Analysis of Fisheries Independent Surveys

Advisors: Ken Pollock (NC State)

Liz Brooks (SEFSC)

Matthew Krachey

mjkrache@stat.ncsu.edu

http://www4.ncsu.edu/~mjkrache

NC State University
DEPARTMENT OF STATISTICS

Ecosystem Management: NOAA Guidelines

Ecosystem management: The management of the multiple uses within an ecosystem that maximizes economic performance while maintaining food web relationships

Ecosystem Management: NOAA Guidelines

Maintenance of traditionally unmonitored species presents a great challenge

Goals of Project

- Develop statistics describing ecosystem / food-web health

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- Develop a simulation environment for generating multi-species trawl data

Fisheries Independent Data

- Provide spatially distributed time-series data

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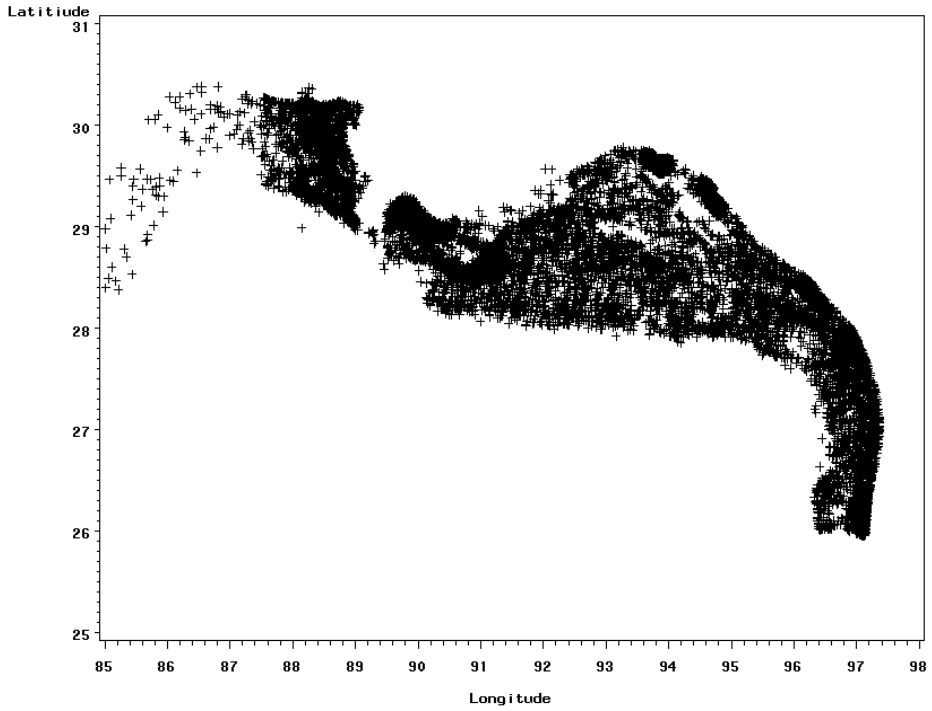
- May demonstrate variability/ distribution of species
- May demonstrate impacts of past management decisions

