Lessons from an adventure into protected species modeling

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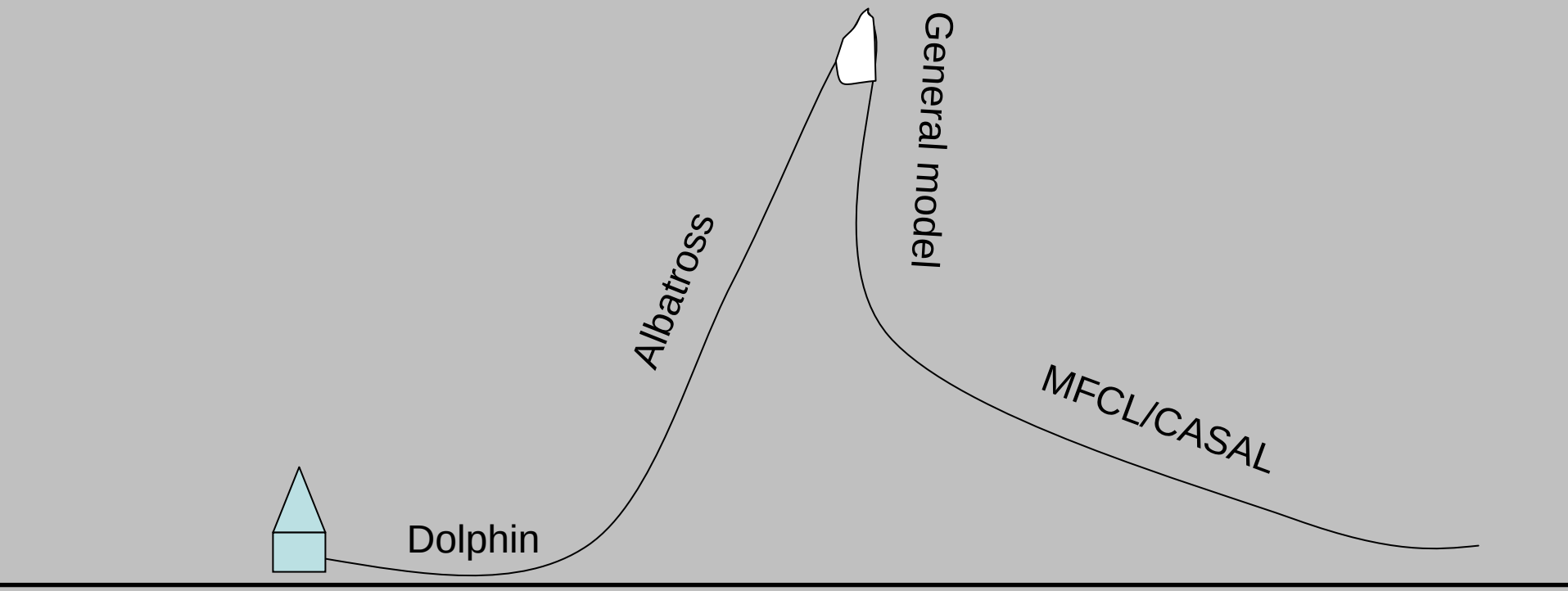
Map



Initial exploration: New Zealand sea lions

- First analysis
  - Simple surplus production model based similar to existing marine mammal models
  - In Bayesian framework
  - One data set
- Second analysis
  - Based on fisheries models
  - More complex spatial and age-structured
  - Great potential
- Lack of acceptance

Feasibility: Application of fisheries models to protected species

- Applied recent developments in fisheries stock assessment modeling to the NCEAS terrestrial species simulated data sets
- Recent developments
  - Integrated analysis
  - Bayesian analysis
  - Random-effects modeling of process error
  - Non-parametric parameter representation
  - Robust likelihood functions
- Used AD Model Builder
- Performed Well

