

Environmental Valuation and Policy Analysis: New Challenges and New Opportunities

Vic Adamowicz
University of Alberta
Edmonton, Alberta, Canada



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DEPARTMENT OF RESOURCE ECONOMICS
AND ENVIRONMENTAL SOCIOLOGY

Overview

- Introduction – environmental valuation
 - Definitions
 - Trends
- A changing landscape for valuation and policy?
- Some new (and not so new) challenges
 - Illustrated by case studies
- Conclusions

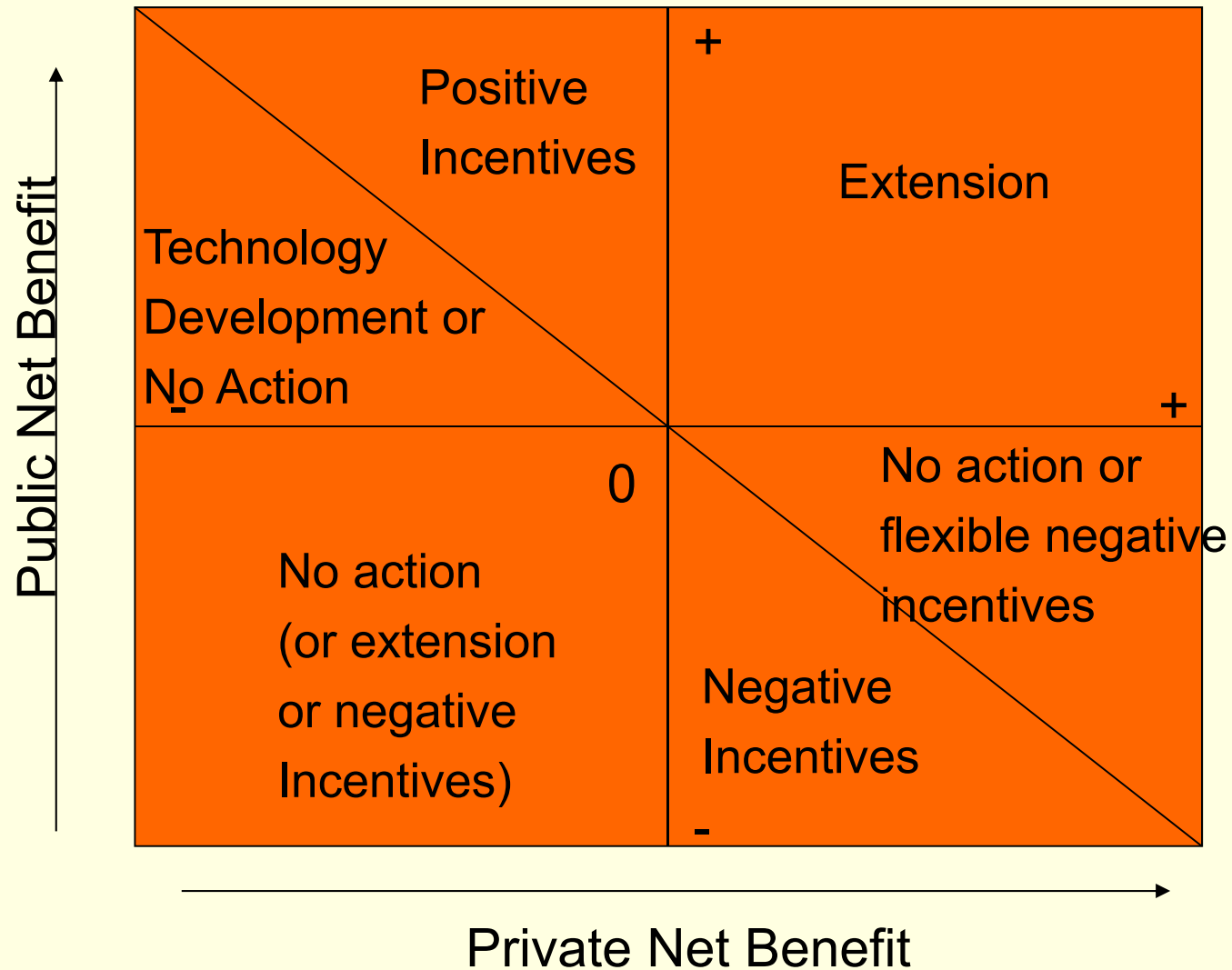


Why measure the monetary value of environmental quality change?

- How much compensation should be paid (to the public) for damage to the environment? (NRDA)
- Evaluation of investments in environmental quality or natural capital (BCA)
 - InVEST, Payments for Ecosystem Services
- Planning (e.g. Coastal Marine Spatial Planning) (BCA)
- How much protected area or effort in species conservation is “enough”? (BCA, RIA)
- How stringent should water / air quality guidelines? (BCA / RIA)
- Sustainability measures (genuine savings, etc.)
- What policy instruments should be used to conserve environmental quality?



Valuation and Policy Design



Pannell (2008), Land Economics

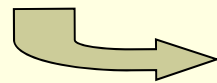
How to value non-market goods and services

Market Data (Revealed Preference)

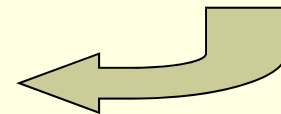
- Property values (hedonic analysis)
- Wages (hedonic analysis)
- **Recreation / tourism behaviour**
- Impacts on producer costs / profits
- Averting costs, costs of illness, etc.

Survey Data

- Stated Preference
- **Contingent valuation**
- **Choice experiments**

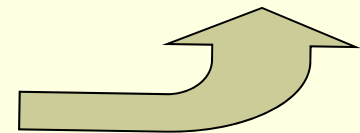


Data Fusion



Experimental Data

- Laboratory Experiments
- Field Experiments



Types of Values

- Use Values
 - Values of goods and services that are reflected through changes in behavior
 - Recreation, Tourism, Property Values, etc.
- Passive Use Values (or non-use values)
 - Values for goods and services that do not have a “behavioral trail” or for which market choices do not reflect values
 - Measurement of value requires “conversations”
 - using structured surveys, interviews etc.



Types of Value

- Carbone and Smith (2010) NBER
 - $U = V(c(Q(q), x, I), h(q))$
 - x ; market consumption goods
 - I ; leisure
 - q ; vector of non-market services derived from the ecosystem
 - $c(\cdot)$; q combined with x, I to create **use** values
 - $h(q)$; **non-use** or **passive use** values
 - Note feedbacks between market and non-market components.



Welfare Measures in General Equilibrium?

- Carbone and Smith (2010)
- Typical formulation (change in q only)
 - $WTP = e(p^0, q^0_{j \neq i}, q^1_i, u^0) - e(p^0, q^0, u^0)$
- General Equilibrium quantities and prices
 - $WTP = e(p^1, q^1, u^0) - e(p^1, q^1_{j \neq i}, q^0_i, u^0)$
- General Equilibrium Total
 - $WTP = e(p^1, q^1, u^0) - e(p^0, q^0, u^0)$



Recent Trends in Valuation Research



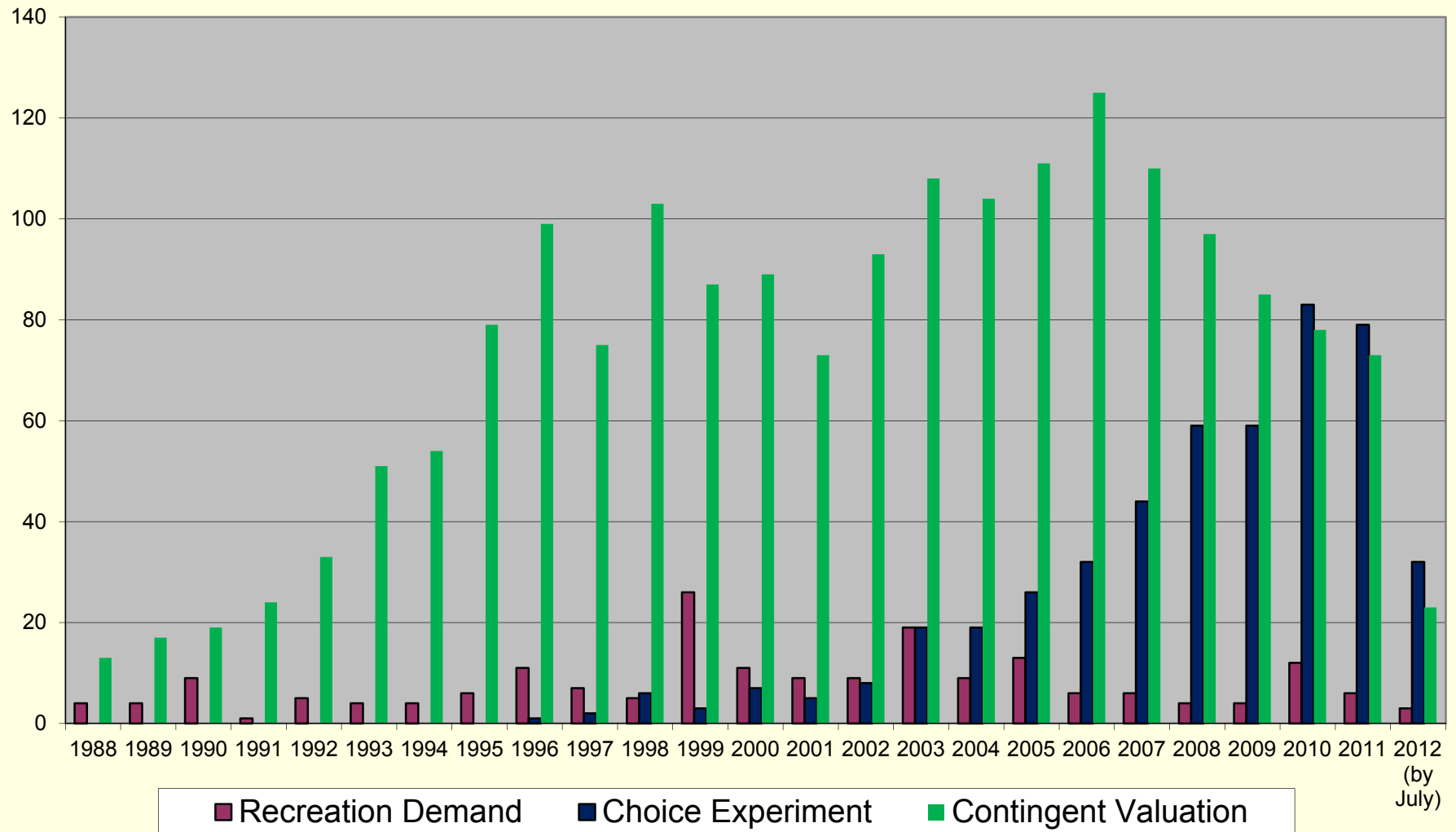
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Publication Trends – Valuation Methods, Geographic Locations

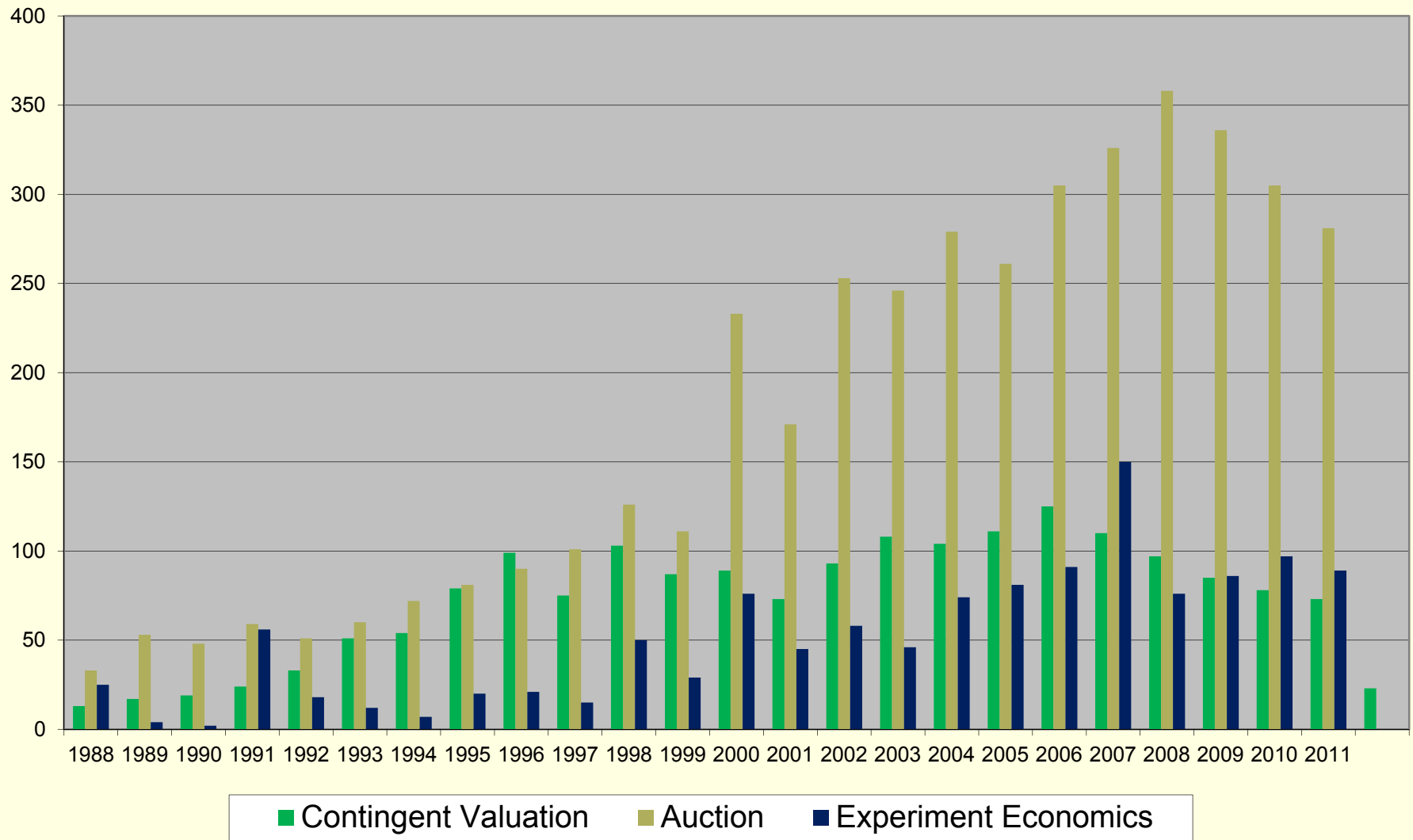
- Trends in major valuation methods
 - Contingent Valuation (stated preference)
 - Choice Experiments (stated preference)
 - Recreation Demand / Travel Cost (revealed preference)
- Comparisons with other economic areas
- Where is the research being done?



