Atlantis Course Universidad de Concepción
Day 2 - Key modelling decisions

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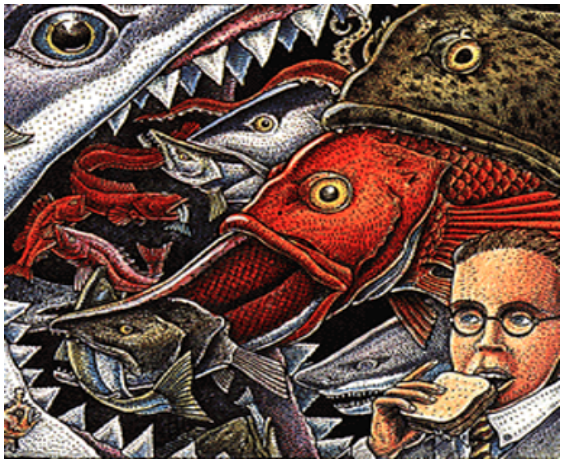
Introduction

- General model design
  - Define your system
  - Define functional groups
  - Map and polygon structure
- State conditions (CDF file)
  - Biomass distribution
- Rate parameters (PRM file)
  - Diets
  - Species movement (within / outside model domain)
  - Recruitment
- Tips and tricks



Complexity tradeoffs

- Spatial
- Temporal
- Processes details (physical, chemical, ecological, anthropogenic)
- Trophic components (taxonomic resolution)
- Human industries
- Stock sub-structure
- Movement

Model complexity: best practices

Attack problems at appropriate scales, with appropriate theories and methods. A universal scale is NOT useful