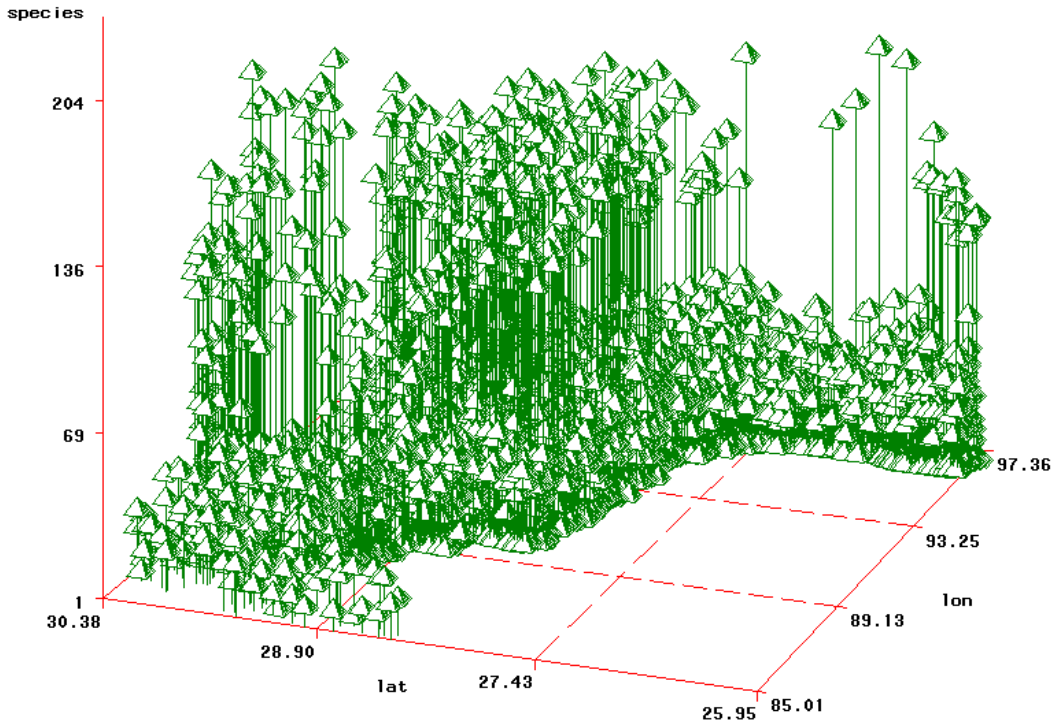
Data Analysis: SEAMAP

Trawl dataset from the gulf of Mexico



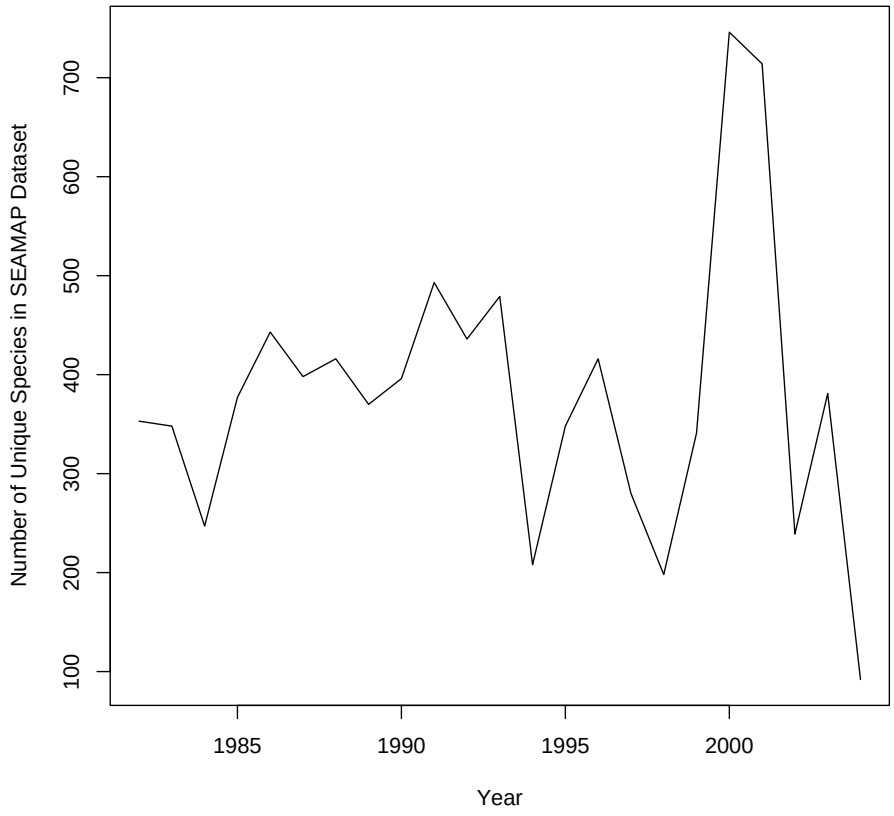
Data Analysis: SEAMAP

Consistent survey design and implementation since 1982



Data Analysis: SEAMAP

Large pool of species



Data Analysis

Detection Probability

- Trawls represent minimum number of individuals / species in each location

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- Failure to include detectibility may lead to radical inferential errors
- Low detection probability of rare species may lead to unnecessary management restrictions
- Estimation difficult in open populations where traditional mark-recapture not plausible

Metrics for Decision Criteria

Want to track:

- Risk of local extinction for target species

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- Major changes in species distributions

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Detectability may be a serious issue!