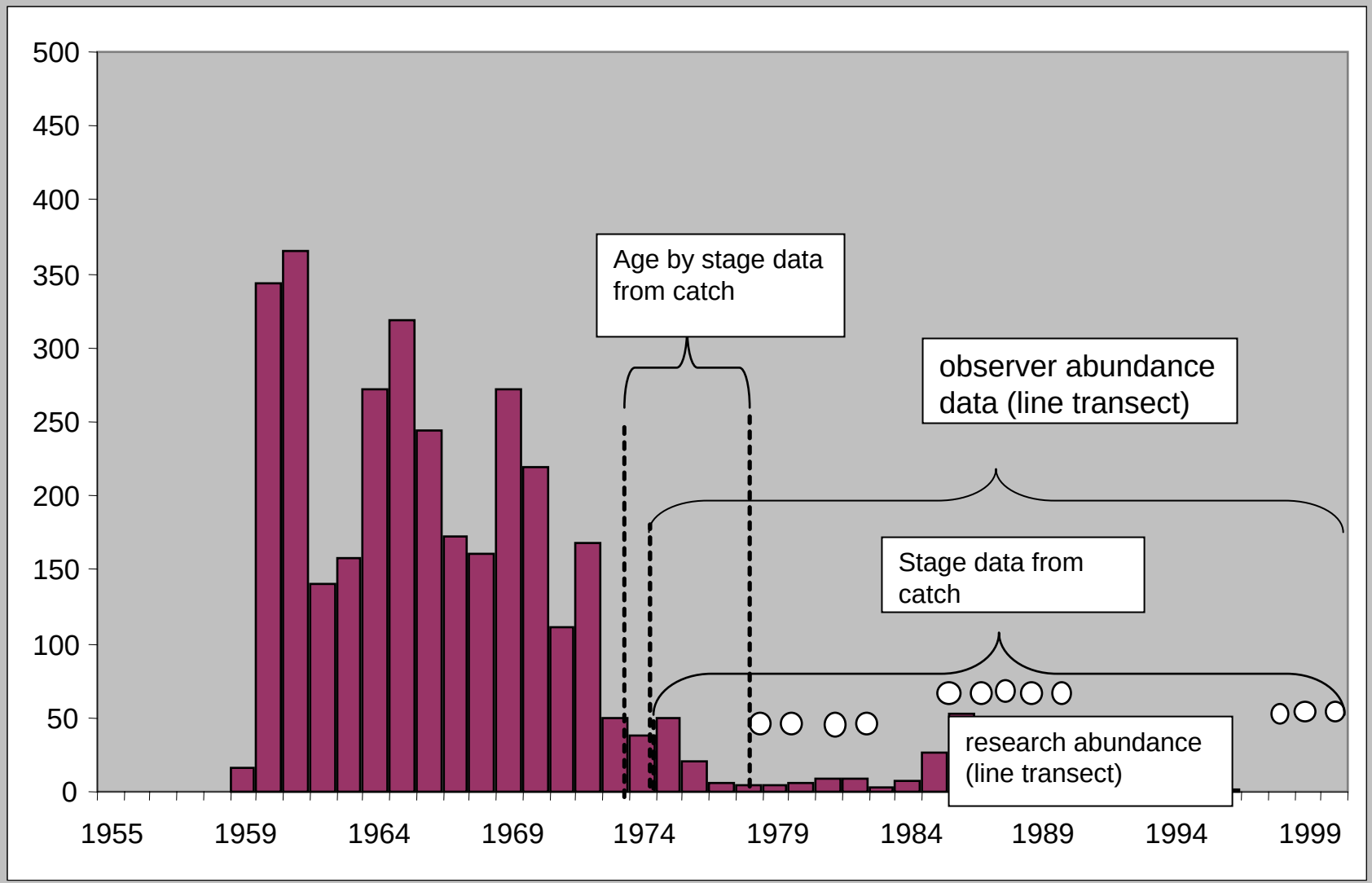
The adventure: PFRP project

- Objective
  - Generate a general Bayesian integrated model for protected species modeling that can be applied to multiple species and used to provide management advice
- Applications
  - Hawaiian population of black-footed albatross
  - Northeastern Pacific stock of spotted dolphin
  - Others