Rudolph Marcus

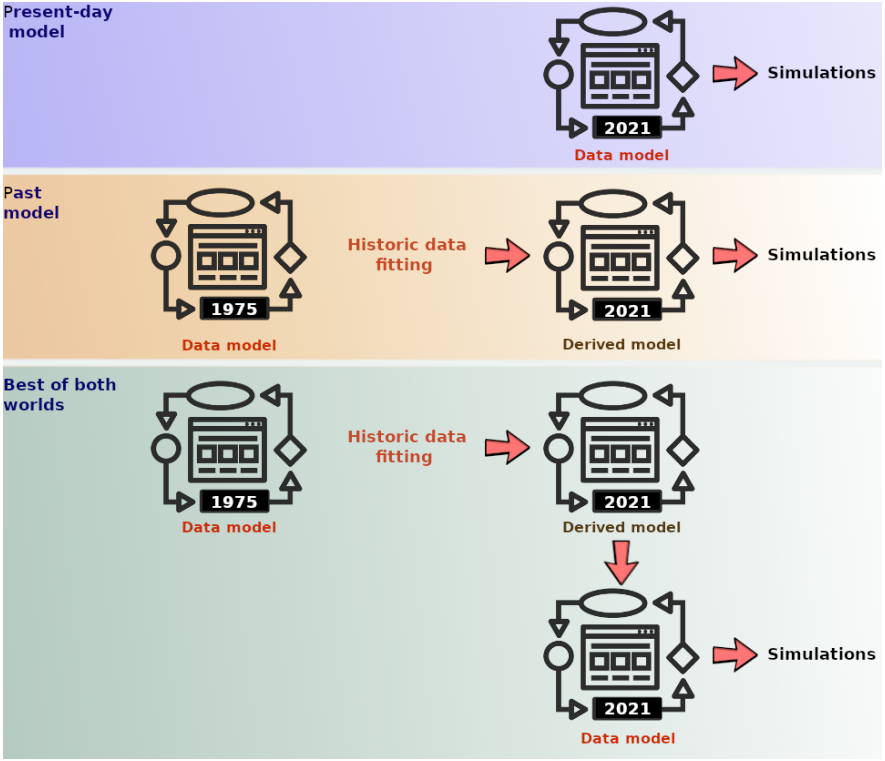
FAO 2007

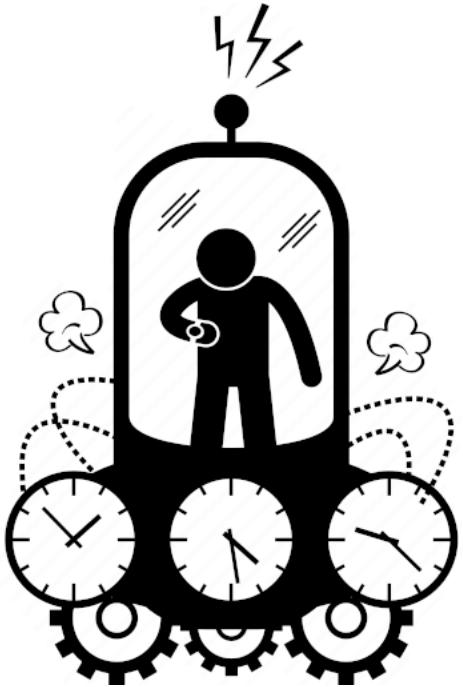
- recommendation given for each feature
- only as much as needed for critical dynamics
- feedbacks critical
- uncertainty means try multiple options

Define your ecosystem

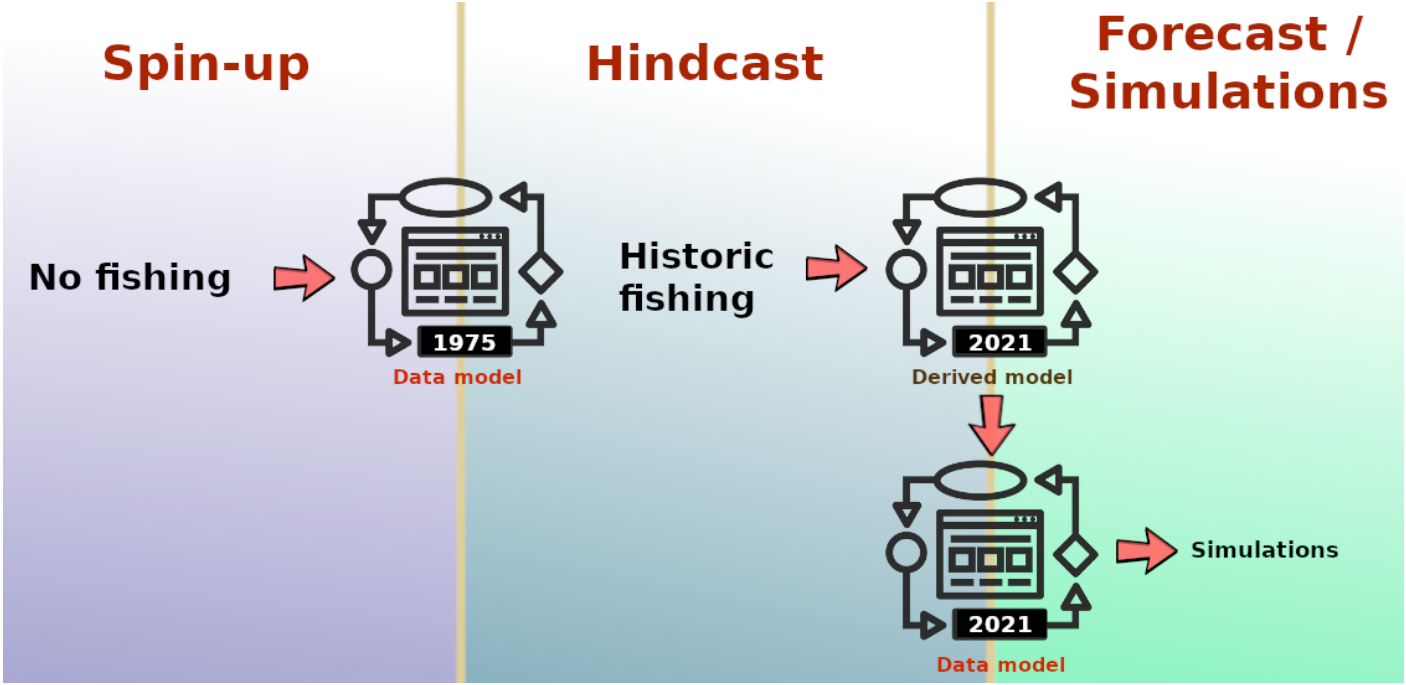
- Depends on the questions you want to answer
- If possible, choose the area to be contained in a natural oceanographic or biogeographic feature, with uniform climate & current system
- Larger area is better with many migratory species
- Mortality is dealt with explicitly in model dynamics rather than assumed and static
- Migrators / transients don’t respect regional jurisdictions