Simulations

Need for simulation environment

- Need to evaluate the performance of estimators
  - Situations that may cause significant bias
  - Relationships between estimator values and underlying distributions

Lotka Volterra Simulations

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- Will be used to simulate trawl data

LV types

- Non fishing

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- Simple fishing (single and multiple species: bycatch)
- Variable species selection fishing
- Variable catchability

LV Equation

$$b(t+1) = b(t)(1+(\epsilon(t)+r-f(t)+r(Ab(t)))+\phi\sqrt{b(t)^t b(t)}$$

- $b(t)$ is a vector of biomasses at time t

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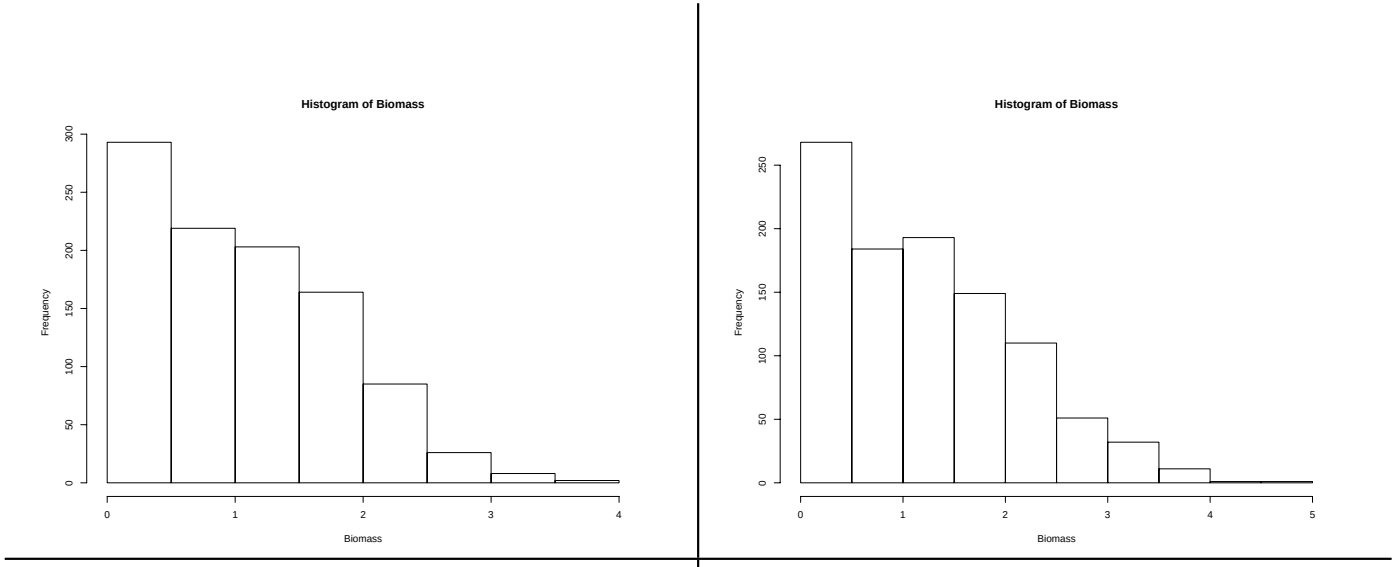
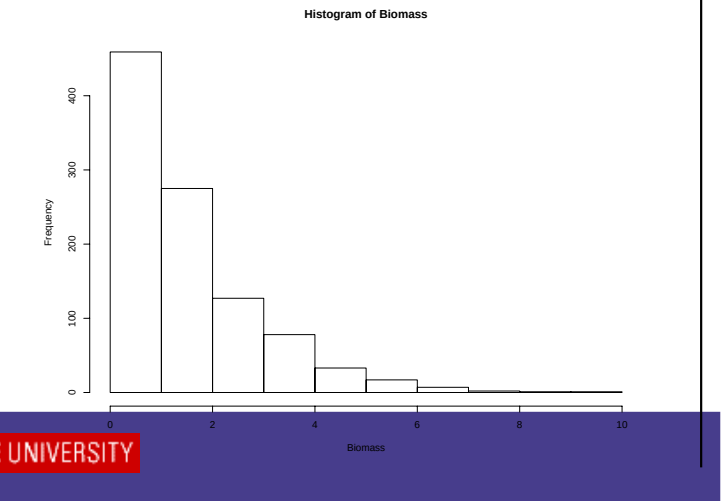
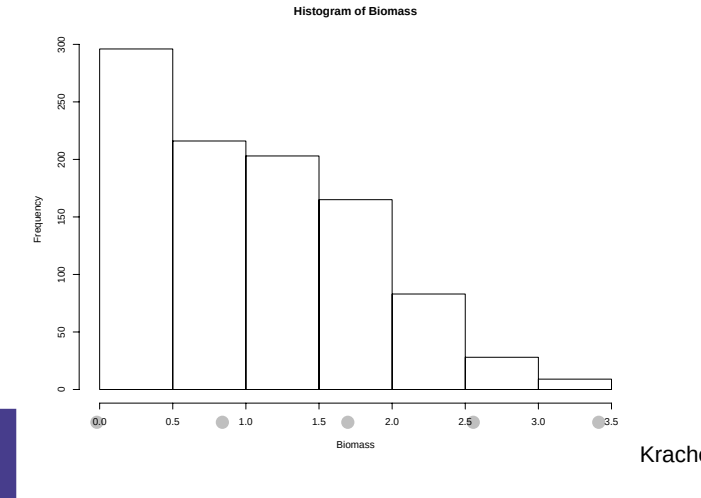
- A is the species interaction matrix
- ϕ is the immigration rate

