Toward Adaptive Fisheries Management:

Is the current fisheries management toolbox sufficient to address climate change?

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"The Economics of Adapting fisheries to climate change"
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Is the current fisheries management toolbox sufficient to address climate change?

Yes…. and No

Related Studies (extensive)

1. Setting the Scene – today's meeting
2. PICES, Sendai, Japan, April 25-30 2010 "Climate Change Effects on Fish and Fisheries", *Forecasting Impacts, Assessing Ecosystem Responses, and Evaluating Management Strategies*
3. U.S. America's Climate Choices, May 19, 2010
4. Special Issue *Journal of Marine Systems*, February 2010
5. PICES North Pacific work NPCREP, BEST, June 2009
6. FAO High Level Conference on World Food Security, April 7-9, 2008
7. U.S. GLOBEC meeting. July 2008
8. Water Report, AR4, IPCC (2007)
9. OECD Fisheries Reports: *Toward Sustainable Fisheries* (1997), *Transition to Responsible Fisheries* (2000)

Study Outline

Strengths

Weaknesses

Impacts

Response

Toolbox Objectives

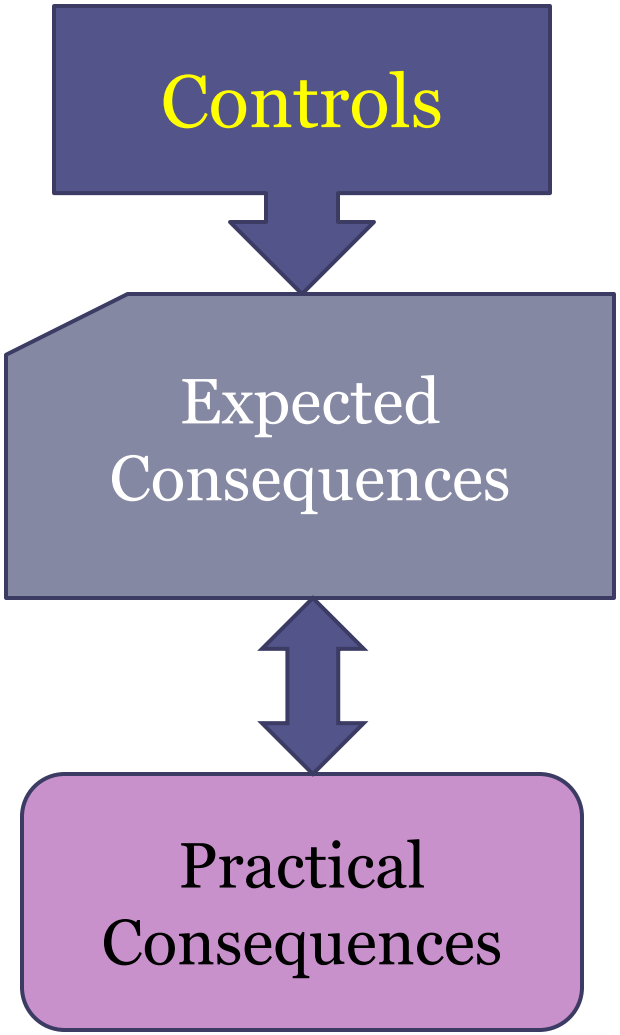
1. Ecological sustainability and ecosystem conservation
   - captured in biodiversity goals
2. Economic viability and social stability
   - sustainable development and socioeconomic support
3. Responsibility
   - shared stewardship and partnership with stakeholders

Fisheries Management Toolbox

Target	Input Controls	Output Controls	Technical Measures
Aggregate Fleet	Total Allowable Effort Limits, Limited licences	Total Allowable Catch limits (TACs)	No take zones (strict MPAs)
Individual Vessel /Operator	Individual Fishing Effort Quota restrictions	Individual operator Quotas (IQs), Individual Transferable Quotas (ITQs), Catch Shares	Time-area closures (multi-use MPAs)
Combined Fleet and Operator	Vessel and gear restrictions	Vessel Catch Limits	Output Selectivity restrictions (for size and sex)

