**Spatial Capture-Recapture Models:**

*Hierarchical modeling of capture-recapture data with auxiliary spatial information.*

Rationale…..

Organization of the book.

**Outline**

**1. Introduction to Spatial Capture-Recapture (Andy) almost draft**

Basic concepts. By way of exploring the failure of model M0 and Mh.

Literature review. Conceptual/methodological approach taken in this book.

**2. A Primer on Bayesian Analysis of GLMs Using R/WinBUGS (Andy) complete draft**

Notation

Bayesian analysis

MCMC

Binomial/Poisson regression models including with random effects.

**3. Closed population models. (Andy) complete draft**

Model M0, Mh, individual covariate models.

Data augmentation

Distance sampling.

**4. Spatial capture-recapture models (Andy) complete draft**

SCR0.

Simulating data in a perfect situation.

Making density maps.

Wolverine analysis.

Discrete state-space

**All kinds of detection functions**

**The implicit home range model**

**5/4b. Poisson and multinomial observation models (Andy/Rahel) early draft**

Alternative observation models. Bernoulli/binomial, Poisson, Multinomial.

Capricailie example – Poisson observation model

Need a mist-netting example. What does secr do**. Rahel can you help?**

SCR as multi-state type of model

Single-catch traps. Approximation by Bernoulli or multinomial (**Rahel** ?)

**Acoustic devices**? (from Efford et al. – use the example from SECR()?).

**6/5. Likelihood analysis and SECR (Andy/Beth) draft**

How to do likelihood analysis. Native R and using SECR.

**7/6.** **MCMC details (Rahel/Richard?) draft**

How to do MCMC for basic Bernoulli/Poisson SCR models (Richard and Rahel)

Rahel’s multi-year version of the code.

**8/7. Model Selection and Assessment (Andy) early stages**

Bayesian p-value stuff.

Testing CSR – complete spatial randomness - sim study

Types of detection models

DIC/AIC type assessments of detection models – Rahel help w/sim study

**8b. modeling space usage in SCR models --- was Modeling detection probability (ANDY)**

**Alternative detection models [put somewhere else]**

**Sensitivity/robustness [put somewhere else]**

**Implicit home range model stuff [put in chapter 4]**

**Detection based on ecological distance**

**Modeling RSPFs stuff (within home range variation)**

**10. Modeling Encounter Probability (Beth) almost draft**

Different detection functions

Models with Covariates: fixed covariates. Partially observed. Unobserved.

Sex and Behavior: The bear model (Gardner et al. JWM) (sex is latent)

Trap type or season (swiss Wildcat model)

Heterogeneity models

Continue to use SECR and WinBUGS in this chapter.

**11. Essential Extensions: state-space covariates (Richard) draft**

Modeling covariates that influence density.

Example: jaguar data?

What does SECR do?

**12. Open population models (Jolly-Seber) (Beth)**

T=2 case.... very simple

General case. Karanth tiger data?

Different models of home range dynamics.

**----------------------------------------------------**

**13. Combining multiple study areas or spatial units. (Andy) ms drafted**

Data augmentation for stratified populations (Royle, Link and Converse paper).

Dirichlet compound multinomial.

Stuff with Sarah Converse

Sarah Converse R code

**14. Estimating density from arrays of point counts. (Richard) biometrics ms**

Spatial non-capture-recapture models.

Basic model for a trapping grid

Poisson/Bernoulli/RN observation models

MCMC code

Simulation study (small)

Including marked guys

Example

**15. Unmarked counts (Richard/Rahel/Beth) Richard/Rahel manuscripts**

**Linear designs – i.e., point transects**

**Configurations of quadrat counts [this would be huge].**

**Other observation models: Bernoulli – Royle/Nichols – other?**

**Lincoln-Peterson type of estimator (encounter rate of marked and unmarked like the McClintock stuff – similar to Beth was applying to raccoon data)**

**16. Unmarked counts (Rahel) Rahel’s work**

**Dealing with multiple years of data**

**Integrating telemetry data**

**Panther case study**

**17. SCR/DS models (Richard)**

**New material.**

**DS with location information. Thinned Point process model. A Poisson GLM.**

**18. Search-encounter models (Andy)**

Uniform search intensity models (Royle and Young)

Non-uniform search intensity:

1-dimension -- trail searches.

distance sampling

stream data: Evan Grants æmander data?

Explicit movement models.

measurement error: Relationship to distance sampling.

What is the effective sample area under this model? precise meaning that is related to movement.......

**20. Miscellaneous topics: (Everyone has to write 1+ section)**

1. **a one-dimensional case study of movement along a stream? (???)**

The idea here is that I thought it would be useful to apply the models to fish or salamanders in a 1-d system because it is simpler and kind of cool, and applies to a lot of problems. Someone needs to take the initative here and put something together.

1. **Combining different data types (Andy)**

Genetics+ camera trapping. (Arjun’s model)

Incidental observations (tourists or road kill or poaching)

SCR + telemetry: Rahel

1. **Raccoon case study. Two-stage design + removals. (Beth)**
2. **CJS model with multiple strata? (Beth????)**
3. **Gibbs or Markov point process models. (Beth)**
4. **Design of trapping arrays. (Rahel/Beth?)**

---------------------------------------------------------------------------------------------------------------------------

**21. Discussion**

SCR models with no individual identity

Spatial correlation is the key

Spatial correlation models (Wolpert and Ickstadt)

Testing ecological hypotheses about space usage.

More complex movement models?

Landscape connectivity

Trapping webs

Acoustic detectors

Appendix 1: R and WinBUGS software

Installing R and useful libraries

Running WinBUGS and other BUGS variants

(required R packages diff between 32/64 bit machines, etc..)

Appendix 2: SCR comparison on different \*BUGS engines

Appendix 3: SPACECAP