

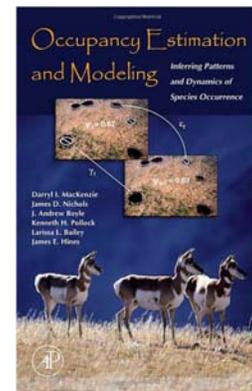
The Wildlife Conservation Society, in partnership with Proteus Wildlife Research Consultants and the Federal University of Rio Grande do Sul, with support from the Gordon & Betty Moore Foundation, is proud to offer the following training opportunity.

## Cost-effective wildlife monitoring at large scales: Introduction to site-occupancy and mark-recapture methods

### Instructors:

#### **Dr. Darryl MacKenzie, Proteus Wildlife Research Consultants**

Dr. MacKenzie is an internationally renowned biometrician, particularly for his work on the development and application of species occurrence models. He has over 15 years experience in applying statistical techniques to ecological and environmental situations, starting at the University of Otago, then progressing to North Carolina State University (based at USGS Patuxent Wildlife Research Center) in 2000, before commencing full-time with Proteus in 2001. Darryl has provided advice on studies for a wide-range of species and enjoys the challenge of combining the statistical theory with the practical realities to develop a pragmatic solution. He has published over 40 peer-review papers, with many in top ecological journals, and is lead author of the book *Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence*.



#### **Dr. Gonçalo Ferraz, Universidade Federal do Rio Grande do Sul**

Gonçalo Ferraz is a biologist interested in the theory and management of wildlife population dynamics. Gonçalo obtained his undergraduate degree in Biology from the University of Lisbon (1995) and a PhD in Ecology and Evolutionary Biology from Columbia University, New York (2004). He lived and worked in Manaus from 2004 to 2012, where he researched the impact of landscape change on populations of birds, fish, and disease vectors. To do this, he employed a variety of statistical models of site-occupancy and mark-recapture data. Gonçalo's research goes hand-in-hand with capacity building: he has taught 18 editions of his graduate Population Ecology class, and trained more than 15 graduate students. Since 2013, he has been assistant professor in the Ecology Department at the *Universidade Federal do Rio Grande do Sul*, Porto Alegre, Brazil.

### **Course Coordination & Logistics:** Wildlife Conservation Society, Brazil Program

[kdidier@wcs.org](mailto:kdidier@wcs.org)

**Course dates & Location:** 15-20 February, 2016. Manaus or Novo Airão, Amazonas State, Brazil. The exact location of the course is still to be determined (see **Course Fee and Travel, Food, & Lodging Costs** for more details).

**Course overview:**

The Amazon is unique in many ways, one of which is its vast size. In particular, protected areas in the Brazilian Amazon cover vast regions, often greater than 5,000 km<sup>2</sup>.

Organizations and individuals involved in conservation and management of protected areas (PAs) and other large regions, including government agencies, researchers, management councils, communities, and civil society organizations, need to know whether their efforts are effective, especially in terms of conserving their target wildlife populations. Unfortunately, effective monitoring of wildlife population across such vast areas is an enormous technical and financial challenge. However, advances in methods over the past decade are now opening the door to the possibility of producing reliable and cost-effective estimates of parameters that are critical for making management decisions, such as species occupancy (% of a PA occupied by a species), abundance (# or density of animals), and species richness, among others. With careful thought to design of monitoring efforts, it is now possible to implement adaptive management at large scales, where wildlife management actions are established, monitored and evaluated in terms of the effectiveness at reaching goals, and adapted based on the monitoring and evaluation results.

The Wildlife Conservation Society, in partnership with Proteus Wildlife Research Consultants and the Federal University of Rio Grande do Sul, with support from the Gordon & Betty Moore Foundation is excited to offer a 6-day intensive course that will introduce participants to the conceptual foundations of monitoring wildlife in the context of PA management, and introduce participants to the powerful Site-Occupancy and Mark-Recapture methodologies.

**Site-Occupancy**

The presence or absence of a species across a set of landscape units is a fundamental concept widely used in ecology (e.g., species range or distribution, epidemiology, habitat modeling, resource selection probability functions, as a monitoring metric, metapopulation studies, biodiversity and species co-occurrence). In addition, surveys to estimate presence/absence can be substantially more feasible, from both a technical and financial standpoint, than surveys for estimating abundance, especially when considering large spatial scales. An important sampling issue, however, is that a species may not always be detected when present at a landscape unit. This will result in "false absences" causing parameter estimates to be biased if unaccounted for, possibly leading to misleading results and conclusions, even with moderate levels of imperfect detection.

