Fisheries and Oceans Canada
Pêches et Océans Canada

ESTIMATION OF THE ECONOMIC BENEFITS OF MARINE MAMMAL RECOVERY IN THE ST. LAWRENCE ESTUARY

Fisheries and Oceans Canada
Policy and Economics Branch
Quebec Region

July 2007

Canada

Fisheries and Oceans Canada
Pêches et Océans Canada

ESTIMATION OF THE ECONOMIC BENEFITS OF MARINE MAMMAL RECOVERY IN THE ST. LAWRENCE ESTUARY

Authors: Olar M.[1], Adamowicz W.[2], Boxall P.[3], West G.E.[4]
Collaborators: Lessard F.[5], Cantin G.[6]

[1]Centre for Research in the Economics of Agrifood (CREA), Laval University, Quebec, QC,
Tel. (418) 656-2131, # 8397, maria.olar@eac.ulaval.ca

[2]Department of Rural Economy, University of Alberta, Edmonton, AB,
Tel. (780) 492-4603, vic.adamowicz@ualberta.ca

[3]Department of Rural Economy, University of Alberta, Edmonton, AB,
Tel. (780) 492-5694, peter.boxall@ualberta.ca

[4]Centre for Research in the Economics of Agrifood (CREA), Laval University, Quebec, QC
Tel. (418) 656-2131, # 3755, gale.west@eac.ulaval.ca

[5]Policy and economics, Quebec Region, Fisheries and Oceans Canada, Quebec, QC
Tel. (418) 648-7758, lessardf@dfo-mpo.gc.ca

[6]Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, QC
Tel. (418) 775-0725, Canting@dfo-mpo.gc.ca

July 2007

UNIVERSITÉ LAVAL

UNIVERSITY OF ALBERTA

Canada

Published by:
Policy and Economics Branch
Fisheries and Oceans Canada
Quebec, QC
G1K 7Y7

N°: Fs124-2/2008A
ISBN: 978-0-662-08378-8

2007

Cette publication est aussi disponible en français.

Suggested citation:
Fisheries and Oceans Canada.«Estimation of the Economic Benefits of Marine Mammal Recovery in the St. Lawrence Estuary» Policy and Economics Regional Branch, Quebec 2008.

Cover photo credits:
Fisheries and Oceans Canada
J.-P. Sylvestre

ACRONYMS

SARA = Species at Risk Act
MPA = Marine Protected Area
DFO = Department of Fisheries and Oceans

ABBREVIATIONS

$ = Canadian dollar
M = million

Printed on recycled paper, 30% postconsommation fiber, FSC certification

ACKNOWLEDGEMENTS

The authors wish to thank Fisheries and Oceans Canada for its financial contribution and Mr. Frédéric Lessard and Mr. Guy Cantin in particular for their collaboration and support during the realisation of this study. We also thank the scientists at the Maurice Lamontagne Institute in Mont-Joli, Quebec, who participated in the scientific focus-group and greatly contributed to the clarification of important issues for the content of the questionnaire.

A special thank you is addressed to Dr. Robert Romain from the Centre for Research in the Economics of Agrifood (CREA) at Laval University, who coordinated the first phase of the project. We also thank Nancy Bergeron from CREA who actively participated in the first phase of the project and Dadi Sverrison from Alberta University who helped with some of the initial focus groups.

FOREWORD

This report is the result of a research project undertaken in 2004 by the Department of Fisheries and Oceans (DFO) – Quebec region, with the prospect of creating a marine protective zone in the St. Lawrence Estuary. Numerous marine mammals in this area are registered, or in the process of being registered, under the Law for Endangered Species (LES).

The St. Lawrence Estuary is a body of water which is internationally renowned for its importance, notably due to the variety of marine mammal species which can be found therein. Many of these species are endangered or could become endangered, especially the beluga and the common seal, which live in those waters year round, and the blue whale, the fin whale and the harbour porpoise, which seasonally visit the area.

Because no information is available about the economic value of marine mammals as existing natural resources in the St. Lawrence Estuary, and since this information would be useful to the Department for both the process of designating a marine protective zone and for the regulatory process of the LES, the Oceans Management Branch (OMB), in concert with the Regional Management of Policy and Economics (RMPE), initiated this research project.

At the beginning of the study, Laval University researchers completed a review of available economic literature in order to determine whether a scientific protocol used elsewhere to estimate the deferred value of natural resources could be applied to the case of marine mammals in the estuary. From this review it was concluded that no other study of this nature was available at the time and that the best scientific methodology to meet the desired goal would be "choice experimentation".

The Department then established a partnership with Laval University and the University of Alberta, leaders in the application and refinement of this methodology, to conduct this study.

Today, the RMPE and OMB are proud to present the final report from this research project, which is the result of close collaborations between the DFO – Quebec Region and our university partners.

We particularly wish to thank Mrs. Olar, Dr. Adamowicz, Dr. Boxall, Dr. West, Dr. Romain and Ms. Bergeron for their outstanding collaboration, as well as all other participants who closely contributed to the success of this study.

Table of contents

Summary

This paper provides estimates of the economic value of marine mammal recovery in the St. Lawrence Estuary. These values, referred to as passive use values, are estimated using stated preference economic valuation methods that employed a national Internet based survey of Canadians in 2006. These methods identify the tradeoffs that Canadians make between different conservation program options including costs. Their choices implicitly reveal estimates of the economic value Canadians place on marine mammal recovery in the St Lawrence Estuary and as such provide measures of the economic benefits of species at risk recovery plans.

To develop the choice experiments, focus groups were held to identify how people characterize the problems inherent in conservation programs for species at risk. The questionnaire was pre-tested to determine an appropriate range of monetary values, to correct problems of clarity and to reduce the time needed to complete the questionnaire. Collected in April 2006, the data contain responses from 2,006 Canadians. In order to examine regional differences, the province of Quebec was over-sampled by 400 respondents. The design of the survey also included a variety of validity checks.

Two types of results are reported in this paper: (1) statistics about attitudes, knowledge and opinions on environmental protection and St. Lawrence Estuary marine mammals and (2) estimation of Canadians' value of St. Lawrence Estuary marine mammal recovery options.

In responses to questions about attitudes towards environmental protection, we found that, among a set of national goals, Canadians desire more action for environmental protection, but even more for health care and prevention which is their number one priority among a list of eight issues facing Canadians. The protection of species at risk ranks sixth in importance, while reducing air and water pollution ranks second. People practicing outdoor activities are more willing to protect species at risk than those who do not. Furthermore, Canadians seem to ignore the location of the species at risk being protected inside Canada; they are equally concerned about marine mammals that are at risk next door to them or elsewhere within Canada.

Economic values were elicited for a number of marine mammal recovery programs that varied in terms of their impact on several species. This variety of programs was chosen to identify the value of varying levels of conservation effort. The estimated willingness to pay (WTP) for different levels of marine mammal recovery ranged from $82 to $242 per year per household. The WTP measures provide information on the value of conservation programs and the marginal value of alternate sizes of conservation programs. A series of tests revealed that people are willing to pay more for programs that contribute to greater increases in marine mammal populations. The results also indicate that the additional value of programs that would improve marine mammal population status beyond the "at risk" threshold is relatively small. Canadians want to ensure that species are not "threatened", but they are not willing to pay much more to move them to "not at risk". They are searching for a cost–minimizing approach in order to reach or remain just above the "at risk" threshold. It appears that Canadians rely very heavily on the scientific assessment of the level of risk associated with the various marine mammal populations.

In contrast with other studies which found that passive use value declines with distance from the environmental site location, this study finds that the passive use value for marine mammals does not vary by distance. Quebec residents living near the St. Lawrence Estuary have the same willingness to pay for the recovery of marine mammals as those living far away. On the other hand, the willingness to pay (WTP) of Quebec residents is smaller than that of other Canadians. This difference probably stems from the economic, demographic and cultural differences between Quebecers and citizens in the rest of Canada, rather than from geographic differences in the distance from the St. Lawrence Estuary.

Because this research provides estimates of Canadians' willingness to pay (WTP) for the perceived benefits of alternative levels of recovery plans for marine mammals protected under the Species at Risk Act, the results can be used by the Department of Fisheries and Oceans in the policy decision making process. For example, the benefits measured in this study can be compared to the costs of different recovery programs to assess the net benefits of alternate recovery programs. These estimates are intended to represent the amounts the public would agree to pay in support of recovery programs if they were presented with the tradeoffs between programs and cost. As with all stated preference valuation exercises there are concerns about the extent to which the values elicited would correspond to an actual referendum or allocation decision if such actions took place. To attempt to address these concerns significant effort was devoted to checking for robustness, reducing hypothetical bias and providing conservative estimates. Of course it must also be recognized that considerations beyond costs and benefits of recovery plans are important in policy decisions regarding protection of species at risk.

1. Overview

The St. Lawrence Estuary is a very important region for many marine mammals because of its large concentration of food, such as krill and capelin. It is a critical habitat for its permanent residents, such as beluga whales and harbour seals, as well as for its seasonal visitors, such as blue whales, minke whales or fin whales. Many whales migrate to the estuary from as far away as the Caribbean Sea to feed and build up energy reserves for their breeding season. The region is also characterised by the intensity of many human activities, such as the shipping, whale watching, commercial activities and sailing. These activities generate potential threats to marine mammals, such as pollution, disturbance, underwater noise, loss of habitat and accidental collisions. Due to low levels of populations, some of the marine mammals present in the St. Lawrence Estuary such as belugas, blue whales, fin whales or right whales are presently considered at risk under the Species at Risk Act.