Define your period





Spin-up method



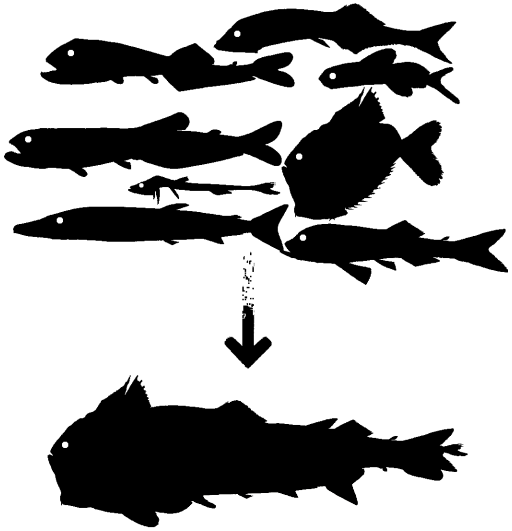
Define your functional groups

- Good reasons to aggregate functional groups
- Ignorance
  - Biomass, diet composition, functional responses within groups may be poorly understood or data unavailable
- Computational convenience
  - Run-time prohibits species-level representation

- Heuristic advantage
  - Too many functional groups makes it difficult to track through interactions and extract causes and consequences

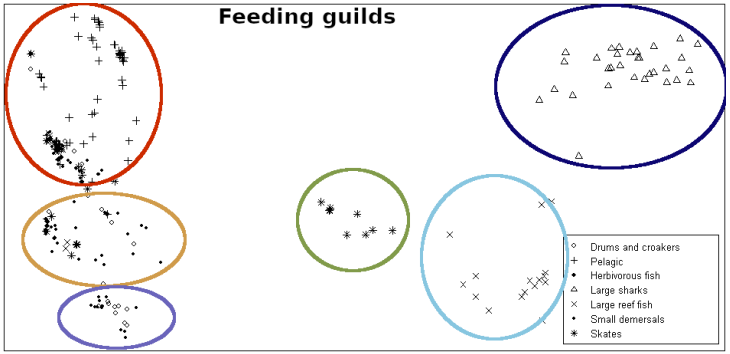
Define your functional groups : Rules of thumb

- Consider stock structure
- Diet, habitat preference, vulnerability to fishing, fishing interest, conservation interest are most important
- Don't aggregate if they have disparate diets, turn-over rates, or trophic levels
- Target resource species individually (**it will pay off**)



