Assessing net change of productive capacity: moving from suitability to fish

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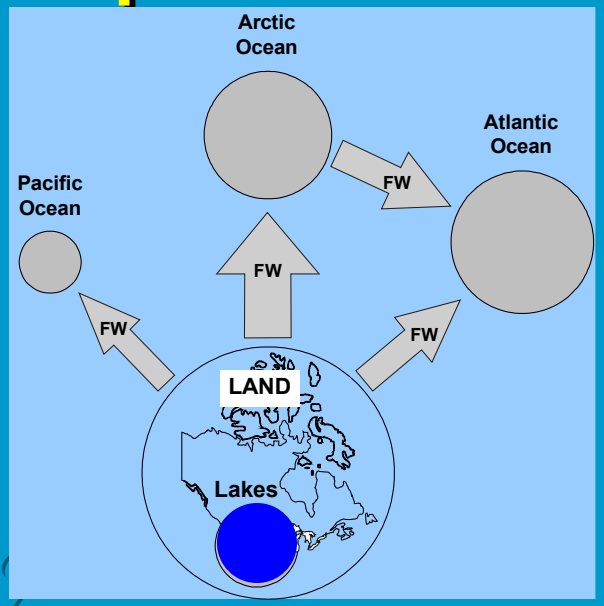
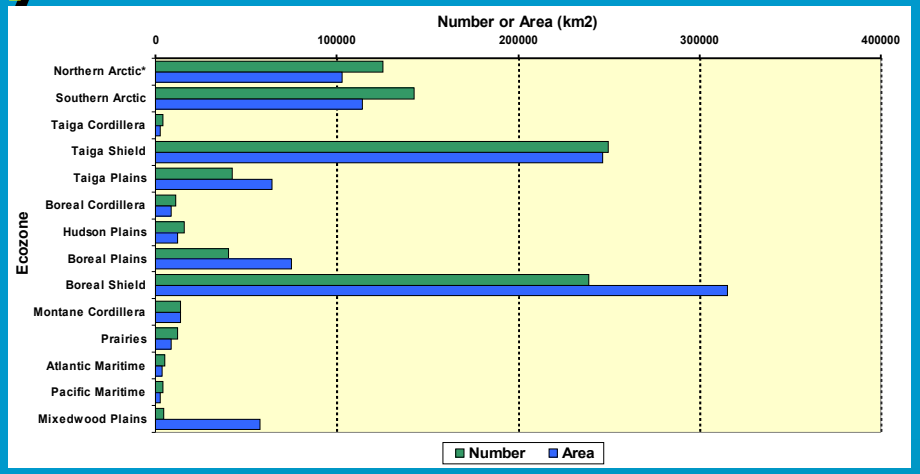
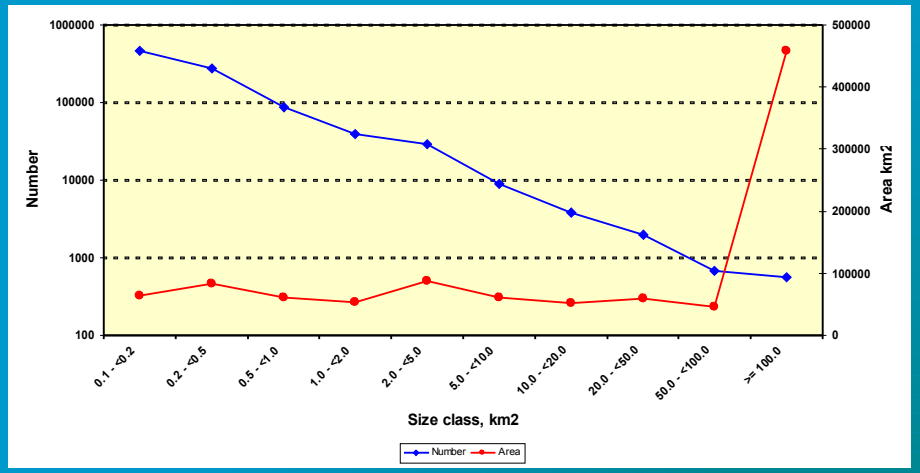
Context

- Aquatic ecosystems in Canada
- Fish habitat issues
- Fish habitat management

Aquatic Ecosystems in Canada

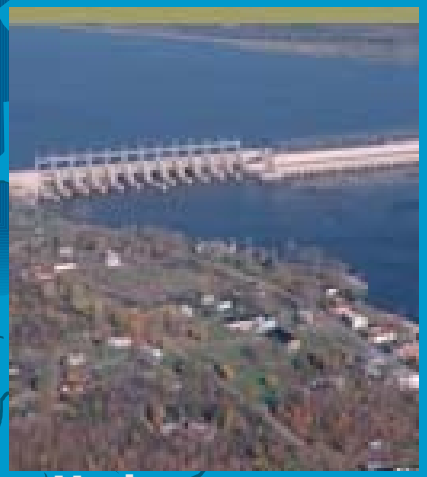






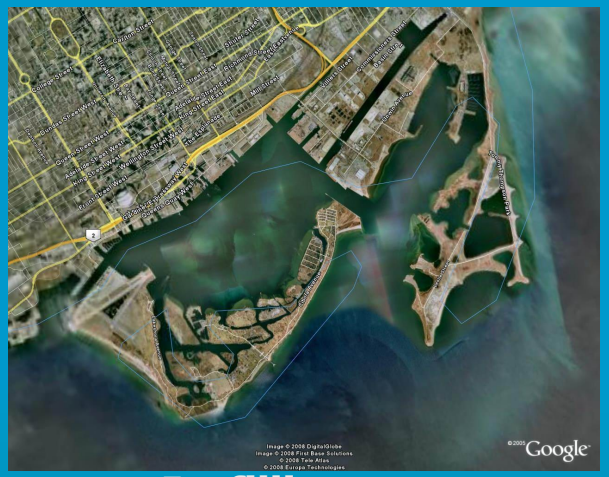
- 4.6 million km2 of Oceans within the EEZ
- 1.0 million km2 of Freshwaters, mostly lakes

