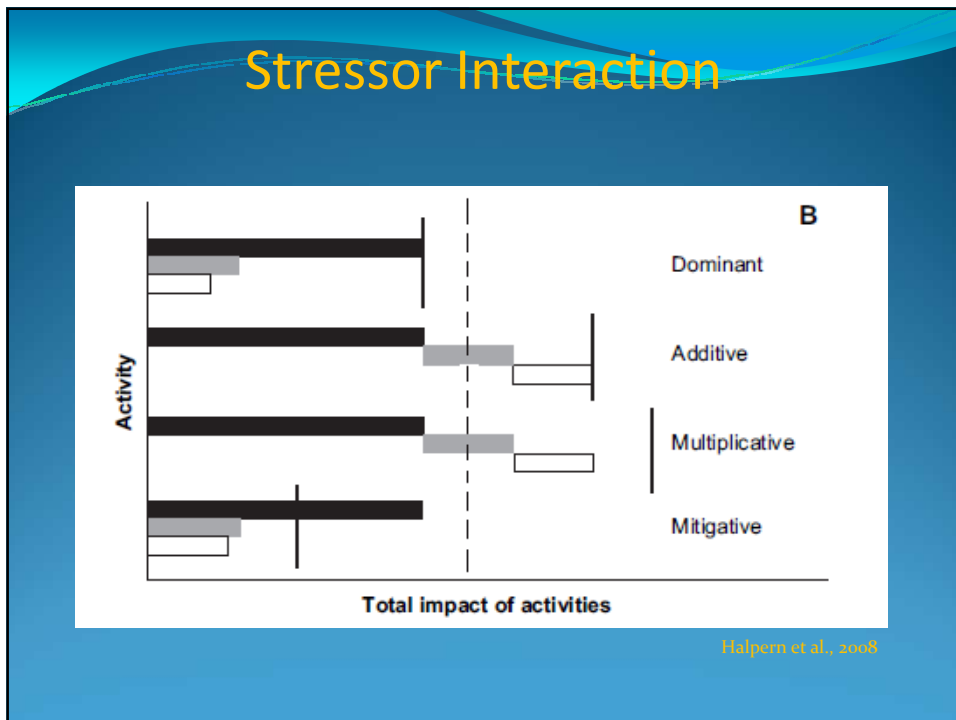
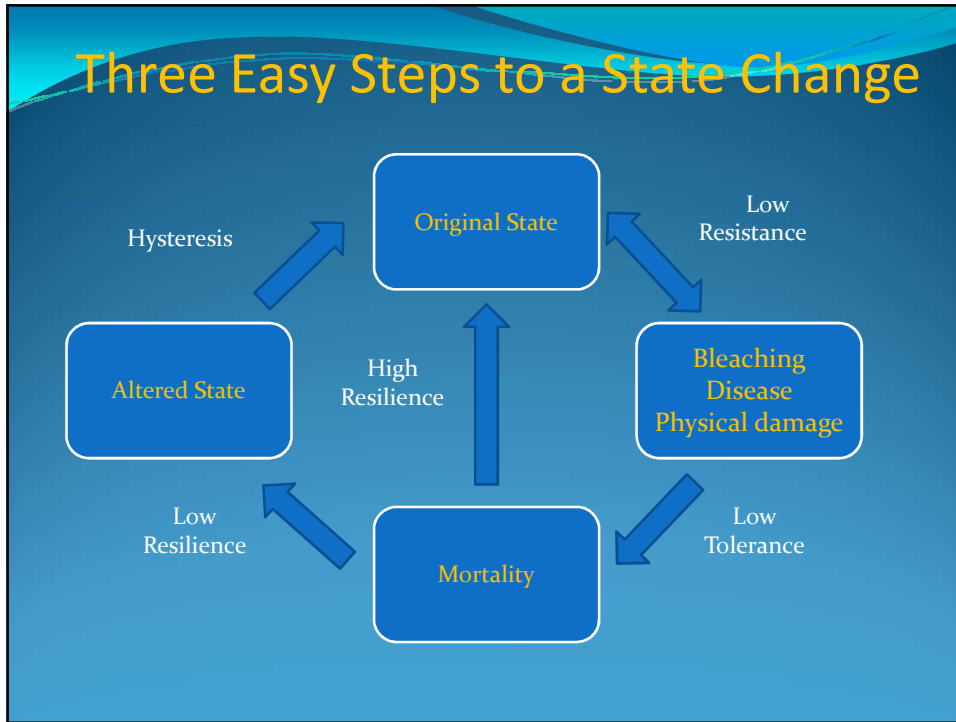