Define your functional groups Methods

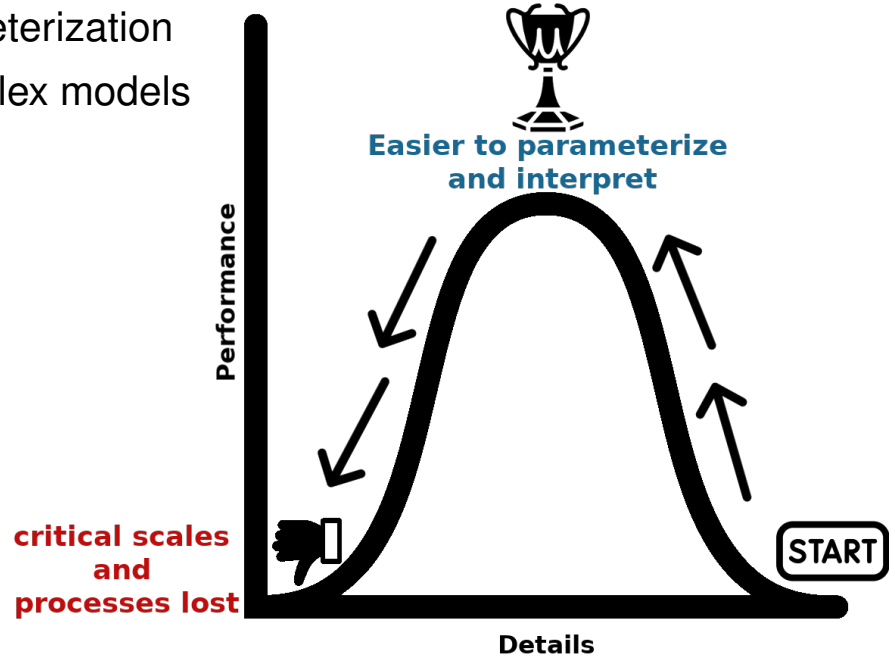
- Subjective / Intuition
- Rule-based
  - Diet
  - Habitat
  - Vulnerability
- Multivariate statistics
  - Cluster analysis1
  - Factor analysis2
  - Multidimensional scaling



MDS of stomach content data Gulf of California

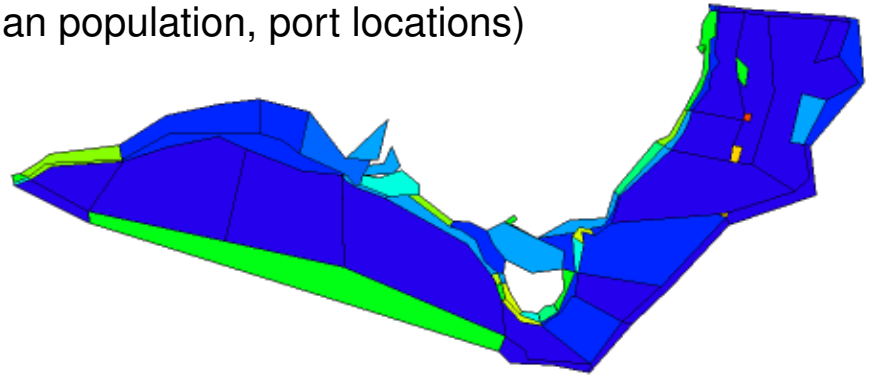
How many groups to use? Prescription VS Prediction

- More detail can be prescriptive not predictive
- Large models with lots of noisy data vs slim-line model with few precise data
- Detail vs. ease of parameterization
- Complex systems / complex models



Map design : Some useful spatial data

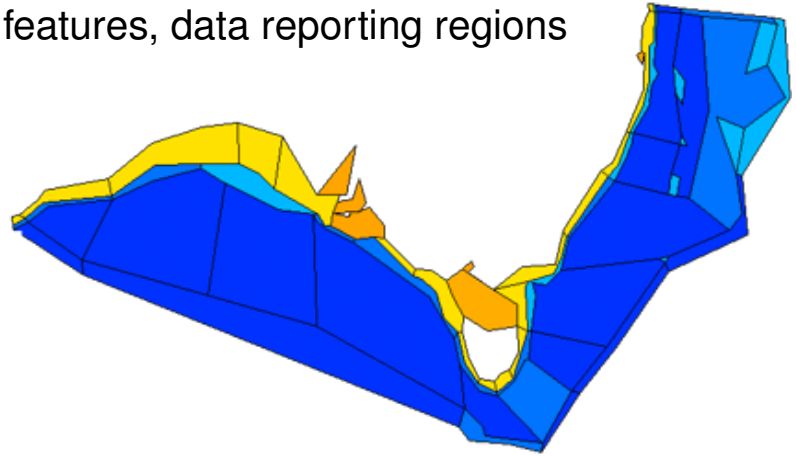
- Bathymetry & coastlines (can read it in directly)
- Habitat type / substrate composition
- rough, flat, soft, canyon & biogenic
- Locations of new & existing marine reserves
- Ancillary information (human population, port locations)
- Fishing areas / depth