Source: Adapted from OECD (1997), Table 1, p.13

Fisheries Management Performance



- Myriad of options, operable at different scales

- Reduction in fishing mortality
- Protection of vulnerable stock components
- Stock recovery

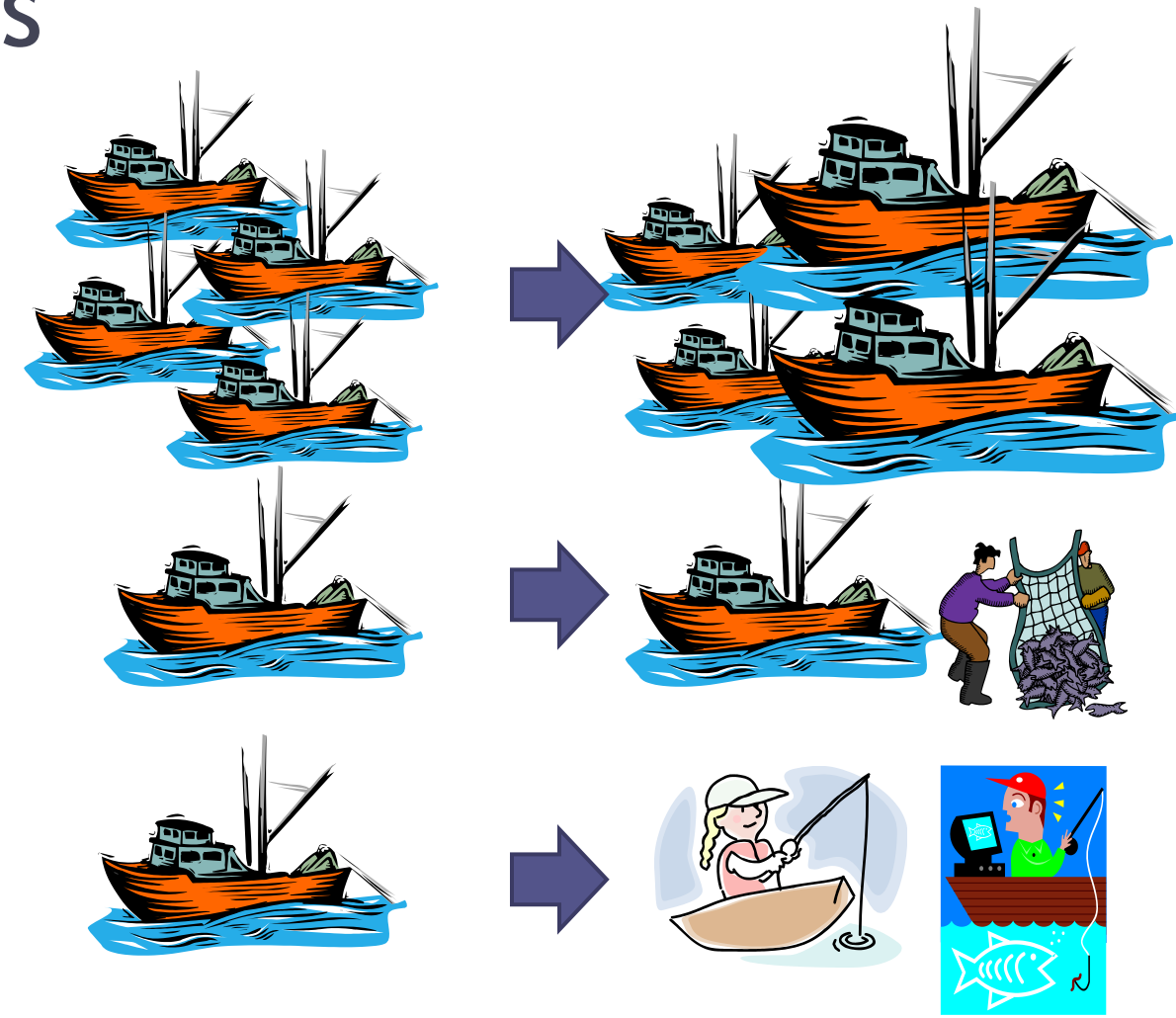
- Operating inefficiences
- Starting point difficulties
- IUU causing (misreporting, highgrade)
- Enforcement problems