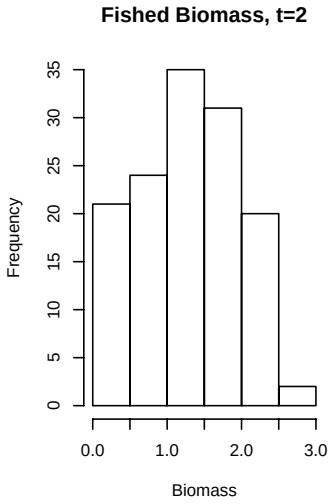
Plots (no fishing)

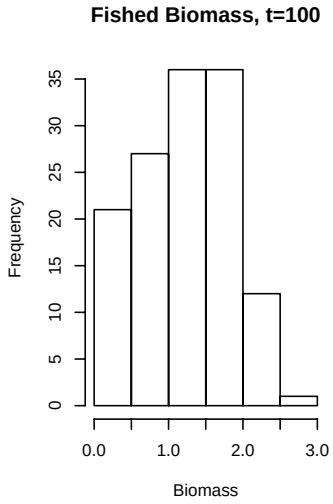


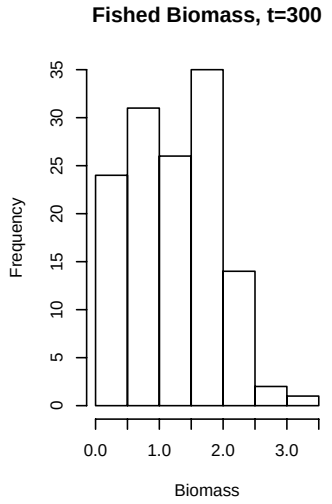


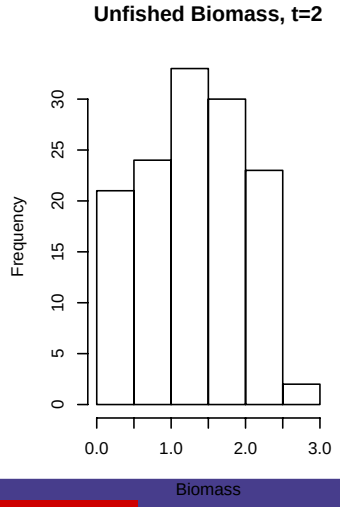


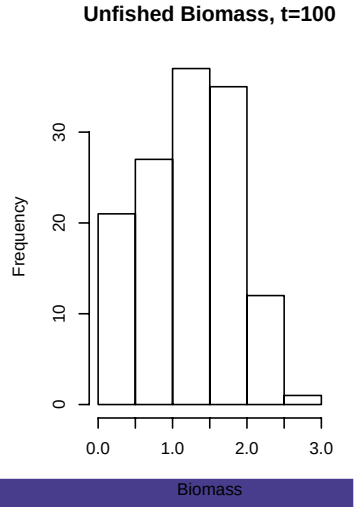
Plots (fishing)