Fish Habitat Issues



Hydro-power

Hardening



In-filling

Urbanization

Fragmentation

Mineral extraction

DFO Referrals 2006-2007

Habitat type	%	Work category	%	Economic sector	%
Palustrine	1.9	Watercourse crossings	27.3	Transportation	18.2
Riverine	52.8	Shoreline works	17.2	Residences	17.1
Lacustrine	23.1	Structures in water	13.6	Urban & rural	13.3
Estuarine	3.2	Instream works	8.0	Mining, oil & gas	13
Marine	8.7	Water management	7.3		

Risk assessment	%	Processing	%	
Not rated	66.4	Letters of advice	65.3	**7245 Referrals**
None	2.3	Operational statements	4.2	**in 2006-2007**
Low	20.5	Class operational statements	19.2	
Medium	7.3	Authorizations	6.0	
High	3.5	Class authorizations	1.7	

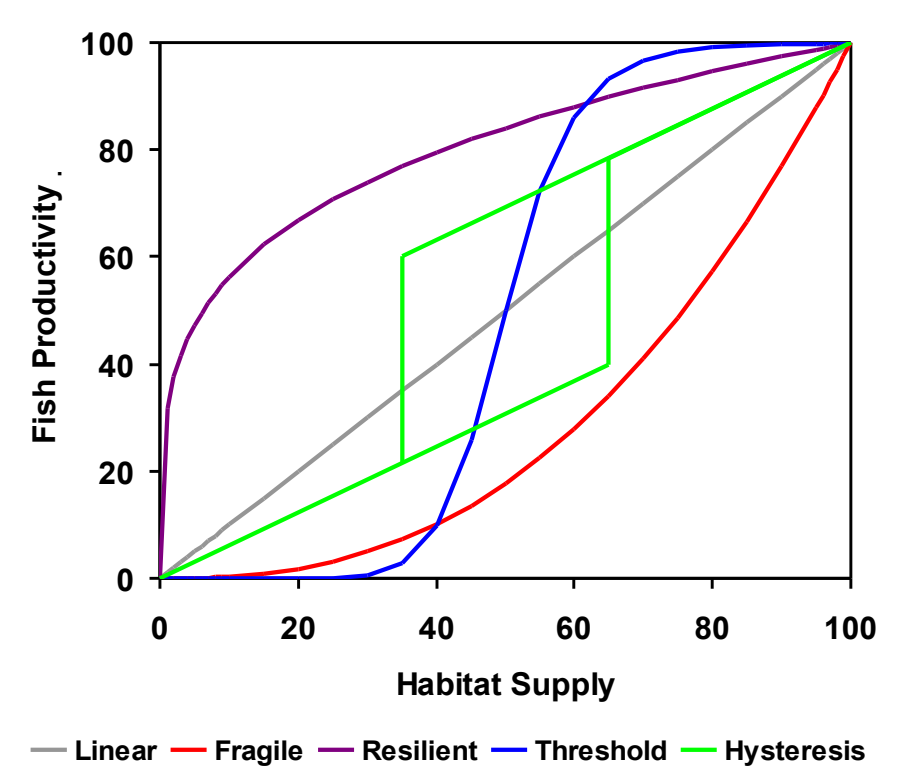
Symptoms

- Assessing net change of productive capacity
- Frames of reference
- Basis of decision-making
- Audit and assessment

Assessing Net Change

- Most assessments:
  - ✓ Are non-quantitative and normally limited to the immediate project footprint
  - ✓ Are often focused on game fish and not the complete food-web or ecosystem
  - ✓ Assume simple linear habitat:productive capacity linkages
  - ✓ Are usually based on suitability not fish
  - ✓ Do not fully consider non-physical habitat
- Extremely difficult to demonstrate the impact of a single project or activity (Minns et al 1996; Rose 2000)