These data will be integrated to build your map based on physical oceanography, biogeography, human activities and data availability

Map design : Polygonal geometry

- Polygon matching physical and ecological features (e.g. bioregionalisation)
- Homogeneous areas = large cells, heterogeneous areas = small cells
- Not so easy to declare but may be more meaningful (detail where needed)
- Can conform to biogeographic features, data reporting regions
- Computationally efficient



Same issues vertically as horizontally

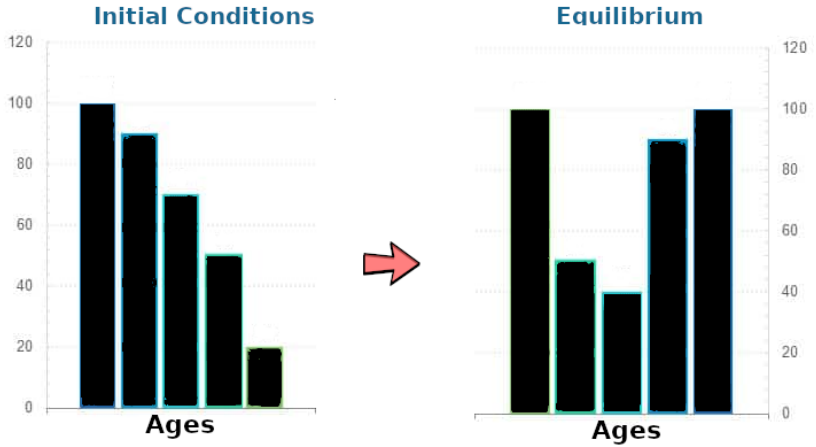
Map design : spatial resolution

- Lower variance shown through time and space
- Less heterogeneous environment and fewer refugia
- Increased self-simplification of trophic web
  - (extinction and exclusion – no spatial refuge)
- Loss of spatial segregation of predator/prey
- Increased boundary condition effects
- Altered predictions of response to perturbation

True for all ecosystem models

State conditions

- Initial biomass distribution:
  - Important for spatial segregation of predator and prey
  - Adult locations important for recruitment
- Equilibrium position
  - Initial structure
  - Life-spam



Ontogenetic biomass distribution

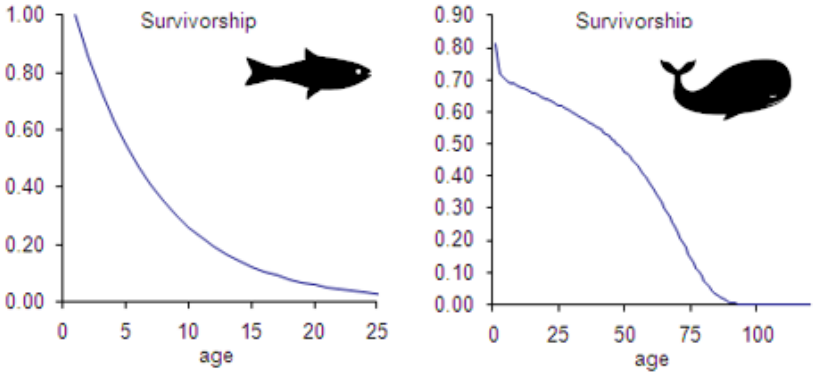
Choosing a survival-at-age model

- The simplest model for predicting numbers at age.

$$N_t = N_{t-1}e^{-z}$$

- Not appropriate for mammals / birds
- Siler's competing risk model (more generic)

$$S_t = S\_Juv_{juvenile,t} \cdot S\_Mat_{,t} \cdot S\_Senescence_t$$



Thank You

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