors.  Wildlife, land, and people: priorities for the 21st century.  Proceedings of the Second International Wildlife Management Congress.  The Wildlife Society, Bethesda, Maryland, USA. (E-reserve)

White, G. C.  2005.  Correcting wildlife counts with detection probabilities.  Wildlife Research 32:211–216. (E-reserve)

White, G. C.  2008.  Closed population estimation models and their extensions in program MARK.  Environmental and Ecological Statistics 15:89–99. (E-reserve)

McClintock, B. T., G. C. White, M. F. Antolin, and D. W. Tripp.  2009.  Estimating abundance using mark-resight when sampling is with replacement or the number of marked individuals is unknown.  Biometrics 65:237–246. (E-reserve)

Distance Sampling and the Program DISTANCE

Buckland, S. T., Marsden, S. J. and R.E. Green. 2008. Estimating bird abundance: making methods work. Bird Conservation International 18:S91–S108 (E-reserve) – *suggested reading for those working on birds*

Hedges, S. and D. Lawson. 2006. Dung survey standards for the MIKE program. Report of the MIKE program (Monitoring the Illegal Killing of Elephants). Available at http://www.cites.org/common/prog/mike/survey/dung_standards.pdf

Heide-Jørgensen, M. P., Laidre, K. L., Burt, M. L., Borchers, D. L., Marques, T. A., Hansen, R. G., Rasmussen, M. and S. Fossette. 2010. Abundance of Narwhals (*Monodon Monoceros*) On The Hunting Grounds In Greenland. Journal of Mammalogy 91:1135—1151. (E-reserve) – *optional reading, example of MRDS, aerial methods, and availability multipliers*

Marshall, A.R., Lovett, J.C., and White, P.C.L. 2008. Selection of line-transect methods for estimating the density of group-living animals: lessons from primates. American Journal of Primatology 70: 452-462.  (E-reserve)

Plumptre, A.J. 2000. Monitoring mammal populations with line transect techniques in African forests. Journal of Applied Ecology 37:356-368. (E-reserve)

Spehar, S.N., Mathewson, P.D., Nuzuar, Wich, S.A., Marshall, A.J., Ku¨ hl, H., Nardiyono and E. Meijaard. 2010. Estimating Orangutan Densities Using the Standing Crop and Marked Nest Count Methods: Lessons Learned for Conservation. Biotropica 42: 748–757. (E-reserve)

Thomas. L. et al. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47: 5-14. (E-reserve)

Modeling Patterns and Dynamics of Species Occurrence

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

MacKenzie, D.I., J.D. Nichols, J.E. Hines, M.G. Knutson, and A.B. Franklin. 2003. Estimating site occupancy, colonization and local extinction probabilities when a species is not detected with certainty. Ecology 84:2200-2207. (E-reserve)

MacKenzie, D. I. 2005. What are the issues with presence-absence data for wildlife managers? Journal of Wildlife Management 69:849-860. (E-reserve)

MacKenzie, D. I. and J. A. Royle. 2005. Designing occupancy studies: general advice and allocating survey effort. Journal of Applied Ecology 42:1105-1114. (E-reserve)

Nichols, J.D., J.E. Hines, D.I. MacKenzie, M.E. Seamans, and R.J. Gutierrez. 2007. Occupancy estimation with multiple states and state uncertainty. Ecology 88:1395-1400. (E-reserve)

MacKenzie, D.I., J.D. Nichols, M.E. Seamans, and R.J. Gutierrez. 2009. Modeling species occurrence dynamics with multiple states and imperfect detection. Ecology 90:823-835. (E-reserve)

## Course Activities:

Lectures, class discussions, and extensive computer work are all significant components of this course. Most days include a combination of formal lectures and computer exercises and each module includes time for direct consulting with instructors about course topics, advance topics and/or their own projects and data.

## Assignments and Grading Policies:

Policy on late assignments: Unless prior permission is received from the course instructor, late assignments cannot be accepted, nor credit awarded.

Grading: Grades are based on the following components:

| | |
|---|---|
| Participation in lectures, discussion and computer exercises | 20% |
| Graded Computer Exercises | 40% |
| Final Exam | 40% |

Grading standards follow this system: A+ = 97%-100%; A = 93%-96.9%, A- = 90%-92.9%; B+ = 87%-89.9%; B = 83%-86.9%; B- = 80%-82.9%. For Mason students, you must receive a passing grade to obtain credit for the course; refer to "Graduate Policies" within the Mason University Catalog (http://catalog.gmu.edu/) for further details.