Habitat:Productive Capacity Links

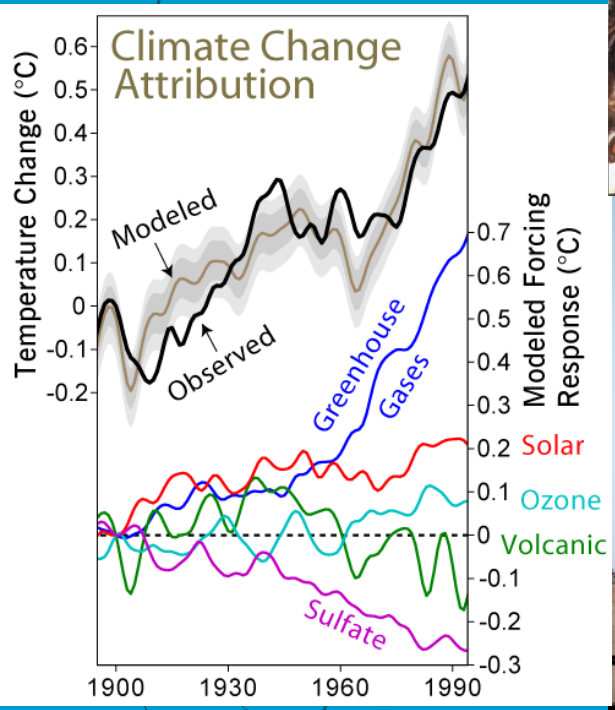


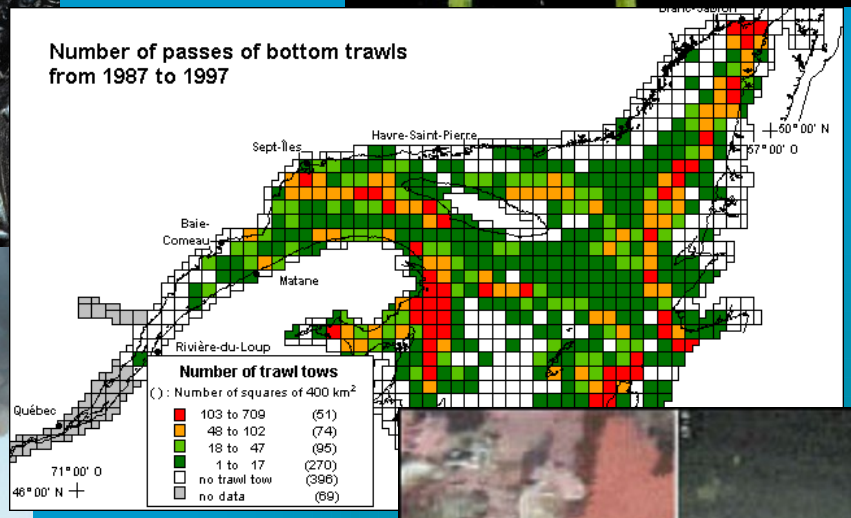
- Evidence suggests links are more complicated involving thresholds or hysteresis
- Detecting impacts arising from these linkages is often very difficult, particularly for single incremental changes

Suitability or Fish?

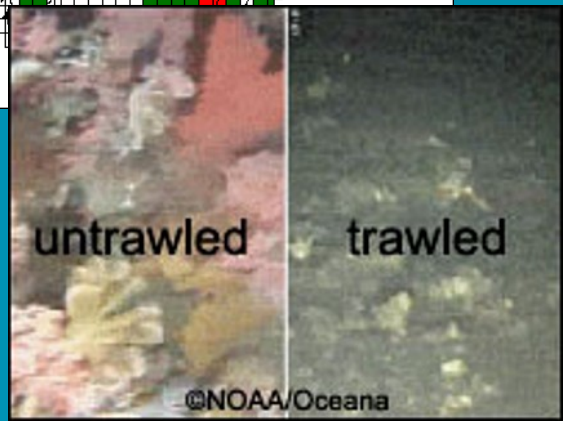
- Suitability and Habitat Equivalency
  - ✓ IFIM, PHABSIM, WSU, IBI
  - ✓ HSI, HEP, REA, HEA, HAAT
- The usual currency now is Space*Suitability
- The currency should be production rates (species, community, and ecosystem)
- The focus on surrogate indices has facilitated the continuing loss of productive capacity

Non-Physical Habitat





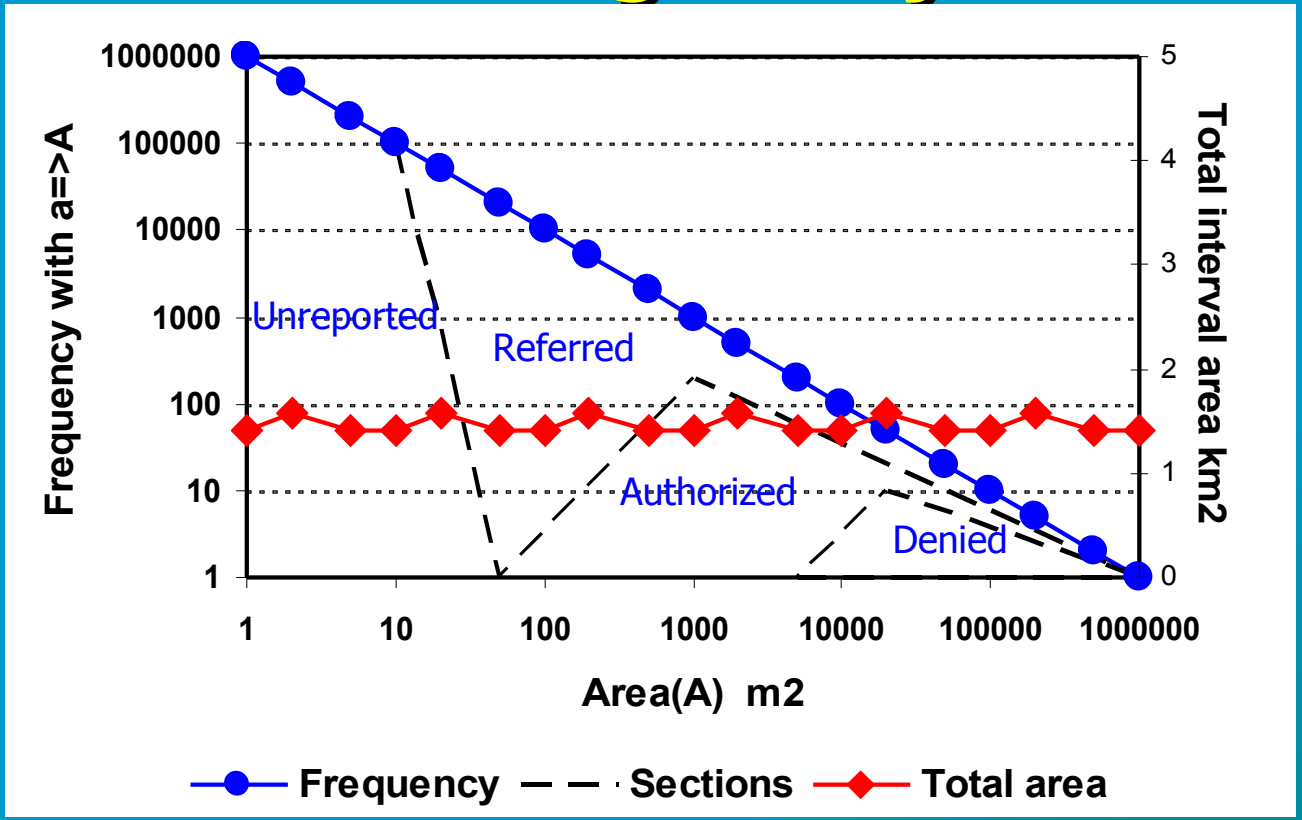
These cause net loss of productive capacity