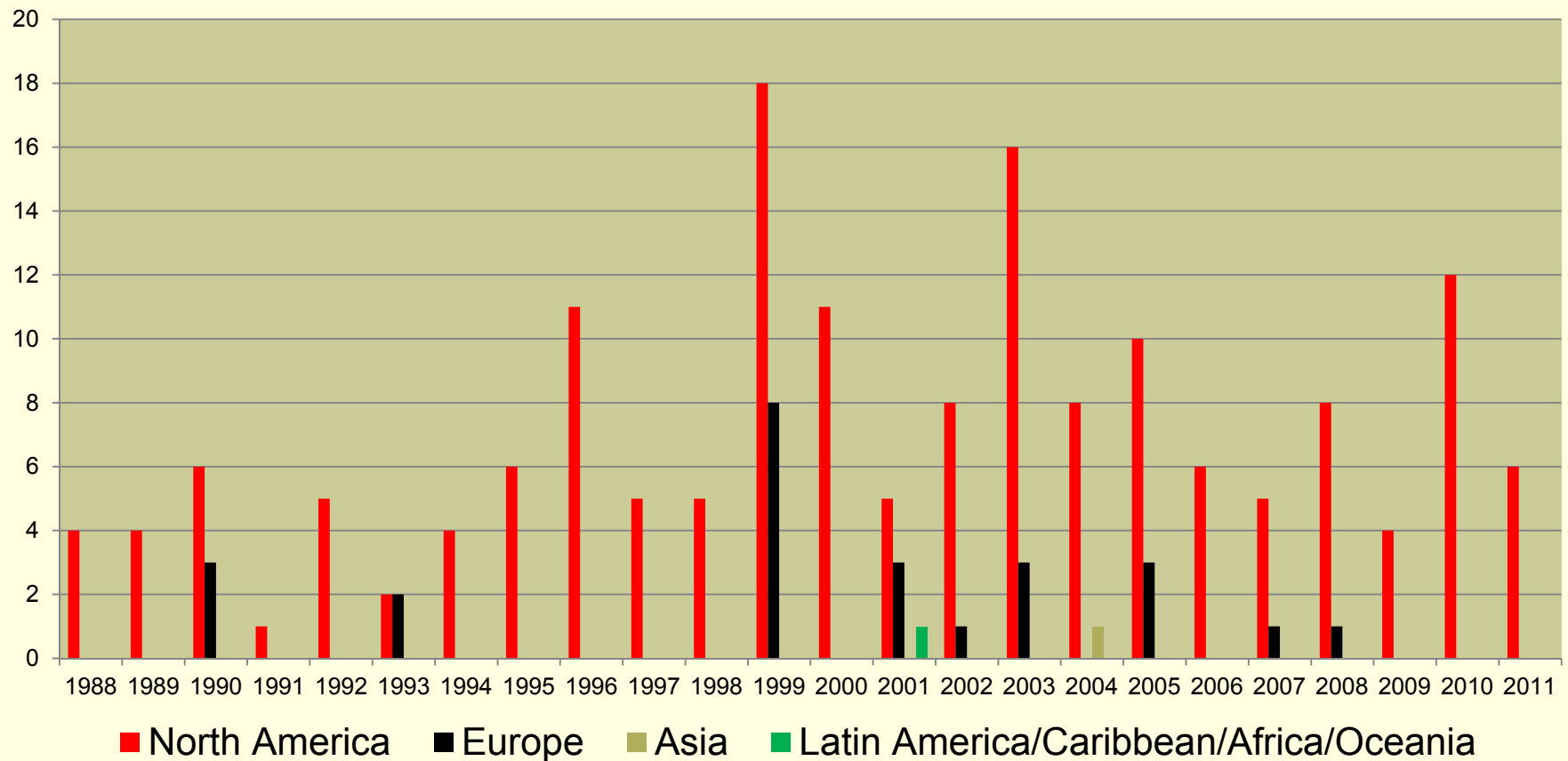
Environmental Valuation Publications in EconLit 1989-2012



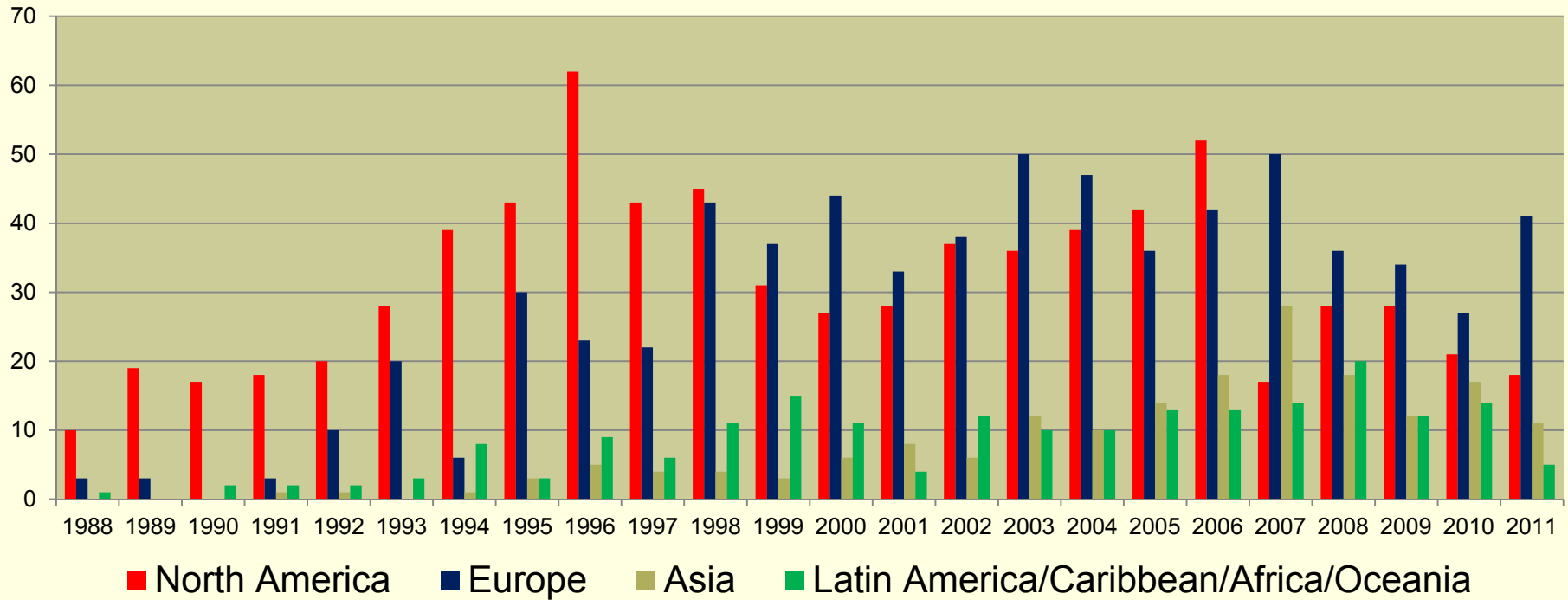
Publications (EconLit)



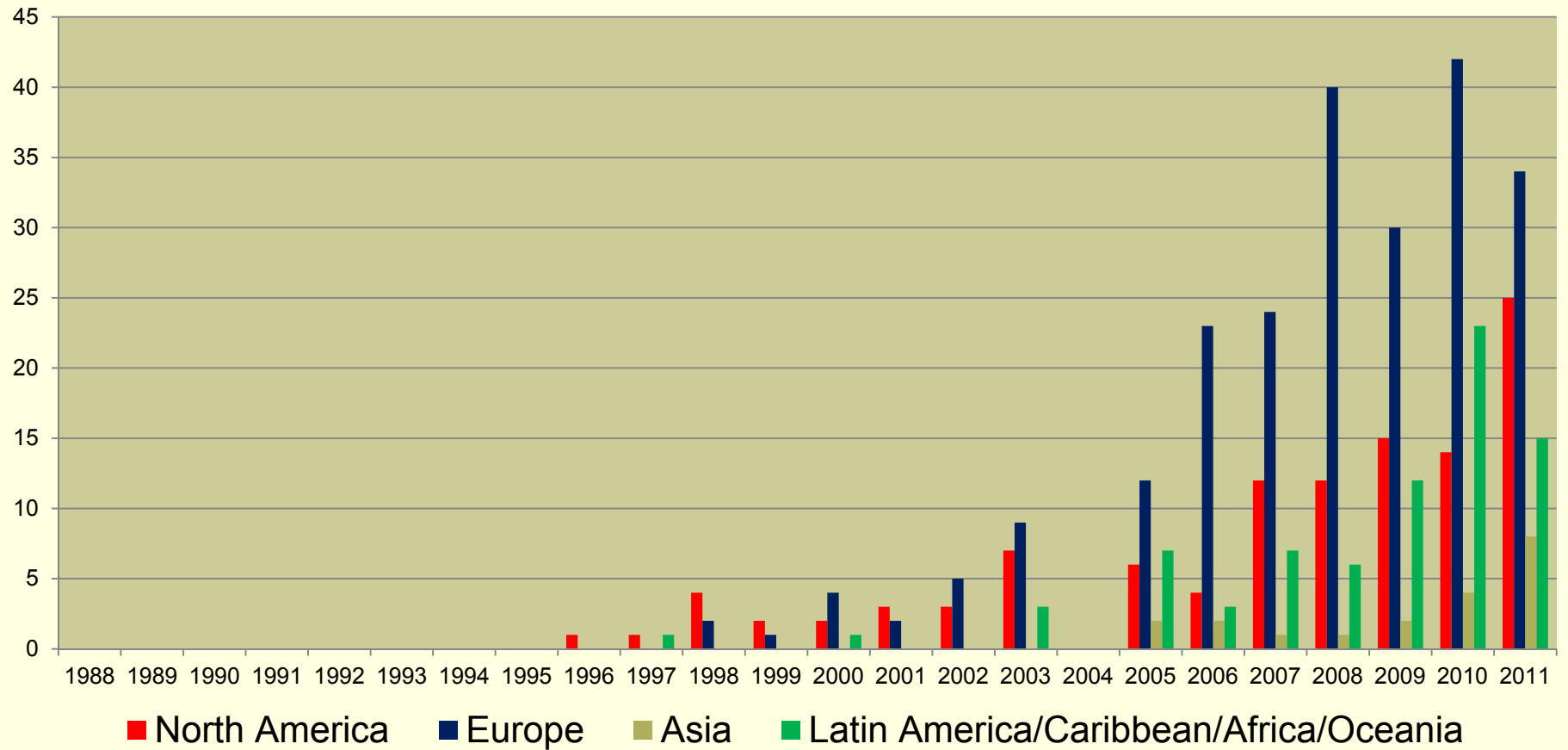
Recreation Demand Publications in EconLit by Geographic Region



Contingent Valuation Publications in EconLit by Geographic Region



Choice Experiment Publications in EconLit by Geographic Region



Messages

- Increasing “stock” of studies, expertise globally
- Stated preference dominates revealed preference analysis
- Strong focus on SP methods, probably primarily for passive use value or combined use and passive use values (total economic value).
- Europe is where the action is!



