

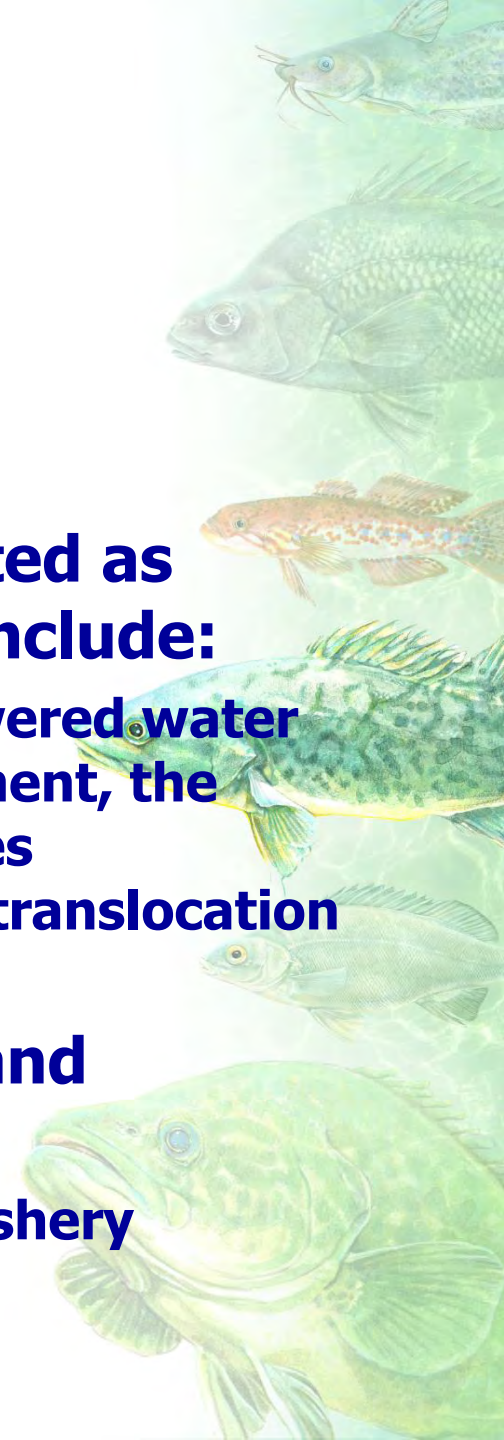
Murray cod Modelling to Address Key Management Actions

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DSE Arthur Rylah Institute, Victoria**



Project Motivation

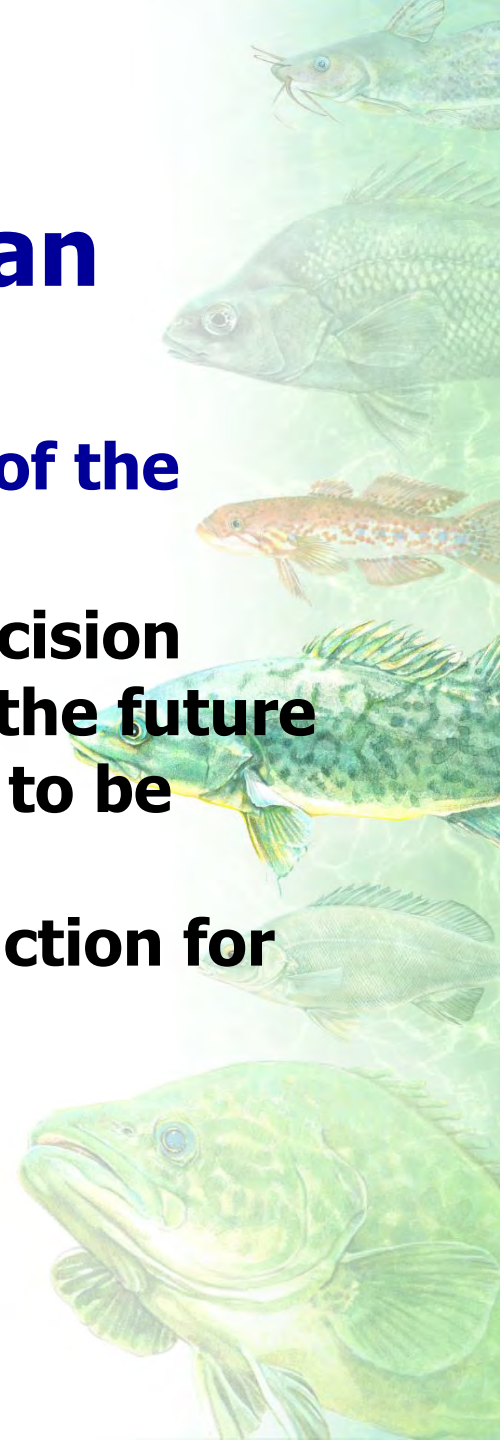
- **Murray cod is an iconic species**
- **Murray cod populations declined, listed as vulnerable EPBC Act 1999; reasons include:**
 - **flow regulation, habitat degradation, lowered water quality, manmade barriers to fish movement, the introduction of alien fish species, fisheries exploitation, the spread of diseases and translocation and stocking of fish.**
- **Murray cod sustain an important inland recreational fishery**
 - **balance between species recovery and fishery requirements**



National Recovery Plan

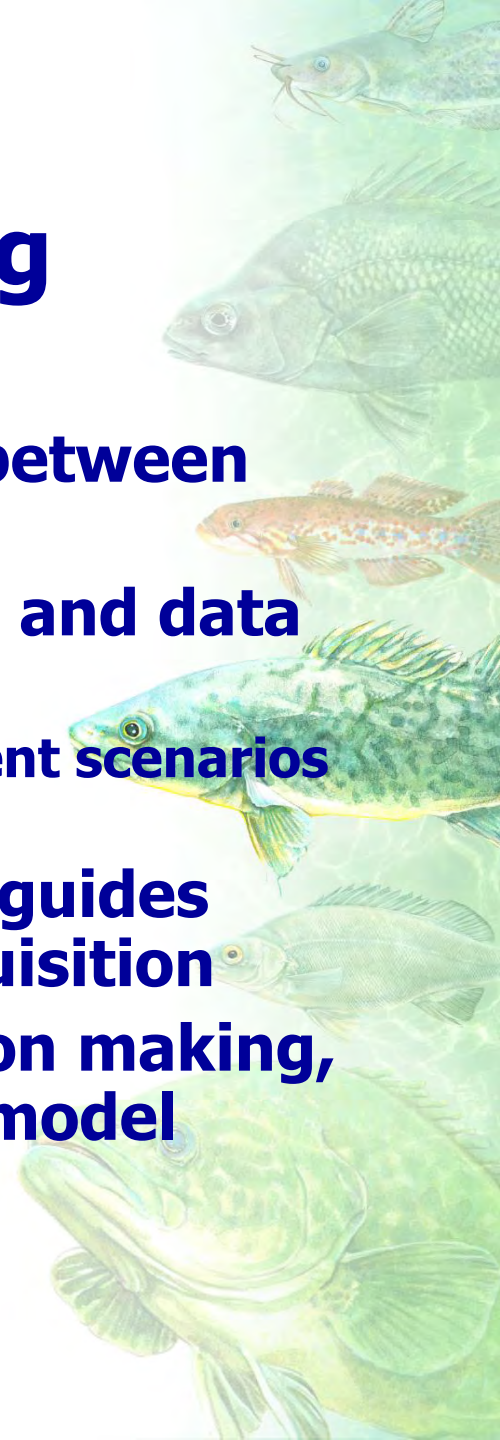
This project will help meet objective 1 of the national Murray cod recovery plan

- **Action 1.12.: Develop appropriate decision support tools and models that allow the future management actions for Murray Cod to be evaluated within a risk management framework. This is a 'High' priority action for the recovery plan.**



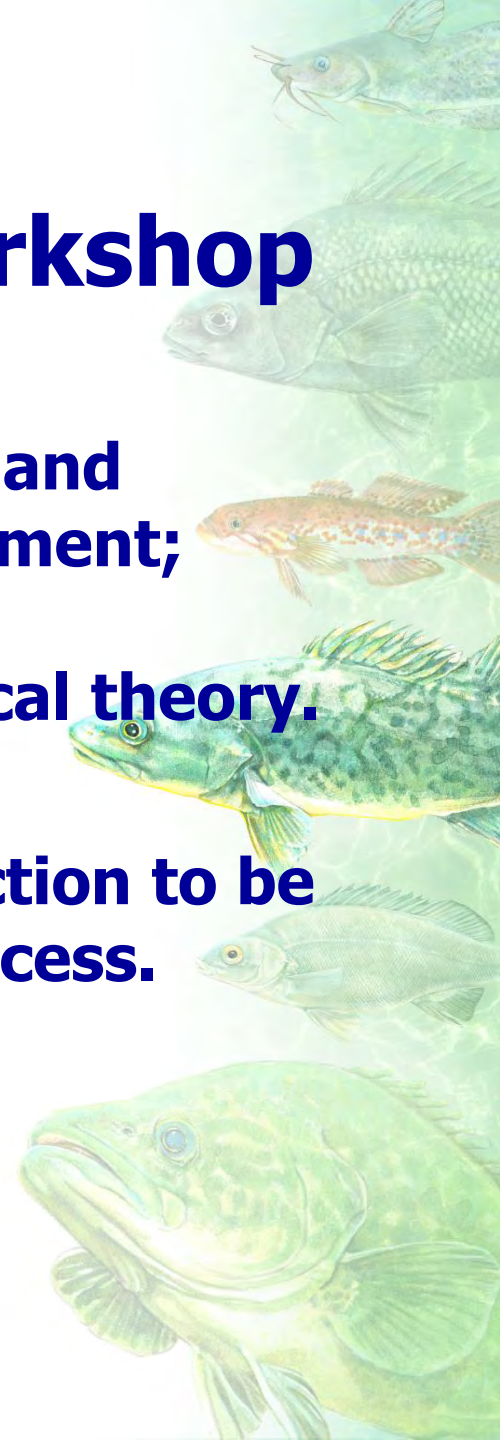
Benefits of modelling

- **Formally articulates the interaction between management, ecology and data**
- **Uncertainty in management, ecology and data can be included**
 - **allowing the risk of particular management scenarios or ecological ignorance to be examined**
- **Addressing gaps in understanding & guides future investment in knowledge acquisition**
- **Creates a framework for clear decision making, monitoring and data collection, and model update**



Murray cod modelling workshop

- **To address uncertainty in: biological and ecological knowledge; data; management; environmental; resource exploitation/extraction; and ecological theory.**
- **The specific interests of each jurisdiction to be identified through this workshop process.**



Murray cod modelling workshop

Participants

- **Managers**
 - Management concerns/requirements
- **Ecologists/Biologists**
 - Ecological issues
- **Modellers**
 - Type of modelling
- **Agreement on risk based approach**



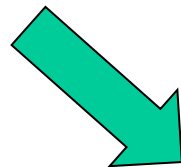
Murray cod modelling workshop

Ecology

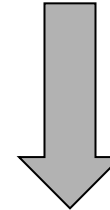


Ecological management 'levers':

- Habitat retention & rehabilitation
- Passage
- Water quality management
(cold water, sedimentation, nutrients etc)
- Protected areas
- Flow management

