

# Modeling Patterns and Dynamics of Species Occurrence Workshop

## 4-day Agenda

### *Day 1*

#### **Background: inferences about animal populations**

- why estimate stuff
  - science
  - conservation/management
- what to estimate
- how to estimate: basic principles

#### **Occupancy: relevance to ecology and conservation**

- Classes of ecological questions
- Conservation/management

#### **Statistical background**

- concepts and notations
- probability
- Maximum likelihood and Bayesian estimation
- logistic regression, covariate modelling and odds ratios
- hypothesis testing
- model comparison and multi-model inference

#### **Single-season model (part I)**

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

#### **Introduction to PRESENCE**

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

#### **Introduction to WinBUGS**

- rework PRESENCE example in WinBUGS

#### **Single-season model (part II)**

- model assumptions
- dealing with heterogeneity
- small sample/finite population inference
- modelling spatial correlation in occupancy

## *Day 2*

### **Design matrices and fitting custom single-season models in PRESENCE**

- worked single-season example (with covariates)
- examination of the output
- results and interpretation
- using results to develop maps

### **Advanced modeling using WinBUGS**

- including covariates
- spatial correlation

### **Single-season study design**

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

### **GENPRES exercises**

### **Multiple-season model (part I)**

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

### ***Day 3***

#### **Multiple-season models in PRESENCE**

- worked MS examples
- examination of the output
- results and interpretation

#### **Multiple-season model (part II)**

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

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

- incorporating interesting biology into modeling
- further worked examples
- examination of the output
- results and interpretation

#### **Using WinBUGS to fit multi-season models**

#### **Multiple-season study design**

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

#### **Modeling multiple ‘species’ simultaneously**

- different ‘species’ (or genders/age classes of same species) may exhibit a similar response to a covariate or environmental changes.
- using PRESENCE to fit such models
- worked examples

#### **Species richness and community dynamics**

- applying single-species methods to address community-level questions
- worked examples

## ***Day 4***

### **Species co-occurrence**

- do species co-occur independently?
- single-season model (co-occurrence pattern)
- multi-season model (co-occurrence process)
- worked examples of each

### **Multi-state occupancy**

- 3-state occupancy – single season
- 3-state occupancy – dynamics
- worked examples

### **Joint habitat-occupancy dynamics**

- simultaneous modeling of habitat and occupancy
- worked examples

### **Other extensions**

- Incorporation of count data and estimates of abundance
- Marked animals
- Combining occupancy and telemetry data

### **Summary, discussion and consulting session**

- analyze own data
- ask specific questions of the instructors