Course (University of Florida, Department of Wildlife Ecology and Conservation): Analysis and Management of Vertebrate Populations and Communities

Venue: Architecture Computer Lab (Arch 116), University of Florida main campus, Gainesville, FL

Dates: March 10, 12 -17, Timing: 8.00 am – 5.00 pm with a one hour lunch break and 15 minute morning and afternoon breaks

Instructors:
James E. Hines (Patuxent Wildlife Research Center, U.S. Geological Survey, Laurel, MD)

William L. Kendall (Patuxent Wildlife Research Center, U.S. Geological Survey, Laurel, MD)

James D. Nichols (Patuxent Wildlife Research Center, U.S. Geological Survey, Laurel, MD)

John R. Sauer (Patuxent Wildlife Research Center, U.S. Geological Survey, Laurel, MD)

Course Coordination:
Madan Oli and H. Franklin Percival (University of Florida, Department of Wildlife Ecology and Conservation, Gainesville, FL)

Course Objective:
To present a unified and science-based approach to the conservation and management of natural animal populations, and to provide participants with information and resources for implementation of this approach. This approach involves three major methodological components: modeling, estimation and decision making.

Specific Objectives:
(1) To provide a conceptual framework for the use of models in the conduct of science and management.
(2) To briefly review frequently-used populations models, with emphasis on tailoring models to their intended use in conservation and/or science.
(3) To present a general conceptual framework for animal population/community estimation methods.
(4) To show how this framework can be used to develop estimation methods applicable to various sampling and logistic situations.
(5) To present the specific rationale and logic underlying the more commonly used approaches to estimating population and community-level attributes, with emphasis on tailoring these methods to meet objectives under logistical constraints.
(6) To present a general rationale and approach for the development of an animal

monitoring program, with emphasis on the use of resulting inferences for conservation and management.
(7) To present a logical framework for making management decisions and to identify the major components of uncertainty typically encountered in the management process.
(8) To outline the implementation of a formal adaptive management process for making informed management decisions in the face of uncertainty.

Outline:

Day 1:
1. Introductions
- 1.1. Introduction to workshop (Nichols) (0.25 hr)
- 1.2. Introduction of instructors/participants/students and their backgrounds and objectives
  - (Group) (0.5 hr)

2. Overview Material
- 2.1. Conceptual framework for population ecology & management (Nichols) (0.25 hr)
  - Include roles of modeling, estimation and decision theory
  - BIDE model

3. Statistical Inference
- 3.1. Statistical distributions (e.g., normal, multinomial) (Kendall) (0.5 hr)
- 3.2. Parameter estimation (Kendall) (0.5 hr)
  - Estimator properties (bias, precision, accuracy)
  - Estimation methods
  - Confidence intervals

BREAK
- 3.3. Hypothesis testing (Kendall) (0.5 hr)
  - Type I and II errors
  - Power
  - Likelihood ratio tests
  - Goodness-of-fit tests
- 3.4. Model selection (information theoretic approaches) (Kendall) (0.5 hr)
- 3.5. Bayesian model updating (Kendall) (0.25 hr)

LUNCH
- 3.6. Hierarchical modeling: Bayesian approach (Sauer) (0.5 hr)

3. Statistical Inference (Continued) (Sauer) (1.00 hr)
- 3.7. Survey sampling (sources of variation)
- 3.8. Sampling design features
  - Replication
  - Randomization
  - Control of variation
- 3.9. Some designs
  - Simple random sampling
  - Stratified random sampling

Other (cluster, systematic, double, dual frame, adaptive)

4. Models

4.1. Role of models in science and management (Nichols) (0.5 hr)

BREAK

4.2. Population modeling review: basic principles (Sauer) (1.5 hr)

- Discrete time matrix modeling (age/stage)
- Projection matrix asymptotics (λ, sensitivity, reproductive value, stable stage distribution)
- Stochasticity (demographic, environmental), PVAs
- Models for management

4.3. Population modeling exercise (Sauer, Hines) (0.75 hr)

Day 2:

4.3. Population modeling exercise cont. (Sauer, Hines) (0.75 hr)

5. Estimation of Animal Abundance and Density

5.1. Overview (Nichols) (0.5 hr)

- Why estimate abundance? Role of monitoring in science and management.
- How to estimate abundance: a canonical estimator
- Indices

5.2. Observation-based methods: miscellaneous (Nichols) (0.5 hr)

- Marked subpopulation
- Temporal removal modeling

BREAK

5.2. Observation-based methods: miscellaneous cont. (Nichols) (0.75 hr)

- Sighting probability modeling
- Multiple independent observers
- Multiple dependent observers

5.3. Implementing observation-based methods

- Introduction to MARK (Hines) (0.5 hr)
- Computer exercises with DOBSERV and/or MARK (Hines) (0.5 hr)

LUNCH

5.4. Observation-based methods: distance sampling

- Introduction to Distance Sampling (Sauer) (0.5 hr)
  - Introductory Concepts
  - Assumptions Underlying the Sampling Technique
- Estimating the proportion of animals detected & counted (Sauer)(0.5 hr)
  - Line Transects
  - Point transect
  - Contrasting Line Transect & Point Transect Sampling
- Survey Design & Field Protocol (Sauer) (0.5 hr)
  - Precision
  - Bias

BREAK

- DISTANCE 4 Software (Sauer-Hines) (1.0 hr)
  - Brief overview
  - Automated Survey Design (Distance 4 exercises)