Frames of Reference

- Small vs. large projects
  - ✓Pareto distribution of impacts
- Cursory cumulative effects assessment
- Shifting baseline syndrome

Many Small Projects vs. Few Large Projects

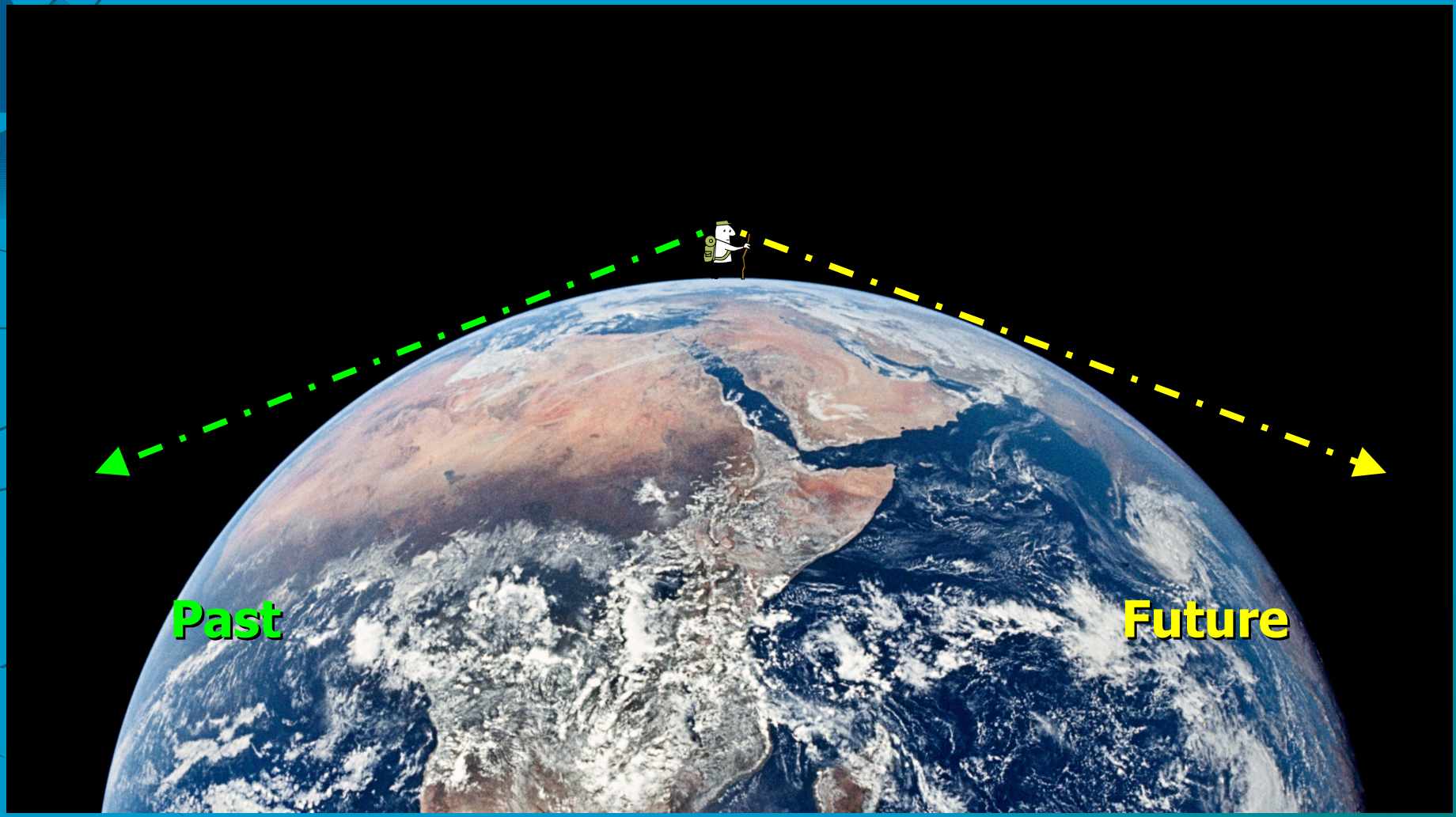


- Impacts probably follow a Pareto-Zipf distribution: $N(a>A) = \alpha \cdot A^{\beta}$ with $\beta \sim -1$
- Many small activities have ≥ impact than few large ones
- There are probably many smaller unreported impacts

Cursory Cumulative Effects Assessments

- Most assessments pay little attention to the accumulated local and regional changes that have already occurred
- Most assessments pay lip service to assessing how expected future pressures will interact with activities proposed now
- Indeed, as conducted now, most environmental impact assessments accomplish little except to waste time and resources