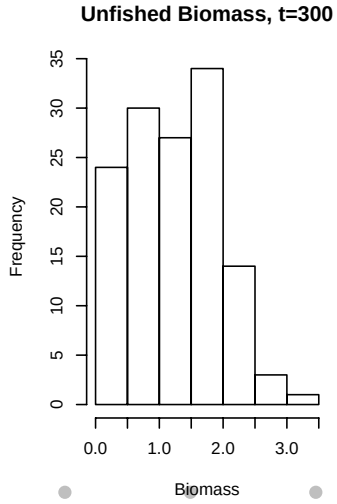












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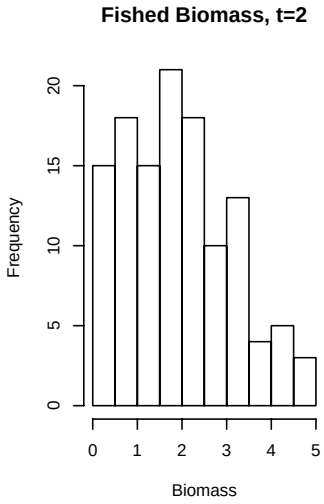

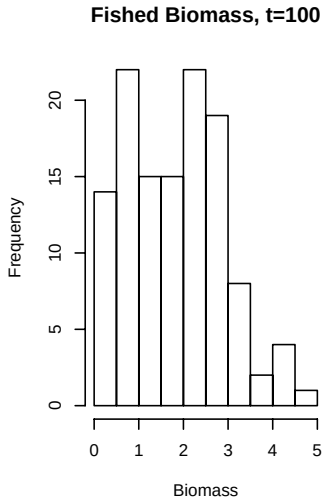

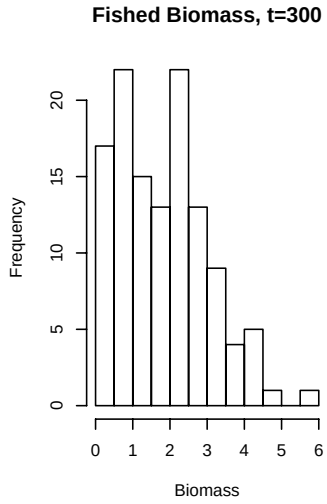

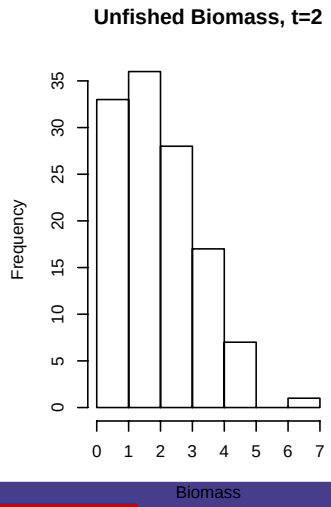

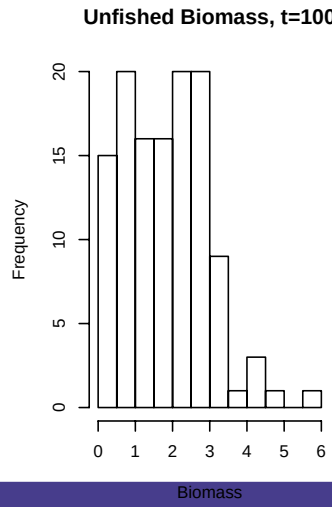

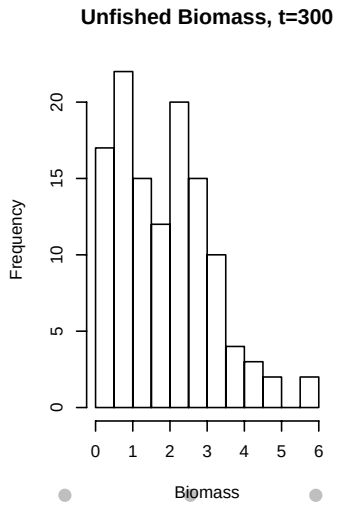

Deliverables

- Some proposed indices:
  - Community Diversity
  - Local Diversity
  - Transience
  - Local Extinction Risk
  - Community Extinction Risk
  - Interpolated Distributions for Key Species

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- Spatial and Temporal Models incorporating these indicators

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- Evaluation of statistical properties of these statistics (bias, variance, sufficiency etc.)

Deliverables 2 (simulations)

- Simple Lotka-Volterra simulation package will be developed

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- Implications of fishing and cessation of fishing will be analyzed