The proclamation of the Species at Risk Act (SARA) in June 2003 created several additional responsibilities for Fisheries and Oceans Canada. Its objective in the application of this act is to help protect aquatic wildlife species from becoming extinct. In order to fulfill its new responsibilities, Fisheries and Oceans Canada created a recovery plan for the St. Lawrence beluga population and proposed the establishment of a Marine Protected Area (MPA) in the St. Lawrence Estuary as a way to recover belugas and other marine species at risk in the region (Bergeron and Romain 2004).

A cost-benefit analysis of this initiative requires knowledge of the monetary value that Canadians place on the recovery of marine mammals at risk. Because this type of information did not exist in 2004, the Quebec regional offices of Fisheries and Oceans Canada proposed that an economic study be conducted to estimate the tradeoffs Canadians are willing to consider for the recovery of marine mammals at risk in the St. Lawrence Estuary. Fisheries and Oceans Canada first ordered an extensive literature review designed to determine what economic studies and methodologies were already available. The main conclusions of the review were that no previous studies had been conducted from which monetary values could be appropriately generalized to marine mammal populations in the St. Lawrence Estuary and that stated preference approaches were the most suitable and efficient method for estimating the value of marine mammal recovery. Based on this information, Fisheries and Oceans then initiated a joint project agreement with the University of Alberta in Edmonton and Laval University in Quebec City. Through this agreement, Fisheries and Oceans agreed to provide the academic researchers in Alberta and Quebec with a data base corresponding to the objectives of the project. This data base was collected by a national market research firm, Ipsos-Reid, based on a questionnaire developed through the collaboration of all three parties.

The goal of this project is to provide estimates of the marginal passive-use value of marine mammal recovery in the St. Lawrence Estuary. This result can be used by Fisheries and Oceans Canada in the cost-benefit analysis of the St. Lawrence Beluga Recovery Plan (BRP) or other marine mammal recovery plans. These values can be used in the decision process for the implementation of the St. Lawrence Estuary Marine Protected Area (MPA) or other MPA. Finally, this study examines if the geographic distance between the respondents' place of residence and the St. Lawrence Estuary plays a role in their valuation of the recovery of marine mammals. Specifically, we compare Quebec respondents with respondents living outside Quebec, as well as differences between respondents inside Quebec who live close to the St. Lawrence Estuary and those who live further away. In addition, several methodological tests are included in the study.

J. Boulva

Harbour seal

This report presents and summarizes the different steps in the development of the survey as well as a detailed description of the questionnaire. The development of the survey, the stated preference method and the econometric model are explained in chapter 2 while the representativeness of the sample and the contents of the data base are discussed in chapter 3. Chapter 4 presents the survey results, including Canadians' attitudes towards the environment, their knowledge of the St. Lawrence Estuary and marine mammals, their estimated willingness to pay (WTP) for the recovery of marine mammals and regional differences in WTP estimates. This chapter also discusses validity criteria for the WTP estimates. The final chapter summarises the results and provides some basic conclusions that can be drawn from the study.

2. Methodology

2.1 DEVELOPMENT OF THE QUESTIONNAIRE[1]

A stated preference survey is intended to provide respondents with accurate information on the current level of environmental quality and the change that is being considered. Respondents are then asked if they would support the environmental quality improvement if it involved a direct cost to their household. The responses to these tradeoff questions, across the set of respondents, provide information on the tradeoffs that individuals are willing to make for the environmental programs. The development of the survey involves careful consideration of information provision, realism and a variety of survey design concepts to try to identify tradeoffs that would actually be made by respondents. In the current case the survey provides information on the current trajectory of marine mammals at risk and the trajectory with the implementation of various recovery plans. The valuation information was collected using a stylized referendum that asked if respondents would vote yes to a recovery plan that had a specific cost impact on their household.

The questionnaire was developed between January 2005 and March 2006 and passed several testing stages. First, a scientific focus group was held at the Maurice Lamontagne Institute (Fisheries and Oceans Canada, Mont-Joli, Quebec), which revealed important issues about the content of possible recovery scenarios and resulting trajectories of marine mammal populations with and without the programs (see Appendix 10 for the rates of growth used to predict changes in the marine mammal populations). In addition, threats to the viability of various species were discussed as was available information on effects of recovery programs on various sectors of the regional economy. This first focus group, in concert with in-depth review of the literature and on-going discussions with scientists, allowed the development of a series of attributes and levels of recovery program scenarios. These scenarios were then integrated with other questions and text describing current information on the species and threats, into a draft of the questionnaire.

After the first draft of the questionnaire was completed, four focus groups involving randomly drawn samples of Canadian citizens were formed to review the questionnaire. The focus group meetings took place in Quebec City and in Edmonton. The recruitment process for all focus groups was conducted by the polling and market research enterprise Léger Marketing. Each focus group session meeting involved about 12 citizens and two of the researchers. Compensation of $50 was given to each participant. Focus group members were asked to complete the questionnaire and then a discussion, led by the two researchers, was held to identify problems of clarity or comprehension and to reduce the time needed to complete the questionnaire. In its final form, the duration of questionnaire response was around 25 minutes.

Two of the four focus groups tested the use of federal funds transfer as payment vehicle for the proposed programs. Precisely, the St. Lawrence Marine Protected Area programs would have been funded through transfer of funds from other federal programs. Many participants in both groups did not realize the implications of tax reallocation. Some explained that this policy implies financing the marine protected area with money from other governmental budgets but did not realize that some social services would have to be reduced.

[1] The questionnaire is available in CD format upon request.

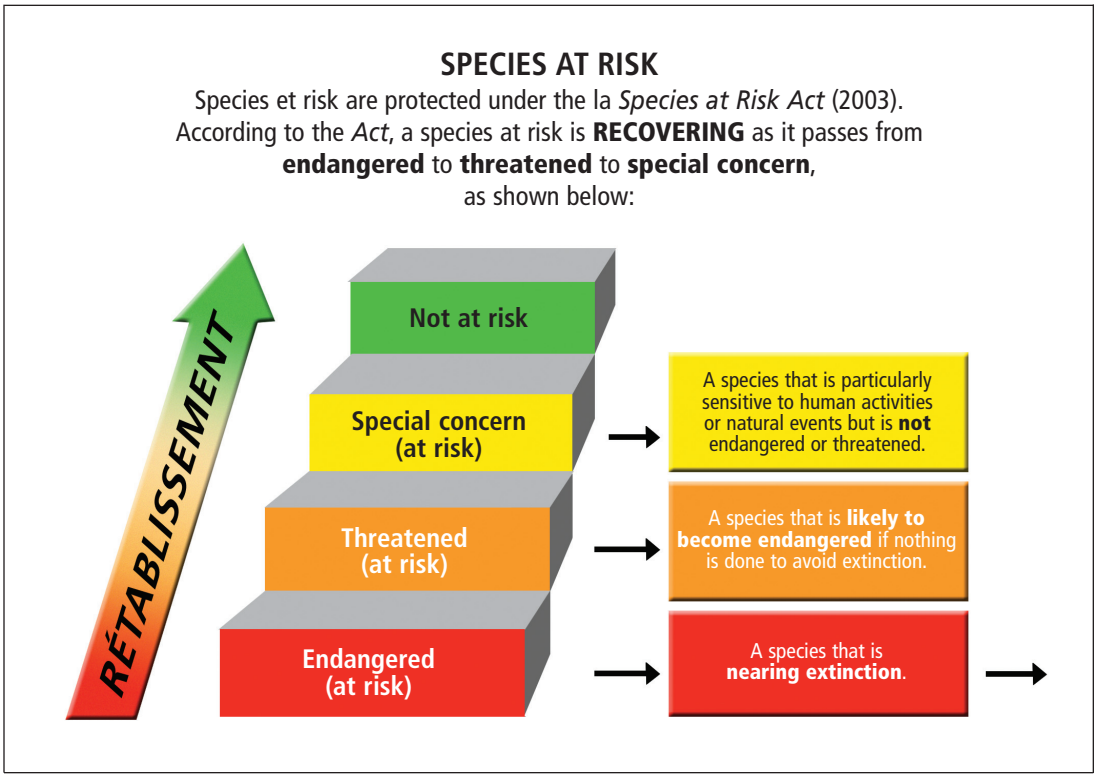
As the votes showed, the hypothetical bias seems to be even higher with transfer of funds than with increases in taxes: more people voted for some form of proposed program in the tax reallocation groups than in the tax payment groups. Still, comments showed that some people voted as if they had to pay from their own pockets. Eventually more explanations would have been necessary to underline that transfer of public funds also implies sacrifices but because of the delicate nature of these explanations, such as giving examples of where the funds could come from, this option was not tested in the survey.

The focus groups also revealed that there was not enough information about the costs implied by the establishment of an MPA in the St. Lawrence Estuary. The so-called "major impacts" concerned respondents and they kept asking for details. Also, we realized that the information on environmental benefits was much richer than the information on the costs so we adjusted the scenarios by providing details on restrictions on shipping and whale watching industries (see Figure 5). These details were added after extensive discussions with industry experts. We also reorganized the presentation of the information on marine mammals because focus groups participants found it too dispersed and repetitive.

After suggestions and modifications from the four focus groups sessions were incorporated, the questionnaire was pre-tested on-line via Internet to determine the appropriate range of monetary values and to eliminate any remaining problems of clarity. One of the most important components of this design phase is the determination of the range of "bid" values or values that are presented to respondents as the payment required if they accept the recovery program offered. The range of bid values must be wide enough to identify the variation in demand and willingness to pay for the programs. There must also be sufficient variation for statistical analysis and the bids must identify the limits (at the low and high ends) of the tradeoffs that respondents will accept. At this stage we also analysed if there was enough variation in the design of the proposed programs, if the comments about the reasons people voted the way they did reveal any particular problem as well as which way of using the question about uncertainty in votes works best. The pre-test involved 88 respondents from across Canada.