Input Controls

Total Allowable Effort Limits/ Limited licences

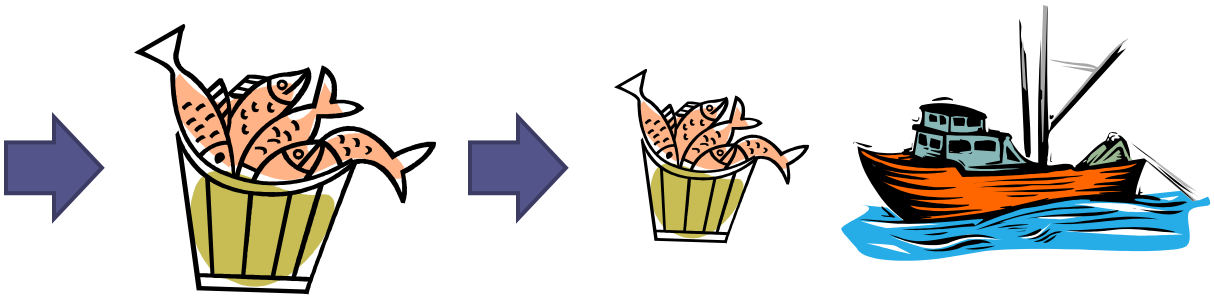
Individual Fishing Effort Quota restrictions

Vessel and gear restrictions

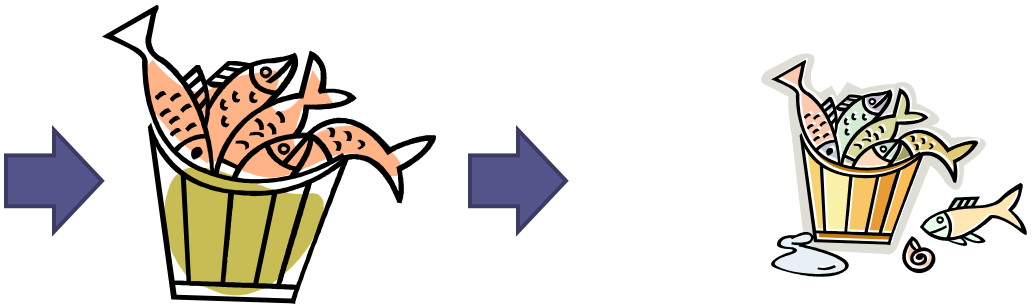


Output Controls

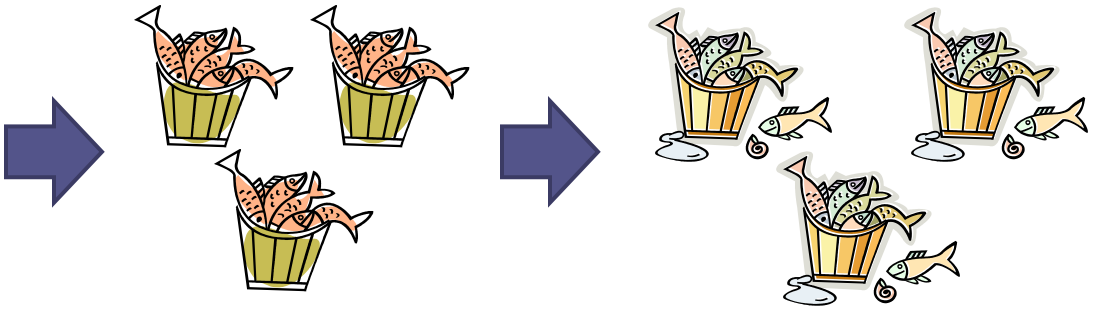
Total Allowable Catch (TACs)