The Valuation Policy Environment

- Historically:
 - Benefit cost analysis (BCA) of projects
 - Some regulatory impact analysis (RIA)
 - Natural resource damage assessment (U.S.)
- Emerging Trends
 - Ecosystem services perspective
 - The Economics of Ecosystems and Biodiversity (TEEB)
 - Expanded scope for BCA, RIA
 - Investment in conservation (InVEST)
 - U.K National Ecosystem Assessment
 - Behavioral economics linkage



Boyd and Banzhaf, 2007, page 632

Table 1 – Inventory of services associated with particular benefits

Illustrative benefit	Illustrative ecosystem services
Harvests	
Managed commercial ^a	Pollinator populations, soil quality, shade and shelter, water availability
Subsistence	Target fish, crop populations
Unmanaged marine	Target marine populations
Pharmaceutical	Biodiversity
Amenities and fulfillment	
Aesthetic	Natural land cover in viewsheds ^b
Bequest, spiritual, emotional	Wilderness, biodiversity, varied natural land cover
Existence benefits	Relevant species populations
Damage avoidance	
Health	Air quality, drinking water quality, land uses or predator populations hostile to disease transmission ^c
Property	Wetlands, forests, natural land cover

Drinking water provision	
Avoided treatment cost	Aquifer, surface water quality
Avoided pumping, transport cost	Aquifer availability
Recreation	
Birding	Relevant species population
Hiking	Natural land cover, vistas, surface waters
Angling	Surface water, target population, natural land cover
Swimming	Surface waters, beaches

^a Managed commercial crops include the range of row crops, marine, and terrestrial species, for food, fiber, and energy.

^b Viewsheds are a topographic concept, delineating the area from which a particular site can be seen.

^c Biodiversity is thought by some ecologists to promote pest resistance.



The Economics of Ecosystems and Biodiversity (TEEB)

- TEEB-D0 aims to synthesize and present the latest ecological and economic knowledge to structure the evaluation of ecosystem services under different scenarios, and to recommend appropriate valuation methodologies for different contexts. It also aims to examine the global economic costs of biodiversity loss and the costs and benefits of actions to reduce these losses.
- TEEB-D1 and TEEB –D2 aim to develop guidance for policy makers at international, regional and local levels in order to foster sustainable development and better conservation of ecosystems and biodiversity. This guidance includes a detailed consideration of subsidies and incentives, environmental liability, national income accounting, cost-benefit analysis, and methods for implementing instruments such as Payments for Ecosystem Services (PES)
- TEEB-D3 enables easy access to leading information and tools for improved biodiversity-related business practice – from the perspective of managing risks, addressing opportunities, and measuring business impacts on ecosystems and biodiversity.
- TEEB-D4 aims to raise public awareness of the contribution of ecosystem services and biodiversity towards human welfare, of an individual's impact on biodiversity and ecosystems, as well as identifying areas where individual action can make a positive difference.
- Source:
<http://www.teebweb.org/AboutTEEB/Background/AimsObjectives/tabid/1040/Default.aspx>



Opportunities and Challenges

■ Opportunities

- Increased profile (and use?) of valuation
- Significant advances in theory, methods and the “stock” of studies / expertise

■ 4 Challenges

- Use Values: Extent of the Market (Attribute Based); Choice Set Formation
- Passive Use Values / Stated Preference Analysis: The Extent of the Market (Spatial)
- Stated Preference Analysis: Employment Effects
- Stated Preference Analysis: Surveys and Strategic Behavior



Challenge 1: Use Values and Choice Set Formation

- Example: Recreation Demand
 - Theory relatively well established
 - Mechanisms to link environmental quality to value
 - Most formulations involve random utility theory, one component of which is a “**choice set**”
 - **Which set of recreation sites are chosen from?**
 - **Usually this is assumed by the researcher**
 - **But choice sets are individual specific.**
 - **Is this a type of “extent of the market”?**



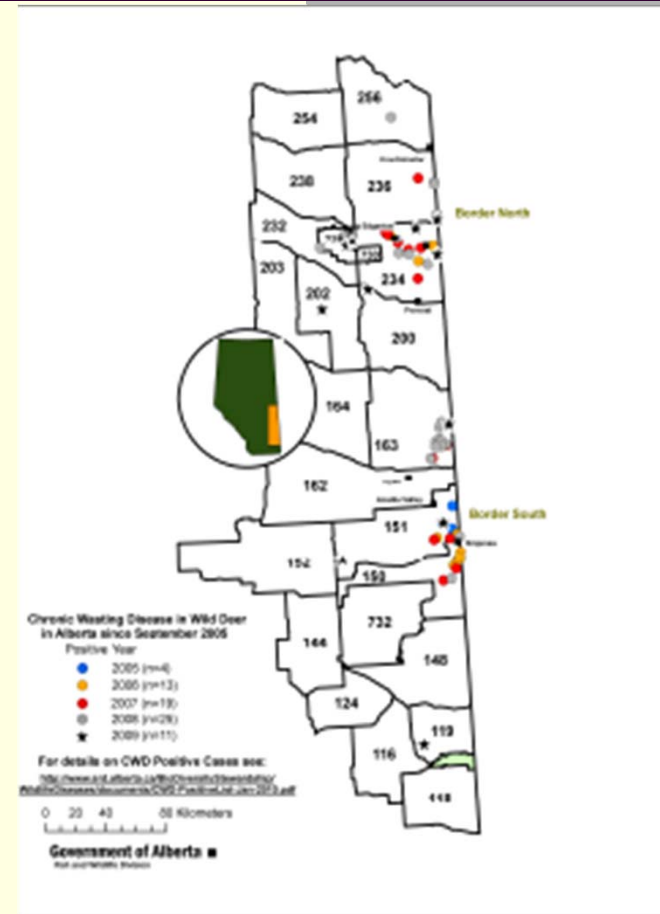
Implications of Choice Set Assumptions

- Long history of concern over choice set misspecification, but relatively little done...
- Applies to a large class of models / applications
 - Transportation
 - Food Choices (health risks?)
 - Housing Demand
 - Stated Preference Data Sets
 - SP Data with multiple alternatives, etc.
 - Marketing
- Little theory or understanding of the impact of misspecified choice sets
- Behavioral Econ – “too much choice”?



A Case Study: What is the economic welfare impact of CWD?

- Chronic Wasting Disease (CWD): prion disease that affects deer, elk and other cervid wildlife species
 - Neurodegenerative disease
 - No known link between the consumption of CWD affected meat and human health, but
 - Cautions were provided to hunters
- CWD might affect a recreational hunter's:
 - choice sets
 - site choice



Analysis

- 2 years of data on hunter choices (and stated preference data)
- Analysis
 - Standard approach (all alternatives in the choice set)
 - Explicit choice set formation model
- Results
 - Welfare impacts up to 3 times larger when choice set formation incorporated
 - Presence of CWD increases the chance that a site is **not considered**; increasing over time
 - Often the choice set effect dominates the utility effect.
 - Truong, Adamowicz, Boxall, 2011.



Choice Set Formation – Next Steps?

- Critical component in modeling, welfare measures.
- Emerging Conceptual Analysis
 - Ding et al. “Threshold Models”
 - Masatlioglu et al AER 2012 Revealed Attention.
- Simulation Analysis
 - Li, Adamowicz, Swait, 2012.
 - 50% difference in welfare measures depending on choice set assumptions
 - Some approximation models are promising
- Continued work on how people form choice sets

Challenge 2: Passive Use Values and the Extent of the Market

- Use values (e.g. recreation) usually decline with distance from the site
- Do passive use values “decay” with distance?
- If not, potentially large impacts on BCA.
 - How many people to include in the BCA?
- A typical case: Endangered Species Protection
- Case studies illustrating the effects....





Fisheries and Oceans
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Analysis of the economic benefits associated with the recovery of threatened marine mammal species in the Canadian St. Lawrence Estuary

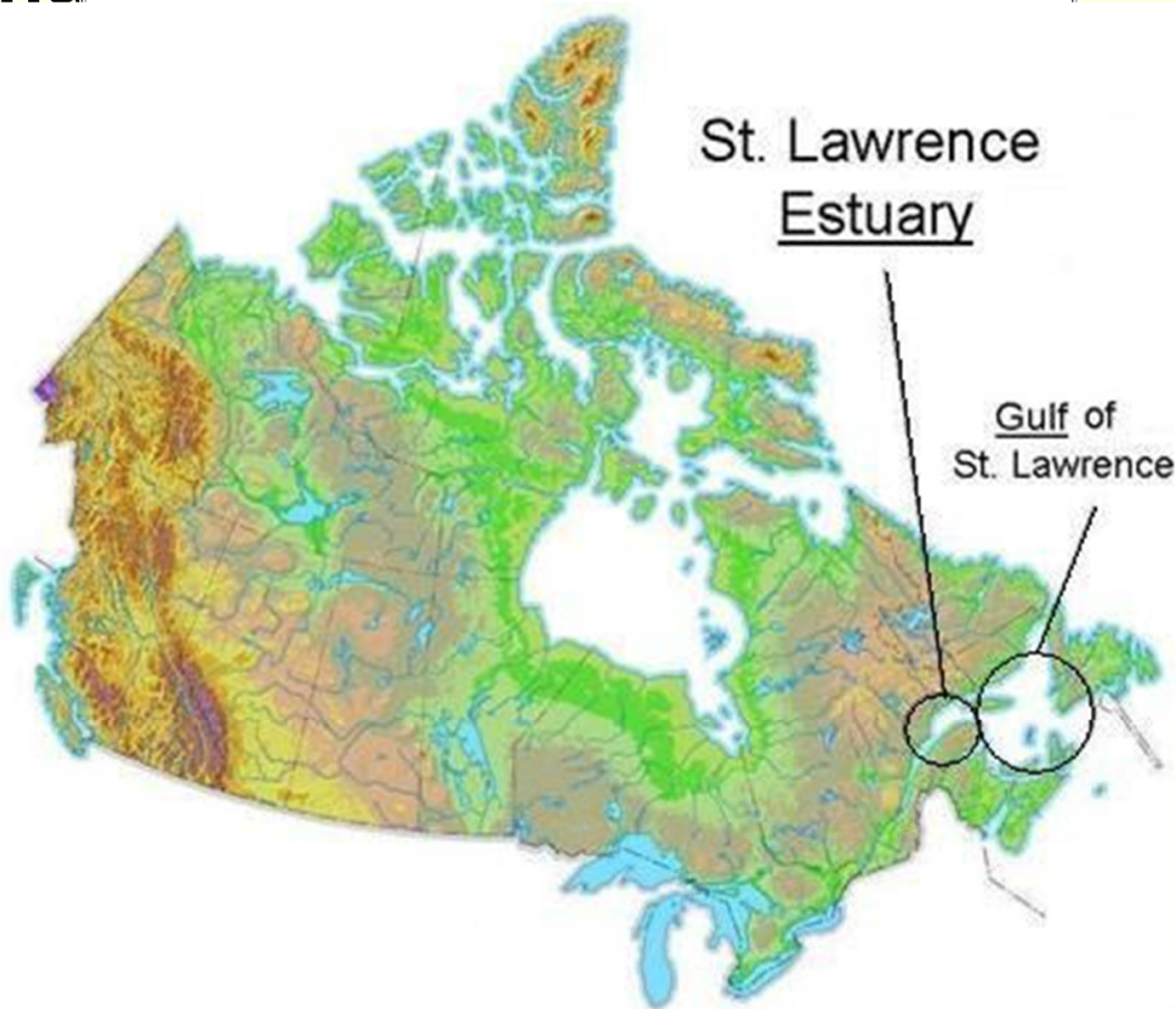
P. Boxall, Adamowicz W., M. Olar, West G.E. and Cantin G.



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Rationale

MARINE MAMMALS IN THE ST. LAWRENCE ESTUARY



St. Lawrence
Estuary
Gulf of St. Lawrence



Key Findings

- WTP for improvements just beyond the threatened threshold are quite high, while the WTP for further recovery beyond this level (i.e. which would totally remove the extinction risk) are quite small.
- **Quebec residents (closest to the species) are willing to pay significantly less for marine mammal recovery than other Canadians!!!**
- Inside Quebec the WTP does not appear to vary with increasing distance from Quebecers residence to the site location.