The final questionnaire had three parts. The first part asked questions about attitudes toward the environment, as well as awareness of the St. Lawrence Estuary. It also provided information about the St. Lawrence Estuary and the problems faced by the marine mammals that are either permanent residents or seasonal migrants. A number of illustrations, figures and diagrams were used to attract the respondent's attention towards the information and facilitate comprehension. For example, Figure 1 was used to explain that a species considered endangered under the Species at Risk Act is in much more danger of extinction than a species that is threatened or of special concern.

Figure 1: Explanation of the different levels of risk identified by the Species at Risk Act.



The second part of the questionnaire consisted of five choice scenarios in which respondent's were asked to vote either for the current situation or for the proposed recovery program that might increase the different populations of marine mammals while imposing varying levels of restrictions on the shipping and whale watching industries and increases in taxes. Before voting, the respondent was informed about the potential benefits and costs of implementing a marine protected area. More detail on this component of the survey can be found below. The third and final part of the questionnaire gathered the respondent's socio-demographic characteristics, such as age, gender, education, income and participation in environmental organizations.

Mode of administration

Several modes of administering the survey were considered, including mail and Internet panel surveys. The Internet panel was chosen mainly because it has the ability to provide respondents with larger amounts of information than mailed surveys in a less intimidating manner through the use of colour maps and graphics and links to Internet web pages that can provide additional information. Colour maps and graphics were especially important for informing respondents about existing conservation areas and marine mammal population levels. Coding and data entry errors are also essentially eliminated by Internet panel surveys.

While there are questions about the representative nature of Internet panels, the panel maintained by Ipsos Reid has over 100,000 members and the firm actively maintains a membership that closely matches a set of socioeconomic characteristics present in the Canadian general public as well as in certain regions. While all panel members must be Internet users, this group is an increasing proportion of the Canadian public. In 2002, 54.3% of Canadians had Internet access from their home (Statistics Canada, 2003). Many others probably have access at work or at school. By 2006, when this study was conducted, the percentage of Canadians with access to the Internet was assuredly higher than it was in 2002.

Proposed programs versus current situation

Figure 2 is an example of one of the six choice scenarios used in this study. As this figure shows, the current situation in the St. Lawrence Estuary is characterised by the presence of approximately 1,000 belugas, 1,000 harbour seals and 250 blue whales. At these levels and for the benefit of this study, belugas and harbour seals[2] are considered threatened, while blue whales are endangered. No marine protected area (MPA) currently exists, but some restrictions on the shipping and whale watching industries are currently enforced. The information in the questionnaire also clearly communicated the existence of the Marine Park and its role in current species conservation efforts.

Each of the six proposed recovery programs had to be understandable and plausible to respondents and provide information on the expected outcome or range of possible outcomes from their establishment. Biologists from the Maurice Lamontagne Institute, including Guy Cantin, helped to create plausible program scenarios which varied with respect to the size of the three marine mammal populations, the restrictions on the shipping and whale watching industries, and the size of the MPA. Each program had an effect on at least one marine mammal species with most programs affecting more than one species. The impacts of the programs on belugas ranged from none, to increases to 2,500 or 5,000 whales. The programs included effects on harbour seals that ranged from none to increase to 2,500 or 10,000 animals. One program included an increase in blue whale populations. The size of the marine protected area was described as being either small or large, while additional restrictions on the shipping and whale watching industries were described as being either major or minor and focusing on either harbour seals or belugas. These programs were designed to be as realistic as possible and to accurately represent varying levels of effort in marine mammal recovery plans.

[2] There is no official status yet. This is a hypothetical status based on the low number of individuals.

Figure 2: Example of one choice set depicting the current situation in the St. Lawrence Estuary and potential outcomes from a hypothetical recovery program.

	CURRENT situation Expected levels in 50 years	**PROPOSÉD program** Expected levels in 50 years
St. Lawrence Belugas	**THREATENED** 1,000 Belugas	**THREATENED** 1,000 Belugas
St. Lawrence Harbour Seals (*No official status yet. Hypothetical status based on the low number of individuals.)	**THREATENED*** 1,000 Harbour Seals	**SPECIAL CONCERN*** At least 2,500 Harbour Seals
Atlantic Blue Whales	**ENDANGERED** 250 Blue Whales	**ENDANGERED** 250 Blue Whales
MPA size	**NO MPA**	**SMALL MPA**
Regilations on SHIPPING and WHALE WATCHING	**CURRENT REGULATIONS**	**Additional** minor restrictions focused on **harbour seals** that **might**: · Reduce jobs · Reduce tourism revenues · Increase the cost of goods shipped in the St. Lawrence seaway
ADDITIONAL annual cost to your household in: · Federal Income Taxes · Increased Prices for Goods	**$0**	**Each respondent randomly received one of the following prices:** **$5, $15, $50, $100, $350**

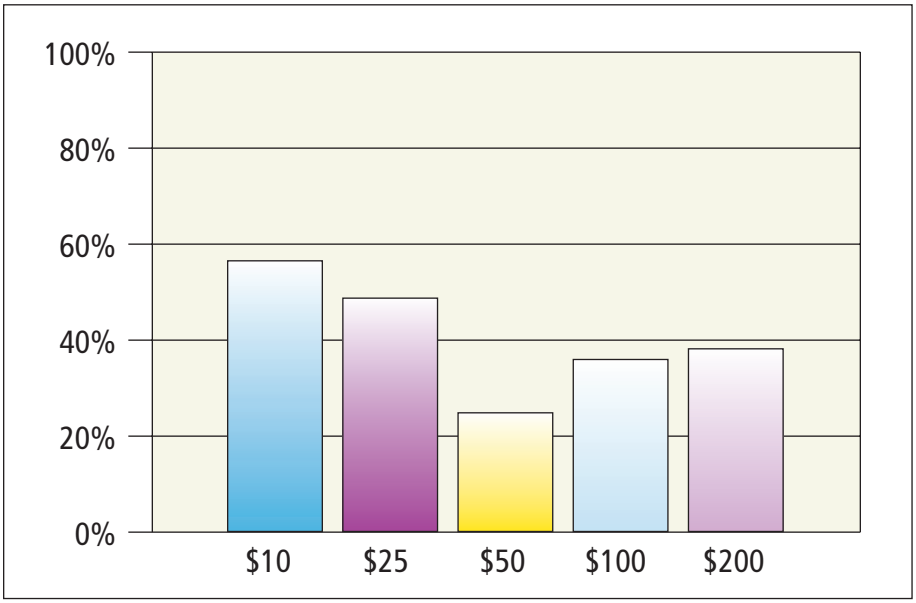
Payment vehicle

One particular challenge in the use and design of the stated preference survey tools is the definition of the cost or price of the proposed environmental change. The recovery programs in this current study had to be associated with economic costs. The potential costs could be met through increases in provincial or federal household taxes, increases in prices of goods and services affected by the changes in policy, or by the imposition of special fees. The use of taxes as a payment vehicle is common because it has properties that make it a credible mechanism for the collection of public funds. However, there are also drawbacks to the use of taxes as the payment vehicle, such as the risk of "nay-saying" (i.e., people voting against the program as a protest against increased taxes and not because they judge the benefits of the recovery program to be unworthy of the cost).

The payment vehicle we finally chose was that each proposed program would generate an additional annual cost to the household in the form of increased federal income taxes and increased prices for goods. The first range of program costs proposed was $10, $25, $50, $100 and $200.

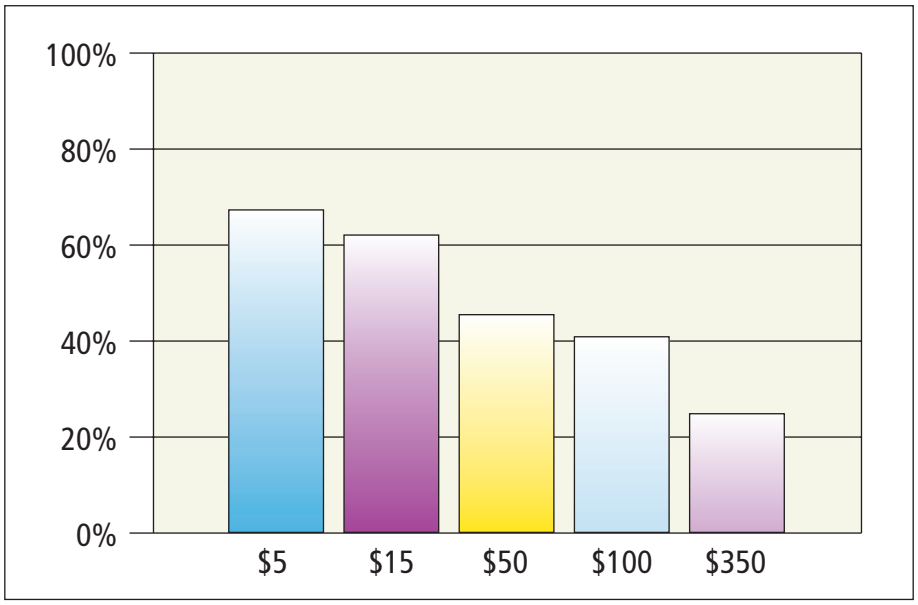
Thus, each program scenario was associated with a cost which was a random draw from a uniform distribution involving each of the five cost levels. However, an initial pre-test showed that this range was too narrow, too few people chose the proposed program at the lowest proposed cost ($10), and too many at the highest cost ($200). Normally, the lowest cost should provide an option that almost everyone chooses, while the highest cost should curtail or "choke off" demand. If this fails to happen then the distribution of costs at the high and low ends is considered to be not well defined. The resulting value estimates are too high or too low, or, in the worst case, price (cost) does not affect demand. A typical rule of thumb is that 80 – 90% of respondents should be voting for the proposed program at the lowest cost, 50% at the middle costs, and 10 - 20% at the high cost. Figure 3 shows that, for the initial program scenario number 1, less than 60% were voting for the proposed program at the low price and almost 40% at the high price, which is not enough variation.