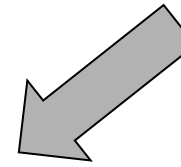


Biology



Biological management 'levers':

- Size limits
- Bag limits
- Closures, spatial & temporal
- Set line controls
- Stockings
- Predators – alien species



Population Model



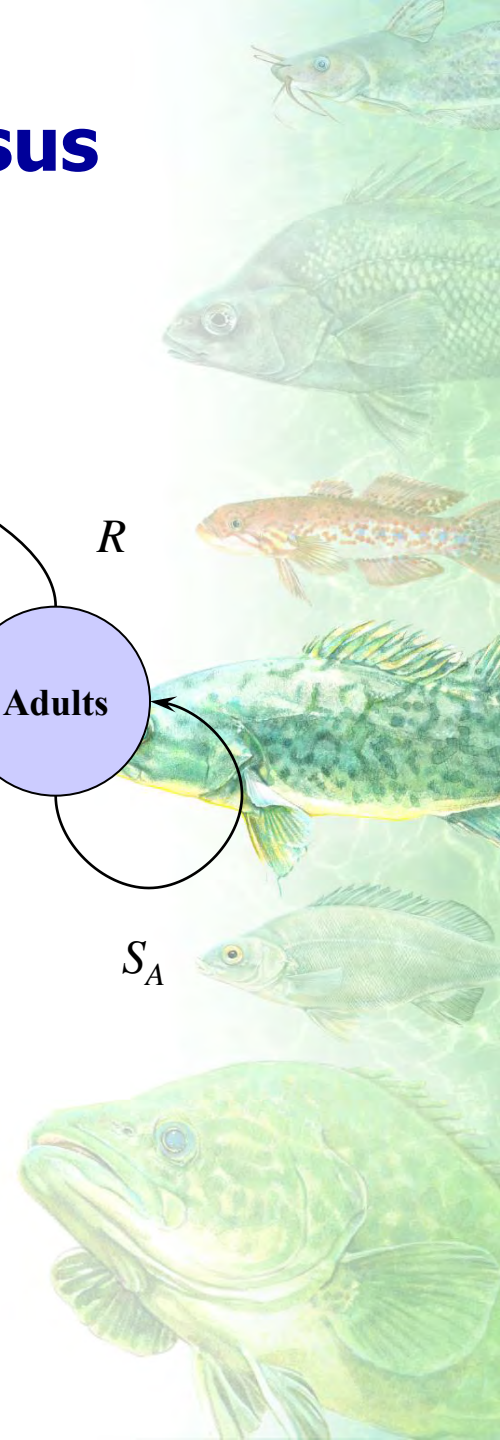
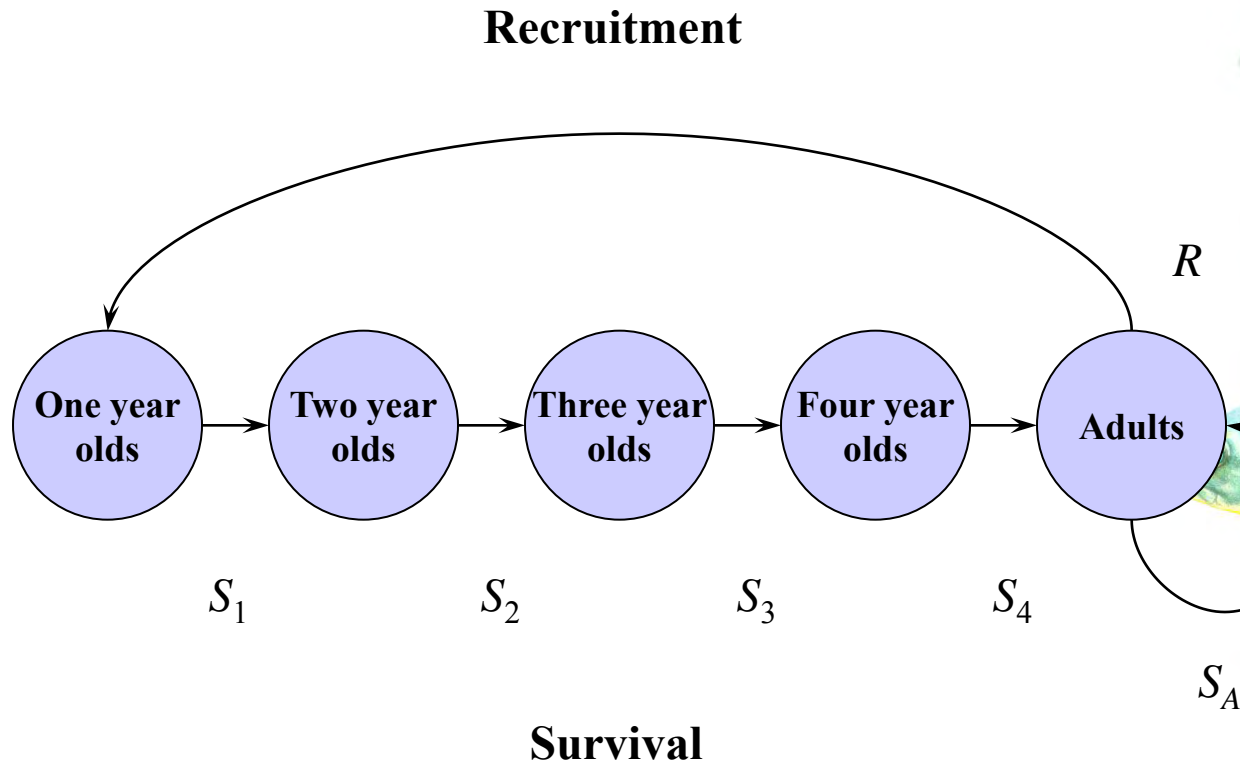
What will the model do?

The model will be designed to

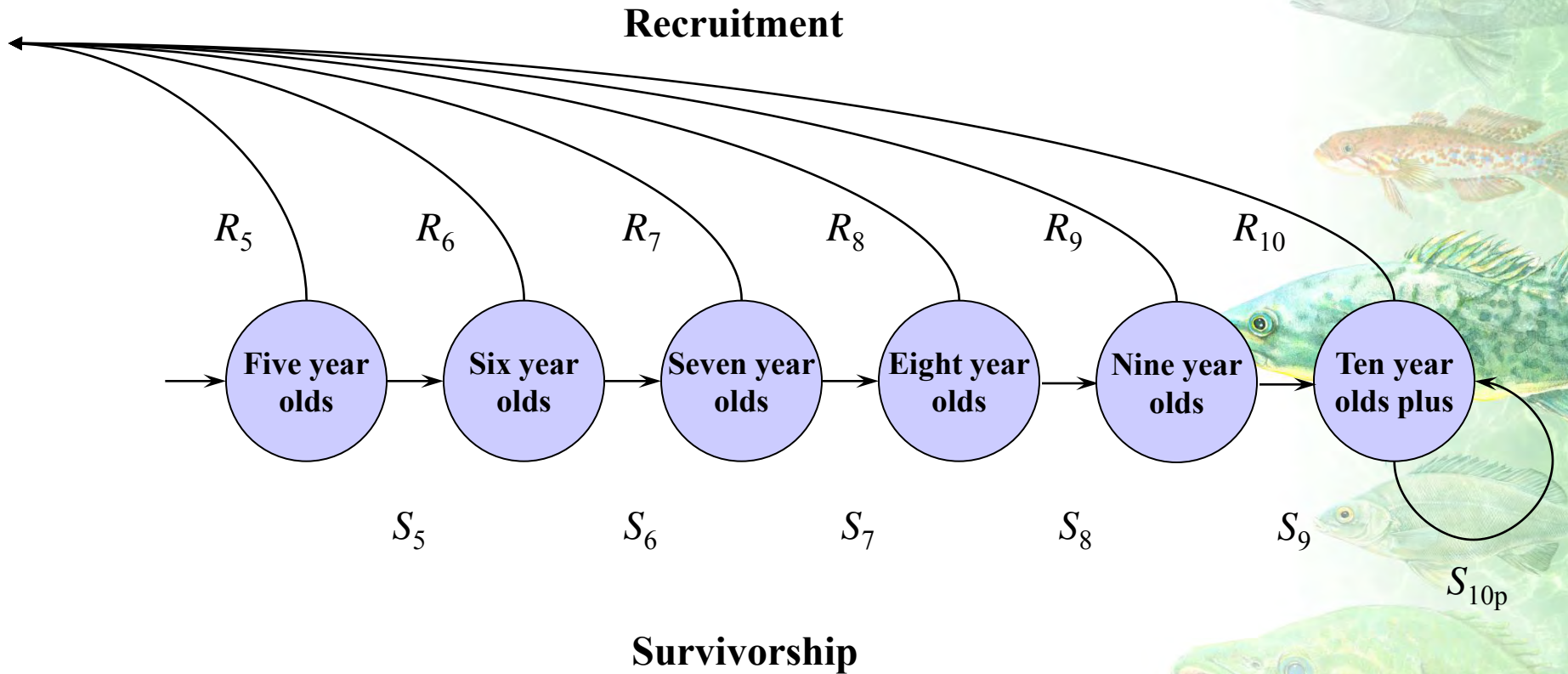
- **Examine a range of alternate management options (i.e. variety of scenarios discussed at the Modelling Workshop)**
- **Risk analysis framework**
- **Flexibility to include new questions/concerns**