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Rationales

Socioeconomic
Analysis

Valuation
tools

Survey
development

Data

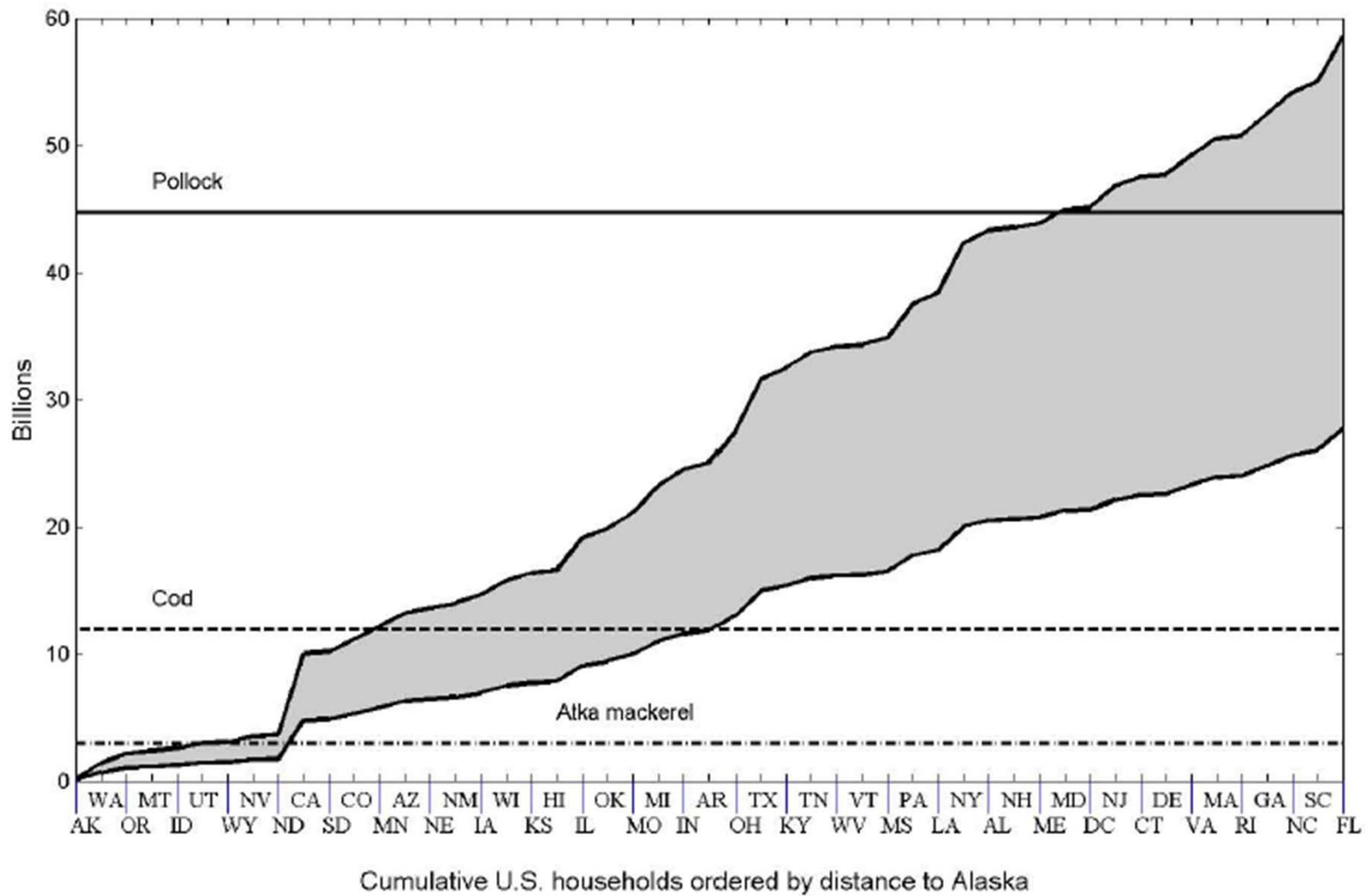
Results

Conclusions

Sanchirico et al 2012 (Marine Policy)

- Conservation values in Coastal Marine Spatial Planning
- Examine benefits and costs of western Stellar Sea Lion in Alaska, USA (Threatened)
- Conservation of Stellar Sea Lions involves restrictions on commercial fisheries.
- Who should be included in the calculation of benefits?
 - Spatial limits?





Source: Sanchirico et al, 2012. Marine Policy (forthcoming) (page 28)

Klamath River Basin Restoration NonUse Value Study

- Mansfield et al, 2012.
- Conducted as part of an economic analysis for the U.S. Department of Interior
- Compared local, regional and national estimates of the benefits of restoration (removal of dams, etc.)
- <http://klamathrestoration.gov/sites/klamathrestoration.gov/files/DDDD.Printable.Klamath%20Nonuse%20Survey%20Final%20Report%202012%5B1%5D.pdf>



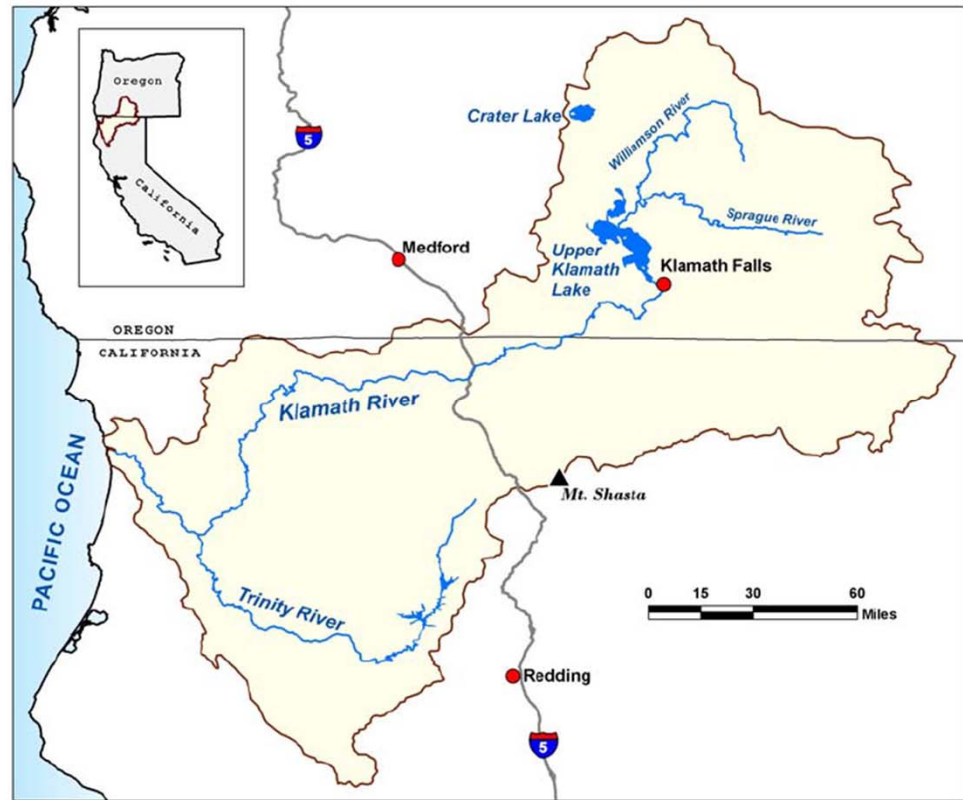
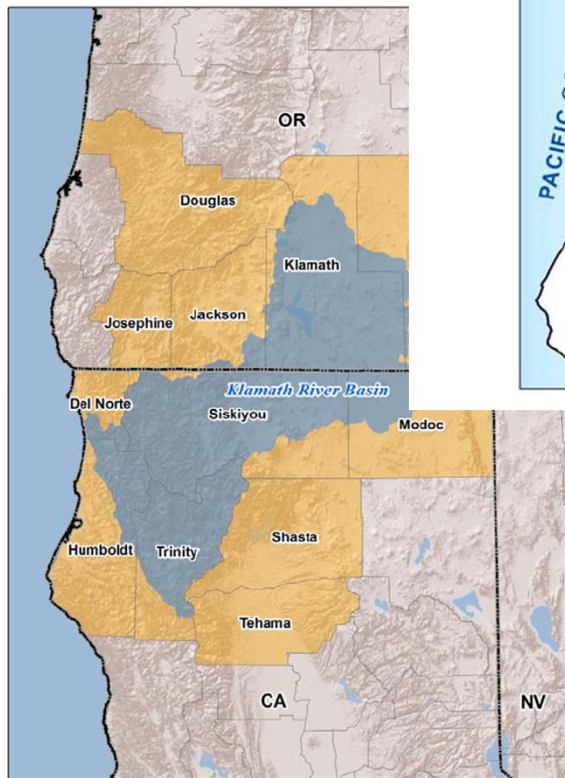


Figure 4-1. The 12-County Area Included in the Klamath River Area Stratum



Table 8-1. Household WTP Values for Action Plan 1 Relative to No Action with 95% Confidence Interval using Error Components Model

Plan	12-County Klamath Area	Rest of Oregon and California	Rest of United States
20-year annual household WTP for full sample	\$160.61 (\$118.72–\$202.50)	\$254.19 (\$189.52–\$318.85)	\$237.77 (\$177.31–\$298.24)
Annualized WTP for full sample based on infinite stream of payments and 4.125% discount rate	\$89.05 (\$65.82–\$112.28)	\$140.93 (\$105.07–\$176.76)	\$131.83 (\$98.30–\$165.24)
20-year annual household WTP for the restricted sample	\$121.85 (\$79.09–\$164.61)	\$213.03 (\$160.90–\$265.15)	\$213.43 (\$155.70–\$271.16)
Annualized WTP for the restricted sample based on infinite stream of payments and 4.125% discount rate	\$67.56 (\$43.85–\$91.27)	\$118.11 (\$89.21–\$147.01)	\$118.33 (\$86.33–\$150.34)

Note: Estimates based on results from Tables 7-9 to 7-14 for ECM.

Source: Mansfield et al, 2012. Page 8-2.

Table 8-5. Aggregate PV of 20-Year WTP with 95% Confidence Interval, Restricted Sample, (in billions of dollars)

	Aggregate PV of 20-Year Annual WTP for Action Plan Relative to No Action	Aggregate PV of 20-Year Annual WTP for Reduced Extinction Risk for Coho Salmon ^a	Aggregate PV of 20-Year Annual WTP for Reduced Extinction Risk for Suckers and Coho Salmon ^b
12-county Klamath area	\$0.217 (\$0.141–\$0.293)	\$0.067 (\$0.016–\$0.119)	\$0.125 (\$0.044 - \$0.207)
Rest of Oregon and California	\$9.071 (\$6.851–\$11.290)	\$2.091 (\$0.643–\$3.538)	\$2.334 (\$-0.054 - \$4.723)
Rest of the United States	\$74.983 (\$54.701–\$95.265)	\$13.487 (\$0.042–\$26.933)	\$27.675 (\$8.319 - \$47.032)
Total	\$84.271 (\$61.694–\$106.850)	\$15.645 (\$0.701–\$30.589)	\$30.135 (\$8.309 - \$51.962)

^a Reduce risk of extinction for coho salmon from high to moderate.

^b Reduce risk of extinction for suckers from very high to high and for coho salmon from high to moderate.

Source: Mansfield et al 2012. Page 8-7.

Summary – Extent of the Market Challenge

- Critical issue in Benefit Cost Analysis
 - Much more important in policy application than many methodological questions
- Particularly relevant in cases like endangered species, unique ecosystems, etc.
- Raises questions about distributional effects
- Limited theory, few empirical analyses



Challenge 3: Employment issues

- Should Benefit Cost Analysis include employment?
 - Impacts of regulation, etc.
- Are respondents in Stated Preference tasks considering employment effects?
 - Do we include potential employment (or other general equilibrium impacts) in environmental valuation?



Employment in Benefit Cost Analysis?

- *“ Cost-benefit analysis, as traditionally performed and as it appears in textbooks, does not take into account employment effects. Cost-benefit analysis of a regulation compares the benefits for the public with the costs of complying with the regulation.... Yet there is no obvious reason for excluding unemployment costs from cost-benefit analysis. “*
- *Masur, J.S. and E.A. Posner. 2011. Regulation, Unemployment and Cost-Benefit Analysis. The University of Chicago Law School Working paper No. 571. Pages 2-3.*



Do Survey Respondents Include Concerns Over “Jobs” in their Responses? Case Study: Species Conservation (A. Entem, W. Adamowicz, P. Boxall and S. Simpson)

- Split Sample Stated Preference Study on Threatened Species Conservation in Saskatchewan, Canada
 - Sample 1: Focus on species conservation.
 - Sample 2: Explicit inclusion of employment impacts as an attribute in the choice sets.
 - Attempt to hold impacts on economy “constant”
- Evaluation of Low, Medium and High species conservation packages



The Milk River Watershed



- A total of 14,923 km²
- Located in the southwest corner of the province
 - Bounded to the west by Alberta and the south by Montana
- The primary land uses:
 - Agriculture
 - Ranches, Farms and Mixed Farms
 - Oil and Gas



Schedule 1 – Legally listed and protected under SARA: Extirpated



Schedule 1 – Legally listed and protected under SARA: Endangered



Schedule 1 – Legally listed and protected under SARA: Threatened



VOTE 2: Please indicate which program you would vote for if this were a provincial referendum on the choice of management options. Please treat this vote independently from the previous vote.