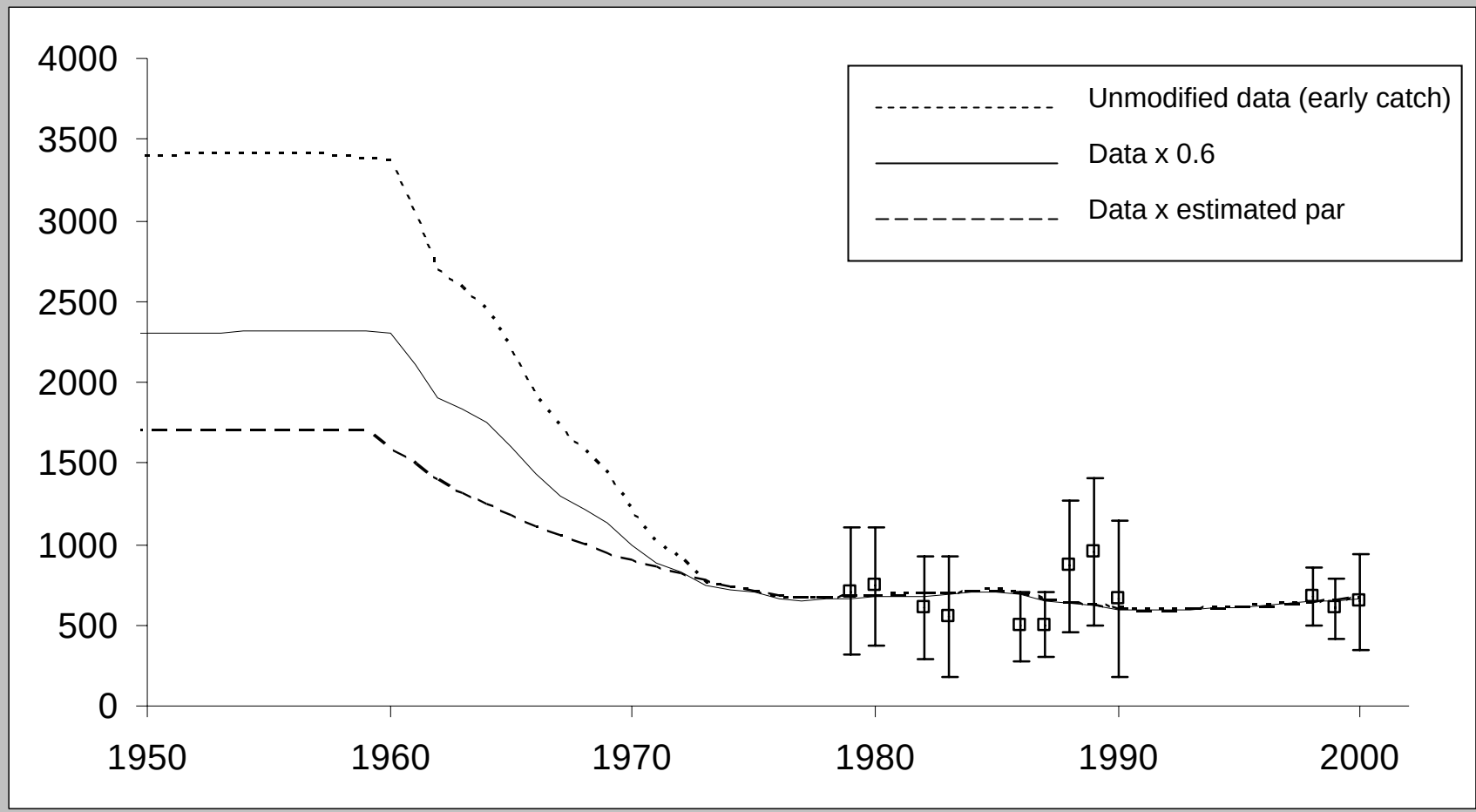
Walking out of the village: northeastern Pacific stock of spotted dolphin

- Data and expertise in house
- Existing models
- Data and model structure similar to fisheries models