Murray cod model consensus

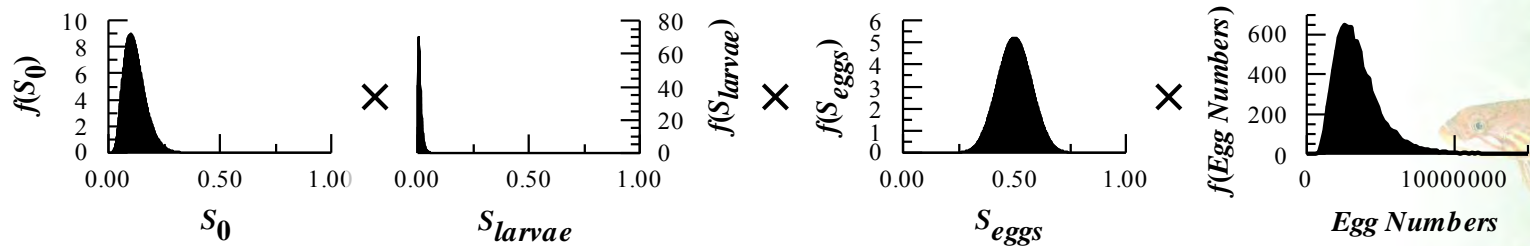


Life history of adult Murray cod

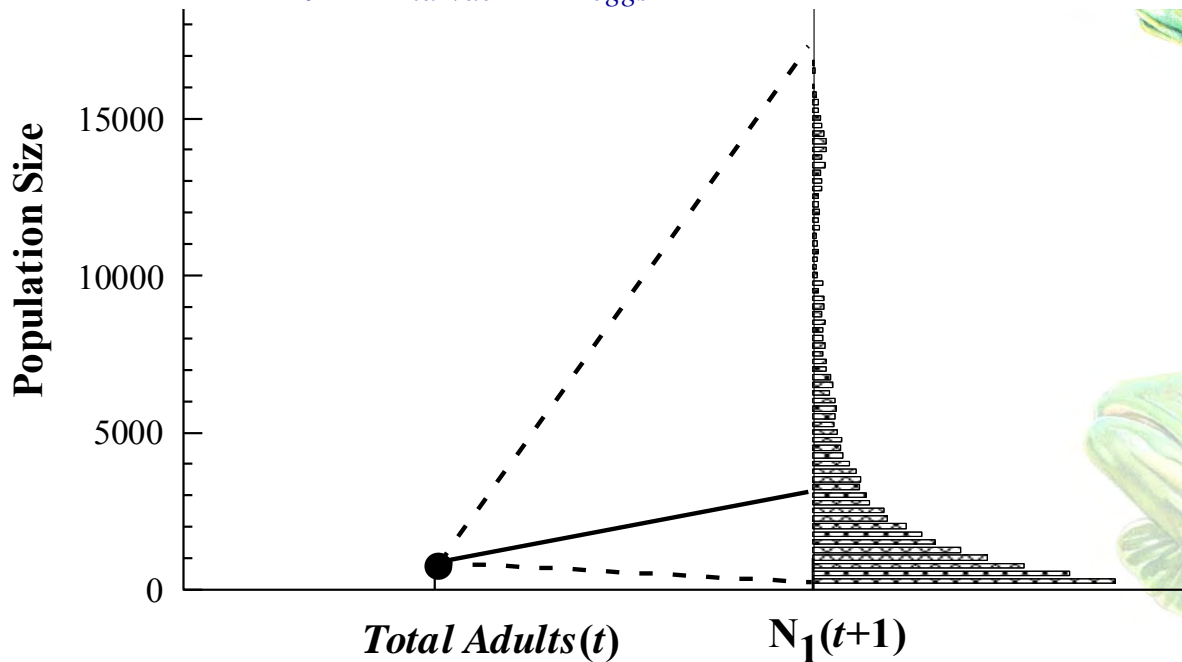


Modelling demographic & environmental variation in recruitment of Murray cod

850 Adults at time t

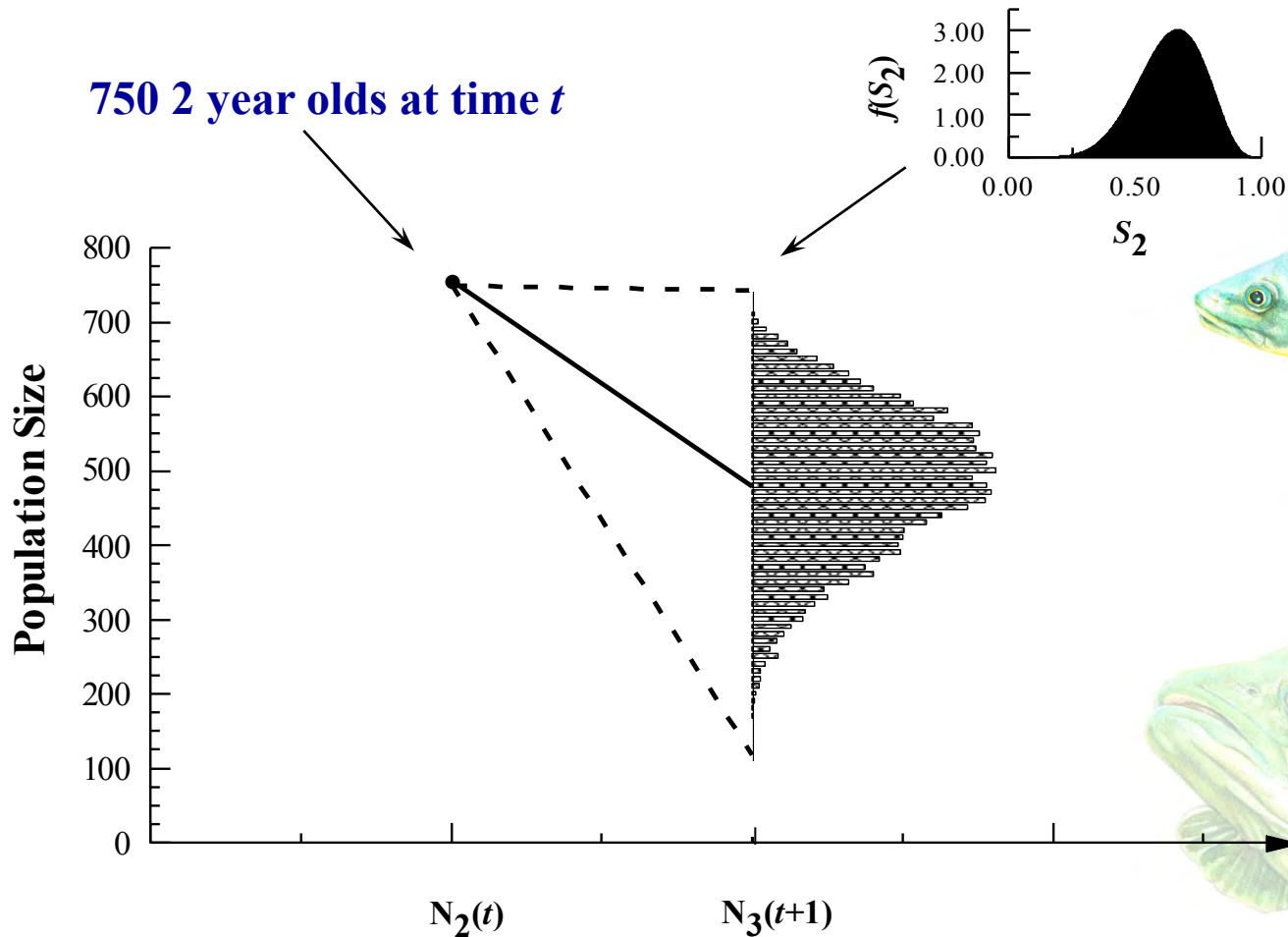


$$N_1(t+1) = \text{Poisson}(S_0(t) \times S_{larvae}(t) \times S_{eggs}(t) \times \text{Egg Numbers}(\text{Total Adults}(t)))$$

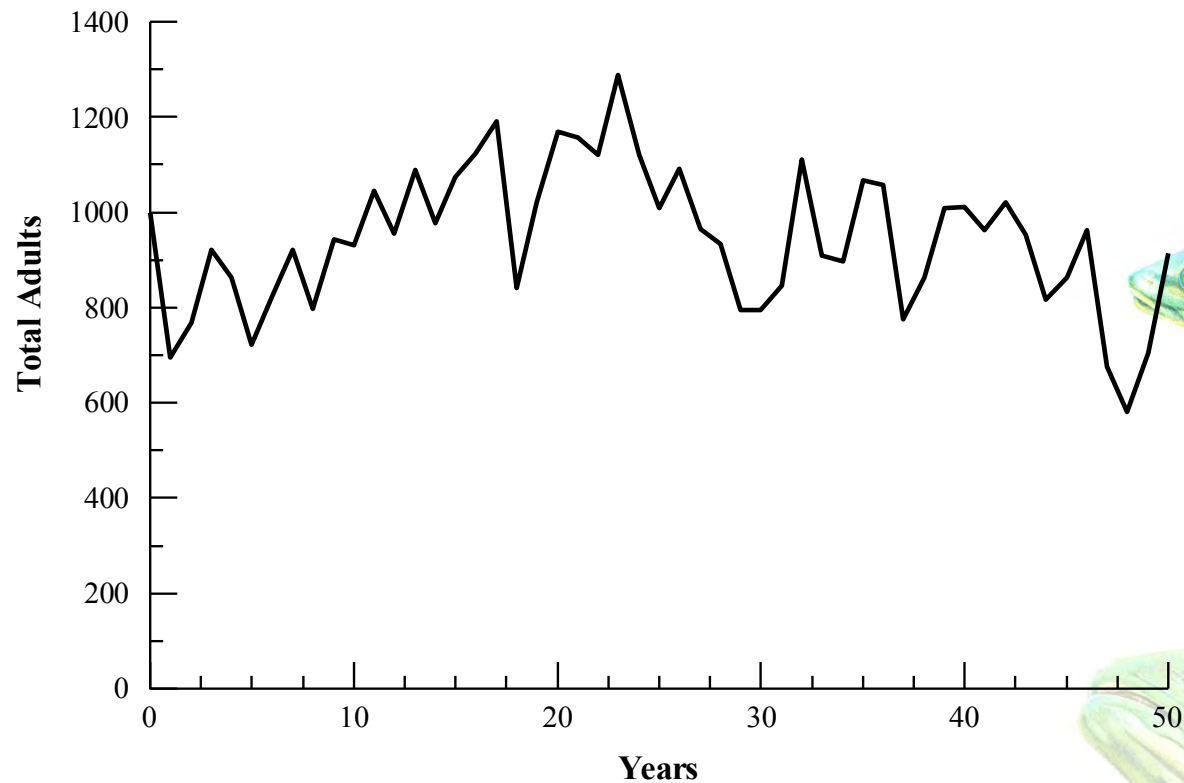


Modelling demographic & environmental variation in survival of Murray cod

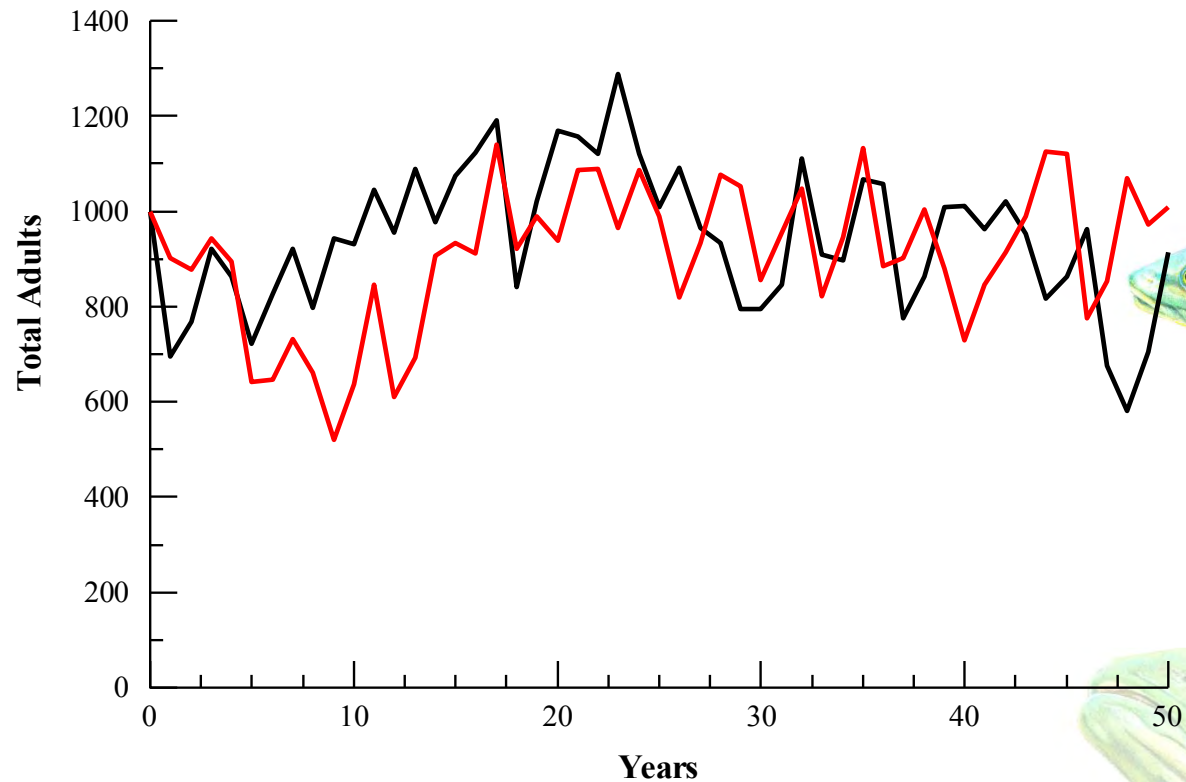
$$N_3(t+1) = \text{Bin}(N_2(t), S_2(t))$$