(1) *Participation in lecture, discussion and computer exercises (20%) (daily)*
Students will be graded on their prompt attendance and *active* participation in all lectures, discussions and computer exercises.

## (2) *Graded Computer Exercises (40%)*

During two separate computer exercises, students will work alone on a worksheet guided computer exercises with a series of questions at the end. Students will turn in these worksheets for grades before open discussion about the exercise in class.

## (3) *Final Exam (40%)*

The exam, conducted on the last day of the course, will include a combination of multiple choice and short answer questions, and in addition to testing knowledge of the analytical theory and study design covered in the course, will require interpretation of code, input and output from the computer programs taught throughout the course.

## Academic Integrity:

*GMU is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.*

## Daily Schedule:

Lectures will generally begin at 8:30am following a 7:30am breakfast. Afternoon activities will resume after a 12:00 lunch break with most instruction ended by 5:30pm and dinner served at 6:00pm. Evening lectures and presentations may be scheduled throughout the course on occasion both to allow students to present their ongoing research, and to provide additional time to elaborate on difficult topics covered that day as required.

| Day | Topic |
| --- | --- |
| Pre-course | Course Preparation and Reading assignments |
| Sunday<br>May 18, 2014 | Afternoon Arrival<br>Transport from Dulles International Airport (IAD) |
| Monday<br>May 19, 2014<br>Day 1<br>10:00am start | Instructor and student introduction, course overview & review of rules and policies for campus<br>**Introduction and review of statistical concepts and frameworks**<br>• Study objectives (not just "analyze these data")<br>• *A priori* hypotheses and associated models<br>• Model inference and selection and the Principle of Parsimony<br>• Maximum-likelihood theory<br>Tour of Campus and Animal Collection, Smithsonian Conservation Biology Institute<br>**Evening Session (7pm):** Introduction to MARK and Cormack-Jolly-Seber Model (European Dipper) |
| Tuesday<br>May 20, 2014<br>Day 2 | **Capture-Mark Recapture/Encounter (CMR) and the Program MARK I**<br>**(AM) Interactive Sessions to Introduce Model and Data types, Key Concepts**<br>• Case Study#1: Cormack-Jolly-Seber Model (Live-Recapture data) – European Dipper<br>• Case Study#2: Band Recovery Models (Recoveries only data) – Greater Sage-Grouse |

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|---|---|
| | • Key Concepts Illustrated and Discussed: Use of covariates, PIMS model building, capture history matrix, Link functions, Graphing in MAR**K**<br>**(AM) The Design Matrix and Associated Issues**<br>• More sophisticated model structure by modeling parameters<br>• Additive models in MARK ("+" notation)<br>• Time (occasion) and group covariates<br>• Individual covariates  theory and application<br>**(PM) Development of Key Concepts with CMR models**<br>• Sampling Populations / Inductive Inference / Types of Uncertainty<br>• Data, notation, constants and parameters<br>• Modeling recovery data and open capture-recapture data<br>• Assumptions<br>• Likelihood and log-likelihood theory<br>Review Session<br>**Evening Session (7pm)**:  Continuation of example work with the Design Matrix |
| Wednesday<br>May 21, 2014<br>Day 3 | **Capture-Mark Recapture/Encounter (CMR)  and the Program MARK II**<br>**(AM)  Closed Capture Models and Jolly-Seber Models**<br>**(PM)**<br>• The Known Fate models<br>• Case Study#3: Models based on telemetry (Known fate data) – Black Ducks<br>• Goodness-of-fit assessment, estimation of a variance inflation factor, *c*<br>**Evening Session (7pm):** Optional work time on Closed Models and Capsid Pradel Model |
| Thursday<br>May 22, 2014<br>Day 4 | **Capture-Mark Recapture/Encounter (CMR)  and the Program MARK III**<br>**(AM) Multi-Strata Models and the Robust Design**<br>**(PM)**<br>• Robust Design examples<br>• Experimental case studies<br>• Model simulations<br>Review Session<br>**Evening Session (7pm):**  Hen Clam example (Cormack-Jolly-Seber Example of a Quasi-experiment) |
| Friday<br>May 23, 2014<br>Day 5 | **Capture-Mark Recapture/Encounter (CMR)  and the Program MARK IV**<br>(**AM)**<br>• Variance components and the Random Effects (RE) models<br>• The Joint Live-Dead Encounters Models – Burnham's model and Barker's model<br>• Mark-Resight Model<br>**(PM) Breakout Sessions:** Material determined by students, time allocated for work on student data sets with supervision and assistance |
| Saturday<br>May 24, 2014<br>Day 6 | **Distance Sampling and the Program DISTANCE I**<br>**(AM) Introduction to Line-Transect Sampling**<br>• Theory behind line-transect methods<br>• Encounter rates and detection function modeling<br>• Study design concerns, biases, assumptions and considerations<br>**(PM) Introduction to the program DISTANCE**<br>• Data structure<br>• Review of Analysis Engines<br>• Data Filters and Model selection<br>• Dealing with Group Size Bias<br>• Demonstration analysis (Wooly Monkeys, Peru) followed by guided analysis for Case study #1 (Impala, Botswana) |
| Sunday<br>May 25, 2014<br>Day 7 | **Day Off**<br>Optional tour of National Zoo, and/or drop-off in Washington, DC |