Figure 3: Demand for the recovery program (% of respondents voting yes) proposed in choice set number 1 at the prices chosen before the pre-test: $10, $25, $50, $100 and $200.



We subsequently decreased the lowest prices to $5 and $15, and increased the highest to $350. The distribution of responses to this range of prices was judged to be much improved in that demand at the extreme prices varied much more (from 69% at the lowest to 25% at the highest) and was decreasing across all prices (see Figure 4). Thus, the costs used in the final survey were $5, $15, $50, $100 and $350. Note that the distribution illustrated above is for program number one. Other programs provide more benefits to respondents and thus a larger percentage of respondents are expected to vote for the programs. This will improve the performance of the low bid (a higher percentage will say yes at this bid level) but may also raise the proportion saying yes at the highest bid level. We evaluated the range of bids across all programs when making the final decision regarding the bid distribution.

Figure 4: Demand for the recovery program (% of respondents voting yes) proposed in choice set number 1 at the prices chosen after the pre-test: $5, $15, $50, $100 and $350.



Yea-saying

"Yea-saying" refers to a respondent's willingness to vote "yes" for a recovery program without seriously considering the costs involved. Because respondents are placed in a hypothetical context when comparing the current situation in the St. Lawrence Estuary to some future proposed program, they could vote for a proposed program without considering that the related costs could be very real. They may vote for a proposed program because of their willingness to fulfill some presumed sense of social obligation or to please the survey administrator. They may also vote yes because they simply like the idea of giving per se, as much as the commodity acquired (Banzhaf et al. 2004). This special case of yea-saying is called "warm glow". In any case, if respondents do not seriously evaluate the economic trade-offs between the recovery program costs and the benefits to marine mammal populations, they will not reveal their true preferences.

To minimize yea-saying, respondents were informed immediately preceding the votes about the potential costs induced to the Canadian and regional economies by the proposed programs, as presented in Figure 5. These costs were mainly derived from the restrictions imposed to the shipping and whale watching industries. Just before the votes, respondents were also requested to take into consideration the additional annual cost to their household implied by these programs. A portion of the script in this section was:

> *"It is very important that you "vote" as if this were a real vote. You need to imagine that you actually have to dig into your household budget and pay the additional costs."*

Lastly, we also tried to avoid any emotional link with marine mammals (e.g. "the cute smiling beluga") by offering neutral descriptions and photos of many of the various marine mammals present in the St. Lawrence Estuary. After the voting process, we asked respondents how important the additional cost to their household was to their votes. Ninety percent (90.2%) answered that it was definitely important, with 51.3% responding that it was very or extremely important. A large majority (86.3%) also declared that restrictions on the whale watching and shipping industries were important to their votes. This was probably due to their awareness of the importance of these two industries: 83.1% of were aware that shipping industry is a significant contributor to the Canadian economy and 54% that whale watching is a significant contributor to the regional economies.

A. MacFarland

Belugas

Nay-saying

At the other extreme, there is "nay-saying"; that is, people who may vote against a proposed recovery program for reasons other than a careful consideration of the costs and benefits of the program. For example, some respondents may reject a program because they want to protest against higher taxes or because they do not trust or believe in the estimations that scientists have made about the efficiency of a marine protected area. However, when we asked respondents about the latter, we found that 64.1% think that scientists are correct about the ability of a marine protected area to protect marine mammals and 75% think that scientist are also correct about the level of risk attributed to the marine mammal species. The majority of the respondents appear to have accepted that the program scenarios were realistic. Furthermore, a sensitivity analysis can be conducted on the value with and without those respondents who rejected the scenario, providing an indication of the effect of these scenario rejection factors on the value estimates.

Figure 5: Potential costs induced to the Canadian economy by the proposed programs.

COSTS associated with the establishment of the St. Lawrence Estuary Marine Protected Area (MPA)

Depending on the level of intervention, experts think that the following potential measures can be considered in a St. Lawrence Estuary MPA project:

SHIPPING INDUSTRY		
	IMPACTS	
	Small MPA	Large MPA
Minor restrictions · Maximal speed of ships limited to 25 knots. · No sewage or used waters evacuated into the St. Lawrence. · Special equipment to rescue marine mammals in case of oil spills.	Minor impact	Minor impact
Major restrictions · Minor restrictions + · Maximal speed of ships limited to 14 knots.	· Critical impact on one ferry lane. · Medium impact on the international shipping.	· Critical impact on one ferry lane. · Substantial impact on the international shipping.

WHALE WATCHING INDUSTRY		
	IMPACTS	
	Small MPA	Large MPA
Minor restrictions · Fever boats allowed to observe one marine mammal at a time. · Forbid beluga observation.	Minor impact	Minor impact
Major restrictions · Minor restrictions + · Fewer whale watching vessels. · Monitoring the respect of the well-being of marine mammals through the presence of an expert (observers) on each trip. · Forbid blue whale and harbour seal observation.	Medium to substantial impact	Medium to substantial impact

2.2 THE VALUATION TOOLS

Passive-use versus use value

To evaluate the economic impact of establishing a marine protected area in the St. Lawrence Estuary, Fisheries and Oceans Canada identified the need to estimate the perceived benefits of this initiative or, more precisely, how much Canadians value the recovery of marine mammals in this region. There are two sets of reasons why people might value an increase in number of seals, whales or dolphins: (1) the pleasure of observing them from shore or via commercial whale-watching activities, and (2) a desire to bequeath environmental conditions to one's heirs or to future generations, a need to preserve options for future uses, or a sense of stewardship or responsibility to preserve the resource (Freeman 2003). The former reason denotes what economists call **use value**, while the latter denotes what it called **passive-use value**. This study deals with the passive-use value of the conservation of marine mammals in the St. Lawrence Estuary.

Using stated preference methods to measure passive use value

Since passive use values are generally unobservable in the market, stated preference methods must be employed to quantify them. Stated preference methods range from asking respondents a single question about a specific program (a basic "contingent valuation" method) to asking respondents multiple choice questions about programs that vary by attributes (an attribute based stated preference methods or "choice experiment"). Our approach is somewhat of a hybrid that best fits that case of recovery programs and species at risk. We describe programs using attributes and we ask each individual to vote on several programs, but in each vote we only offer two programs – the current situation and a single proposed program. As such our approach is somewhere between a contingent valuation task and a choice experiment with multiple program options and choices. There are five main components to our stated preference experiment:

Attributes: The attributes are the descriptors or important components of the good or service that is being valued. For the current study, these include the SARA designation and population sizes of belugas, harbour seals and blue whales; the geographic size of the marine protected area; and the restrictions applied to the shipping and whale watching industries (see Appendix 1).

Attribute levels: The levels are the different amounts of attributes that are possible. For the current study, there were levels of variation in the hypothetical population increases for belugas, harbour seals and blue whales, in the geographic size of the marine protected area, in the amount of restrictions applied to the shipping and whale watching industries, and finally the possible cost of the recovery program. See Appendix 2 for the levels of all the attributes used in this study.

Alternatives: The alternatives are the different choice scenarios that are available to a survey respondent to choose among. Each alternative is comprised of different combinations of the attribute levels. Thus, respondents had to assess their willingness to move from the current situation to a hypothetical state (see Appendix 1). Each of the two alternatives depicts the possible "state-of-the-world" at some point in the future.

Choice Set (Choice Task): The choice set required respondents to assess their level of interest in each of the alternative future situations. In this study, the first alternative consistently hypothesised that the current situation would remain unchanged into the future. The second alternative hypothesised that, in the future, the recovery program would have varying levels of success in increasing marine mammal populations, but with varying levels of costs to the shipping and whale watching industries and to the respondents themselves (see Appendix 1). One could design choice sets such that there would be three or more alternatives to choose between.

In this study there were 6 choice sets but each questionnaire only included 5 of them. Four of the six available choice sets (numbers 1, 2, 4 and 5) appeared in all questionnaires while two of them (numbers 3_1 and 3_2) only in half of the questionnaires. Instead of giving 6 choice sets to each respondent, we chose this strategy to lessen the burden of filling in the questionnaire, while keeping a high level of variation in the proposed programs. In order to eliminate order effects, the order of presentation of the choice sets was randomized. For example, some respondents answered choice set number 1 in their second choice set while others received it at some other point in the sequence of the five tasks.

Choice Series: The choice series is the number of choice alternatives that are possible given the number of attributes and attribute levels under study. In most applications, this number varies between 4 and 16 scenarios, although as many as 64 have been utilized in the marketing literature. Typically the number of scenarios presented is a function of the complexity of the valuation exercise and the statistical design. The statistical design must ensure that the universe of constructed choice sets guaranties that enough combinations of attribute levels and alternatives are presented to the sample of respondents to estimate the parameters of the resulting valuation model. In most cases, as well as in this study, designing choice sets with all of the possible combinations of attributes and levels requires so many choice sets (360 in this study) that experimental design procedures must be utilized to develop what is called a fractional factorial design. Experimental designs can be a complex component of the analysis depending on the number of attributes and levels and on the complexity of the choice context. In our study, budgetary limitations and a desire to provide only programs that provided realistic combinations of ecological outcomes resulted in the final selection of 6 choice sets.