	CURRENT PROGRAM	PROPOSED PROGRAM
	Risk of species disappearing from the Milk River Watershed in 30 years	
Burrowing Owl	Moderate Risk	Low Risk
Greater Sage-Grouse	High Risk	Moderate Risk
Loggerhead Shrike	Moderate Risk	Moderate Risk
Sprague's Pipit	Low Risk	Low Risk
Swift Fox	Low Risk	No Risk
	ADDITIONAL annual <u>cost</u> to your household:	
Your household's share of additional income taxes, to be paid every year for the next 30 years	\$0	\$150

2A. Please carefully compare the two alternatives presented in the table above. If you had to VOTE for one these two programs, which one would you vote for?

*Please select **one** response from the options below.*

- CURRENT program
- PROPOSED program

VOTE 2: Please indicate which program you would vote for if this were a provincial referendum on the choice of management options. Please treat this vote independently from the previous vote.

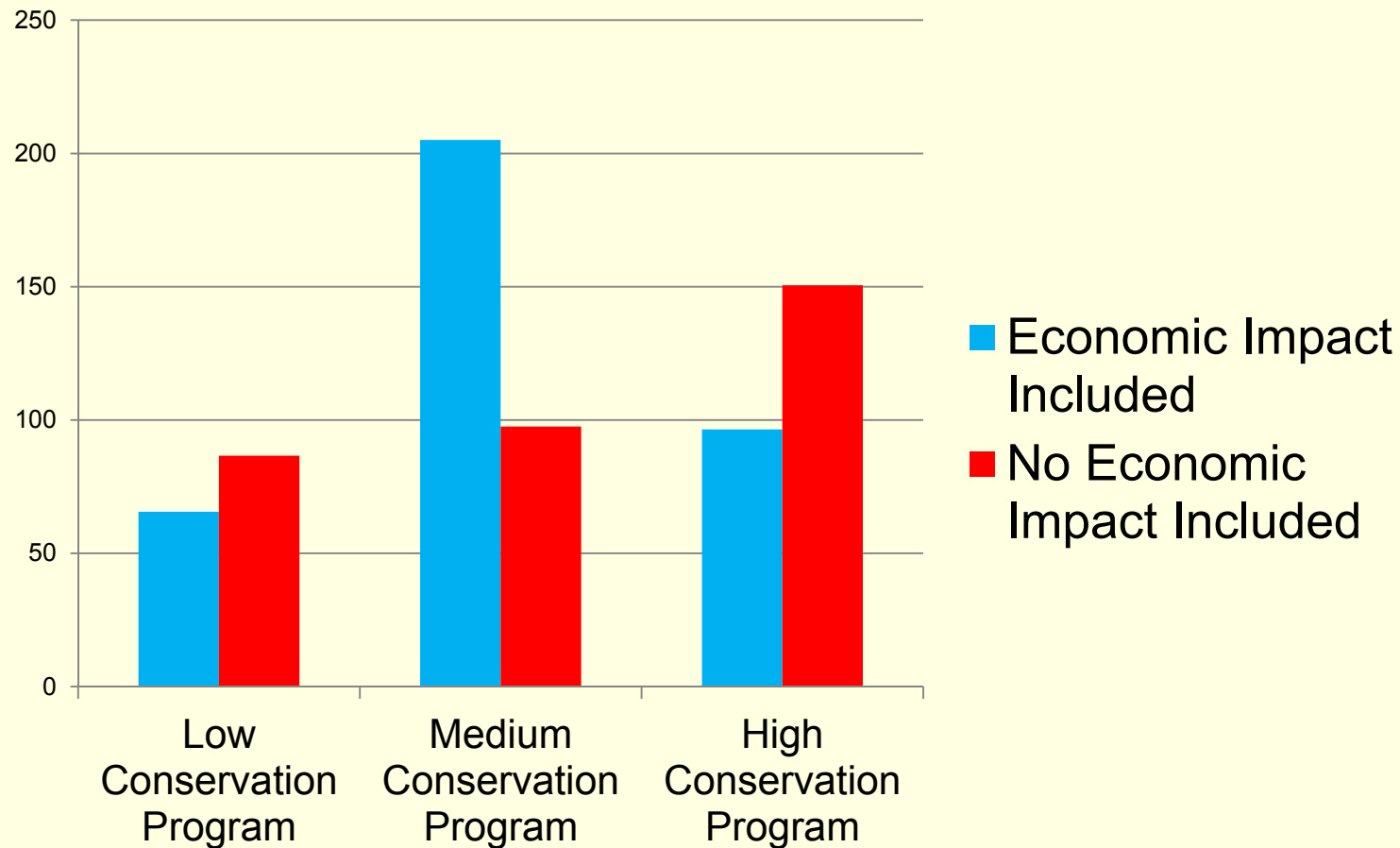
	CURRENT PROGRAM	PROPOSED PROGRAM
	Risk of species disappearing from the Milk River Watershed in 30 years	
Burrowing Owl	Moderate Risk	Low Risk
Greater Sage-Grouse	High Risk	Low Risk
Loggerhead Shrike	Moderate Risk	Moderate Risk
Sprague's Pipit	Low Risk	No Risk
Swift Fox	Low Risk	No Risk
	Impact on Industry in the Milk River Watershed	
Agriculture	Low Impact	Moderate Impact
Oil and Gas	Low Impact	Low Impact
	ADDITIONAL annual <u>cost</u> to <u>your household</u> :	
Your household's share of additional income taxes, to be paid every year for the next 30 years	\$0	\$300

2A. Please carefully compare the two alternatives presented in the table above. If you had to VOTE for one these two programs, which one would you vote for?

*Please select **one** response from the options below.*

- CURRENT program
- PROPOSED program

Results



Results

- Are respondents anticipating economic consequences from the proposed environmental quality changes?
 - Beyond the payment they are asked to make?
- Are respondents blending their WTP for species conservation and their WTP to maintain an “industry” (e.g. agriculture).
- What is the best way to frame and evaluate a program that may have broader economic impacts?



Challenge 4: Stated Preference Data and Strategic Behavior

- Do people respond strategically?
- Do they take “hypothetical” surveys seriously?
- Significant advances in the literature
 - Focus on consequentiality, incentive compatibility
 - Interesting emerging results
- But, are there other response strategies that we should worry about?



Consequentiality

- Strategic Behavior is a function of
 - Perceived payment obligation
 - Expectations about actual provision of the good
- Ideally, we would like respondents to perceive that they actually may have to pay the amount, and that their choice will affect provision of the good.
- Carson and Groves (2007)



Consequentiality / Strategic Behavior

- Vossler et al (forthcoming, AEJ-Micro): “Truth in Consequentiality”
- Examine “real” and hypothetical choice experiments for a public good.
- Incentive Compatibility Requirements
 - **Consequentiality, and**
 - **Independence** across choices.
- An Interesting Finding:
 - Question regarding perceived consequentiality:
 - **“To what extent do you believe that your votes will be taken into account by the authorities”?** (pg. 26)
 - “In other words, conditional upon participants perceiving their responses to have more than a weak level of policy influence, stated preferences are equal to revealed preferences.” (pg. 27)



Carson and Groves revisited (2011)

One of the most interesting directions for future research we believe is how the CG neoclassical framework and various predictions from behavioral economics interact. At the heart of CG's reading of the empirical evidence is that neoclassical marginal conditions appear to hold while much of the behavioural critique concerns stepping back to a much more primitive level regarding behaviour. Bernheim and Rangel (2009) provide an examination of what welfare economics might look like if it is based on consumer choice which is influenced by factors identified by the behavioural critique.

- Is the difference between hypothetical and real responses “social desirability bias” or strategic behavior?

Carson, Richard T. and Ted Groves in Jeff Bennett, ed., International Handbook of Non-Market Environmental Valuation (Northampton, MA: Edward Elgar, 2011), p316.



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Levitt and List Theoretical Model

- Levitt and List (2007 JEP, CJE)
 - $U(a,v,n,s) = M(a,v,n,s) + W(a,v)$
 - M-moral, W-wealth, a- action, v-financial, n-norms, s-scrutiny
 - Possible (desirable) to isolate W from M?
 - Remove social desirability effect that would not occur in actual voting / choice.
- Is social desirability driving the difference between “surveys” and “real votes”?



A Potential “Solution”: Inferred Valuation

- Can people accurately “predict” their own behaviour in contexts that contain ethical / moral components?
- Could people’s prediction of others’ behavior better reflect their “actual” behavior?
- Inferred valuation method (Lusk and Norwood, 2009 JEEM, Land Econ)
- Literature
 - Lusk and Norwood, Mazar et al (JMR, 2008), Epley and Dunning (JPSP, 2000), Blaceticis et al (JPSP, 2008), Carlsson et al (2008)



A Case Study

- 3 Measures of Benefits
 - Traditional
 - Those who believe survey is policy relevant
 - Inferred valuation
- Compare with range of cost assessments



Economic Analysis of Threatened Species Conservation: The Case of Woodland Caribou and Oilsands Development in Alberta, Canada

Grant Hauer, University of Alberta, Canada

W.L. (Vic) Adamowicz, University of Alberta, Canada

Stan Boutin, University of Alberta, Canada

Steve Cumming, Université Laval, Canada

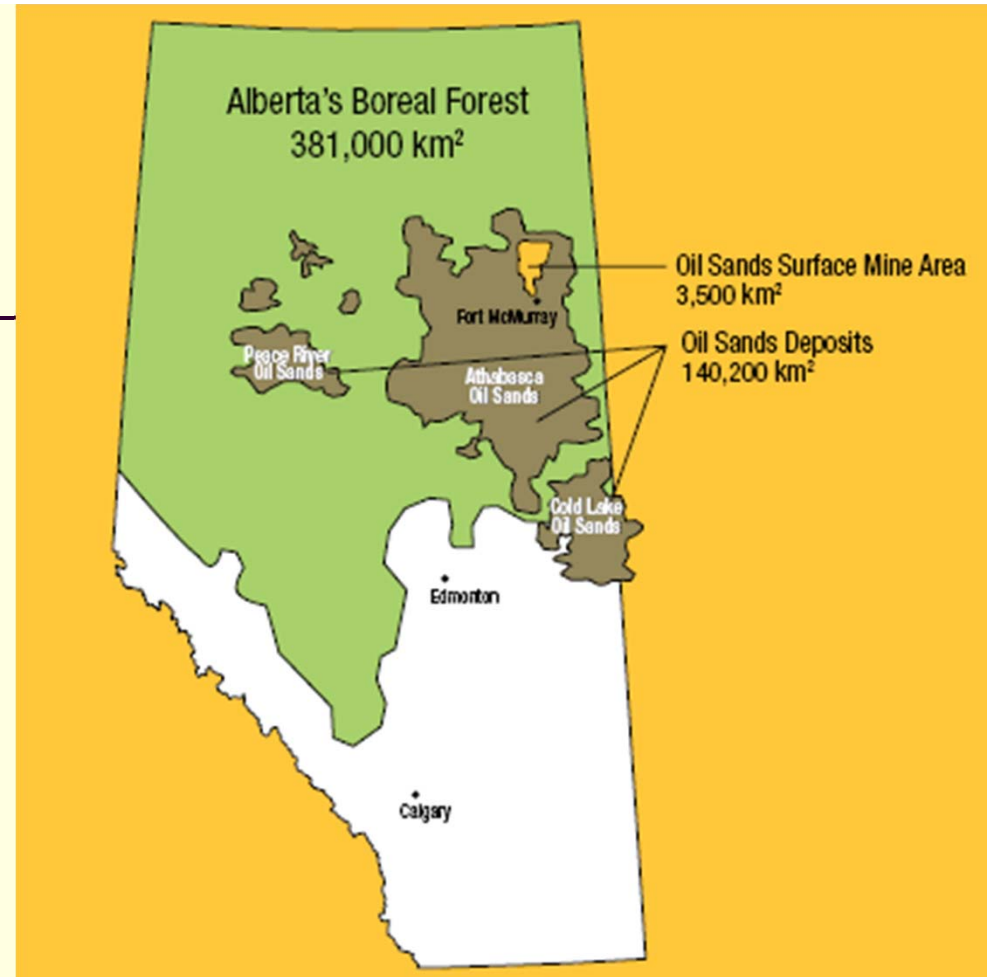
Richard Schneider, University of Alberta, Canada

Valuation Analysis

Vic Adamowicz, Peter Boxall, D. Harper, G. Hauer, and T. Truong.