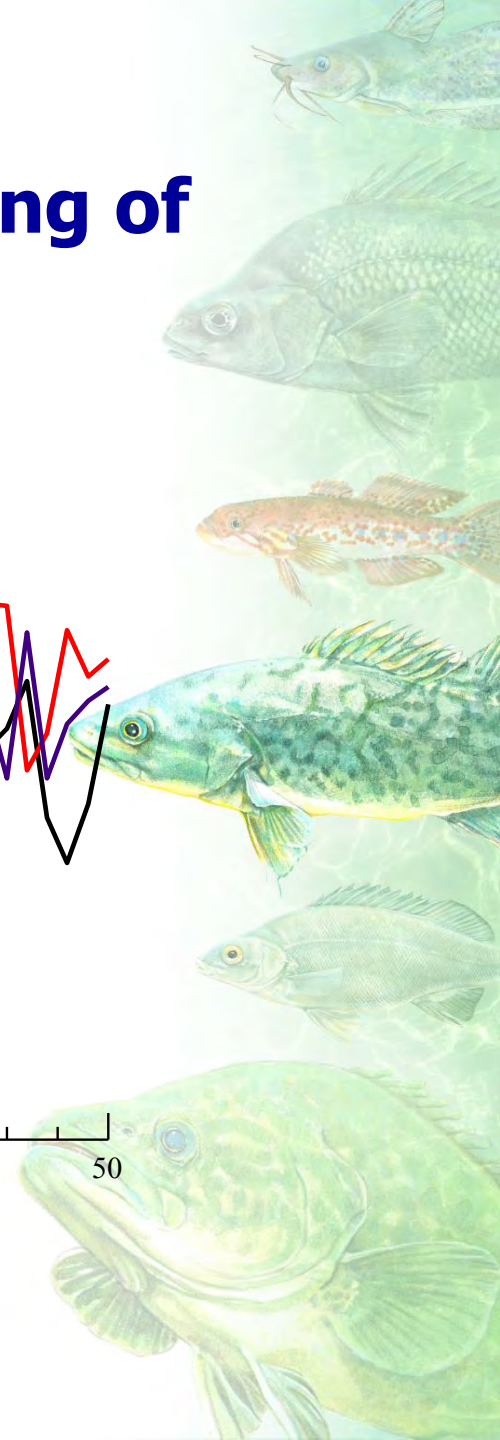
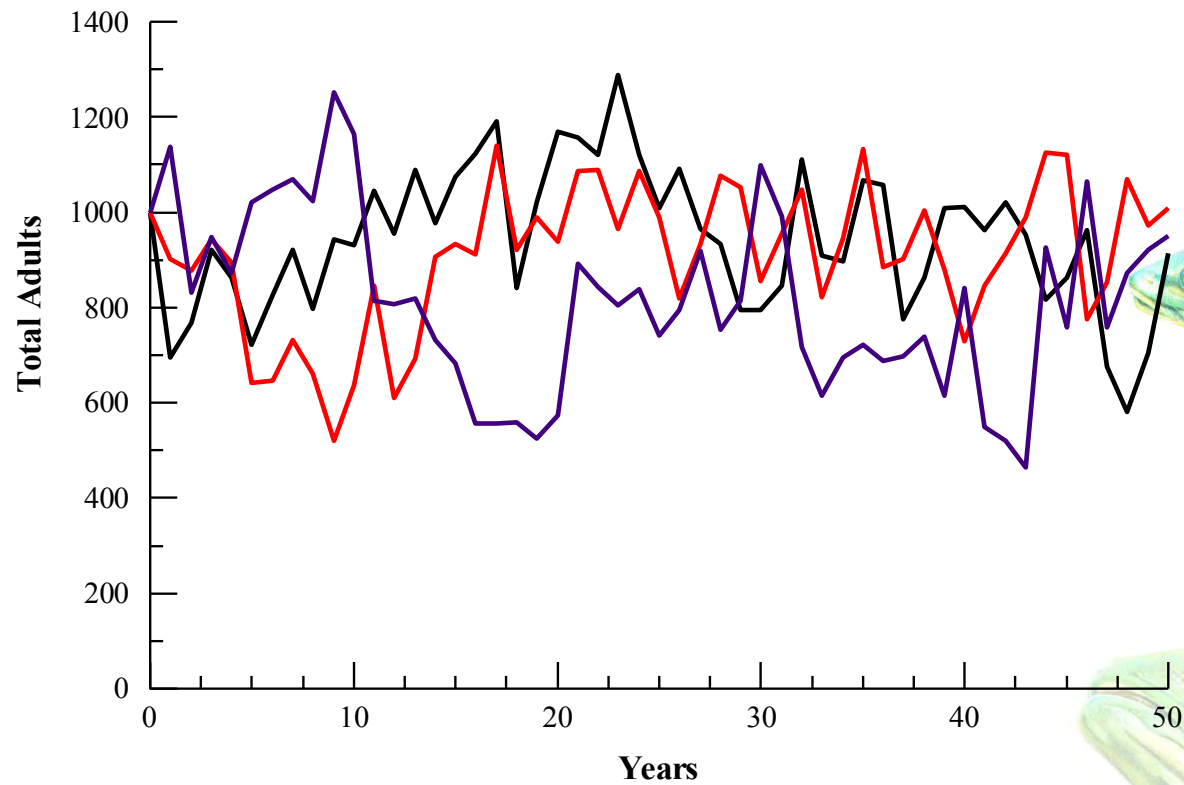
Stochastic Population Modelling of Murray cod



