**Spatial Capture-Recapture Models:**

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

Rationale…..

Organization of the book.

**Outline**

**PART 1: Introductory stuff**

**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.

**1b. Some modeling issues………………… [Richard]**

**Statistics**

**Models**

**Assumptions**

**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.

**PART 2: Some basic models**

**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**

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

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

**9. 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.

**5. 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()?).

**16. 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.......

**PART 3: Tools and Extensions**

**8. 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

**17. Design of Spatial Capture-Recapture studies [RAHEL]**

**13. Hierarchical SCR (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

**7.** **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.

**PART 4: Advanced models**

**10. Ecological Distance models in SCR (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)**

**11. state-space covariates (Richard)**

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.

14. SCR for unmarked individuals.

- All individuals are unmarked  
- Explain basic concept (encounter histories are latent)  
- Show an example (perhaps NOPA data again)[JAGS and custom R code]  
- Discuss how to improve precision with prior info  
- Discuss alternative observation models (Royle-Nichols type of model)  
- Points along a transect design  
- Make connection to Wolper-Ickstadt convolution models for general purpose spatial modeling  
  
15. Combining marked and unmarked guys.  
- Some individuals are marked  
- Relationship to mark-resight stuff  
- Show an example (2nd year of puma data?)[custom R code]  
- How many individuals need to be marked? Precision issues  
- How much info do the unmarked guys contribute?  
- What if marked guys aren't a random sample?  
- ????

**Topics to not forget in these two chapters.**

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

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

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

**Dealing with multiple years of data**

**Integrating telemetry data**

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

**New material.**

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

**PART 5: Stuff we’re not covering too much in this book**

**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?)**

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**21. Discussion**

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: Doing GIS kind of stuff in R