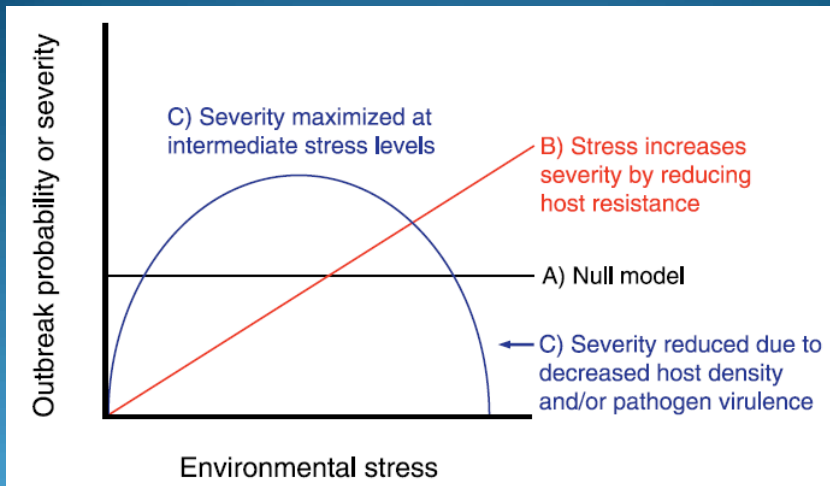
Importance of Coral Reefs

- One of the most biologically diverse ecosystems
- Provide ecosystem services and livelihoods
 - \$1 billion in tourism from GBR alone
- 20% lost; 24% at risk of collapse; 26% in danger of damage (Wilkinson 2006)
- Yet corals have persisted for at least 215 million years

2

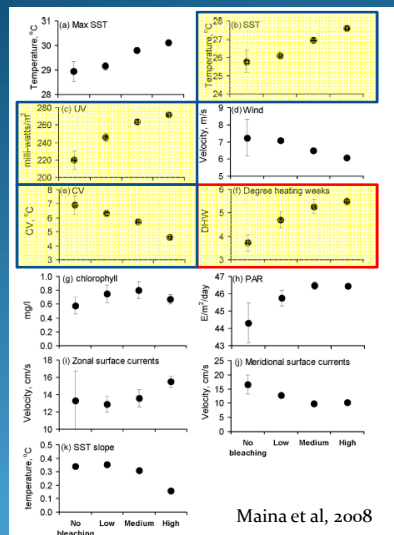


Disease predictors



Bruno et al. 2003, 2007

Bleaching predictors



Best predictors of bleaching were:

- SST variability
- Temperature
- UV

Stressor Interaction Example

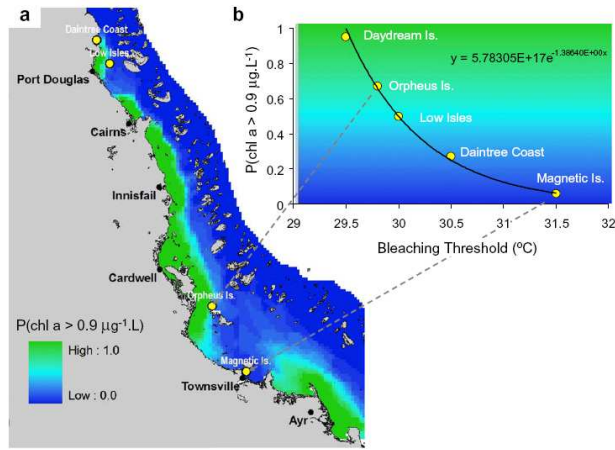
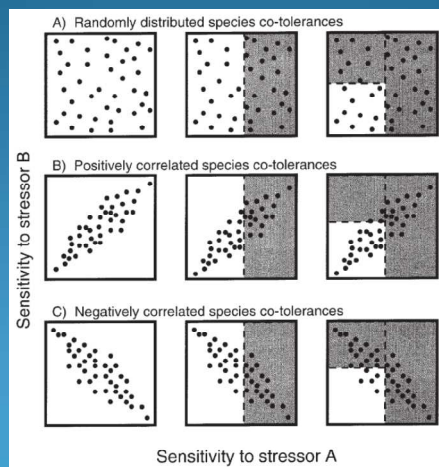


Fig. 3. (a) Flood plume analysis for the GBR lagoon (1969–2002) showing the annual exceedence probability of Chl *a* > 0.9 µg/L (after Wooldridge et al., 2006), (b) Quantitative spatial link between upper thermal bleaching limits and degree of exposure to nutrient-enriched terrestrial waters.