During the administration of the questionnaire, respondents were to examine each choice task and choose (actually vote for) one alternative in each choice set. In so doing, the researchers assume that the respondent trades off attributes among the alternatives. By completing the choice series, respondents revealed their preferences for the attributes in the design. Researchers can determine these preferences once data have been collected by estimating parameters which represent "taste or importance weights" on the various attributes associated with the alternatives. Typically, probabilistic choice models are used to estimate these weights. From these results the researcher can determine respondent utility levels for particular attributes and the economic welfare measures associated with changes in those attributes.

Reduction of hypothetical bias

An important issue in the design and analysis of stated preference surveys, including contingent valuation and choice experiments, is hypothetical bias. This is the bias in willingness to pay that arises from the use of a hypothetical valuation format. In the valuation of public goods, such as protected areas, one cannot avoid the use of hypothetical valuation questions. However, recent research has provided a number of techniques that can minimize hypothetical bias. The first of the techniques we employed was to include a brief "cheap talk" script. Cheap talk scripts involve revealing to the respondent the hypothetical nature of the trade-off votes, but reminds them to consider these tasks as real votes. The addition of these "cheap talk scripts" has been shown to generate responses in hypothetical surveys that calibrate well to actual market or payment transactions (e.g. List 2004). While we have no actual market to compare with in this case, it is hoped that the mechanism works in a similar fashion and results in respondents thinking about the monetary consequences of the programs.

In addition, text was developed to attempt to portray that the survey was a "consequential" survey instrument that has real policy implications. Research has revealed this procedure to be effective in reducing hypothetical bias (Cummings and Taylor 1999; Murphy et al. 2005). Figure 6 depicts the actual text used on the screen prior to the first valuation task.

J.-P. Sylvestre

Blue Whale

Figure 6: The text used to reduce hypothetical bias prior to the valuation tasks.

Now we'd like your opinion on what to do in the St. Lawrence Estuary.

The next series of questions you to compare the **current situation** in the St. Lawrence Estuary with different scenarios about what **could happen** within the **next 50 years** if a Marine Protected Area (MPA) was created.

These scenarios will **vary** in terms of the following **four** characteristics:

- Different potential impacts on the populations of beluga, blue whales and harbour seals;
- Small or large **MPA area**
- Minor of major **restrictions** on the whale whatching and shipping industries; and
- Higher or lower **cost** to help fund the MPA

We are asking you to state whether you feel that the program, and the transfer of funds, should be undertaken.

After critically analysing the differences between the current situation and the proposed option, you will be asked to "**vote**" by choosing one over the other.

Some people might choose to vote to keep the current situation because they think:

- It is too much money to be transferred for the type and number of marine mammal improvements.
- Marine mammal populations seem to be stable and don't need additional protection.
- There are other places, including other environmental protection options, where my money would be better spent.

Other people might choose one of the proposed program options because they think:

- The improvement in marine mammal populations is worth the money.
- The marine mammal populations need protection.
- This is a good use of money compared to others things federal government money could be spent on.

PLEASE NOTE:

We know that how people vote on survey is often not a reliable indication of how people would actually vote at the polls. In surveys, some people ignore the monetary and other sacrifices they would really have to make if their vote won a majority and became law. We call this hypothetical bias. In surveys that ask people if they would pay more for certain services, research has found that people may say that they would pay 50% more than they actully will in real transactions.

It is very important that you "vote" as if this wew a real vote. You need to imagine that you actually have to dig into your household budget and pay the additional costs.

A second procedure used to address hypothetical bias was the addition of certainty question following the votes. After each vote, the respondent answered the following question about uncertainty: "*How certain are you that this is the choice you would make if this was an actual referendum? Please check one response only: Very Certain, Somewhat Certain Somewhat Uncertain, Very Uncertain*". The answer to this question is used to change uncertain votes for the proposed program into votes against this program. Thus, a very uncertain and a somewhat uncertain YES vote could be changed into a NO vote. This approach has also been shown to calibrate hypothetical responses to real – market like – transactions (see Blumenschein et al. 1998 or Harrison 2005). The direct implication of this change is the reduction of the estimated willingness to pay and hence generates conservative measures of values. A sensitivity analysis has been conducted using the original data and the responses adjusted for certainty. The responses adjusted for certainty appear to perform better in the statistical analysis and thus all the estimations that follow use the choices adjusted for uncertainty.

2.3 THE ECONOMETRIC MODEL

Random utility theory

Economic theory supposes that when people make choices they pursue happiness or, in economic terms, they maximize their utility. In choosing among hypothetical programs this means that each respondent chooses the alternative that yields the highest utility. For our analyses, we model utility in the simplest and most common way - as a linear function of the attributes of the proposed programs and of income. We suppose that an increase in the number of belugas induces a linear increase or decrease in respondent's utility. Mathematically this is written in the following way:

$$u_{ij} = \alpha_i + \beta z_i + \gamma_i v_j + \delta (y_j - C_i) + \varepsilon_{ij}$$

Where u indicates happiness/preferences/indirect utility of respondent j for program i, z vector of attributes of program i, v vector of household characteristics of j, y represents income of j, C the cost of program i, and ε is a random error term.

Random utility theory assumes that an individual's utility or preferences have elements that are unknown to the researcher and thus random. This randomness is marked by the presence of the error term e which appears because the researcher cannot know all the factors influencing the respondent's utility and captures this unobserved component through a random variable.

The constant α_i represents the level of utility of a program or option that is not associated with the attribute levels or income. This parameter reflects information about preferences for the current situation relative to the program that is not associated with recovery program levels or marine mammal populations.

The δ coefficient measures the utility respondents derive from one more dollar in their pockets (marginal utility of income). This coefficient is considered constant across alternatives because it is not probable that different alternatives (different sizes of the marine protected area, for example) could have a substantial change on how much people appreciate money. The β and δ coefficients have a similar interpretation as the marginal utilities of the program attributes (e.g. marine mammal populations).

Willingness to pay (WTP) versus willingness to accept (WTA)

The change in economic value can be measured in several ways, but economists tend to evaluate it in terms of money because dollars are comparable, thus the impacts of different policies or programs can be easily compared (Bergeron and Romain 2004). The monetary welfare measure used in this study is **compensating surplus** which is commonly called **willingness to pay** (WTP) under the assumption that people like environmental improvements. The compensating surplus measures how much money has to be taken away from people *after* the proposed program has been implemented in order to keep them at the same welfare level as in the current situation. Thus, supposing that people appreciate an increase in marine mammal population, they will be happier once the proposed program is implemented. In order to keep them at the level of happiness they had before the implementation of the program, this additional happiness should be taken away by a decrease in their income. This decrease in income represents the compensating surplus. The higher the compensating surplus, the higher people's appreciation or value of an improvement in marine mammal population.

People could also be asked about a decline in environmental quality and whether they would accept compensation for the decrease. This represents how much money has to be given to people in the current situation in order to keep them at the same welfare level as if the proposed program would have been implemented. This would constitute a **willingness to accept** (WTA) compensation measure of value or **equivalent surplus**.

Unlike equivalent and compensating variations which differ because of the income effect generated by the change in price, in theory equivalent and compensating surplus should be equal. Unfortunately, empirical works typically find that equivalent surplus (WTA) is 5 times higher than compensating surplus (WTP) (Haab and McConnell 2002). One explanation that fits well with public goods (the marine mammals in this study) is the inability of people to substitute between public and private goods (Hanemann 1991). Thus, because marine mammals are irreplaceable, people need much more money to compensate for their loss than they would pay for their recovery. Unfortunately there is no explanation for private goods, such as pens or mugs, but studies show that the difference declines as respondents become familiar with the process (Haab and McConnell 2002). The NOAA[3] Blue Ribbon Panel recommended that researchers measure WTP (compensating surplus) not WTA (equivalent surplus). **Therefore, we employ WTP measures in our analysis**.

[3] NOAA stands for U.S. National Oceanographic and Atmospheric Administration.

Computing WTP per proposed program

Let u_{1j} indicate the level of happiness (i.e. utility) of respondent j when the proposed program is implemented, u_{0j} the level of happiness of respondent j in the status quo and WTP the willingness to pay for the proposed program. To simplify, we suppose that utility depends only on income and a program summarized by α_i. By definition of the compensating surplus, WTP is the sum of money that has to be taken away from respondent j after the proposed program has been implemented in order to keep his happiness at the same level as in the current situation. Thus:

$$u_1(y - WTP_j, \alpha_1) = u_0(y, \alpha_0)$$

$$\Rightarrow \quad \alpha_1 + \delta(y_j - WTP_j) + \varepsilon_{1j} = \alpha_0 + \delta y_j + \varepsilon_{0j}$$

$$\Rightarrow \quad WTP_j = \frac{\alpha_1 - \alpha_0}{\delta} + \frac{\varepsilon_{1j} - \varepsilon_{0j}}{\delta}$$

Letting $\alpha = \alpha_1 - \alpha_0$, $\varepsilon = \varepsilon_{1j} - \varepsilon_{0j}$, and noting that the mean of the error term is assumed to be 0, the expectation of WTPj with respect to preference uncertainty (ε) is:

$$E_\varepsilon(WTP) = \frac{\alpha}{\delta}$$

Once α and δ are estimated via a probit or a logit model, the calculation of WTP is straightforward.