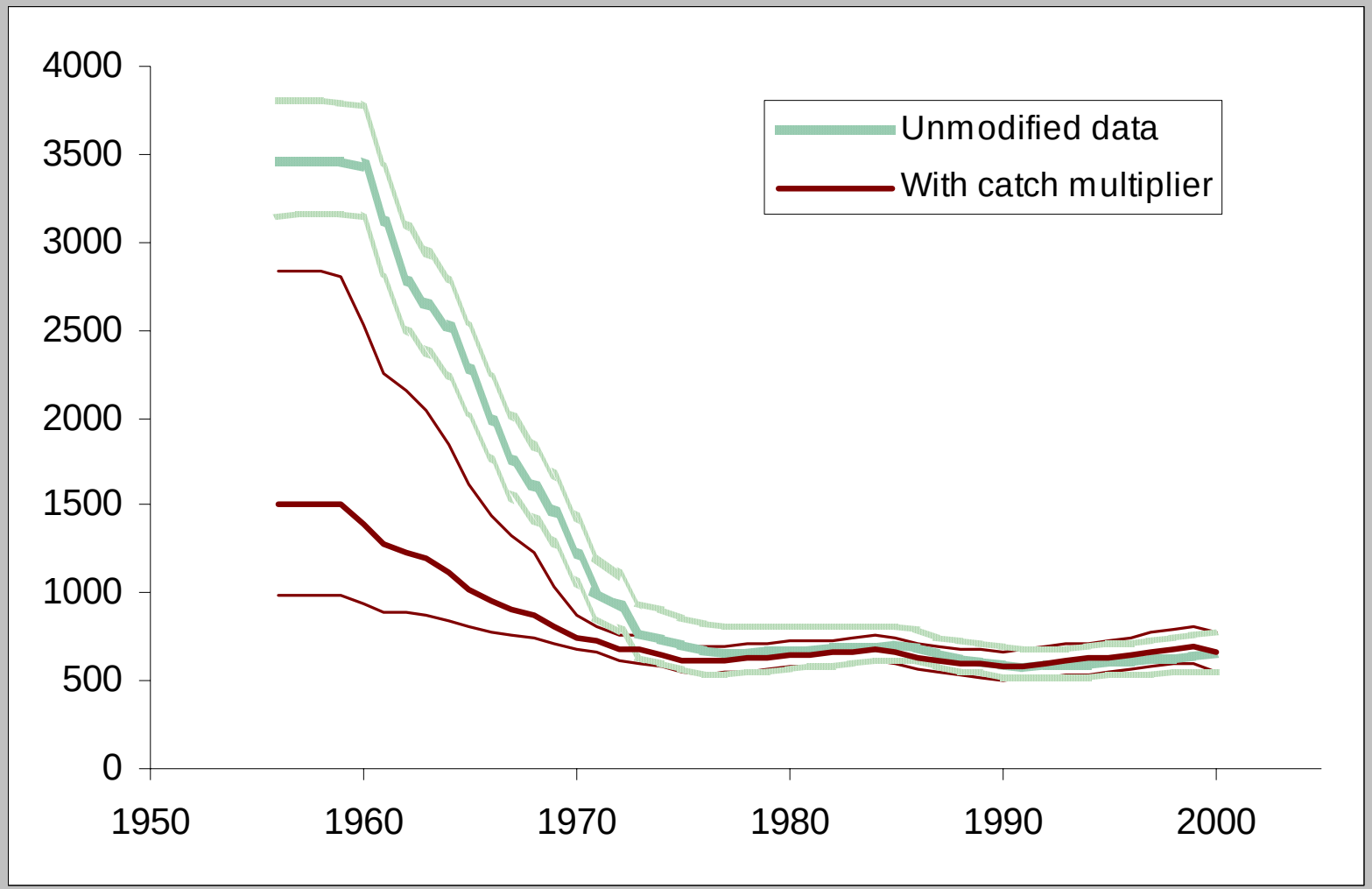
Dolphin application: data



Dolphin application: fits to abundance data



Dolphin application: Bayesian estimates of uncertainty



Dolphin application: publication

- Hoyle, S. D. & Maunder, M. N., 2004. A Bayesian integrated population dynamics model to analyze data for protected species. *Animal Biodiversity and Conservation*, 27.1: 247–266.