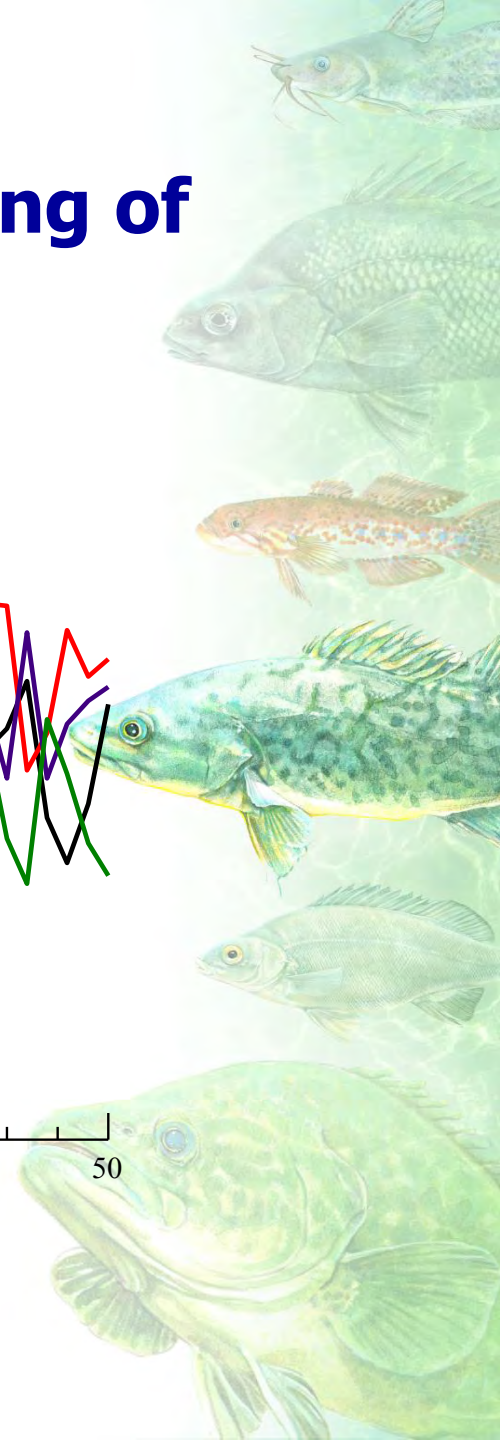
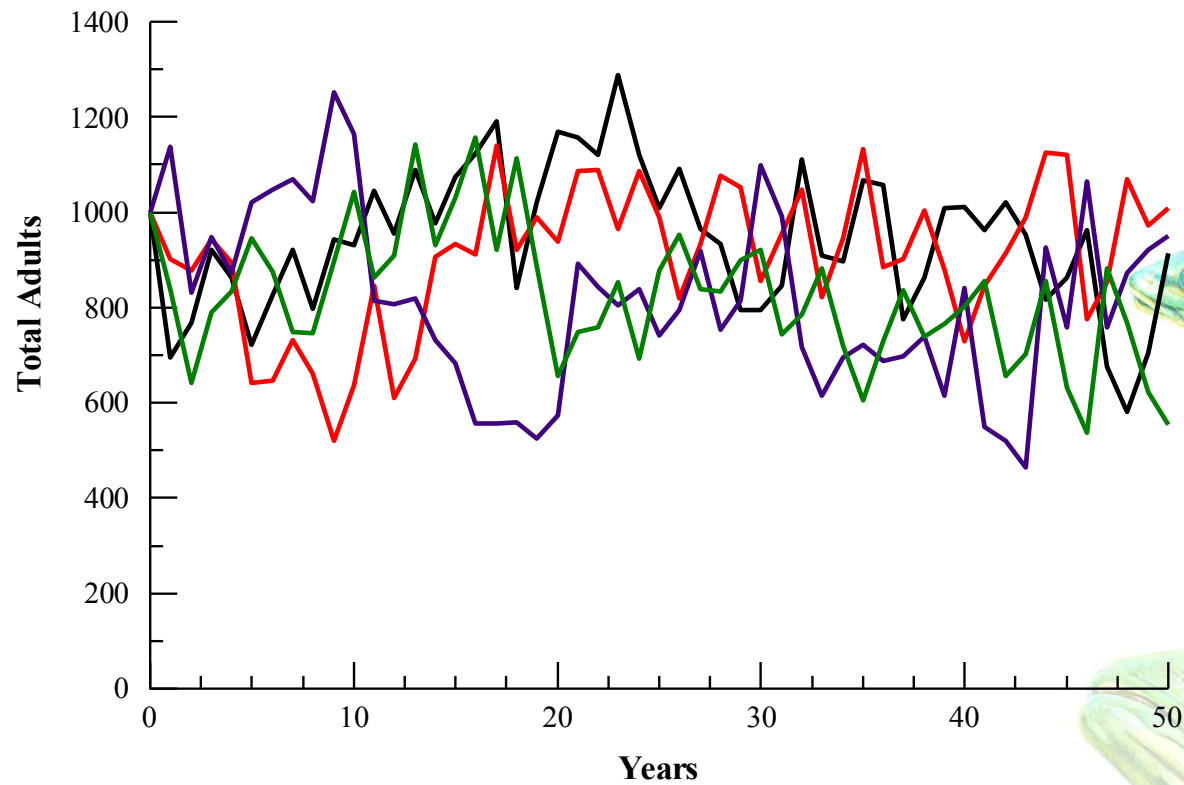
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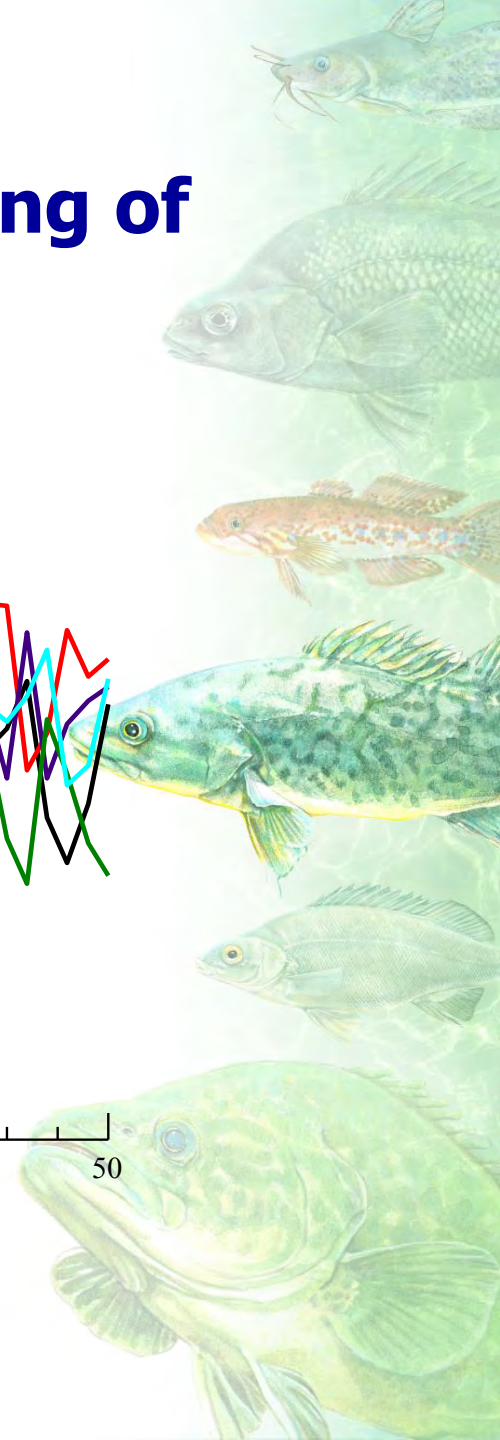
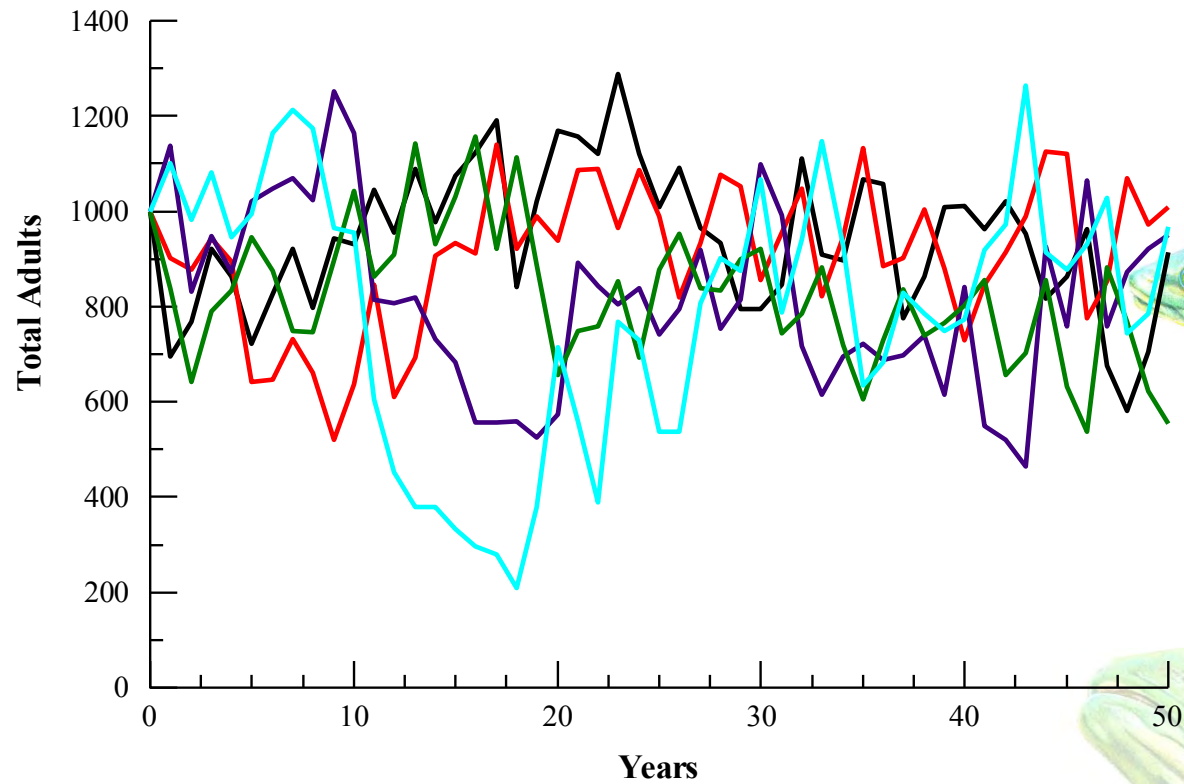
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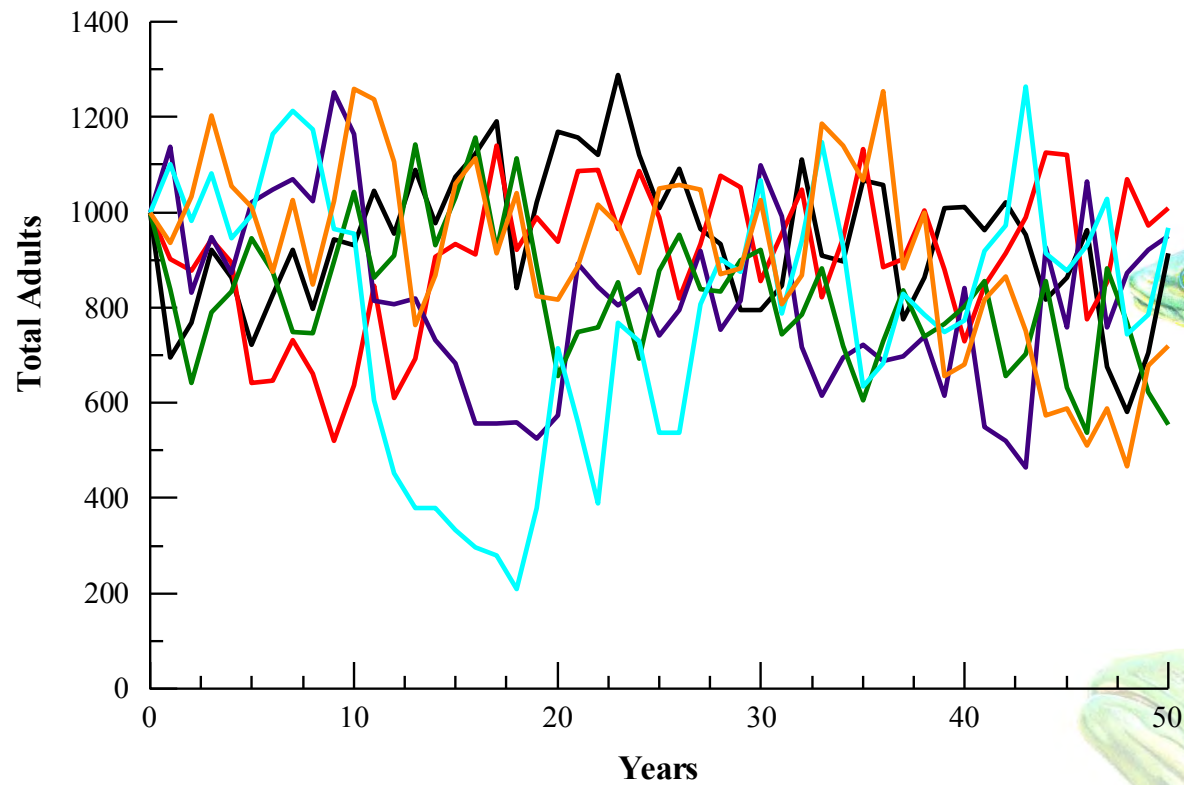
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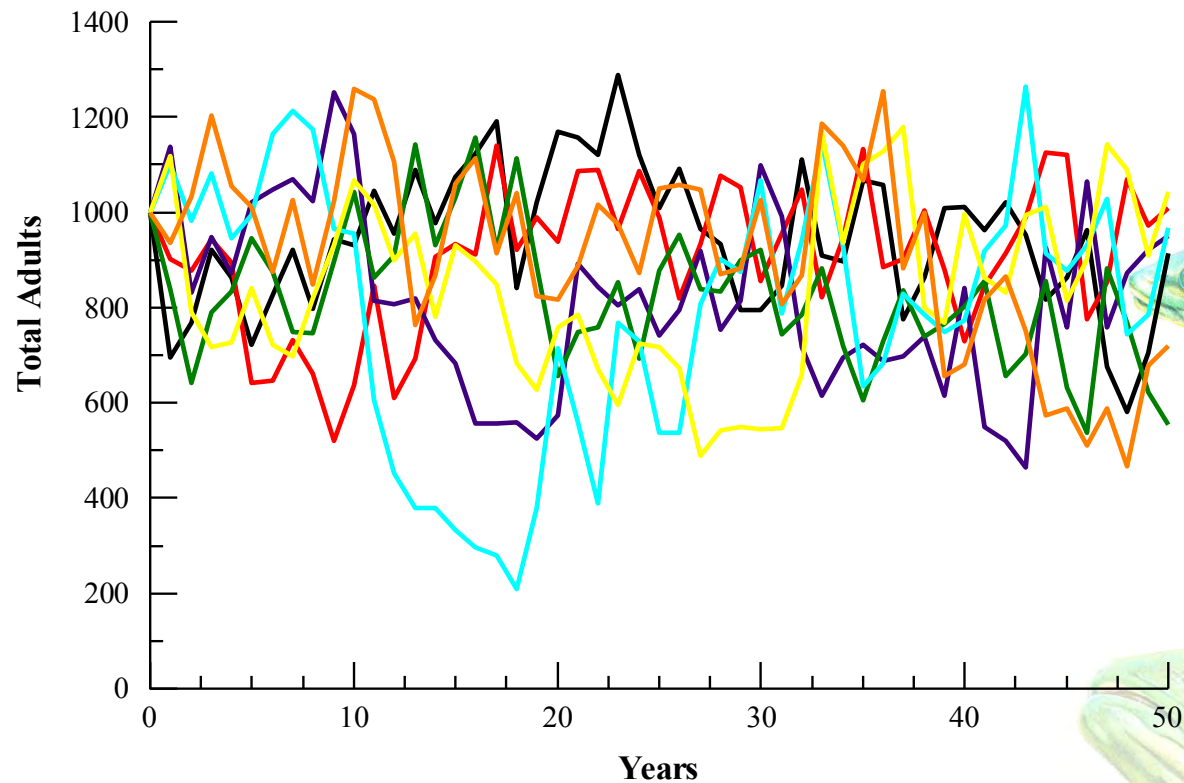
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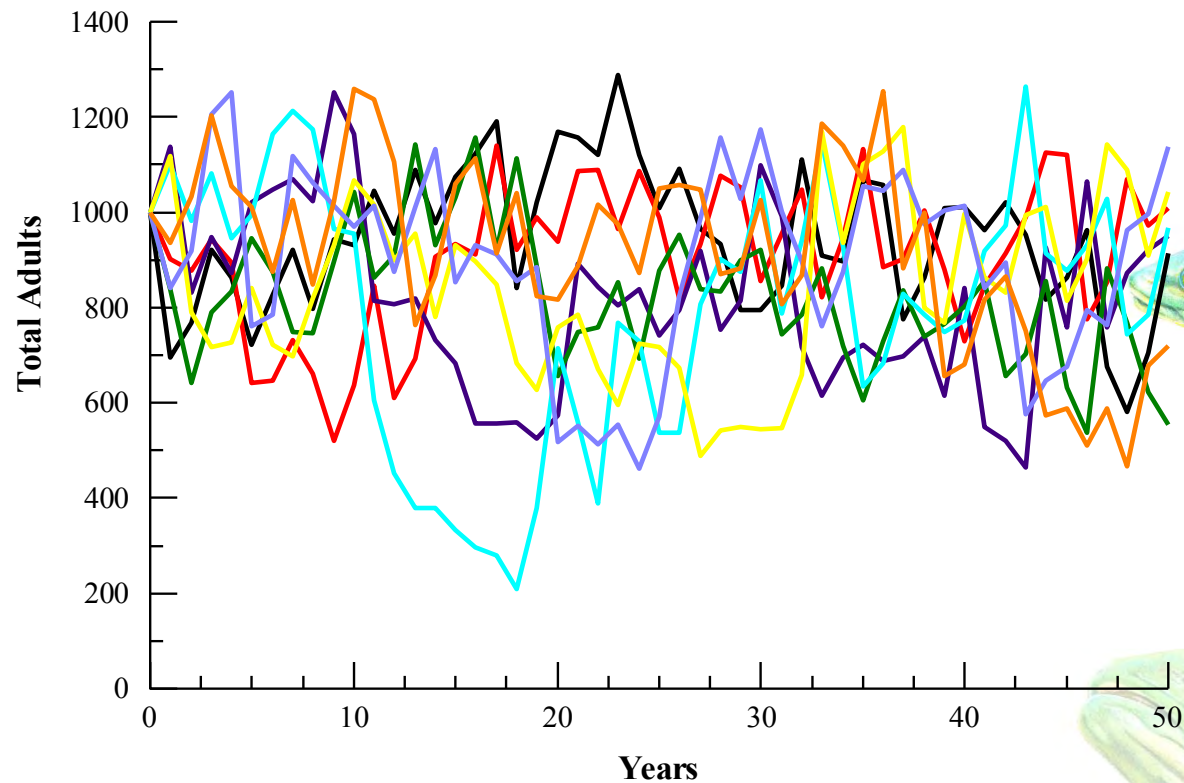