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http://www.ags.gov.ab.ca/energy/oilsands/alberta_oil_sands.html

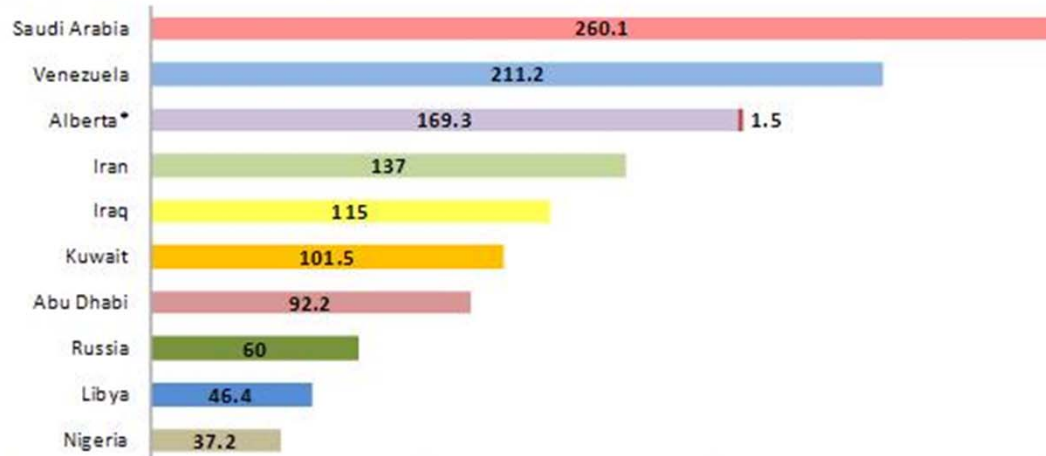
<http://environment.gov.ab.ca/info/library/8042.pdf>



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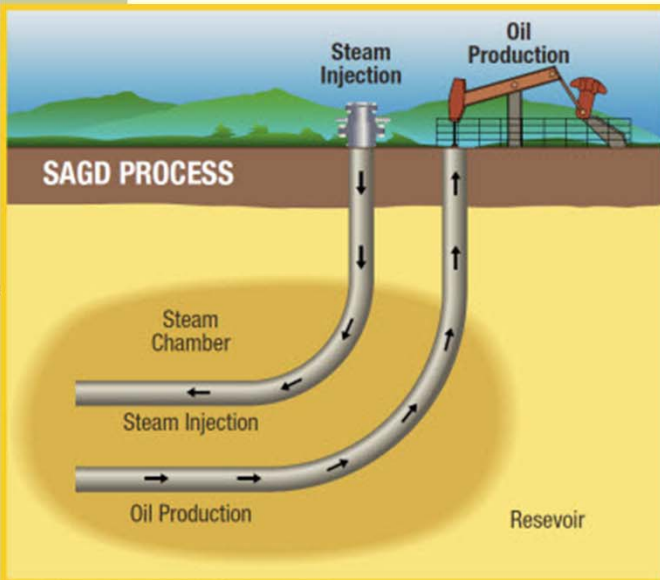


World's Largest Oil Reserves in 2010 (Billion Barrels)



*Alberta's total oil reserves were 170.8 billion barrels, of which crude bitumen reserves accounted for 169.3 billion barrels and conventional crude oil reserves for 1.5 billion barrels.

Sources: ERCB 2011 ST-98 Report "Alberta's Energy Reserves 2010 and Supply/Demand Outlook 2011 - 2020" and Oil & Gas Journal "Worldwide Look at Reserves and Production. Special Report", December 6, 2010, Vol. 108, Issue 46.



Source: Canadian Centre for Energy Information



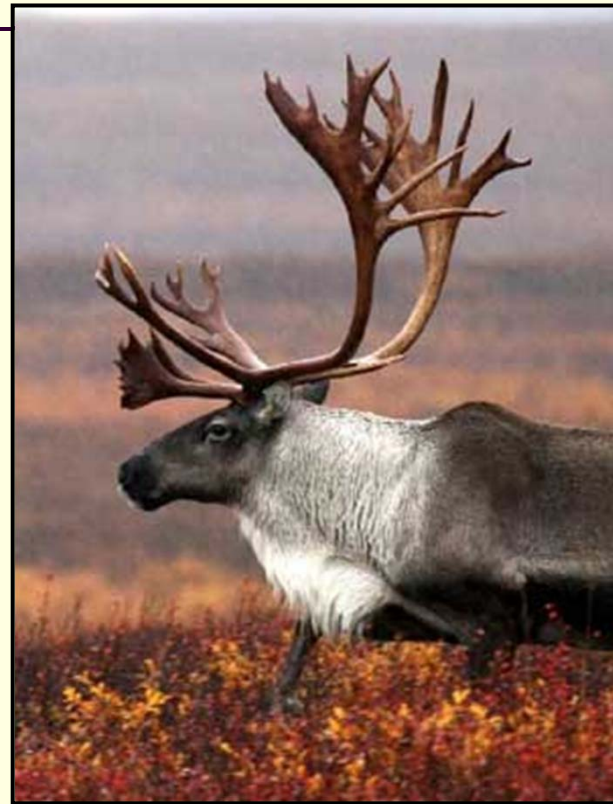
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Source: <http://www.energy.gov.ab.ca/OilSands/791.asp>

Woodland Caribou



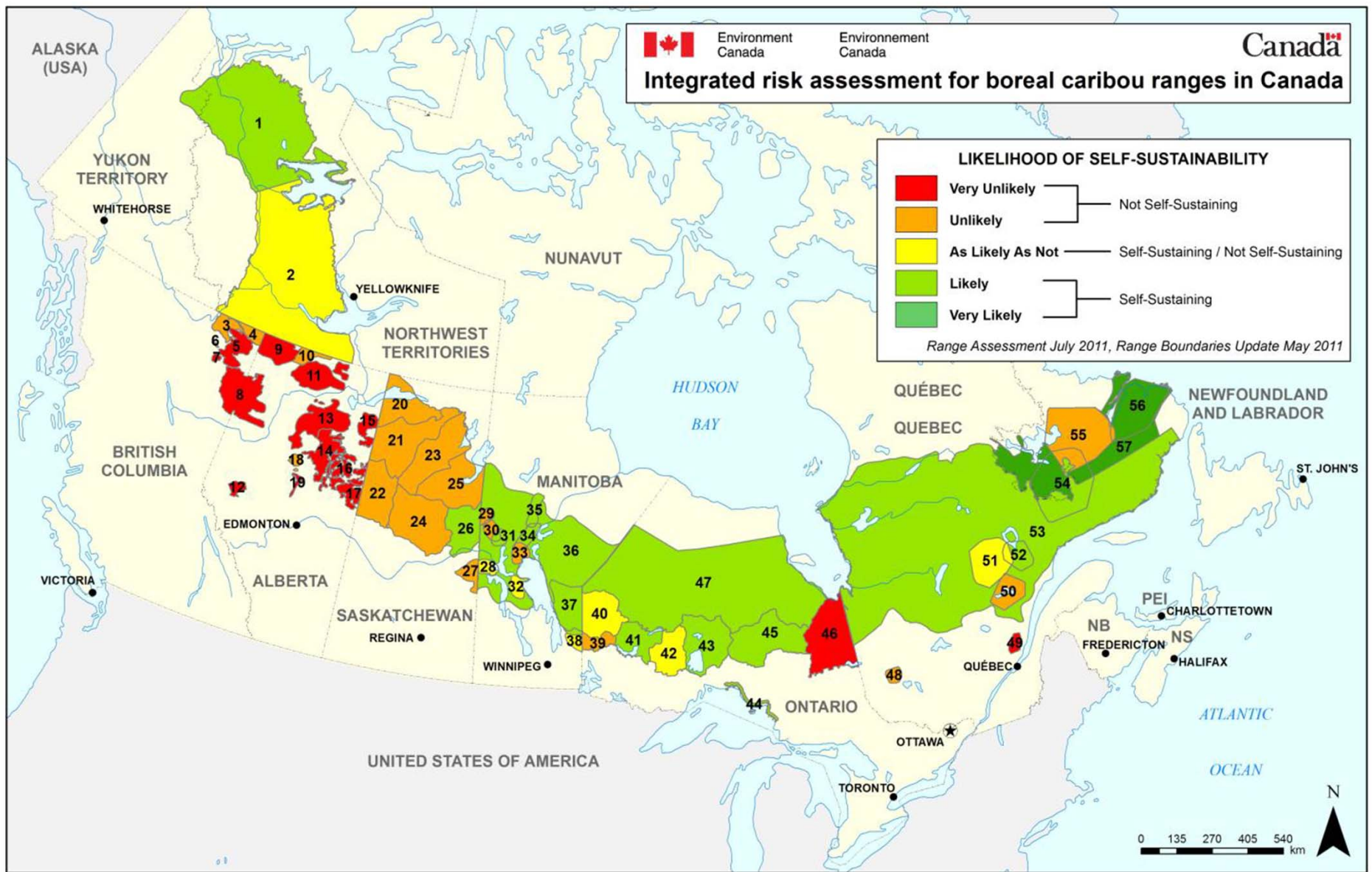
www.yfwmb.yk.ca



www2.csdm.qc.ca

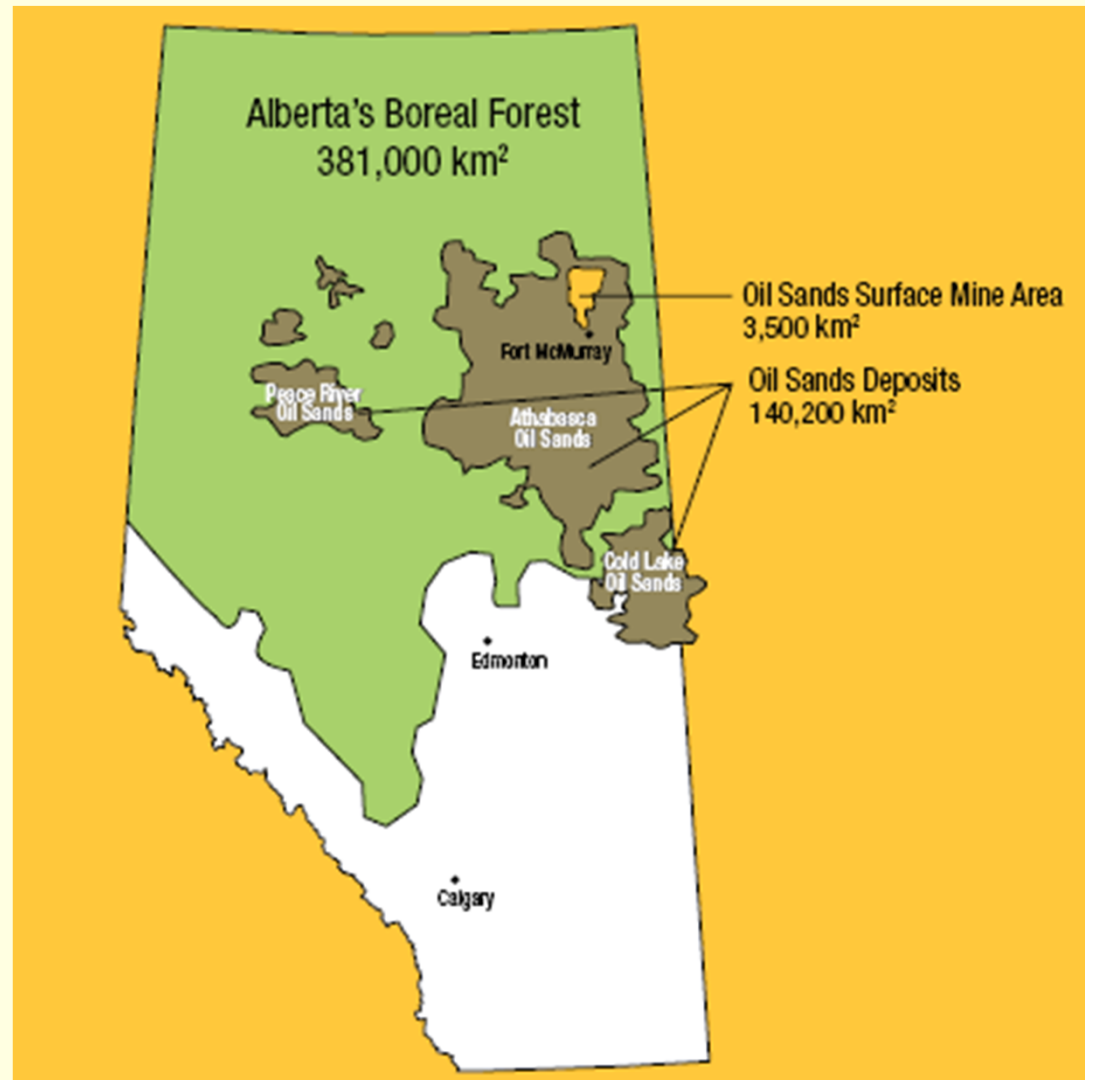
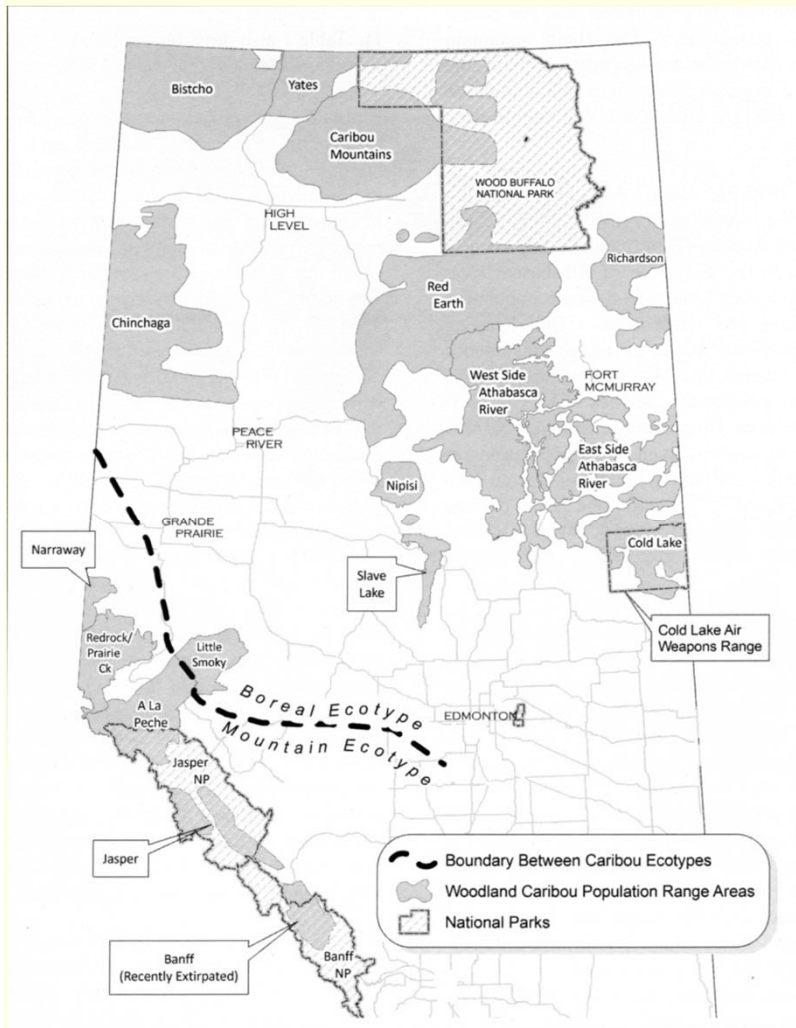