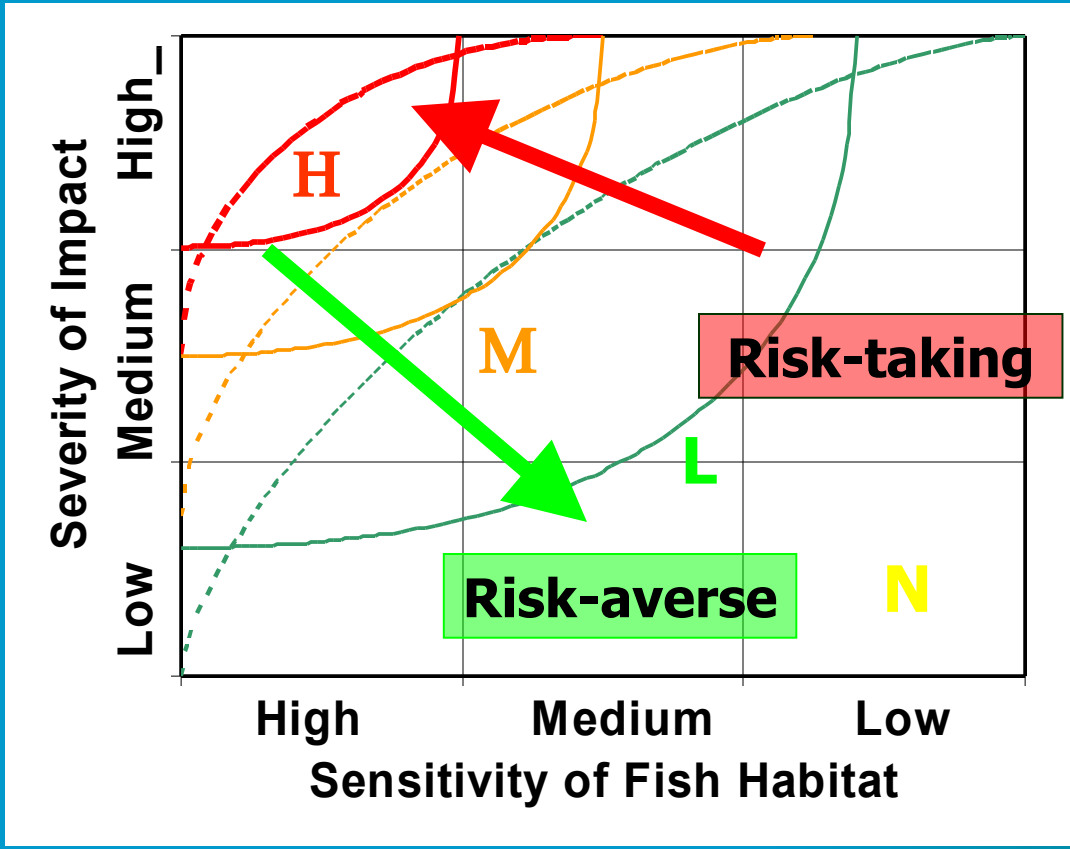
Shifting Baseline Syndrome



Basis of Decision-Making

- *Ad hoc*
  - ✓ Most decision-making is informal, non-quantitative
  - ✓ Heavily dependent on limited experience and beliefs of practitioners
- Risk management framework
  - ✓ Introduced as part of government-wide attempts to deal with risk
  - ✓ Usually concerned for the risk-taker rather than the resource-at-risk
  - ✓ Current guidance document is flawed
  - ✓ A good idea if implemented with quantitative guidelines and audited

Risk Management Framework



- Current guideline is risk-taking BUT should be risk-averse
- Lacks operational definitions for sensitivity and severity
- No consideration of cumulative impacts (past & future)

Audit and Assessment

- Effectiveness of mitigation and compensation
  - ✓ Limited evidence to support many measures in routine use
  - ✓ Little evidence that humans can match nature in restoring or creating habitat
- Monitoring and audit programs
  - ✓ No national habitat program despite the existence of many fishery assessment programs
  - ✓ Too few systematic audits; too many unevaluated monitoring reports specified in authorizations; available evidence shows net loss is common
  - ✓ Assessments often focus on non-fish performance metrics, e.g., did the culvert withstand the 10-yr flood rather than can the fish get through?

Remedial Approach

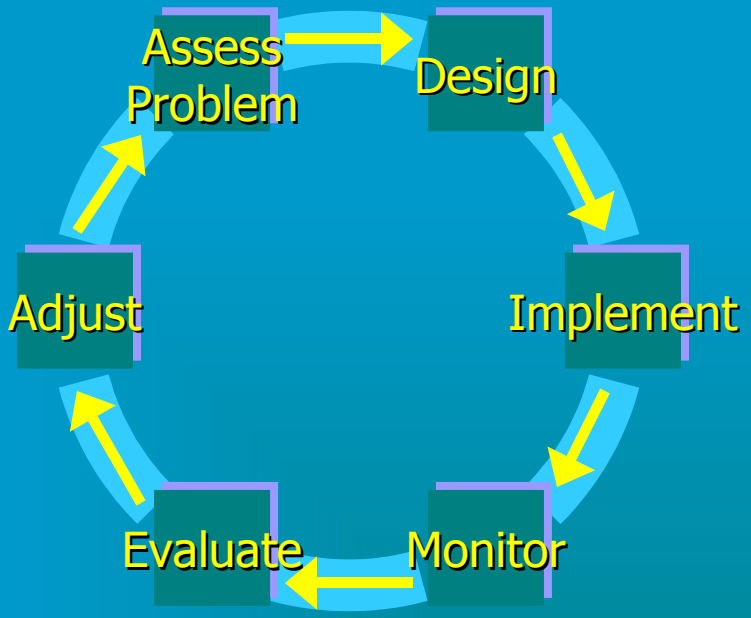
- An ecosystem approach
- Active adaptive management
- Quantification
- Establishing limits
- Implementation challenges

"The economy is a wholly owned subsidiary of the environment"