This course will cover many of the latest methods for modeling patterns and dynamics of species occurrence in a landscape while accounting for the imperfect detection of the species. Participants will be introduced to available software through worked examples, and there will be special emphasis on aspects of study design.

**Mark-Recapture (also known as Capture-Recapture)**

While site-occupancy approaches focus on the state and fate of landscape units—or sites, mark-recapture aims at the state and fate of individual organisms, e.g. their survival and abundance. The abundance (or density) of a species in a region is also a fundamental concept in ecology, and often the most desirable population parameter(s) needed for management of species. Unfortunately, for many species it can be expensive and technically challenging to estimate abundance. However, for some species Mark-Recapture techniques represent a conceptually simple, technology straight-forward, and cost-effective way of estimating abundance, in addition to other population characteristic of interest such as

survivorship, movement and activity patterns, and population structure (sex, age, and size classes).

This course will briefly introduce students to the use and applicability of Mark-Recapture techniques and analysis in the context of large-scale monitoring of wildlife populations, emphasizing methodological and sampling design considerations.

#### **Course Fee:**

On acceptance into the course, participants will be required to pay a minimal course fee to WCS of no more than **R\$ 500,00 (Brazilian Reais)**. The final fee will be lower if the course is held in Manaus. The fee will be used to offset *some* of the costs for holding the course, including food, lodging, and transportation from Manaus to Novo Airão (if the course is held there), and compensation for instructors. The fee will be **non-refundable**, except in cases of unexpected hardship (e.g., sickness or family emergencies) and refunds will be made solely at the discretion of WCS. Some exceptions to the payment of the fee can be made, at the discretion of WCS, for those who demonstrate economic hardship.

#### **Travel, Food, and Lodging Costs:**

*If the course is held in Novo Airão*, after payment of the course fee, WCS will cover

- Transportation from Manaus to Novo Airão and back, in the form of shared transportation (buses or vans), on Feb 14 (the day before the course) and Feb 21 (the day after the course).
- Breakfast and lunch during the 6 days of the course. Participants will need to cover dinner costs.
- Lodging for 7 nights (the nights of Feb 14, 15, 16, 17, 18, 19, and 20)

*If the course is held in Manaus*, WCS will only provide breakfast during the 6 days of the course. Participants will need to cover lunch and dinner costs, will need to arrange and pay for lodging in Manaus (we will provide some recommendations), and daily transportation to and from the course.

Independent of whether the course is held in Manaus or Novo Airão, WCS will not pay for or contribute to participant costs to travel to Manaus, except in a few cases. ***If the only reason you cannot participate in the course is due to the economic costs (travel, housing, food), please let us know and WCS will consider providing financial assistance.***

#### **Applying to participate in the course:**

All those interested in applying for the course must complete a course application, included on pages 7-8, and return in to Dr. Karl Didier ([kdidier@wcs.org](mailto:kdidier@wcs.org)) by Nov 22, 2015. We have space for **20 participants**. Decisions about acceptance into the course will be made by the instructors and staff from WCS Brazil.

To be accepted, applicants **must**:

- **Have the ability to understand, read, and speak English well.** The entire course, including discussions, will be held in English. Although Dr. Ferraz speaks

Portuguese and can help translate specific concepts, if necessary, continuous translation will not be available.

- **Have completed previous coursework in statistics.** Applicants must have taken at least one statistics course previously- introductory stats or more advanced. Previous experience with regression-based methods (e.g., linear or logistic regression, generalized linear models) would be particularly beneficial, but not required. Although we will review basic statistical concepts, we will not spend much time doing so.
- **Commit to participate in the entire course (all 6 days).**

Although all who meet the above three criteria are welcome to apply, including students, priority will be given to those applicants who meet some or all of the following criteria:

- **Are active practitioners in natural resources management or conservation** (i.e., working for a government agency or civil-society organization directly involved in the management and conservation of biodiversity). Students and researchers that are not active conservation practitioners are encouraged to apply, but are not our priority audience.
- **Are actively working in the Brazilian Amazon**
- **Are actively working in one or more conservation units, protected areas, or indigenous territories**

## Tentative Course Agenda:

***Sunday Feb 14: Travel to Novo Airão from Manaus, if course is held in Novo Airão***

### Day 1 (Monday Feb 15)

#### Background

- Why, what and how overview of sampling populations
- Occupancy applications
- Review of statistical methods
  - concepts and notations
  - probability
  - methods of estimation
  - covariate modelling with logistic regression
  - model comparison and multi-model inference
  - computer exercises in Excel