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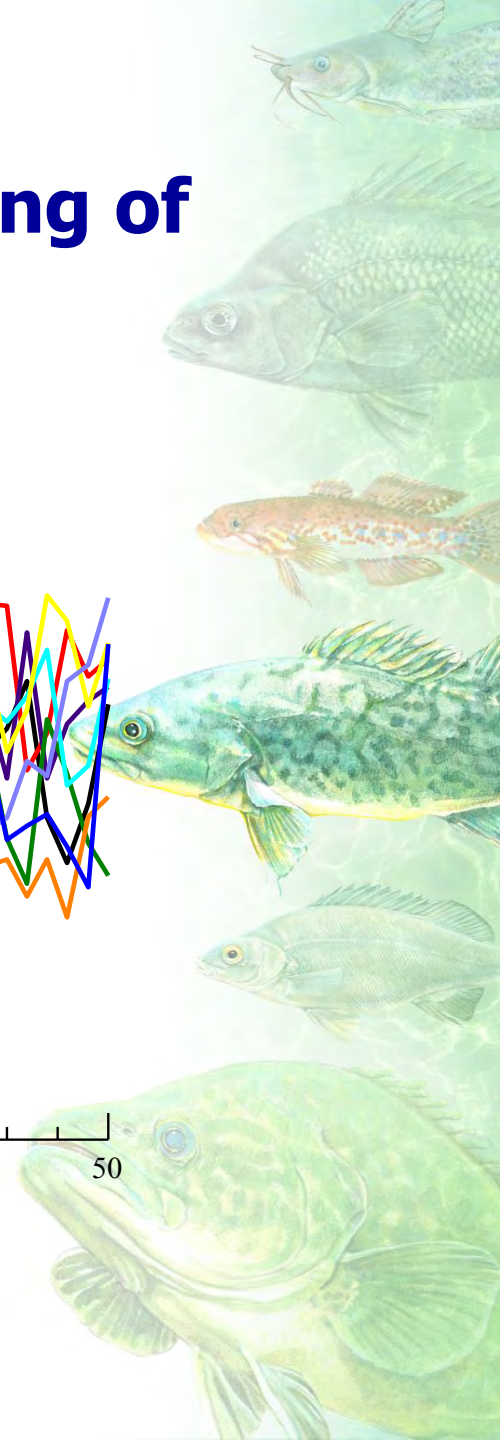
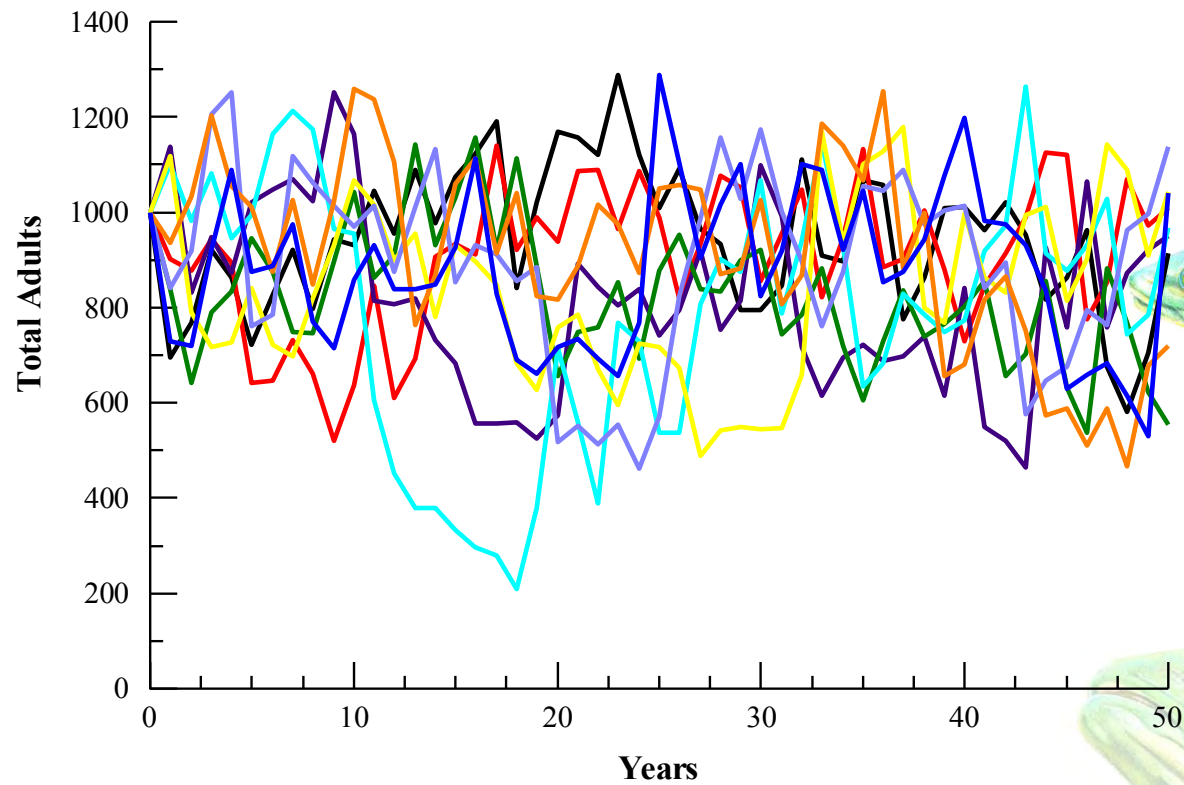
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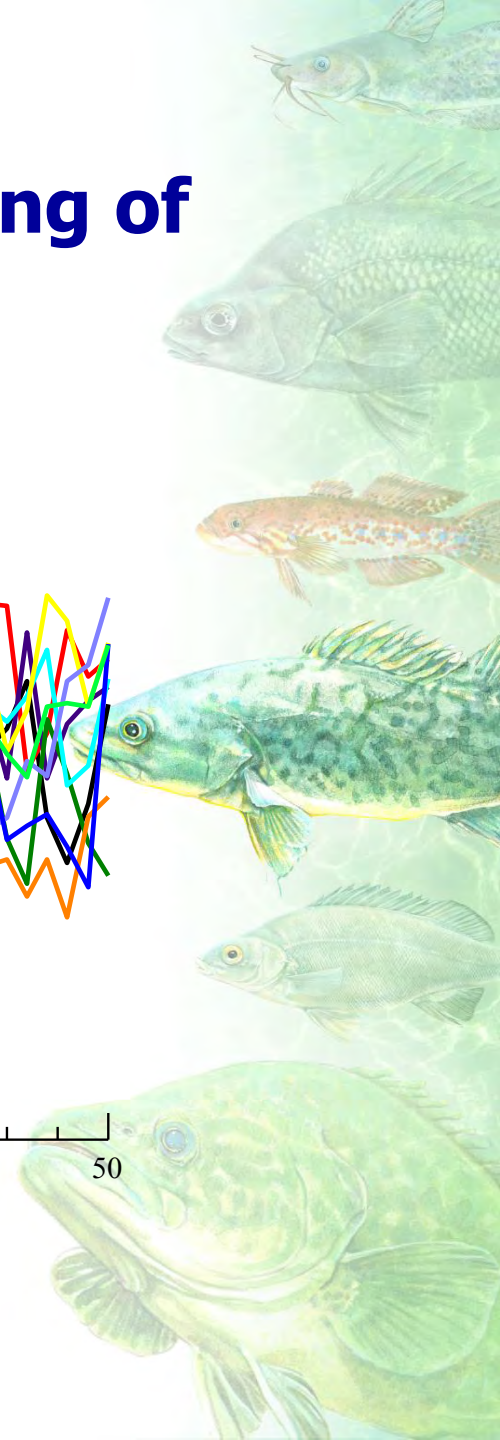
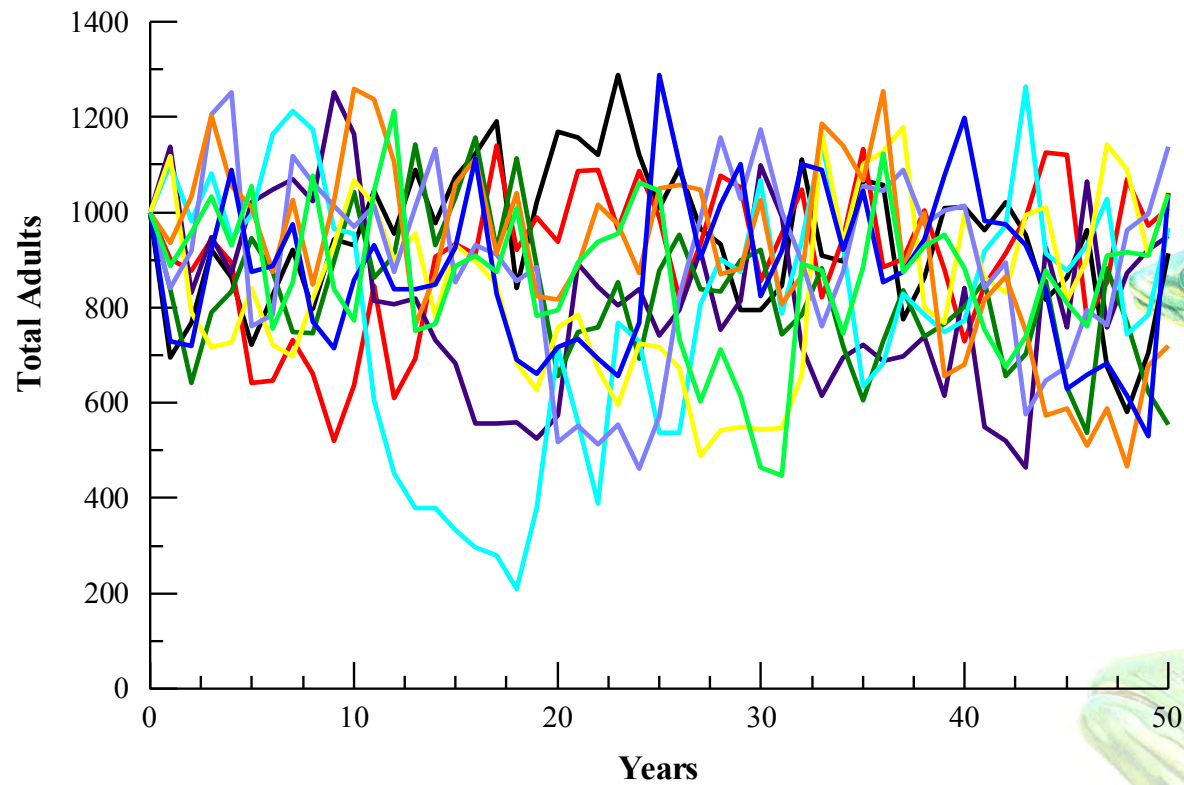
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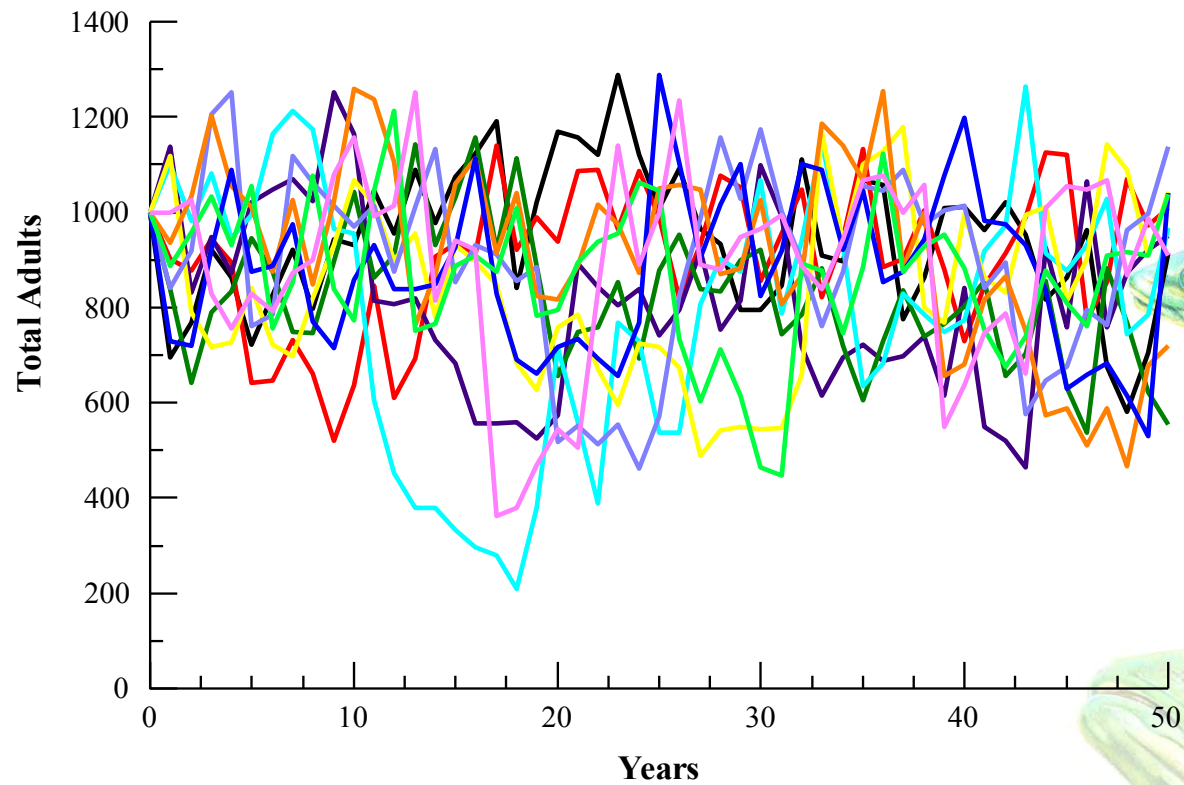
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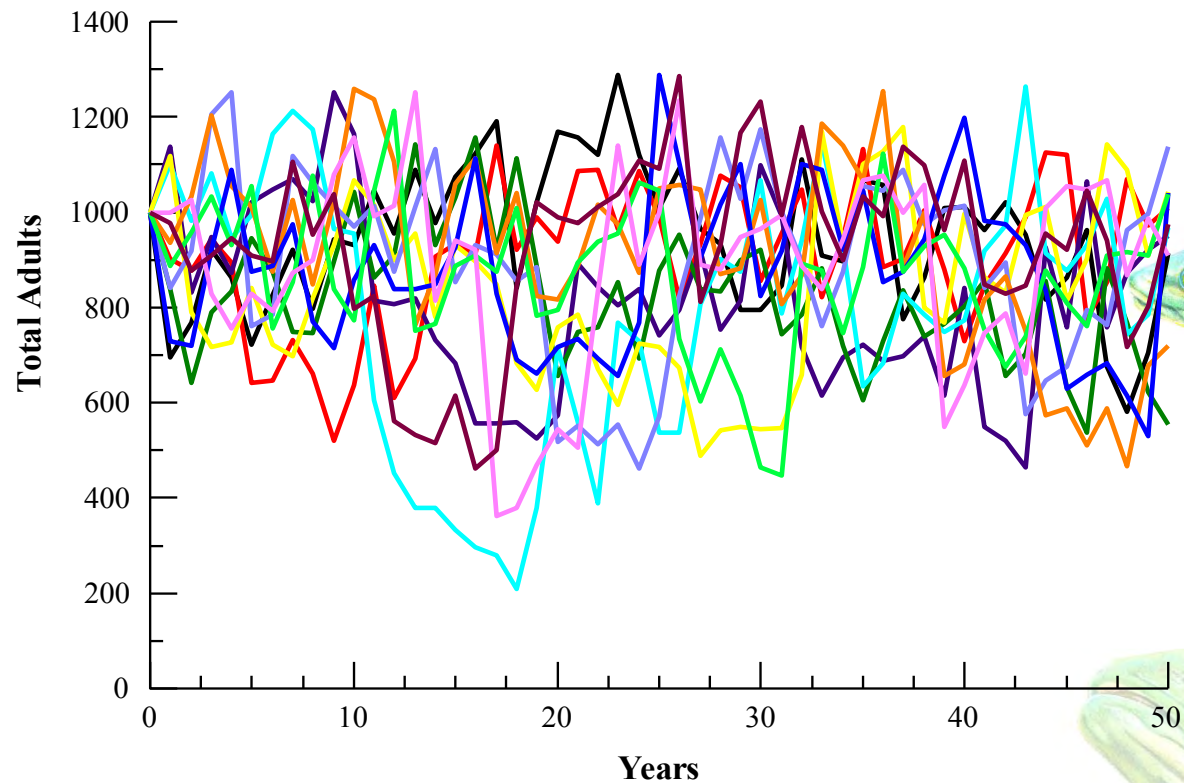
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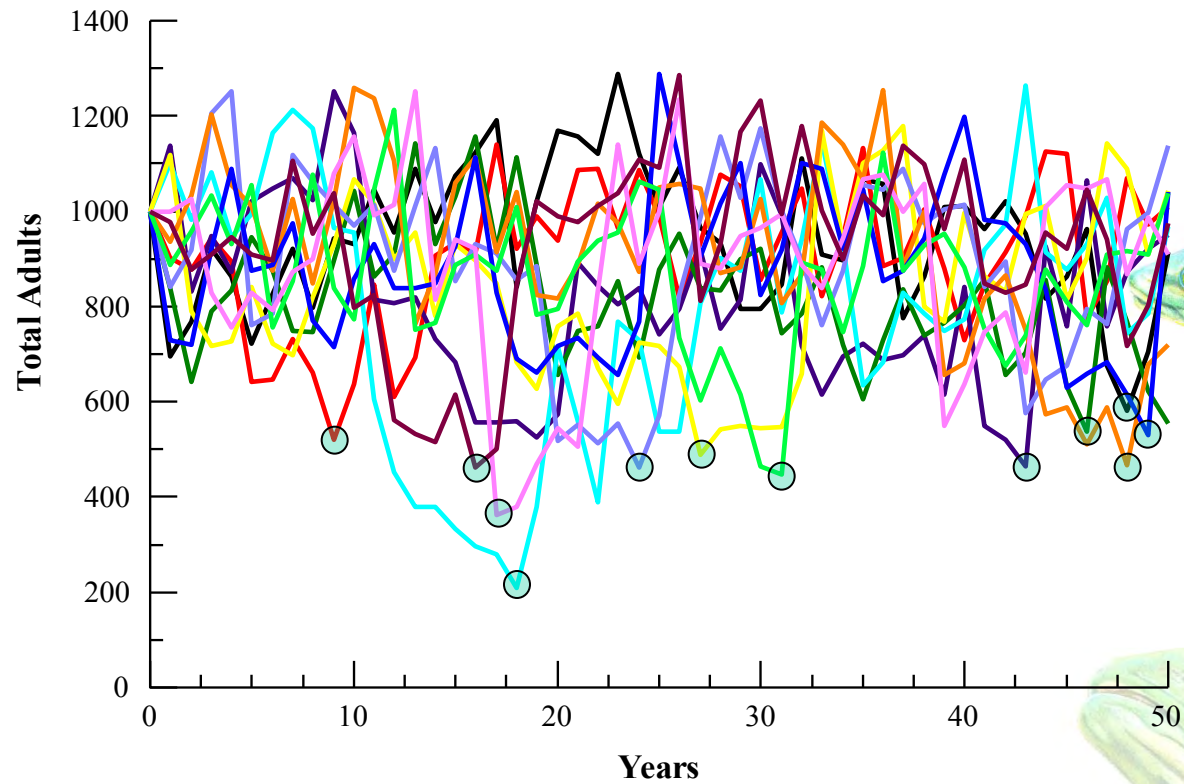