Quotation attrib. Gaylord Nelson

Active Adaptive Management

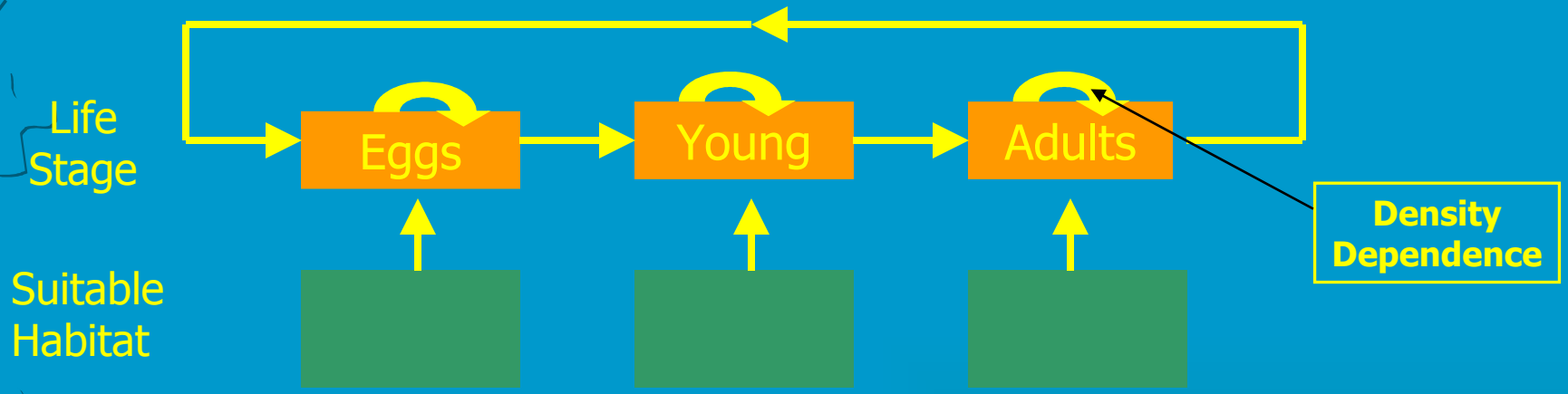
- "Learning by doing"
- Widely advocated but also widely abused/misunderstood
- A recurring cycle of activities requiring systematic planning, collaboration, modelling, and evaluation
- Active AM requires large-scale experimentation
- Most agencies unwilling to commit the people, time, and $$ investments required
- We are already putting the resources at risk. Why not take the opportunity to learn something useful?



Quantification

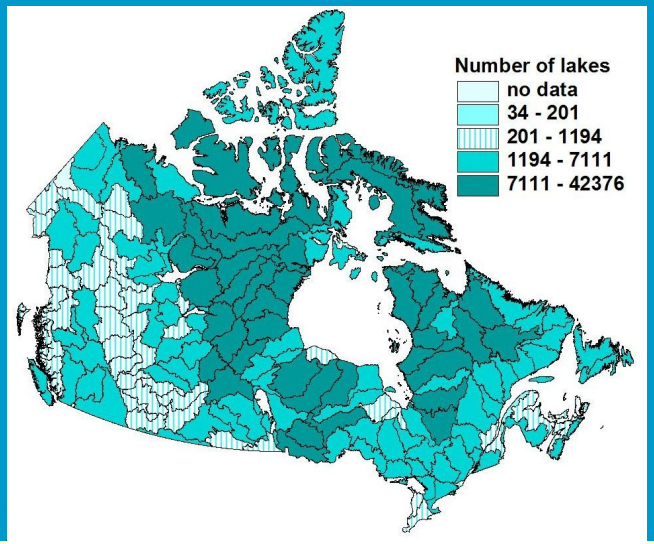
- Individual projects and activities
  - ✓ Net change assessment for productive capacity not suitability units
  - ✓ Decision analysis tools
  - ✓ Assessing effects of mitigation and compensation
- Integrated regional management
  - ✓ Productive capacity accounts
  - ✓ Cumulative impact assessment

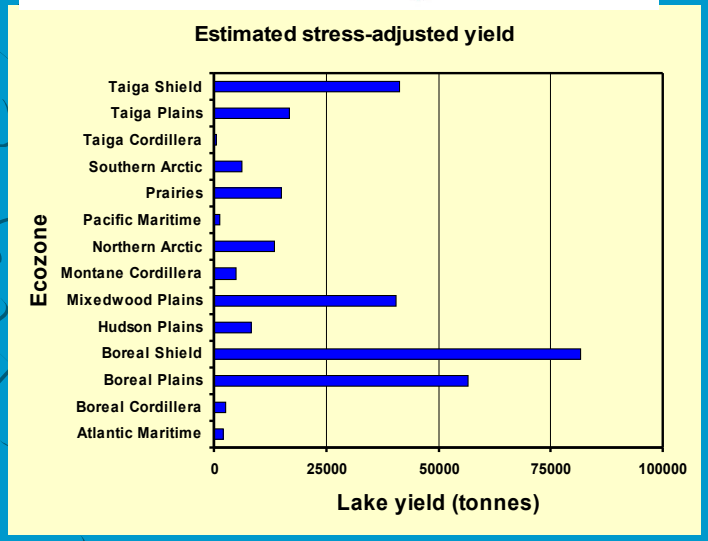
Project and Activities



- Stage-structured models scaled to viable population/community/ecosystem space
- Life history parameters (birth, death, growth, movement) linked to habitat supply, quality and distribution
- Use to assess incremental and cumulative impacts
- Use to assess benefits of mitigation and compensation actions
- Decision analysis methods to weigh risks and options
- Large-scale active AM to iteratively improve management

Integrated Regional Management





- Productive capacity accounts
  - ✓ Regional estimation of total productive capacity of all fish habitat
- Cumulative impact assessment
  - ✓ Ongoing assessment of all stressors
  - ✓ Ongoing tracking of ALL habitat changes
- For example, estimated potential yield by ecozone of all Canadian lakes
  - ✓ Used Schlesinger-Regier (TAFS 1982) model based on MEI and mean annual air temperature with lake resource estimates (Minns et al 2008)
  - ✓ Can be done for all aquatic resources