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Source: Environment Canada, 2011, Page 5

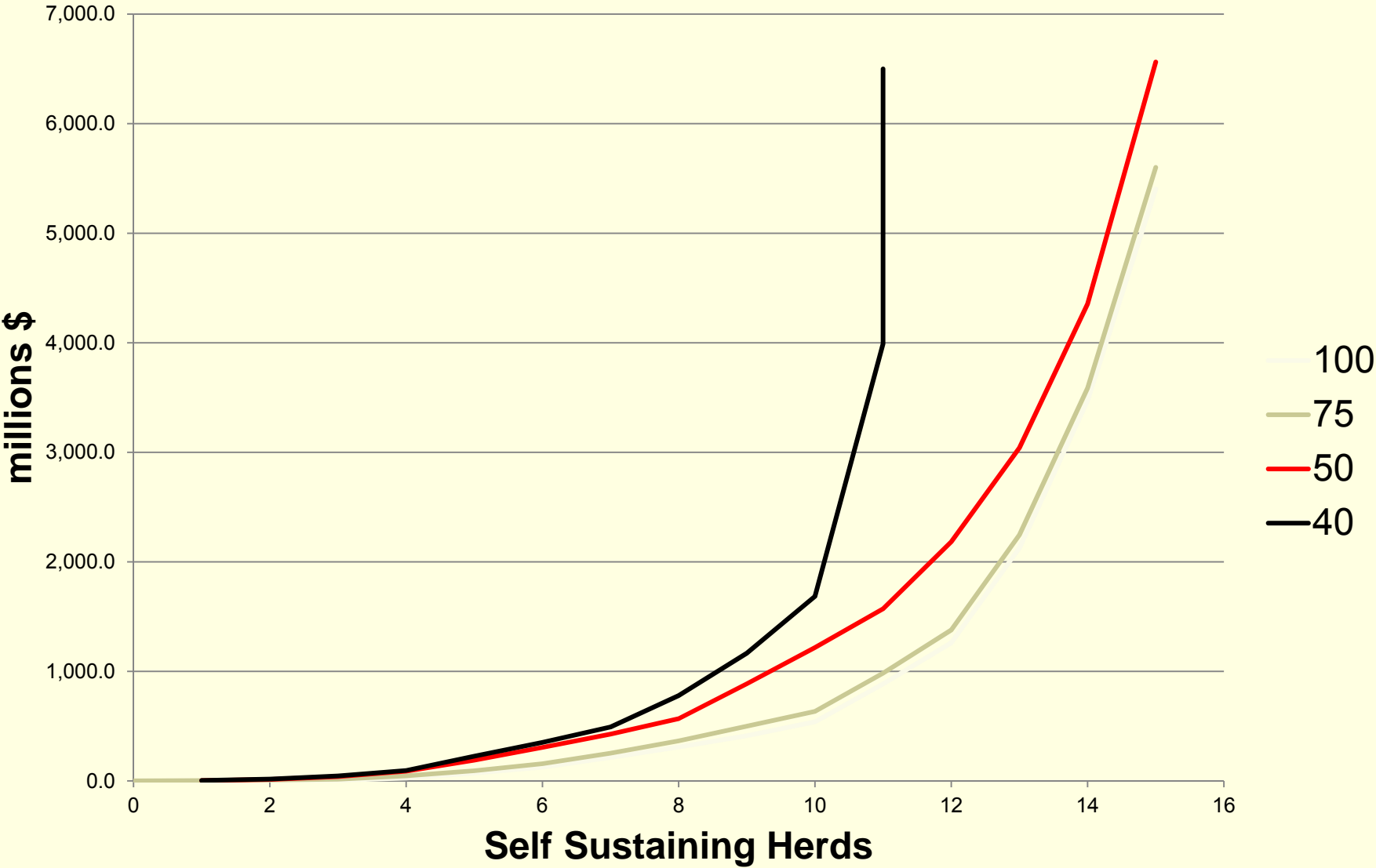
Woodland Caribou in Alberta



ASRD and ACA 2010

<http://environment.gov.ab.ca/info/library/8042.pdf>

Total Costs for Alternate Time to Recovery Objectives

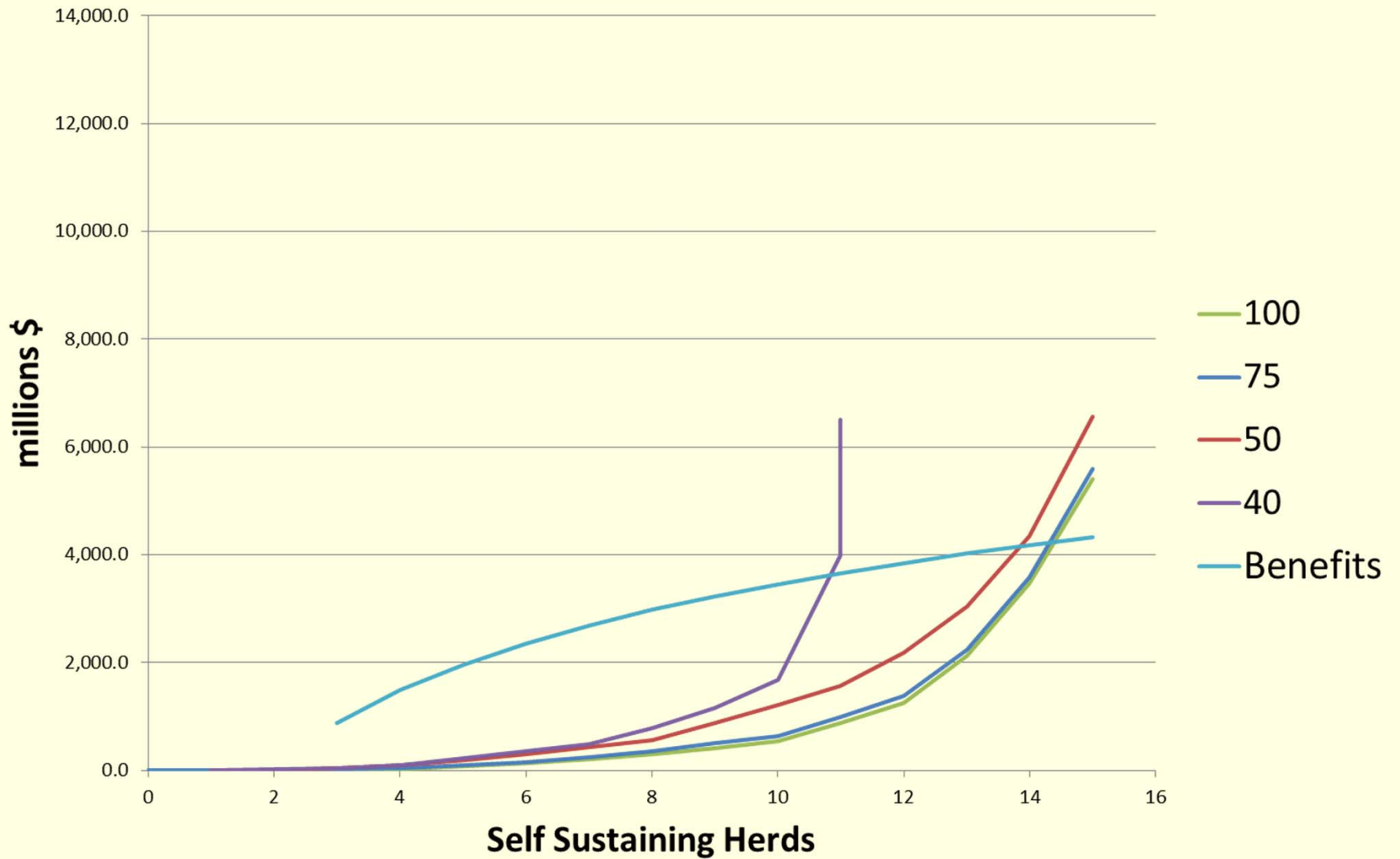


But what about benefits?

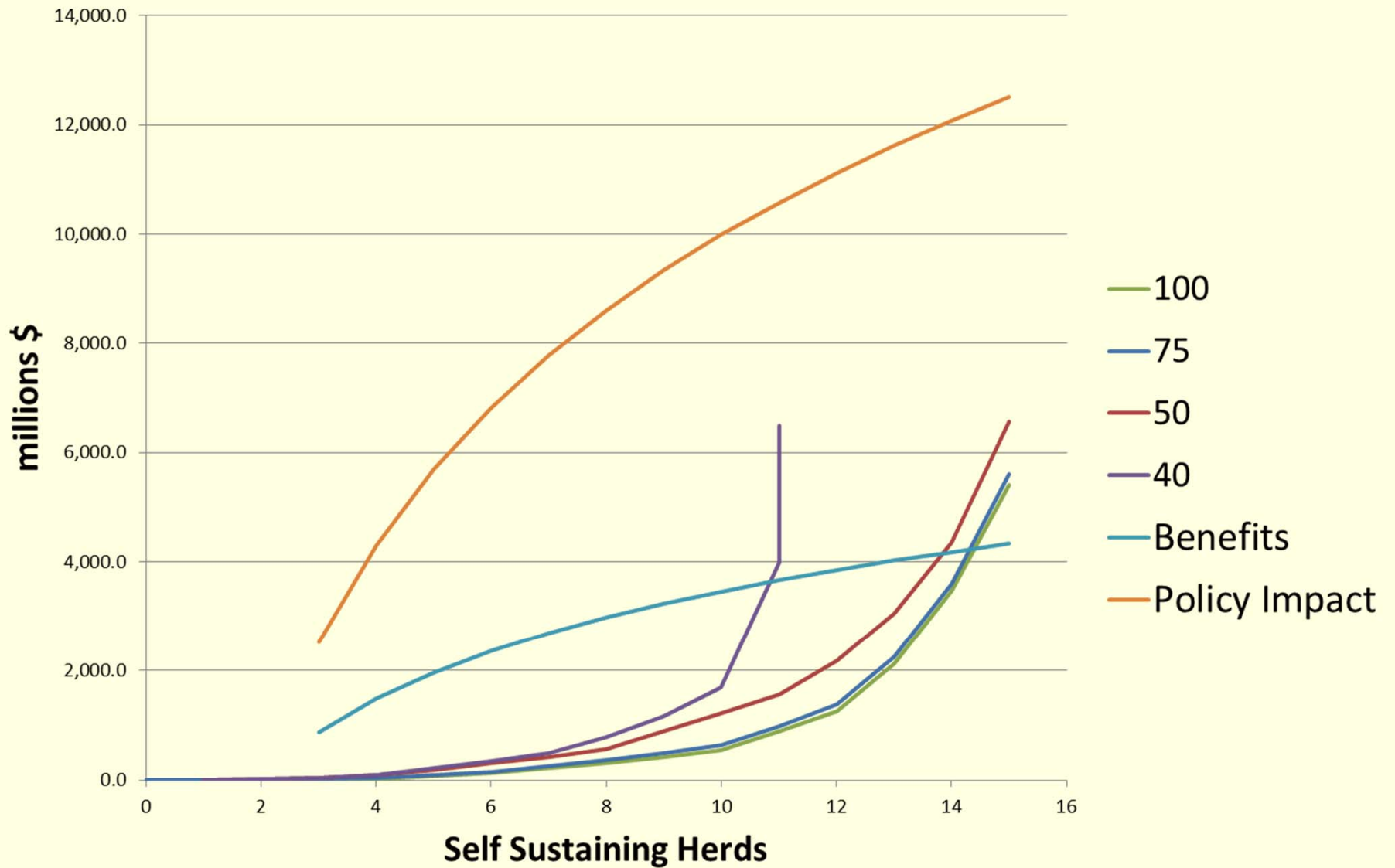
- Species at Risk Act describes the need for benefit information (as well as costs)
- Agency "push" to assess benefits
- Developed a stated preference task to assess WTP for different levels of caribou conservation (numbers of herds at self-sustaining status).
- Somewhat novel implementation....