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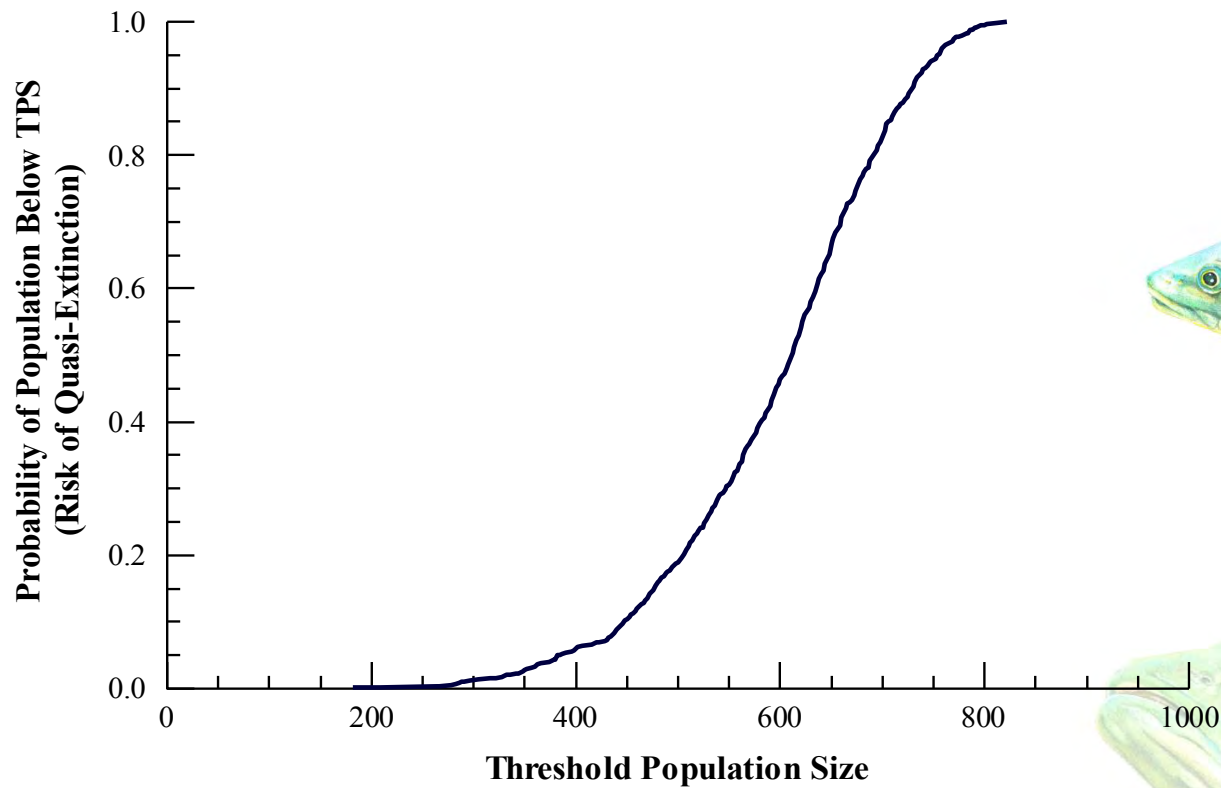
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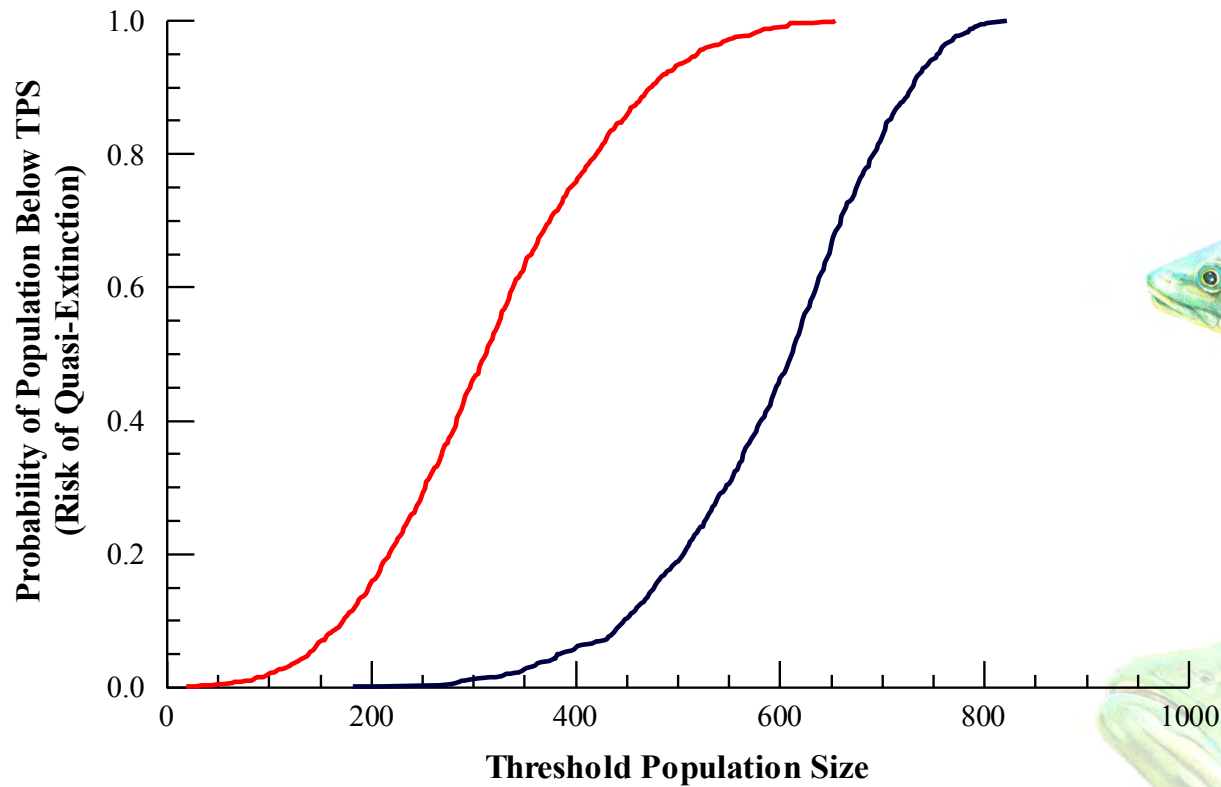
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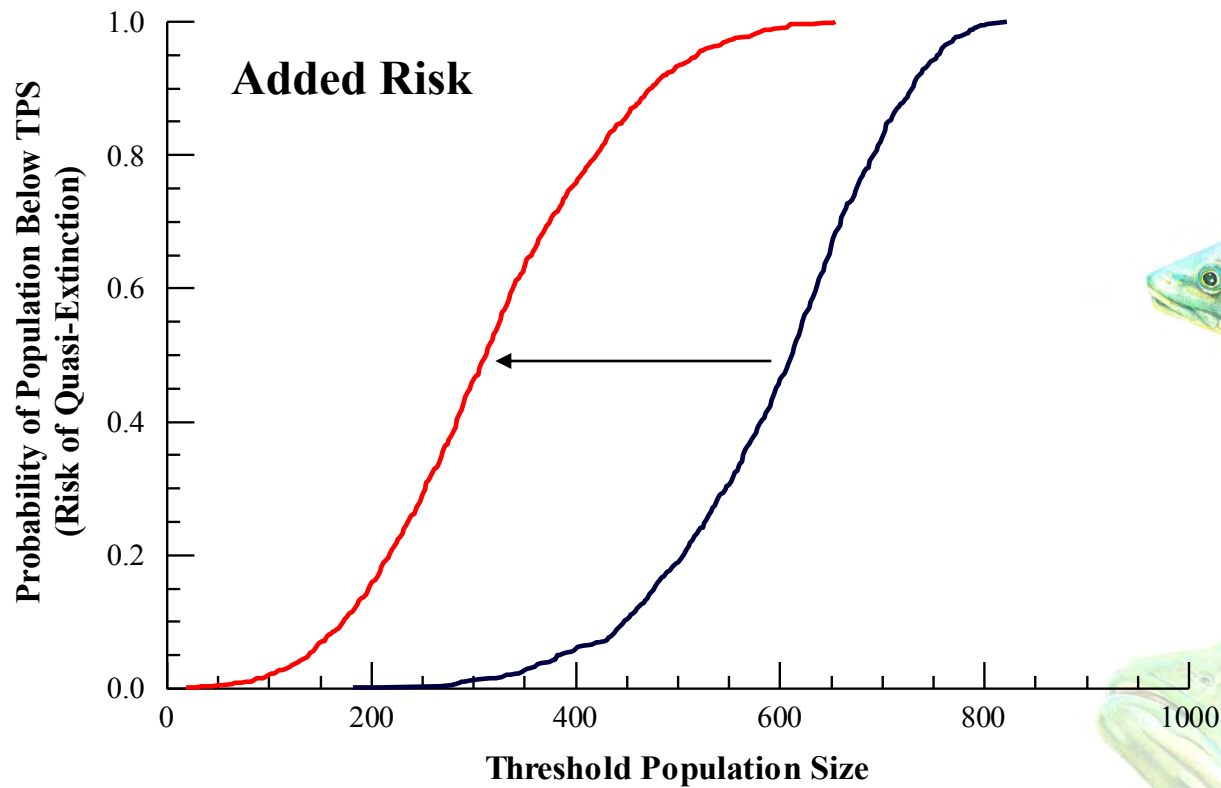
Stochastic Population Modelling of Murray cod – Risk Assessment



Stochastic Population Modelling of Murray cod – Risk Assessment



Stochastic Population Modelling of Murray cod – Risk Assessment



Stochastic Population Modelling of Murray cod – Risk Assessment

Scenario	Value	Absolute difference	Percentage change
No fishing	593		
Slot@600-1000	418	-175	-29.52
10%	398	-195	-32.86
700+20%	384	-210	-35.34
Slot@500-1000	314	-280	-47.10
700+30%	302	-292	-49.16
600+20%	273	-321	-54.06
Inc+20%	241	-352	-59.39
20%	176	-417	-70.28
600+30%	162	-432	-72.73
Dec+20%	124	-470	-79.18
Inc+30%	74	-520	-87.59
30%	59	-535	-90.10
Dec+30%	37	-556	-93.77

Where to

- **Refine the model**
- **Run the scenarios**
- **Analysis of scenarios**
- **Report stakeholders (2nd workshop)**
- **Establish model within framework for Murray cod management**