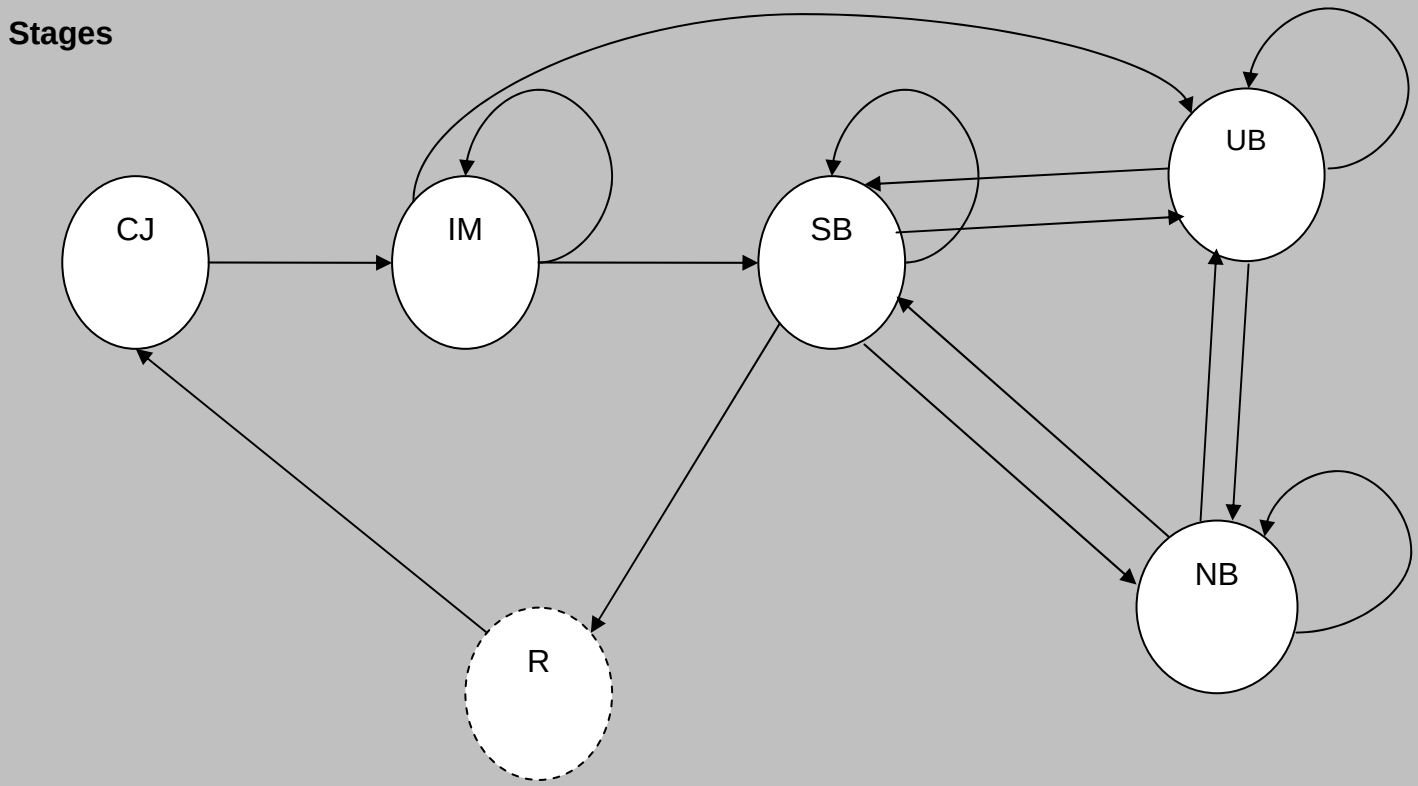
Climbing Mount Everest: Hawaiian population of black-footed albatross

- Data collected and held by multiple parties
- Structure different to standard fisheries models
- Existing models not using data

Albatross application: data

- Effort data
  - Longline: AL, HA, CA, Japan deep & shallow, Taiwan, Korea
  - Driftnet: large mesh (Japan), squid (Japan, Korea, Taiwan)
- Bycatch rate estimates
  - Longline (some fisheries, multiple years)
  - Driftnet (all fisheries, 1 year)
- Mark-recapture
- Nest counts at islands
- Fledged chick counts at islands

Albatross application: model structure



Change of plan

- Predicted by reviewers
- Objective
  - Generate a general framework for protected species modeling that can be applied to multiple species and used to provide management advice

Can general fisheries models be used for protected species modeling?

Mark recapture data

- Recaptured individuals are re-released
- However, most analyses treat re-releases as new individuals
- Only a few “memory models” like releases
- The re-released individuals live
- The only difference between fisheries and wildlife models is the allowance for live recaptures

Catch and effort data

- Many protected species have limited or no catch data
- Need to model fishing mortality using effort
- Can F be estimated if there is only effort?