Wooldridge, 2009

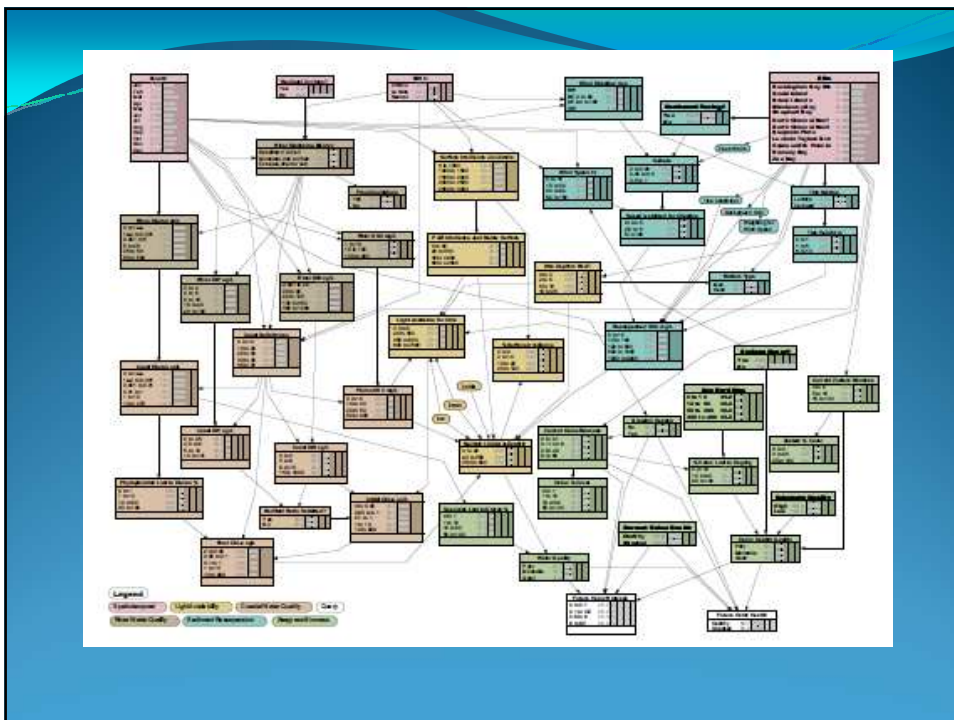
Stressor effects on community composition

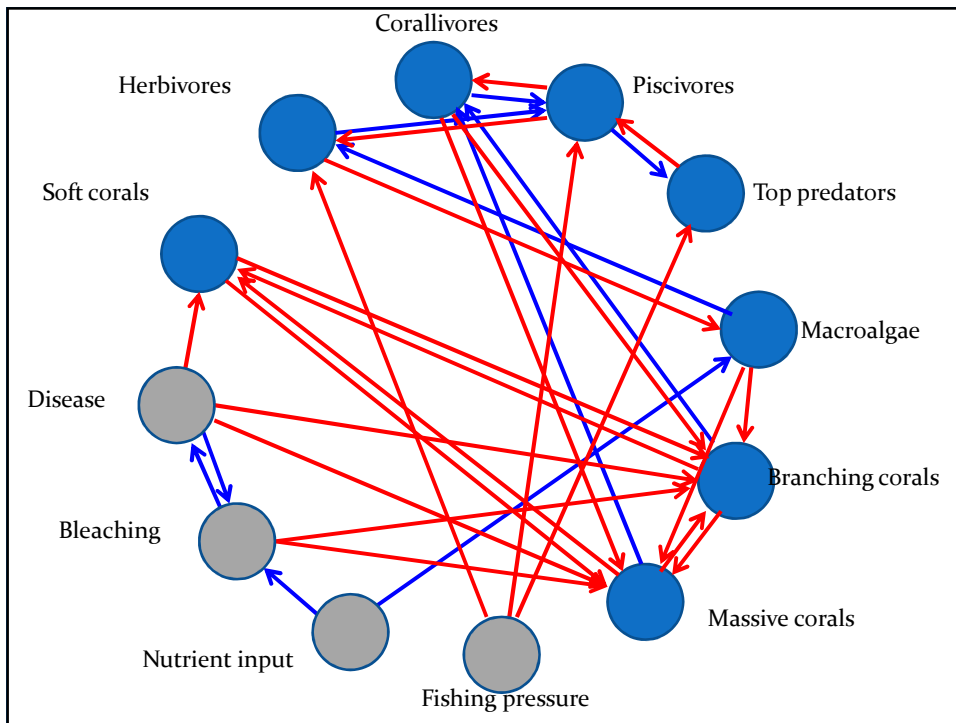


Vinebrooke et al., 2004

“A [model] should be as simple as possible, but no simpler.”
– paraphrased from Einstein

