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)
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Course Coordination:
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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
   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
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 ($\lambda$, 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


  6.1. 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 \( \beta \) and components of \( \beta \)

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
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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)