Distance Sampling Analysis (Sauer) (1.5 hr)
Basic Analysis
Analysis for Clustered Populations
Introducing Covariates into the Analysis
Distance 4 CDS/MCDS analysis exercise

Day 3:

5.5. Capture-based methods: closed CR models
2-sample model (Nichols) (0.50 hr)
Data structure
Models and estimators
Study design
2-sample model exercises (SURVIV, MARK) (Hines) (1.0 hr)
K-sample closed models (Kendall) (0.5 hr)
Data structure
Models

BREAK

K-sample closed models cont. (Kendall) (0.75 hr)
Models
Model testing and selection
Confidence interval estimation
Study design
K-sample closed model exercises, CAPTURE, MARK (Hines) (1.0 hr)

LUNCH

K-sample closed model exercises cont. (Hines) (0.5 hr)
5.6. Density estimation with closed CR models (Nichols) (0.5 hr)
Ad hoc boundary strip approach
Nested grids
Gradient designs (e.g., trapping webs)
5.7. Other capture-based methods (Kendall 0.5 hr)
Removal methods
Change-in-ratio methods

6. Estimation of Animal Vital Rates (survival, reproduction, movement)

6.1. Introduction, relevance of detection probability (Nichols) (0.25 hr)

BREAK

6.2. All marked animals detected (Sauer) (1.0 hr)
Binomial survival model
Nest success
Radiotelemetry data
Study design
Computer exercises (SURVIV, MARK) (Hines) (1.0 hr)

Day 4:

6.3. Tag recovery models (Sauer) (1.0 hr)
6.4. Open population CR models
Single-age models (Nichols) (0.5 hr)
Data structure
Modeling

Single-models continued (Nichols) (0.5 hr)
- Time-specific covariates
- Multiple groups
- Capture history effects
- Individual covariates
- Model selection
- Model assumptions
- Estimator robustness

BREAK

MARK: PIMs and design matrices (Hines) (0.75 hr)

MARK exercises: Single-age models, band recovery models (Hines) (1.0 hr)

LUNCH

Single-age models (Nichols) (1.0 hr)
- Estimation of abundance
- Estimation of 8 and components of 8

Multiple-age models (Nichols) (0.5 hr)
- Data structure
- Modeling

Multiple-age model exercise (Hines (0.5 hr)

BREAK

Multiple-age model exercise cont. (Hines (0.5 hr)

Multistate models (Kendall) (0.75 hr)
- Data structure
- Modeling

Multistate model exercise (Hines) (0.5 hr)

Day 5:

Multistate model exercise cont. (Hines) (0.5 hr)

Multistate models**:** special uses (Kendall) (1.0 hr)
- Unobservable states
- Band loss

Multistate models: state misclassification (Kendall 0.5 hr)

BREAK

Multiple-age multisdtate models: variable age at recruitment (Nichols) (0.5 hr)

6.5. Open models with extra information (Nichols 0.5 hr)
- Capture-recapture + band recoveries
- Capture-recapture + radio telemetry
- Capture-recapture + auxiliary sightings (Barker models)

6.6 Pollock's robust design

Introduction (Kendall) (1.0 hr)
- Data structure
- Ad hoc approach
- Recruitment components
- Model-based approach

LUNCH

Model extensions (Kendall) (1.0 hr)

Temporary emigration

Open robust design

Robust design with band recoveries

Multistate robust design

"Mother of all Models"

Robust design computer exercises (Hines) (1.0 hr)

BREAK

7. Estimation of species richness and community dynamics

7.1. Population-community analogy (Sauer) (0.25 hr)

7.2. Species richness estimation (Sauer) (0.5 hr)

Data structure and designs

Modeling and estimation

7.3. Multiple-season community dynamics (Sauer) (0.5 hr)

Data structure

Modeling and estimation

7.4. Community dynamics exercises with SPECRICH, COMDYN (Hines)(0.5 hr)

DAY 6:

7.4. Community dynamics exercises cont. (Hines) (0.5 hr)

8. Estimation of site occupancy and occupancy dynamics

8.1. Single-season, single species occupancy (Nichols) (0.5 hr)

Data structure and designs

Modeling

Assumptions and their relaxation

Computer exercise (PRESENCE) (Hines) (0.75)

BREAK

8.2. Multiple-season occupancy dynamics (Nichols) (0.75 hr)

Data structure

Modeling

Example(s)

Computer exercise with PRESENCE (Hines) (0.5 hr)

8.3 Occupancy extensions (Nichols) (0.5 hr)

2-species occupancy

Multi-state occupancy

Joint occupancy-habitat modeling

Community level occupancy

LUNCH

9. Conservation/Management in the face of uncertainty

9.1. Elements of an informed decision (Kendall) (0.5 hr)

Objectives

Management alternatives

Model(s) of system response to management

Model weights (for multiple models)

Monitoring program

9.2. Sources of uncertainty (Kendall) (0.25 hr)
Environmental variation
Partial controllability
Structural uncertainty
Partial observability
9.3. Decision analysis under uncertainty (Nichols 0.5 hr)
General approach
Example
9.4. Adaptive management (Kendall)
The process (0.5 hr)
BREAK
Examples (0.5 hr)
10. Exam review/questions (Hines-Kendall-Nichols-Sauer) (1.5 hr +)

Day 7:
11. Exam (4.0 hr)
LUNCH
12. Discussion/Evaluation/Consultation (Hines-Kendall-Nichols-Sauer) (4 hr)