What Information is Really Needed to Inform Adaptation Strategies to Climate Change

Jake Rice DFO – Canada

(and Daniel Duplisea)

PICES FUTURE Open Science Meeting

Structure of talk

- How well does supply (of science advice) meet demand (for policy support)?
  - General approach to providing science support for adaptation planning
  - The policy nature of adaptation planning
- Specific implications for fisheries
  - What is the nature of major science inputs?
  - How can fisheries planning use this support?
- Alternatives

Work in Progress

General approach to provision of science advice to policy

- Downscale global climate model forecasts to regional and sub-regional scales.
- Advise on future conditions under which human activities will be conducted
  - Different temperature & salinity regimes, sea-level
  - Increasing attention to phenology
- Important (often overlooked) difference:
  - Coastal activities – what new conditions will be encountered in coastal places?
  - At-sea marine activities – where will the traditional conditions for an activity be found in future?

Policy and Adaptation

- Built infrastructure (coastal)
  - Regulate by integrated coastal planning, zoning, building codes
  - Support: What new standards for zoning and regulation codes will give same level of protection under future conditions
- At-sea use of ocean resources
  - Policies for access, economic investments, markets, employment
  - Support: what will be available to resource users?

Match of supply and demand - infrastructure

- Sea level rise forecasts important for all the regulatory tools (how to build / zone to give same degree of protection)
  - Pretty good match
- Characterization of frequency and severity of extreme events even more important
- Policy context of intensification of coastal use conflicts has some MAJOR externalities we must plan for
  - Increased urbanization, coastal population growth,
  - Changing viability of land-based food production & some industries (energy production) under changing conditions.
  - Forecasts are being made – not always strong connections between scientific communities

Marine Resource use - FISHERIES

DOMINANT APPROACH – Bioclimatic Envelop Modelling:

a) Species tolerances are inferred from survey data and a few oceanographic & bathymetric variables
b) Sometimes temperature-dependent physiological rate processes added to occurrence models
c) Future oceanographic conditions (and sometimes productivity) projected from downscaled Global climate models
d) Species distributions forecast by putting results of a) & b) into output of c.
e) Various ways to add stochasticity to climate but usually based on means not probability distributions for species

OPERATIONAL ISSUES WITH APPROACH –

Several ecological shortcomings: overlooks:

- Community assembly rules – risk of over-predicting;
- Behavioural adaptability – risk of under-predicting.
- Climate change will be seasonal and variance will change, not just the mean.

- Nature of the policy support it can provide –
  - Where well known species may be found in future
    - Limits (steaming time) predicted better than internal pattern of abundance and seasonality (CPUE)
  - What species/stocks are present in a given place?
    - Must be built up additively from individual species

Where is BEM approach useful in informing fisheries policy / adaptation

- The approach does not predict *fisheries*, just distribution of fish.
  - Useful for fisheries that can pursue stocks that they traditionally fish –
    - BEM does predict new boundaries
  - MAY be useful for predicting where bycatch issues may arise –
    - **if** BEM can be parameterized for bycatch species
  - MAY be useful for predicting changes in expected yield of main stocks –
    - **if** BEM can be linked to temperature- sensitive physiological parameters and possibly bottom-up productivity.
- All of these may be useful for mobile capture fisheries

Factors affecting costs of large-scale marine capture fisheries

FACTORS	CLIMATE CHANGE IMPACTS	SCALE OF CLIMATE IMPACTs
Capital costs	Availability and willingness of capital	???? (indirect + or -)
Labour costs	Availability and wage scales	Low (or High - indirect, +)
Markets	Alternatives to fish	Mod-high (indirect, likely +)
Fuel costs	Supply, Changes in fuel needed per trip	???? (indirect + or -) See below
Gear Costs	Changes in catchability?	Low to high: direct and -

BEM links to main factors:

- Increased steaming time to new distribution
  - Based on OECD data a 10% change in adjacency to home port increases fuel costs approximately 0.3%.
- Changes in aggregation affects q – Unknown
- Changes to gear – Only if better opportunities available

SMALL-Scale fisheries and climate change

Emphasis has to be on PLACE-BASED forecasting.

- Small-scale fisheries are place-based and tied to human communities more strongly than to fish communities.
- **Many case histories of fish communities available to fishers changing, and human communities adapting.**

- Need to collaborate with social scientists to understand adaptive capacity of communities.
- Provide advice and scenarios to managers and policy makers linking forecasts of fish communities to patterns of human community needs and capacities.

- Support could be built up, in theory, from summing ALL relevant BEM models, IF they can predict relative productivity as well as distribution. DEMANDING and UNLIKELY

Ecological Forecasts / Scenarios

Aggregate ecological community properties

Research experience with strengths and weaknesses,

- Functional group forecasts?
  - Do size/productivity of functional groups have consistent relationships with physical oceanographic features?
  - Will rate-linkage parameters change under climate scenarios?
- Size-based forecasts?
  - Systematic tabulation of if/how slopes and intercepts vary in relation to latitude, and major habitat types

What can managers and policy makers DO with such forecasts

They will have at least general forecasts of :

- The biomass of small fish entering the system.
  - Focus on the MIDDLE of end to end models, where we have most information to parameterize and test anyway.
- The loss of biomass in the system to predation mortality:
  - Don’t need species-specific diets and feeding rates
- The expected size (lengths) and relative biomass of the large fish community (usually attracts fishing effort first)
- The general distribution of life histories of the species that are available to exploit

With that information communities and managers can plan for the general type of fisheries that are likely to be viable

Conclusions

Useful work being done but challenges remain

- For coastal infrastructure science support needs to look more at extreme events rather than average
- The BEM approach to fisheries forecasting is interesting from a scientific perspective but:
  - Mostly relevant to large scale mobile fisheries.
  - Major factors affecting large scale fisheries in future are NOT where their traditionally fished stock are going to be.
- Small scale fisheries and fishing communities are extremely adaptable and we should work towards providing place based predictions that recognise and encourage that adaptability
- And focus effort on role of fishing in food security and poverty alleviation, not just profit of the few capital-intensive fisheries

Greater attention to PLACE BASED FORECASTS OF FISH COMMUNITIES, NOT FISH-BASED FORECASTS OF PLACES