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| Monday<br>May 26, 2014<br>Day 8 | **Distance Sampling and the Program DISTANCE II**<br>**(AM)**<br>    •   Multipliers, Cue Counting and Indirect Surveys<br> **(PM)**<br>    •   Case Study #2 (Elephants, Sumatra)<br>    •   Case study #3 (House Wren, Point Transects) |
| Tuesday<br>May 27, 2014<br>Day 9 | **(AM) Distance Sampling and the Program DISTANCE III**<br>    •   Distance Sampling with Covariates (MCDS) – Case Study #4 (Amakihi point transects)<br>    •   Advanced Topics based on interest<br>**Breakout Session:** Material determined by students, time allocated for work on student data sets with supervision and assistance<br><br>**(PM) Occupancy Modeling and the Program PRESENCE I**<br>    •   Relevance of Occupancy to Ecology and Conservation<br>    •   Brief review of Statistical Background<br>    •   The Single Season Model<br>    •   Introduction to PRESENCE (demo) – fitting single season models with covariates |
| Wednesday<br>May 28, 2014<br>Day 10 | **Occupancy Modeling and the Program  PRESENCE  II**<br>**(AM) Continuing the Single Season Model**<br>    •   Single season model; assumptions<br>    •   Single season study design<br>    •   Guided Case Study Exercise – Single Season Model<br>**(PM) GENPRES Demonstration**<br>     **Multiple Season Model**<br>    •   Model Description<br>    •   Implicit and explicit dynamics<br>    •   Missing observations<br>    •   Covariates<br>    •   Demonstration of Multi-season models in PRESENCE |
| Thursday<br>May 29, 2014<br>Day 11 | **Occupancy Modeling and the Program  PRESENCE  III**<br> **(AM)  Multiple Season Model** cont'd<br>    •   Guided Case Study Exercise – Multiple Season Model<br>    •   Spatial correlation and neighborhood effects<br>    •   Study Design and GENPRES<br>**(AM) Multi-State Occupancy**<br>    •   Single and Multiple Season Models<br>    •   Demonstration of Multi-State Models in PRESENCE<br>**(PM) Additional applications and topics**<br>    •   Species co-occurrence models<br>    •   Joint habitat-occupancy dynamics<br>    •   False positive modeling<br>    •   Species richness or biodiversity and community dynamics |
| Friday<br>May 30, 2014<br>Day 12 | **Occupancy Modeling and the Program  PRESENCE  IV**<br>**(AM) Breakout Session:** Material determined by students, time allocated for work on student data sets with supervision and assistance.<br>**(PM)**<br>Continued consulting time and breakout sessions<br>Course Evaluations<br>Group Photo and Certificate Presentation |
| Saturday<br>May 31, 2014<br>Day 13 | **Shuttle to Washington Dulles International Airport** |

## Instructors

**Sarah Converse**, PhD, Research Ecologist, Patuxent Wildlife Research Center. Email**:** sconverse@usgs.gov.

> Sarah has been a Research Ecologist in the Endangered Species Research Group at Patuxent Wildlife Research Center since 2007.  Previously, she was a post-doctoral research associate in the Quantitative Methods Research Group at Patuxent.  Her research program is built around 2 themes - quantitative population ecology of endangered species and decision analysis applications in endangered species management. Sarah received her PhD in Wildlife Biology at Colorado State University. She is actively involved in professional training courses at the US Fish and Wildlife Service's National Conservation Training Center focusing on the topics of Structured Decision Making and Decision Analysis.

**Evan Grant**, PhD, Wildlife Biologist, Patuxent Wildlife Research Center and Conte Anadromous Fish Laboratory**.** Email**:** ehgrant@usgs.gov.