#### Occupancy modeling for single-season data (part I)

- basic sampling situation (data type)
- model history and development
- missing observations
- covariates

#### Introduction to software, PRESENCE

- worked single-season example (no covariates)
- examination of the output
- results and interpretation

## Day 2 (Tuesday Feb 16)

### Occupancy modeling for single-season data (part II)

- model assumptions
- dealing with heterogeneity

### Software session, PRESENCE

- worked single-season example (with covariates)
- examination of the output
- results and interpretation
- second worked example with covariates

### Occupancy modeling for single-season data (part III)

- small sample/finite population inference
- modelling spatial correlation in occupancy

### Software session, PRESENCE

- worked single-season example (with covariates)
- examination of the output
- results and interpretation
- second worked example with covariates

## Day 3 (Wednesday Feb 17)

### Single-season study design

- site selection
- allocation of effort
- design comparisons
- survey timing
- miscellaneous issues
- covariates
- GENPRES

### Study design exercises

- determining sample size requirements with Excel and PRESENCE
- evaluating study design using the software GENPRES

### Occupancy modeling of long-term data (part I)

- basic sampling situation (data type)
- model history and development
- approaches to modeling changes in occupancy over time
- missing observations
- covariates

### Multiple-season models in PRESENCE

- worked multi-season example
- examination of the output
- results and interpretation

#### Day 4 (Thurs Feb 18)

##### Occupancy modeling of long-term data (part II)

- alternative parameterizations
- characterizing occupancy dynamics
- modelling spatial correlations in occupancy dynamics

##### Worked multiple-season examples and computer exercises

- incorporating hypotheses of occupancy dynamics into modelling
- worked example
- examination of the output
- results and interpretation
- alternative parameterizations

##### Multiple-season occupancy study design

- relationship with single-season designs
- long-term design
- adding sites over time

*HALF DAY BREAK*

#### Day 5 (Friday Feb 19)

##### Beyond presence-absence measures

- multi-state occupancy models
- abundance with N-mixture models
- computer exercises in PRESENCE

##### Abundance estimation with mark-recapture data

- historical perspectives
- modern formulations
- model assumptions

#### Day 6 (Saturday Feb 20)

##### Worked examples in software MARK

##### Spatially explicit capture-recapture models

##### Summary and Discussion

- analyze own data
- ask specific questions of the instructors
- address design issues

***Sunday Feb 21: Return to Manaus if course is held in Novo Airão***

**Cost-effective wildlife monitoring at large scales: Introduction to site-occupancy and mark-recapture methods**

**Application Questionnaire:**

- Please answer all questions
- Return to Karl Didier [kdidier@wcs.org](mailto:kdidier@wcs.org) by Nov 22, 2015 (Sunday) along with your CV
- You may answer questions in English or Portuguese

Your Name: \_\_\_\_\_

Primary Institution with which you are affiliated \_\_\_\_\_

**1. Why do you want to take this course (please respond in <150 words)?**

**2. Do you have the ability to....**

A. Understand spoken English well? Yes\_\_\_\_ No\_\_\_\_

B. Read English well? Yes\_\_\_\_ No\_\_\_\_

C. Speak English well? Yes\_\_\_\_ No\_\_\_\_

**3. What previous courses in statistics have you successfully completed and in what year(s)?**

**4. What statistics software packages have you used before?**

**Have you used the package R? Yes\_\_\_\_ No\_\_\_\_**

(Questionnaire continue on next page)

5. Will you be able to participate in all 6 days of the course? Yes\_\_\_\_ No\_\_\_\_

6. Are you actively working in the Brazilian Amazon? Yes\_\_\_\_ No\_\_\_\_

A. If so, in which states?

7. Are you actively working in one or more conservation units, protected areas, or indigenous territories? Yes\_\_\_\_ No\_\_\_\_

A. If yes, what are their names?

8. Are you an active conservation practitioner? Yes\_\_\_\_ No\_\_\_\_

A. If so, with which organizations (government agencies, civil society organizations, etc.) are you currently working or collaborating?

B. If so, please briefly describe (<150 words) one or two of the conservation projects on which you are currently working.

9. Are you currently a student enrolled in a university or post-graduate program?

Yes\_\_\_\_ No\_\_\_\_

A. If so, in which institution/university and in which degree program (name, MS or PhD) are you enrolled?

10. Is there anything else we should know about you?