“... All models are wrong, but some are useful”
– George E.P. Box

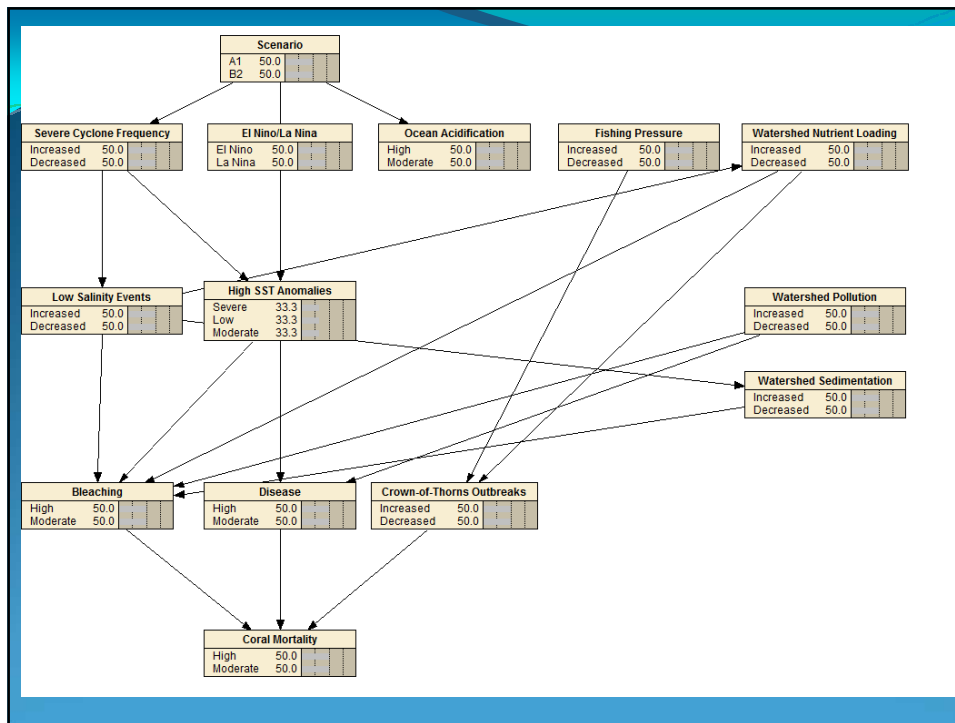




Stressor Interactions

Stressor affecting . . . →

Stressor being affected ↓	Acidity	Bleaching	CoTS outbreaks	Cyclones	Disease	Irradiance	Nutrient Loading	Increased SST	Symbiont Clade
Acidity		?				↓	↑	↑↓	
Bleaching	↑		?	?	↑	↑↓	↑	↑	↔
CoTS outbreaks	?	?	↑	↑	?		↑	↑	↔
Cyclones	↑							↑↓	
Disease	↑	↑	↑	↑	↑	↑	↑	↑	↔
Irradiance		↑					↓	↑	↔
Nutrient Loading				↑				↑	
Increased SST				↓		↑			
Symbiont clade	↔	↔			↔	↔	?	↔	



Proposed methods

- Use literature review to come up with plausible model (or set of models) for expert review
- Use one-on-one interviews to elicit opinions on models
 - Which linkages are most important
 - How much uncertainty exists for parameter ranges and linkage direction/strengths
- Possibly use questionnaire to come up with list of most important stressors

Elicitation problems

- Eliciting network structure
 - Free-form, or constrained?
 - Yes/no, or scoring of linkages?
- Eliciting CPTs
 - Defining thresholds (e.g., critical temperature)
 - Unlikely that any expert will be aware of critical thresholds for more than a few stressors
- Disentangling frequency and severity
 - E.g. cyclones

Other problems

- Ground-truthing
 - Insufficient data to train and verify model
- Model may be too high-level to be informative
- Spatial implementation
 - Climate change forecasts are generally coarse-resolution
- Temporal implementation
 - Single-time step (e.g. Present vs 2050)
 - Annual time-step
 - Handling feedbacks

Key outcomes

- What is the management objective?
 - Maximize (a certain type of) coral cover?
 - Maximize tourist revenues?
 - Minimize visual impacts?
- How to manage conflicting or orthogonal objectives?
 - E.g., managing for fisheries value vs. managing for tourism

Reef Futures

- What will the GBR look like under different climate change scenarios?
- How might different management strategies affect these outcomes, if at all?
- Might there be ways to manage stresses more effectively?

Think Globally, Manage Locally

<p>Acidification Ocean Warming Increased UV/PAR Increased sea levels</p>	<p>Nutrient Loading Sediment Loading Pollution Overfishing</p>
<p>Cyclones Low-salinity Events Disease Outbreaks Temperature anomalies</p>	<p>CoTS Outbreaks</p>

Comments? Questions?