> Dr. Grant coordinates Amphibian Research and Monitoring Initiative (ARMI) activities in the Northeast by conducting and developing amphibian research and monitoring projects. Information from surveys in the Northeast are used to determine the proportion of surveyed areas that are occupied by various species of amphibians, and to estimate amphibian survival, dispersal, and population sizes and trends over space and time. This information is used to inform management of National Park and Wildlife Refuge Resources in the northeast. He received his Ph.D. in Marine, Estuarine and Environmental Sciences from the University of Maryland, College Park.  His research focuses on the movement ecology of stream amphibians, but he has other interests in ecology at larger spatial scales.

**Jim Hines**, Computer Specialist, USGS, Patuxent Wildlife Research Center. Email: jhines@usgs.gov.

> Jim is a Computer Specialist and Scientist at the U.S. Geological Survey's Patuxent Wildlife Research Center (PWRC). He received his Bachelor's Degree in Mathematics from the University of Maryland, and has been working at PWRC since 1977. His main interest is in developing user-friendly software for the analysis of ecological data, maintaining PWRC's software webpage, and analyzing ecological data, especially dealing with the estimation of population parameters. Hines developed and continues to maintain software widely used across the globe, including programs CAPTURE, PRESENCE, JOLLY, SPECRICH, DOBSERV and others. He also provides support and advice to field biologists carrying out statistical analyses of their own data, especially through internet list servers and mailing lists. Jim has published over 150 scientific articles and has received several awards from the USGS.

**Joe Kolowski**, PhD, Research Ecologist, Center for Conservation Education and Sustainability, Smithsonian Conservation Biology Institute. Email: kolowskij@si.edu.

> Dr. Kolowski's broad research interests are in mammalian ecology in the human landscape and the investigation and mitigation of human-wildlife conflict. Specifically, he is interested in the use of spatial data at the landscape and local scale to investigate the influence of human activities on mammalian space use patterns, social systems, demographics, and the dynamics of human-carnivore conflict. His doctoral work investigated interactions between humans and large carnivores in and around the Masai Mara National Reserve in southwest Kenya, with a focus on spotted hyena spatial ecology and analysis of livestock depredation patterns. He joined CCES in 2007 as a post-doctoral fellow and investigated the effects of oil exploration on the behavior and ecology of

ocelots, primates, and other mammals in northern Peru. Since late 2009, Dr. Kolowski has managed the Center's graduate and professional level capacity building programs yet continues to be involved in various research programs within CCES, both in Gabon and Peru, investigating the influence of extractive activities on forest wildlife. He has a bachelor's degree in natural resources and wildlife ecology from Cornell University, a master's degree in wildlife ecology from Southern Illinois University at Carbondale, and a doctoral degree in zoology from Michigan State University.

**Jim Nichols**, PhD, Senior Scientist, USGS, Patuxent Wildlife Research Center. Email: jnichols@usgs.gov.

Nichols' broad interests involve the dynamics and management of ecological populations and communities. Much of his research focuses on methods for obtaining inferences about ecological populations and communities. He is also interested in the application of decision-theoretic ideas to ecological management and conservation. He has worked on a wide variety of species and systems worldwide.

**Gary C. White**, PhD, Professor Emeritus Department of Fish, Wildlife and Conservation Biology Colorado State University. Email: Gary.White@ColoState.edu.

Gary was born in 1948 (the year of Aldo Leopold's death), growing up on a farm in central Iowa, and graduated with a BS (1970) from the Department of Fisheries and Wildlife at Iowa State University, an MS (1972) in Wildlife Biology from the University of Maine at Orono, and a Ph.D. (1976) in Zoology from the Ohio State University. He spent 1976–77 as a post-doctoral researcher with the Utah Cooperative Wildlife Research Unit at Utah State University. From 1977–84, his position was a scientist in the Environmental Science Group at Los Alamos National Laboratory, and in 1984, he moved to the Department of Fishery and Wildlife Biology at Colorado State University. He retired (was emancipated) in 2007 and is currently a Professor Emeritus and still maintaining an office and conducting consulting work. Much of his past research involved work with the Colorado Division of Wildlife developing monitoring strategies for prairie dogs and swift fox, and monitoring and modeling of deer, elk, and antelope populations. His personal research time is spent developing and teaching Program MARK. Other software packages he has developed include CAPTURE, SURVIV, RELEASE, DEAMAN, and NOREMARK. He taught 2 graduate courses at Colorado State, Population Dynamics and Analysis of Vertebrate Populations. His proudest achievement is receiving The Wildlife Society's 51st Aldo Leopold Memorial Award and Medal in March, 2000.