Stage structure

- Many protected species are classified into stages
  - Juvenile and mature
  - Breeders and non-breeders
- Need to include stage structure in model
  - Extension of areas, but possible one way movement
  - Extension of sexes or growth morphs
  - Controls on transition probabilities

Observable stages in the population (a.k.a. color phases) – available stage structure frequency info could be useful

Neonate

Two-tone

Speckled

Mottled

Fused

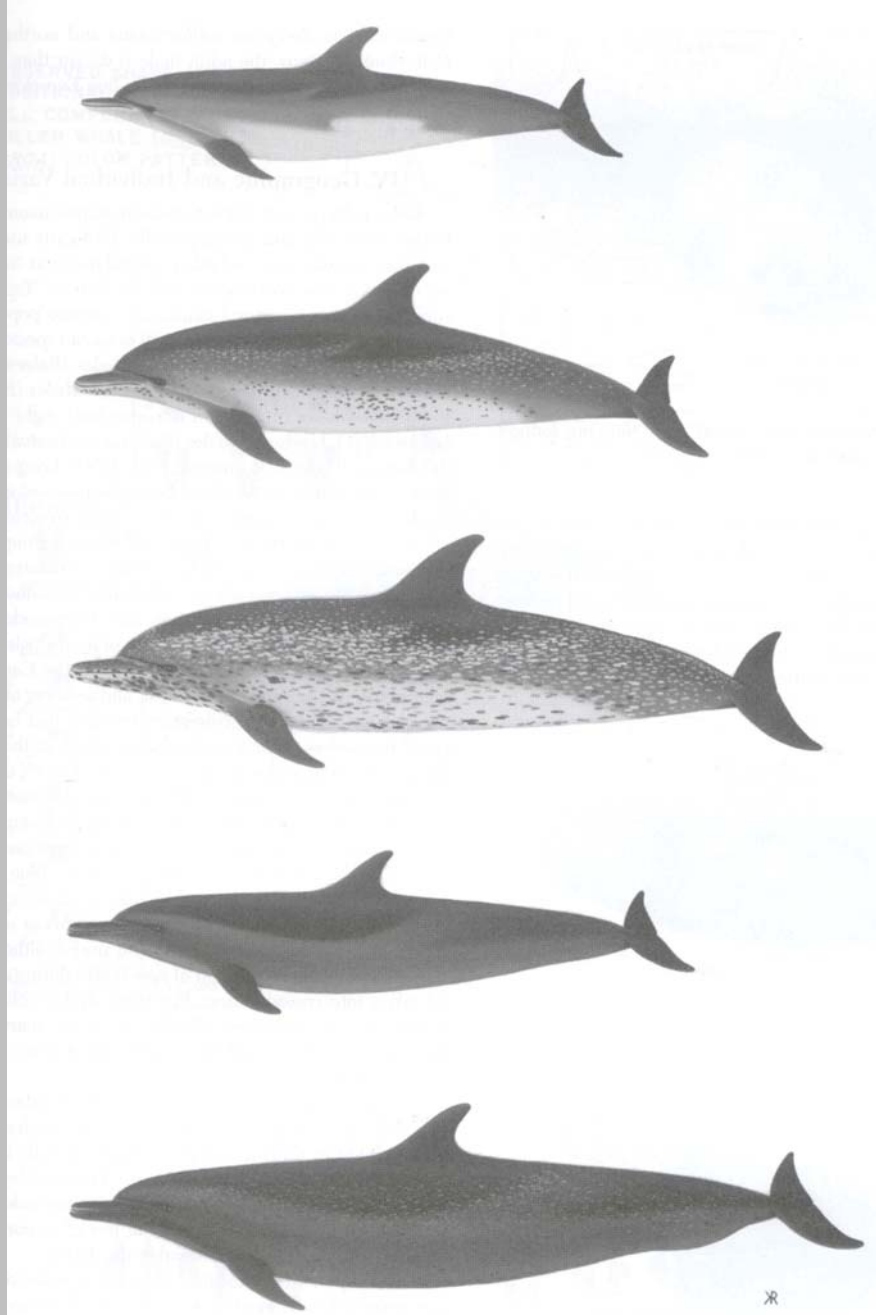


Figure 3 *Development of color pattern in two spotted dolphins:* Stenella frontalis *(top three) and* S. attenuata *(bottom two). From Perrin* et al. *(1987).*