Individual Quotas (IQs, ITQs), Catch Shares

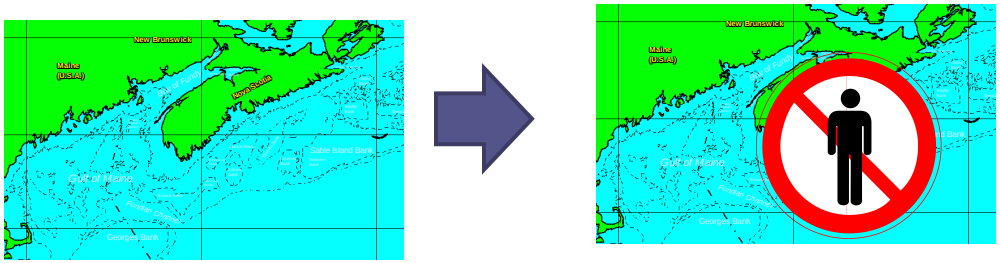


Vessel Catch/ Trip Limits

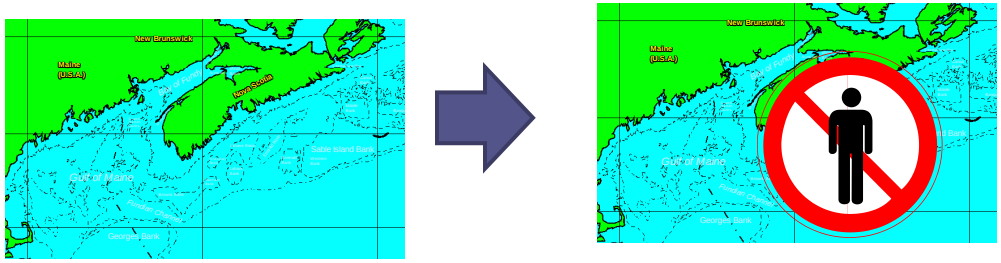


Technical Measures

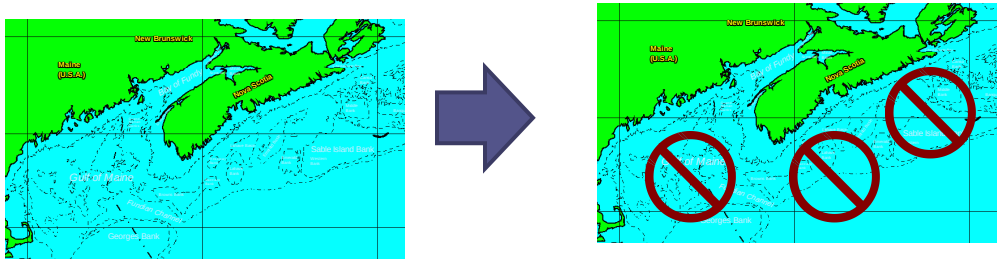
No take zones (strict MPAs)



Time-area closures (multi-use MPAs)



Output Selectivity restrictions (size and sex)

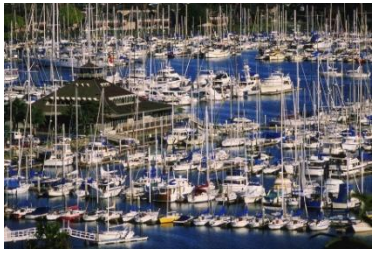


Management Scale, Measures & Participation

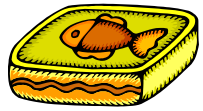
Local

Regional

National



International



Toolbox Strengths

1. Local knowledge and governance
2. Adoption of the Precautionary Approach
3. International associations and agreements
4. Fisheries and Aquaculture Carbon footprint