Establishing Limits

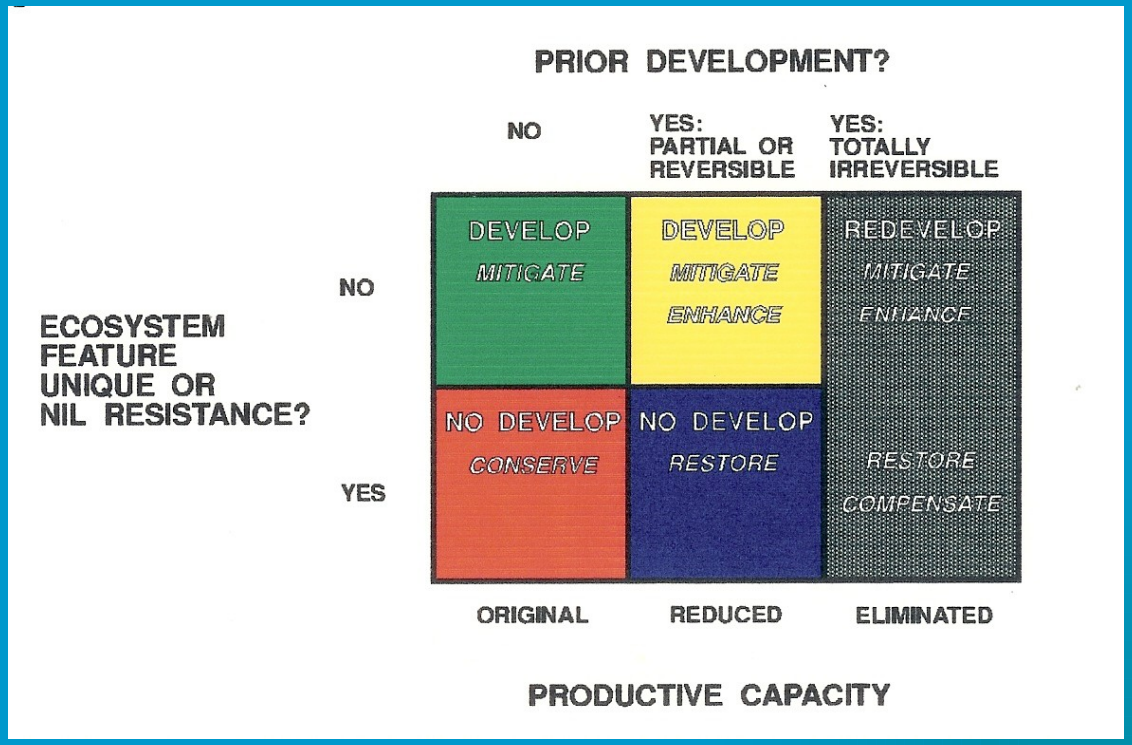
- Precautionary practice
- Recognizing impact threshold, setting absolute development limits
- Protected areas (MPAs & FPAs)

Precautionary Practice

#	Technological risk	Fish habitat management
1	Seriousness and irreversibility of harm addressed.	Examine seriousness and irreversibility of HADD.*
2	Societal distribution of possible costs and benefits of policies and technologies.	Proponent pays for mitigation and compensation.*
3	Technological options for preventing, arresting, reversing, or mitigating possible harm and the opportunity costs of selecting a given policy option.	Use best available mitigation and compensation tools.*
4	Society's inclinations regarding erring on the side of caution (Type I) and erring on the side of laxity (Type II).	Shift bias toward caution (Type I) and away from laxity (Type II). (guilty unless proven innocent)
5	Democratic decision-making.	Public disclosure of assessment process and results.*
6	Burdens of persuasion and proof (shifted to the proponents of potentially harmful technology).	Onus on proponent to show activity will not cause HADD or will attain net gain.
7	Right to know.	Access to information.*
8	Funds to mitigate future harm	Performance bonds.*
9	Compensating victims of unmitigated harm.	Mandatory compensation for all losses.
10	The duty to prevent harm.	No net loss (NNL) of PC.*

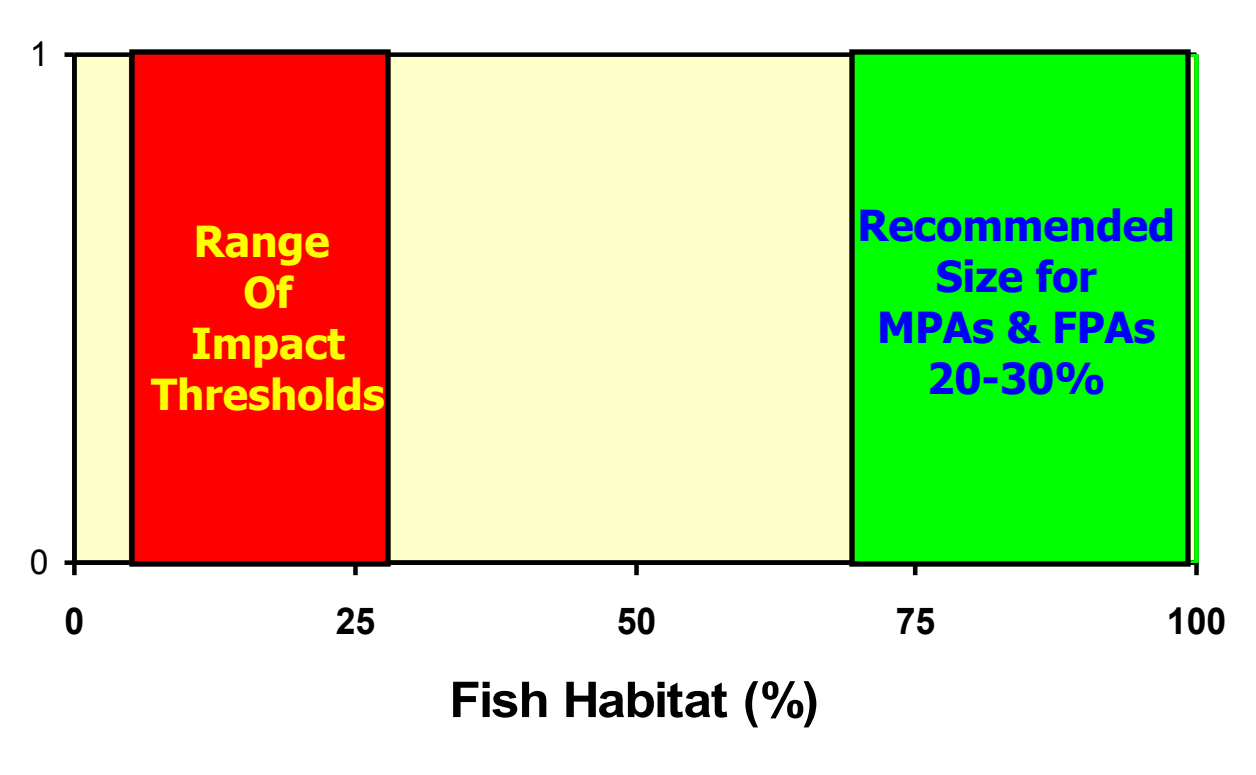
- Based on Hornbaker and Cullen (2003)
- Components (*) partially addressed now