Modifications to general fisheries models

- General models that use mark-recapture data
  - MFCL
  - CASAL
- Marked individuals may not killed
- Stage structure (Easy in CASAL use area in MFCL)
- Estimate catch based on effort (MFCL can do this)

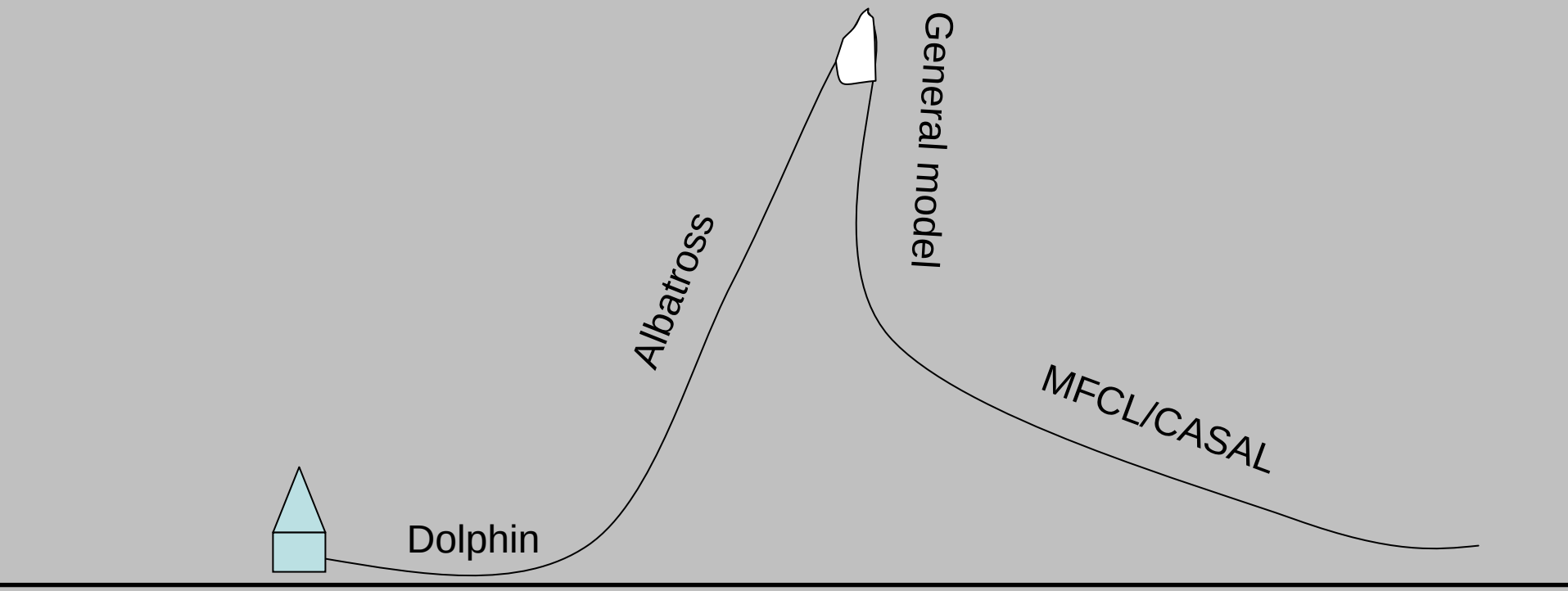
Scenic highlights

- EURING conference
- Convergence of fisheries and wildlife models
- Collaborations with statisticians
- Teaching courses

Pitfalls

- Lack of quantitative scientists
- Access to data
- Understanding of data and system by modelers
- Understanding of model needs by biologists
- Quantitative methods are still evolving

Map



Needs

- More quantitative scientists
- Educate biologists and managers about models
- Flexible modeling tools
- Collaborations between modelers and biologists
- Quantitative methods

Solutions

- Provide training in quantitative methods
  - Courses
  - Manuals
- Provide flexible quantitative tools
  - General models
  - AD Model Builder
  - Libraries
  - Examples
- Modelers work with groups that have the data and the biological knowledge
- Modelers collaborating with statisticians

Acknowledgements

- PFRP provided funding
- Groups who supplied data