The logit model

When the respondent chooses between the current situation and the proposed program he/she compares the two utilities and votes for the proposed program if it gives him/her a higher utility, that is if . Otherwise he/she chooses the current situation. This is what econometricians call a binary logit or binary probit model depending on the distribution of the error term (logistic or normal). Thus, the dependent variable in the binary logit model is the vote v (1 if the proposed program is chosen and 0 otherwise) while the independent variables are all the variables determining utility as differences between their values in u_1 and u_0: the price associated with each proposed program and the attributes. The logit model is written as follows:

$$v = \begin{cases} 1 & if \quad u_1 - u_0 \geq 0 \\ 0 & if \quad u_1 - u_0 < 0 \end{cases}$$

$$\Leftrightarrow$$

$$v = \begin{cases} 1 & if \quad \alpha_1 - \alpha_0 + \beta(z_1 - z_0) - \delta\, Price_j + \varepsilon_1 - \varepsilon_0 \geq 0 \\ 0 & if \quad \alpha_1 - \alpha_0 + \beta(z_1 - z_0) - \delta\, Price_j + \varepsilon_1 - \varepsilon_0 < 0 \end{cases}, \quad o\grave{u} \ \frac{\varepsilon}{\sigma} \sim \text{Logistic}\left(0, \frac{\pi^2}{3}\right)$$

We employ logit models in our estimation of program and attribute values.

3. Data

Data were collected via Internet by Ipsos-Reid in April 2006. They obtained a response rate of approximately 52% which is the percentage of responses from the entire set of panel members invited to respond. The full data base contained responses from a sample of 2,006 Canadians; however, in order to examine regional differences, the province of Quebec was over-sampled by 400 respondents. The full data base was subsequently split into two data banks. One is representative of all Canadians. It is comprised of 1,606 respondents, including a representative sample of 367 respondents from Quebec. The second data bank is comprised of all 767 respondents from Quebec (i.e., the 367 Quebec respondents included in the Canadian sample plus the 400 additional Quebec respondents). The margin of error is +/-2.5% for the Canadian sample and +/-3.5% for the Quebec sample for a confidence interval of 95%. Except for the tests for regional differences, all results reported in this paper come from the data bank representing all Canadians.

Table 1 shows that the two data banks are representative of the Canadian and Quebec populations in terms of three key characteristics: level of education, male/female distribution and household income. The percentage of women in the two samples is almost identical to the percentages in the two populations. Median yearly household income was slightly higher in our samples than in the two general populations. People educated beyond high school were also slightly overrepresented in our two samples. Table 2 shows that the Canadian sample is also representative of the Canadian population in terms of its distribution across provinces.

The percentage of respondents reporting having seen whales, seals or other marine mammals in nature, outside aquariums, is just over 55% in the Canadian sample (see Table 3). At first glance, this percentage seems very high. However, in landlocked provinces located far from the oceans, such as Ontario, Saskatchewan, Manitoba and Alberta, the percentage having observed marine mammals in nature is substantially lower than in provinces boarding the ocean, such as Newfoundland, Labrador, British Columbia, Nova Scotia and Prince Edward Island. While it is plausible that approximately 45% to 52% of Canadians living in landlocked provinces have travelled great distances to observe marine mammals in their natural habitats, it is also plausible that those that have seen marine mammals in nature may have been more highly motivated to fill in the questionnaire. If this were true, there may be a sample selection bias in our data. Maybe some respondents did not read the entire question and ignored the "in nature, outside of aquariums" statement, such that those who saw seals inside aquariums answered positively instead of negatively. Unfortunately, we are unable to correct for any possible bias because we have no data from the 48% who did not respond to the questionnaire.

Table 1: Sample vs population distributions of socio-demographic characteristics.

	CANADA		QUEBEC	
Characteristic	**Sample**	**Population** (15 years and over, 2005)	**Sample**	**Population** (15 years and over, 2005)
Number of respondents	1606	-	767	-
% female	49.8 %	49.0 %[1]	50.6 %	50.9 %[2]
Median household income	$60,000 — $70,000	$58,100[1]	$55,000 — $60,000	$54,400[3]
% married	52.7 %	-	40.3 %	-
% educated beyond high school	58.7 %	57.6 %	59.8 %	58.6 %
Average household size	2.9	-	2.8	-
% with children 17 and under in house	30.6 %	-	27.2 %	-
Average age	47	-	45	-
Environmentalists	3.4 %	-	2.2 %	-

[1] Computed with data provided by Statistics Canada, CANSIM, tables 051-0001 and 051-00011.
[2] Computed with data provided by Statistics Canada, CANSIM, tables 111-0009.
[3] Computed with data provided by Statistics Canada, CANSIM, tables 282-0003 and 051-00011.

Table 2: Sample vs population distributions across provinces.

Province	**Canadian sample** (1606 respondents)	**Canadian population**[4] (15 years and over, 2005)
Alberta	10.7 %	9.9 %
British Columbia	15.9 %	13.4 %
Manitoba	3.6 %	3.6 %
New Brunswick	2.8 %	2.4 %
Newfoundland & Labrador	0.9 %	1.6 %
Nova Scotia	2.6 %	3.0 %
Ontario	37.5 %	38.7 %
Prince Edward Island	0.4 %	0.4 %
Quebec	22.9 %	23.9 %
Saskatchewan	2.7 %	3.0 %

[4] Computed with data provided by Statistics Canada, CANSIM, tables 051-0001.

Table 3: Percentage of the Canadian sample having observed marine mammals in nature, outside of aquariums.

Canada	55.2 %
Newfoundland & Labrador	86.7 %
British Columbia	77.6 %
Nova Scotia	73.2 %
Prince Edward Island	71.4 %
New Brunswick	60.0 %
Quebec	55.6 %
Alberta	51.7 %
Manitoba	50.0 %
Saskatchewan	48.8 %
Ontario	44.9 %

4. Results

Two types of results are reported in this paper. First, statistics about attitudes, knowledge and opinions regarding environmental protection and St. Lawrence Estuary marine mammals are presented, followed by estimations of Canadians' willingness to pay for St. Lawrence Estuary marine mammal recovery. Sections 5.1 and 5.2 present the first category, while 5.3 and 5.4 the second.

4.1 ATTITUDES TOWARD THE ENVIRONMENT AND ENVIRONMENTAL TRADEOFFS

Desire for action on environmental protection

While the Canadians surveyed for this study declared that more action is necessary to protect the environment, this topic was not their number one priority among a list of eight issues facing Canada. Health care and prevention was in first place, while three environmental issues were ranked as follows: reducing air and water pollution 2nd place, protection of species at risk 6th place, and maintaining parks and wildlife 8th place (see Appendix 3). In Quebec the situation was similar with one exception; improvement of roads and highways increased from a level 4 priority to a level 2.

We ran correlation, as well as factor and reliability analyses, and found that the eight issues can be grouped together under two overriding concerns: environmental protection issues and socio-economic welfare issues (see Appendix 4 for results of the factor and reliability analyses). The former includes the three environmental issues presented above, while the latter is comprised of the five remaining issues (education, health care, roads, economic growth and taxes). We found that women desire more action on both categories of issues than men. For example, 52.2% of the women surveyed want higher than the average action for environmental protection, while this figure drops to 44.2% for men (see Table 4). These percentages increase to 56% and respectively 45.9% for socio-economic welfare (see Table 4). Similar results are found in the Quebec sample.

Table 4: Distribution of desire for action on environmental protection and socio-economic welfare issues by gender (Canadian sample).

	Men (n = 806)	Women (n = 800)	Full sample (n = 1,600)
Environmental protection Want greater than average action	44.2 %	52.3 %	48.2 %
Socio-economic welfare Want greater than average action	45.9 %	56.0 %	50.9 %

Does participating in outdoor activities influence Canadians' willingness to protect species at risk?

The Canadians in our survey enjoy outdoor activities and Quebeckers even more: 84.6% of Canadians and 88.27% of Quebeckers had participated in at least one outdoor activity during the past 12 months. The most popular outdoor activity was hiking, followed by sightseeing and beach activities, and the least practiced was hunting. Ecotourism ranks towards the bottom with only 7.3% of Canadians practicing this activity. The pattern is quite similar in Quebec.

An analysis of correlations between the 12 outdoor activities suggested that three distinct categories of activities could be constructed: activities that use natural resources (i.e., fishing or hunting), activities for physical exercise (i.e., swimming, canoeing, hiking or skiing), and passive observational activities (i.e., bird watching, wildlife viewing, sightseeing, ecotourism or photographing nature). While 45% of people practicing observational activities consistently voted in favour of creating a Marine Protected Area, only 38% of people practicing fishing or hunting activities voted similarly (see Table 5). Those who most often voted for maintaining current marine protection initiatives (i.e., not creating a Marine Protected Area) are people who reported they do not participate in outdoor physical exercise activities (27.5%). These people appear to be much less convinced of the need to increase efforts to recover marine mammals in the St. Lawrence Estuary.

Table 5: Distribution of the number of votes in favour of creating a Marine Protected Area by types of outdoor activities (Canadian sample).