Kozlowski's Ultimate Environmental Threshold



- **"The stress limit beyond which a given ecosystem becomes incapable of returning to its original condition and balance. Where these limits are exceeded as a result of the functioning or development of particular tourist or other activities, a chain reaction is generated leading toward irreversible environmental damage of the whole ecosystem or of its essential parts."**

Absolute Limits and Reserves

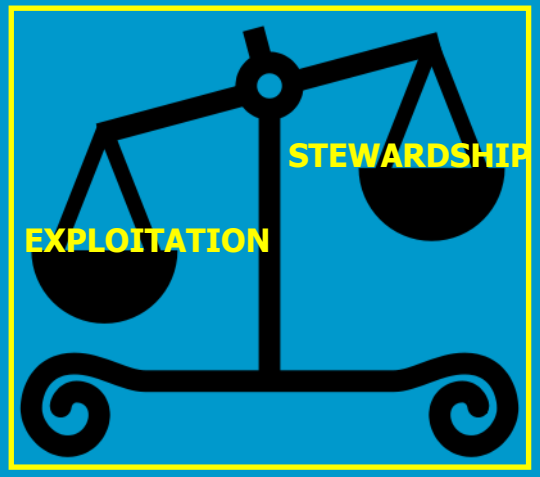


- Impacts thresholds for various stresses are low
- MPAs and FPAs alone will not prevent losses
- Absolute activity level limits are also required

Implementation Challenges

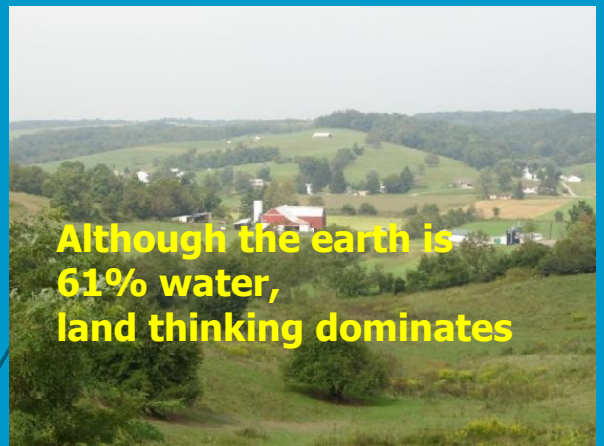
- Finding the political and societal will and leadership needed to succeed
- Accepting absolute limits on all human activities and the establishment of extensive reserves
- Integrating habitat and fisheries management into complete ecosystem management systems
- Undoing much accumulated damage to ensure future sustainability

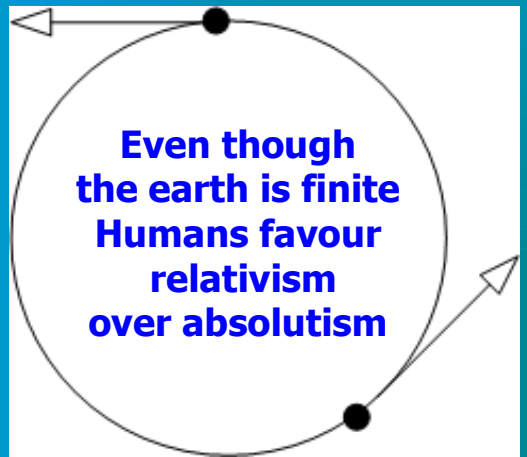
Underlying Issues



We need "an ecology of the long now" (Carpenter)

Or, "a 500 year plan" (Tonn)





Conclusions

- The current approach to fish habitat management in Canada cannot achieve no net loss of productive capacity.
- The elements of a remedial approach are available but implementation requires a major adjustment of mindsets in government, in business, and in the community at large.
- Accepting that the productive capacity of the earth is finite and that humans cannot improve on nature would be the good starting point.
- Are we ready to take up the challenge?

Thanks

- To the organizers of this symposium for inviting me to participate
- To Susan Doka, Bob Randall, and Lorne Grieg for providing feedback on an earlier draft of the paper
- To you for listening

"When we face the reality of what we have done to the planet, how will we stop weeping?"
Opening line from 'A Dream About A Pig' by D.M. Black