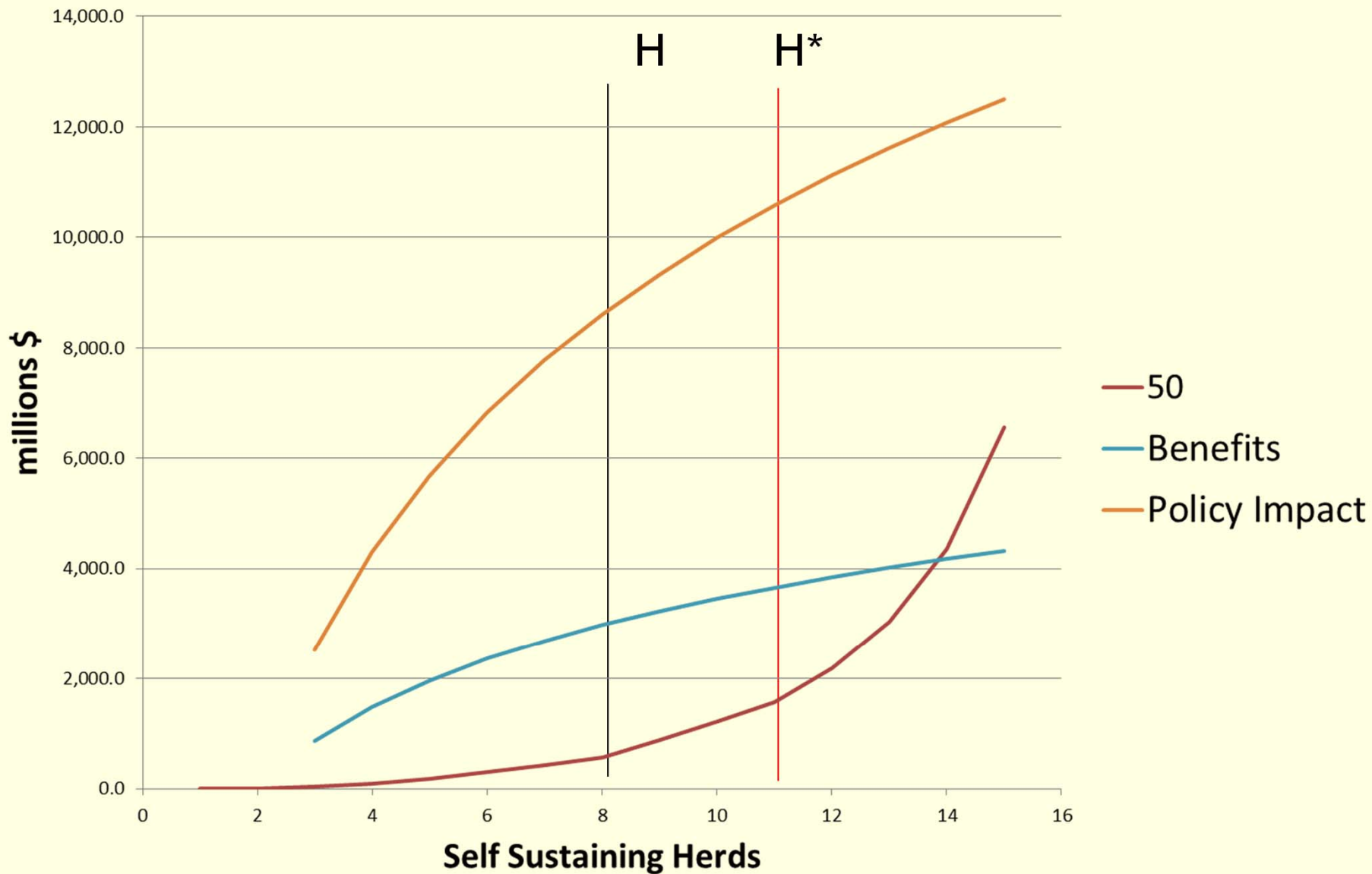
Total Benefits and Costs for Alternate Time to Recovery Objectives



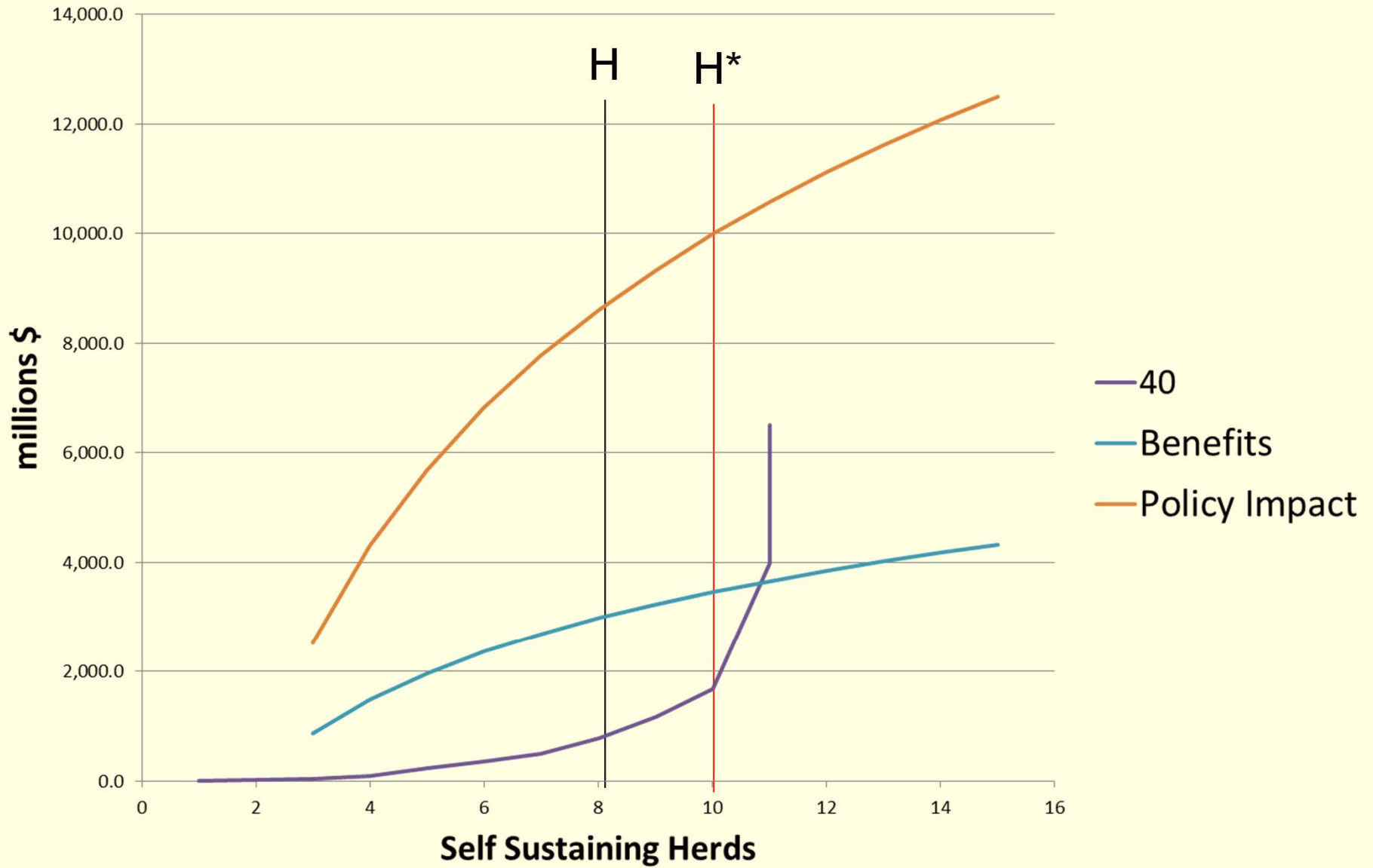
Total Benefits and Costs for Alternate Time to Recovery Objectives



Total Benefits and Costs for Alternate Time to Recovery Objectives

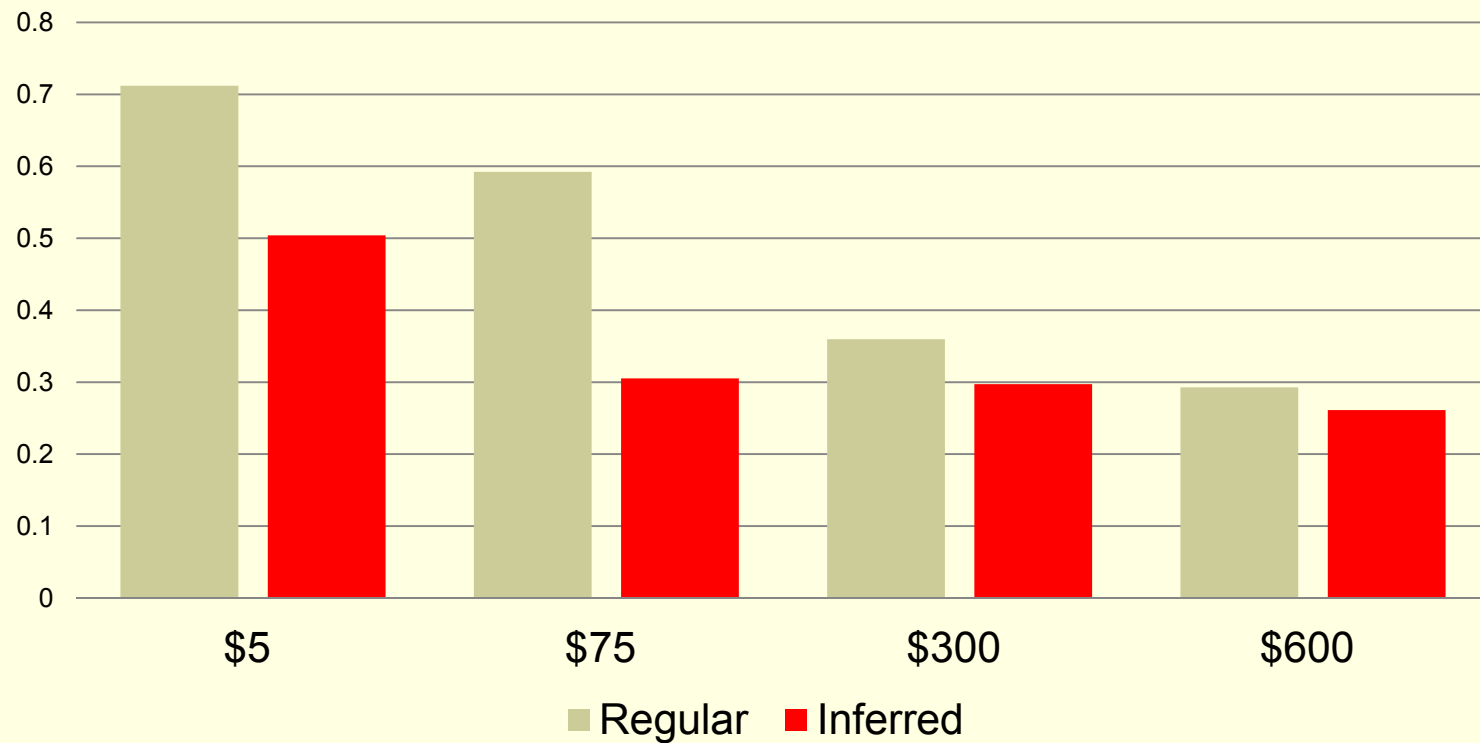


Total Benefits and Costs for Alternate Time to Recovery Objectives



Inferred Valuation?

% Yes Choices by Bid Values



Lessons Learned

- Mechanism for Valuation Elicitation affects the optimal outcome
 - More research on inferred valuation required.
- Cost calculations and requirements are also important in this case
- Cost **and** benefit calculations are quite variable!
- Conservation objectives are challenging to define
 - Defining **when** to meet the target may be at least as important as determining what the target is.



Conclusions

- Valuation and Policy – Increased Activity?
 - More expertise, greater stock of studies
 - Significant technical advances
 - RP versus SP Balance?
- To be used effectively, valuation requires a “Governance Framework”
 - Benefit cost analysis, Regulatory impact analysis
- Many challenges remain – and have significant policy relevance!
 - Extent of the Market
 - Employment
 - Stated Preference / Incentive Compatibility



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