	Observational activities (ex: bird watching, photographing nature)		Physical exercise activities (ex: canoeing, skiing)		Activities using natural resources (ex: fishing, hunting)	
# of YES votes	**No (n=542)**	**Yes (n=1064)**	**No (n=429)**	**Yes (n=1117)**	**No (n=1144)**	**Yes (n=462)**
0 or 1	24.4 %	20.5 %	27.5 %	19.7 %	21.7 %	22.1 %
2 or 3	36.1 %	34.5 %	30.6 %	36.7 %	33,1 %	39.8 %
4 or 5	39.4 %	45.0 %	42.0 %	43.6 %	45,2 %	38.1 %
Total	100 %	100 %	100 %	100 %	100 %	100 %

Tradeoffs between business interests and environmental protection

In order to capture Canadians' preferences for environmental tradeoffs, we constructed the concept of '*willingness to trade business for environmental protection*'. The concept was measured by level of agreement or disagreement with the following two statements: (i) "*No environmental improvement program should be carried out that is injurious to business*"; and (ii) "*Environmental improvements are fine if they don't increase taxes*" Canadians in our sample were clearly divided in their willingness to sacrifice business interests for the benefit of environmental protection. While 50.6 % consider that environmental protection is more important than business interests, 49.4 % consider that business interests are more important than environmental protection. This pattern was quite similar in the Quebec sample. However, results from yet another question indicate that when environmental protection is limited to protecting species at risk and business interests are limited to loss of jobs, the trade-off was much clearer. Jobs were clearly viewed as being more important. Thus, 71.6% of Canadians and 82.2% of Quebeckers are "*somewhat*", "*very*" or "*extremely*" concerned that efforts to protect species at risk will reduce jobs.

4.2 AWARENESS OF MARINE MAMMALS AND MARINE PROTECTED AREAS

Marine mammals

A large majority of the Canadians surveyed were at least somewhat knowledgeable about marine mammals. The most well known species among the three presented in this study was the beluga with 80.3% of Canadians stating that they were "*somewhat*" or "*very*" familiar with them. The harbour seal was next with 77.4% and the blue whale third with 70.9%. Moreover, the vast majority (94.5%) was also interested in observing marine mammals in nature, with 25.8% stating that they were "*extremely*" interested. The situation was similar in the Quebec sample.

Despite relatively high knowledge of marine mammals and desire to observe them, 60.9% of the Canadians surveyed were not aware that several marine mammal species living in or migrating to the St. Lawrence Estuary are at risk. In Quebec, however, this percentage drops to 44.2%, most probably because the majority of the St. Lawrence Estuary is situated within the boundaries of Quebec. On the other hand, the importance of the St. Lawrence Estuary as a habitat for marine mammals was more common knowledge: only 47.4% of Canadians and 24.8% of Quebeckers were not aware of the importance of the St. Lawrence Estuary for marine mammals.

As mentioned earlier, many of the Canadians surveyed consider that more action is needed to protect species at risk, but they are unaffected by where the species at risk needing protection are located inside of Canada. About 78% of respondents were concerned about the marine mammals at risk in the St. Lawrence Estuary, while the percentage is almost the same (76.5%) for those concerned about marine mammals at risk elsewhere in Canada. The correlation between the two is also very high: $r = 0.852$, $p = 0.00$. Even respondents from Quebec, who live much closer to the St. Lawrence Estuary, are equally concerned about marine mammals at risk regardless if they are near or far.

The importance of protecting species at risk is also reflected in the respondents' voting behaviour. Approximately 90% declared that the increase in marine mammal populations was somewhat to extremely important when considering whether to vote for or against a proposed recovery program. The majority of Canadians (74.9%) and an even greater majority of Quebeckers (81.1%) also agreed that Canada should spend "*a lot more*" money to protect St. Lawrence belugas and harbour seals and the Atlantic blue whales.

Marine protected areas

People seemed confident in the role that marine protected areas could play in protecting species at risk. Over 89% of the Canadian sample and 88.4% of the Quebeckers sampled had a positive reaction, and 90% of both Canadian and Quebec respondents declared that the size of the potential St. Lawrence Marine Protected Area played an important role in their final voting decisions. As for the Saguenay St. Lawrence Marine Park, 76.2 % of Canadians had no idea that it exists; 16.6% have heard or read something about it and only 4.5% had actually visited it. In Quebec, fewer people were unaware that this marine park exists (57.2 %); more had heard or read about it (24.9%) and more reported having visited it (13.3%).

4.3 ESTIMATES OF THE WILLINGNESS TO PAY (WTP)

4.3.1 DETERMINANTS OF FAVOURABLE VOTES

In order to estimate the willingness to pay for St. Lawrence Estuary marine mammal recovery, we estimated several models from the choice data. All of these models were based on a linear expression for the underlying utility function as explained above. Additional annual cost to the household, age, beluga population, seal population and blue whale population are treated as quantitative (continuous) variables, while the recovery programs, education, participation in environmental organizations, Quebec residency, gender, household income and regulations on shipping and whale watching are modelled as qualitative (discrete) dummy variables.

Table 6 provides the initial econometric results. The majority of the independent variables in the models are significant at the 5% level. Across all models, the coefficient of the price variable is always negative and significantly different from 0 at the 1% level of significance. This confirms our prior expectation that the probability of voting for a recovery program decreases when the price of that program increases. In other words, the demand for each recovery program decreases as the proposed annual cost to the household increases.

The first model gives information on the probability of choosing each program relative to program 1 (i.e., after accounting for the constant, the implied coefficient of program 1 is 0, such that the other programs are assessed relative to this program). The most appreciated program appears to be program number 4 because its dummy variable coefficient is the highest (0.68) among all the program dummies. The popularity of programme 4 is followed, in decreasing order of importance, by programs 3_1, 5, 3_2, 2 and 1.

Model 2 expands on the first model by adding individual characteristics, such as age, gender, household income, education and residence in Quebec. As Table 6 shows, age, education and income have a positive impact on the probability of voting for the proposed programs. Older people tend to vote more favourably towards species recovery programs relative to younger people, and people with college and university diplomas are also more likely to choose the proposed programs. It is somewhat surprising that active participation in environmental organizations does not have a significant impact on the willingness to recover marine species at risk. Also surprising are the findings that Quebec respondents voted less favourably toward recovery of the St. Lawrence Estuary marine mammals than Canadians from other provinces, and that women have a lower propensity to vote for species recovery programs than men.

The third model explains voting tendencies in terms of the various program characteristics. Canadians are more likely to vote "yes" for larger increases in the numbers of belugas and harbour seals, while they are less likely to vote favourably when restrictions on shipping and whale watching pass from minor to major. The coefficient for blue whales is not significant probably because the programs don't offer enough variation in the population of blue whales. The size of the marine protected area does not appear as an independent variable in this model specification because it is perfectly correlated with the blue whale population (i.e., when it was stipulated that the size of the MPA would be "large", the number of blue whales also increased).

The fourth and final model expands on model 3 by adding the individual characteristics used in model 2. The coefficients of the household characteristics remain almost identical to those obtained in model 2 and the coefficients of the program attributes also remain virtually unchanged from model 3.

J. F. Gosselin

Harbour seals

Table 6: Parameter estimates for four standard logit models.

	Model 1	Model 2	Model 3	Model 4
Constant	0.346 ** (0.054)	0.021 (0.124)	0.250 ** (0.057)	-0.074 (0.125)
Additional annual cost to the household	-0.004 ** (0.0002)	-0.004 ** (0.0002)	-0.004 ** (0.0002)	-0.004 ** (0.0002)
Dummy indicating program 2	0.107 ** (0.073)	0.107 ** (0.073)	-	-
Dummy indicating program 3_1	0.649 ** (0.092)	0.658 ** (0.092)	-	-
Dummy indicating program 3_2	0.171 * (0.089)	0.168 * (0.089)	-	-
Dummy indicating program 4	0.680 ** (0.074)	0.684 ** (0.074)	-	-
Dummy indicating program 5	0.500 ** (0.074)	0.504 ** (0.074)	-	-
Age	-	0.004 ** (0.0016)	-	0.004 ** (0.0016)
College degree or higher	-	0.258 ** (0.050)	-	0.258 ** (0.049)
Environmental activism	-	-0.012 (0.084)	-	-0.011 (0.084)
Quebec	-	-0.204 ** (0.056)	-	-0.204 ** (0.056)
Women	-	-0,119 ** (0.047	-	-0.119 ** (0.047)
Income $20-35k	-	0.257 ** (0.097)	-	0.257 ** (0.097)
Income $35-55k	-	0.161 * (0.090)	-	0.160 * (0.090)
Income $55-80k	-	0.088 (0.086)	-	0.185 (0.086)
Income $80-150k	-	0.137 (0.085)	-	0.136 (0.085)
Income > $150k	-	0.143 (0.131)	-	0.141 (0.131)
Number of belugas	-	-	0.0002 ** (0.0004)	0.0002 ** (0.0004)
Number of harbour seals	-	-	0.00006 ** (0.00001)	0.00006 ** (0.00001)
Number of blue whales	-	-	-0.00003 (0.0001)	-0.00003 (0.0001)
Regulations on shipping and whale watching	-	-	-0.712 ** (0.151	-0.723 ** (0.151
Pseudo R^2	0.059	0.065	0.058	0.063
Log likelihood	-5176.05	-5144.04	-5184.63	-5152.62

Note: standard errors in parenthesis.
* Significant at 10 % or better.
** Significant at 5 % or better.