November 19, 2014

Curriculum Committee
College of Humanities and Social Sciences
George Mason University

MEMO: New Course Proposed – Estimating Animal Abundance and Occupancy

This memo serves to provide the information requested by the CHSS Curriculum Committee for the approval of a new course. The course in question has been offered twice under the CONS 697 (Special Topics) category, and after two very successful and popular offerings, we are now seeking to establish it with its own course designation.

Under the standard protocol of the Smithsonian-Mason School of Conservation, this course was initially reviewed and approved by the SMSC Academic Program Committee. The initial course concept was approved by the APC in Fall 2011, and the full syllabus was reviewed and approved in August 13, 2012.  The current course syllabus along with the Course Approval Form and associated requested information are being sent in parallel to the COS and CHSS Curriculum Committees now for review.

Course Objectives and Learning Outcomes:

This course aims to provide a solid grounding to students in all phases of research focused on estimating animal abundance and occupancy, starting with the framing of objectives and study design, moving into basic model types, and reviewing program design and structure. The focused use of relevant real-world case studies, and extensive time for one-on-one work with instructors will demonstrate clearly how these techniques are applied to field studies, and how flaws and challenges in data analysis can be identified and remedied. By the end of the course, students will be comfortable identifying the scientific questions that can be addressed with each technique and implementing basic analyses in all 3 programs. More advanced techniques in each program will be demonstrated, indicating when they are appropriate and how results can be interpreted. Finally, students will leave the course with a detailed list of available resources, in both print and online, to assist in the use of more advanced techniques.

By the end of this course, students will be able to:

- Associate a given scientific question or objective related to estimation of a population dynamics parameter or abundance or occupancy with the appropriate field method and analytical technique
- Import raw data into each of the course's computer programs
- Perform basic analyses in all three programs without supervision including the use of covariates, model selection and testing of model fit
- Identify digital and printed resources to assist in study design, field implementation and data analysis and interpretation for all three analytical frameworks
- Identify circumstances under which advanced techniques are necessary and properly identify those techniques
- Accurately troubleshoot field studies during stages of design, data collection, data import and analysis in all 3 programs

- Properly identify all components of analysis outputs from each of the three programs and interpret their relevance to the scientific question at hand

Statement of Need: Although a range of statistical courses exists within CHSS and COS, no courses offer training in these specialized techniques and programs. However, these three programs in particular are currently some of the most important analytical tools for wildlife biologists and ecologists studying animal populations. It can be very challenging to teach yourself these programs, and while some workshops do exist outside of the university setting, they are expensive and they typically cover only 1 of these three approaches. Early ecology, biology and zoology graduate students that receive training in this full suite of analytical approaches will be capable not only of analyzing their own animal data properly, and according the most current theory, but will also be much more competitive in acquiring research positions post-graduation.

Relationship to Other Courses: In reviewing the current catalog of courses at Mason in both CHSS and COS, as well as other departments, we could find no courses that are similar to this one. While there are various courses at Mason that cover statistical approaches potentially relevant to ecologists and zoologists, none teach the three common analytical approaches we teach in this course.

Audience and Enrollment: This course has been offered twice as a special topics course. The course has reached maximum enrollment both times (15 students) and in both cases there were at least two individuals on a waiting list. These statistical approaches continue to increase in popularity and utility and we are confident interest in this course will continue and likely increase over time. Because the course is taught by well-known experts (indeed the authors of the associated software programs in two cases) in these approaches, students have high confidence that there expectations for the course will be met. This course is oriented toward ecology, zoology, biology and conservation biology graduate students who are either looking to expand their toolbox of analytical skills for future research, or need immediate assistance with their graduate research.

Faculty Available: This course employs the assistance of two primary guest instructors from outside Mason (Dr. Gary White, and Dr. Jim Nichols) to assist the primary instructor, Dr. Joe Kolowski in teaching the material. With the exception of Dr. Joe Kolowski (Affiliate Faculty, Environmental Science and Policy), there are no faculty at Mason that we are aware of that are trained to teach these approaches.

Anticipated Rotation: Currently there appears to be adequate demand to offer this course once/year.

Concentrations or Requirements that this course will fill:  For graduate students within ESP, this course would fulfill their "methods" requirement.

Sincerely,

Joe Kolowski, PhD
Graduate/Professional Training Manager
Smithsonian-Mason School of Conservation