Toolbox Weaknesses

1. Consultative governance systems, governmental "command and control" subject to lobbying
2. Data deficiencies in ecosystem observations and monitoring
3. Undefined objectives, and targets
4. Difficulties operationalizing the PA
5. Fisheries and aquaculture carbon footprint

Environmental Impacts

1. Warming – increasing heat, rising temperatures
2. Changing ocean salinity, water column stratification, mixing in lakes and oceans
3. Changing Ocean circulation, coastal upwelling changes in timing, latitude
4. Sea level rise, land subsidence
5. Ocean acidification, increased CO2
6. Atmosphere-ocean, land-ocean exchanges
7. Low frequency climate variability patterns
8. Increased frequency of extreme weather
9. Cumulative climate changes lead to “regime shifts”

Toolbox Response to Impacts I

Description	Impacts on F and A	Fishery Management Toolbox Response
Warming	Stress in fish; changes in species ranges Predator-prey mismatch	MPAs, improved science **Enhanced systems for observation and monitoring** ; Shift to fixed or passive gear
Changing ocean salinity	Increased vertical stratification; Reduction in prey and productivity	**Longitudinal observation system** from surveys, more science on behaviour of fish
Changing Ocean circulation	Increased run-off, Nutrient supply primary productivity reduced	**Observations, ecosystem monitoring systems, Improved and direct science surveys on the ecosystem monitoring**
Sea level rise, land subsidence	Loss of coastal fish breeding and nursery habitats, reduced aquaculture Salt water intrusion damage	**Ecosystem observations**, shore and fisheries based; Analysis and tracking evidence; financial information analysis Integrated tracking of coastal water systems; Policy adjustment from evidence to shift to brackish water species

Toolbox Response to Impacts II

Description	Impacts on F & A	Fishery Management Toolbox Response
Ocean acidification	Coral bleaching, mortality	**Enhanced science and ecosystem observation**; longitudinal records, trends
Atmosphere -ocean, exchanges	Reduced diversity of livelihoods, less predictable rain/dry seasons	**Enhanced information and ecosystem monitoring observation systems**; integrated water use from all sources; dependence on fisheries and aquaculture
Climate variability	Reduced productivity Increased invasive species	**Improved analysis of catch observations, timing, life history and spatial range**; technical measures
Increased extreme weather	Disease or predators, Loss of fishing gear, damage/loss of aquaculture facilities and stock	**Improved ecosystem monitoring and observations**, science and engineering for advanced technology and innovation on materials and gear
"Regime shifts"	All, above, lower water quality, increased length of the growing season, and range expansions polewards	**Enhanced science and ecosystem modeling, observation, and analysis systems**

Toolbox Responses Summary

1. **Enhanced ecosystem observation systems**
2. **Improved science of fish behaviour**
3. **Protection of vulnerable species components**
4. **Integrated tracking of water systems**
5. **Gear shifts**
6. **Policy shifts**
7. **Sector dependence analysis**
8. **Technological innovation**

Adaptive Fisheries Management

- Governance Needs
- Integrate all users
- No panacea
- Encourage information exchange at all levels
- Institute real co-management
- New Zealand SeaFIC implementation strategy

Managing Risk and Uncertainty

- Enhanced Ecosystem Observation Systems
- Clarifying Ecosystem Objectives
- Incorporating Risk in Precautionary Measures
- Building resilience in communities
- Establishing Seasonal Management Decision Making

Best Practices and Further Research

- Strategies
  - Herbivore Aquaculture
  - Natural solutions
  - Fishing Gear Shift - Passive gear, spawner protection, more juvenile fishery emphasis
  - Technological innovation
  - Climate change education

- Communities
  - Renew Role of Governments
  - Identify Partners
  - Understand community dependence on F&A

Acknowledgements

- **C-Change**
  - www.coastalchange.ca
  - www.facebook.com/coastalchange

- **C-FOAM**
  - www.C-FOAM.management.uottawa.ca

- **Ocean Management Research Network (OMRN)**
  - www.OMRN-RRGO.ca