4.3.2 WILLINGNESS TO PAY (WTP) PER RECOVERY PROGRAM

For the estimation of willingness to pay per proposed program, we used the parameters and covariance matrix resulting from Model 1 to produce the results that are presented in Table 7. As noted in the previous section, the most appreciated recovery program is program number 4, which offers the greatest increases in all of the marine mammal population numbers. Thus, Canadians are willing to incur annual costs of $242 per household to improve the risk status of harbour seals and belugas from "threatened" to "not at risk", and that of blue whales from "endangered" to "threatened". Program 4 is the most valued program in spite of the fact that it generates the highest costs to the economy by proposing that there would be additional major restrictions on the shipping and whale watching industries. The least preferred program appears to be program number 1, which only offers improvement in the status of harbour seals. Canadians are willing to pay $82 for this program. Hence, the average willingness to pay for marine mammal recovery programs in the St. Lawrence Estuary ranges from $82 to $242 per household.

It is important to point out that the WTP for some initial improvements in the populations of marine mammals is quite high while the additional WTP for recovering marine mammals from these improvements to the "not at risk" status is low. For example, Canadians are willing to pay $200 for program 5, which improves the at-risk status of the beluga and harbour seal populations up to "special concern". This is only one step better than their actual "threatened" status. In sharp contrast, they are only willing to pay an additional $35 for program 3_1, which hypothetically brings these two populations up to the "not at risk" status. This suggests a highly non-linear valuation function. Canadians want to make sure that species are not "threatened", but they are not willing to pay a great deal more to move them beyond that level to the "not at risk" status. This result confirms findings from previous studies regarding the decreasing nature of the marginal WTP for environmental improvements: initial environmental improvements are valued more than subsequent improvements (Rollins and Lyke 1998, Adamowicz et al. 1998). People appear to be using a cost–minimizing approach to achieve some acceptable threshold level of environmental improvement. This puts considerable weight on the need for accuracy in the scientific assessment of the thresholds and the risk level associated with those thresholds.

Table 7 also provides the standard deviations of the estimated WTP for each of the proposed programs, and Appendix 6 presents their density functions. These statistics reveal the relatively low dispersion of the WTP estimates. Because these estimates of WTP are based on Model 1, which does not incorporate household specific variables, the variation in WTP does not arise from differences among individuals, but rather from the randomness of the estimated parameters. As such, the estimated means and standard deviations for WTP presented in Table 7 are the same for each individual in the sample.

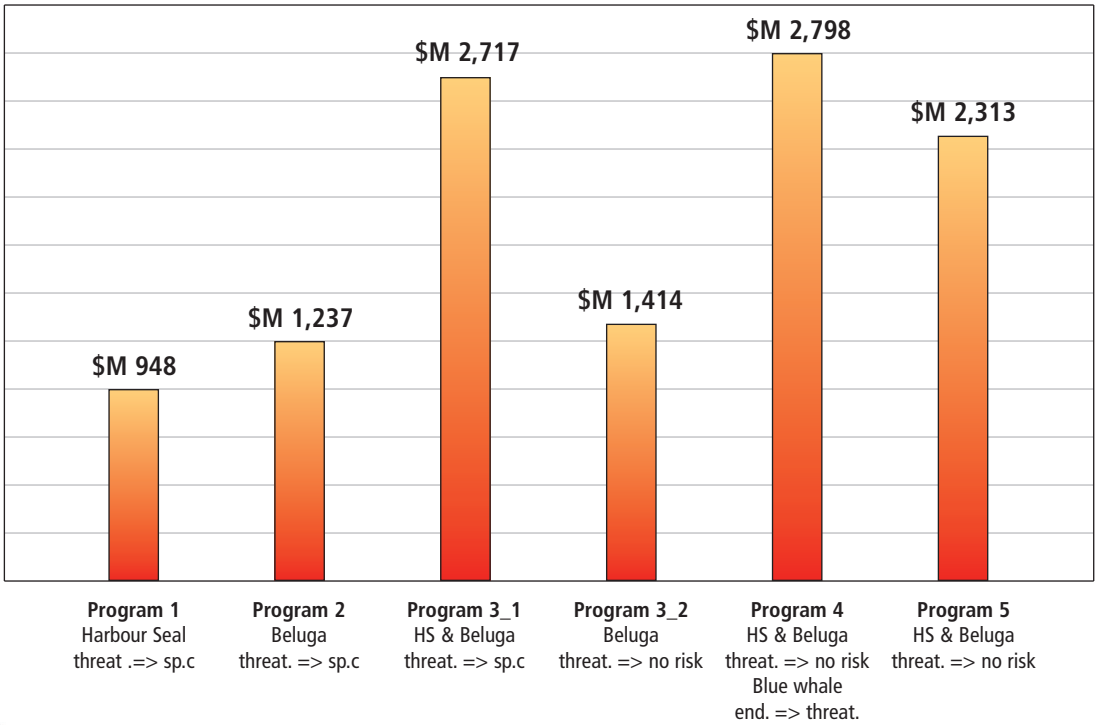
Table 7: Mean and standard deviation of the WTP per program.

	Mean WTP $	Standard deviation of WTP $
Program 1: **Harbour seal recovery from threatened to special concern.**	82	12.30
Program 2: **Beluga recovery from threatened to special concern.**	107	12.21
Program 3_1: **Beluga & harbour seal recovery from threatened to not a risk.**	235	19.11
Program 3_2: **Beluga recovery from threatened to not a risk.**	122	17.19
Program 4: **Beluga & harbour seal recovery from threatened to not a risk and blue whale recovery from endangered to threatened.**	242	14.18
Program 5: **Beluga & harbour seal recovery from threatened to special concern.**	200	13.18

4.3.3 AGGREGATED VALUES OF WTP

In order to use the results of this study in a cost-benefit analysis, the projection of the benefits at the scale of all households in Canada could be useful. These aggregate values are calculated by multiplying the average WTP per household by the total number of households in Canada in 2001 (i.e., 11,562,975 households[3]). As shown in Figure 7, Canadians apparently place a significant value on the recovery of marine mammals in the St. Lawrence Estuary. Their aggregate willingness to pay ranges from $948 to $2,798 million depending on the magnitude of the expected recovery.

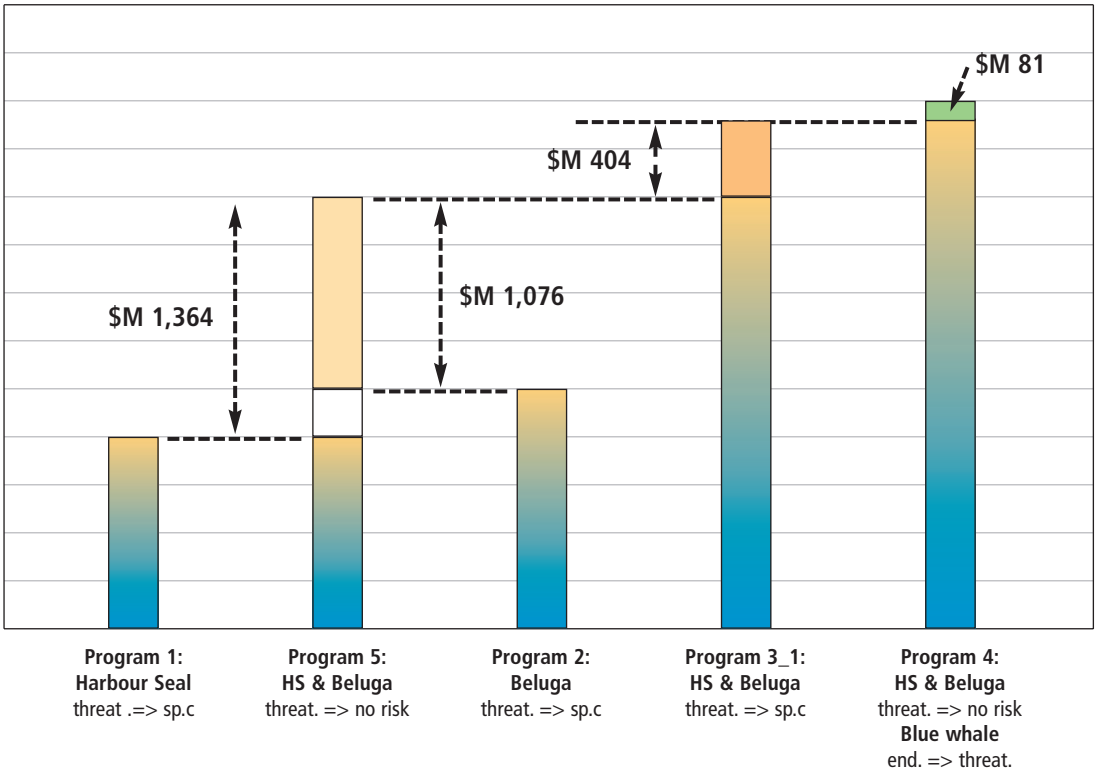
Figure 7: Aggregated WTP per St. Lawrence marine mammal recovery program.



[3] Source: Statistics Canada 2001

More insight into the valuation of marine mammals can be obtained by estimating the marginal values attributed to improvements in program recovery levels (see Figure 8). For example, by comparing program 5 to program 1 and program 5 to program 2, we conclude that the increased value for including beluga whale recovery along with harbour seal recovery is approximately $1,364 million, and $1,075 million for including harbour seal recovery with beluga recovery. The marginal value for recovery is much less when the other species in the study are already considered to be in very good health ($ 81 million for blue whale recovery when harbour seals and belugas are "not at risk"). The additional value of recovery measures that might be necessary to ensure that marine mammals are fully "not at risk" is also quite small (i.e., $ 405 million to recover harbour seals and belugas beyond "special concern" to "not at risk"). As we concluded in the previous section, people apparently value the recovery of marine mammals up to a certain threshold, but place less value on the additional efforts needed for total species recovery or for the recovery of all species in the study.

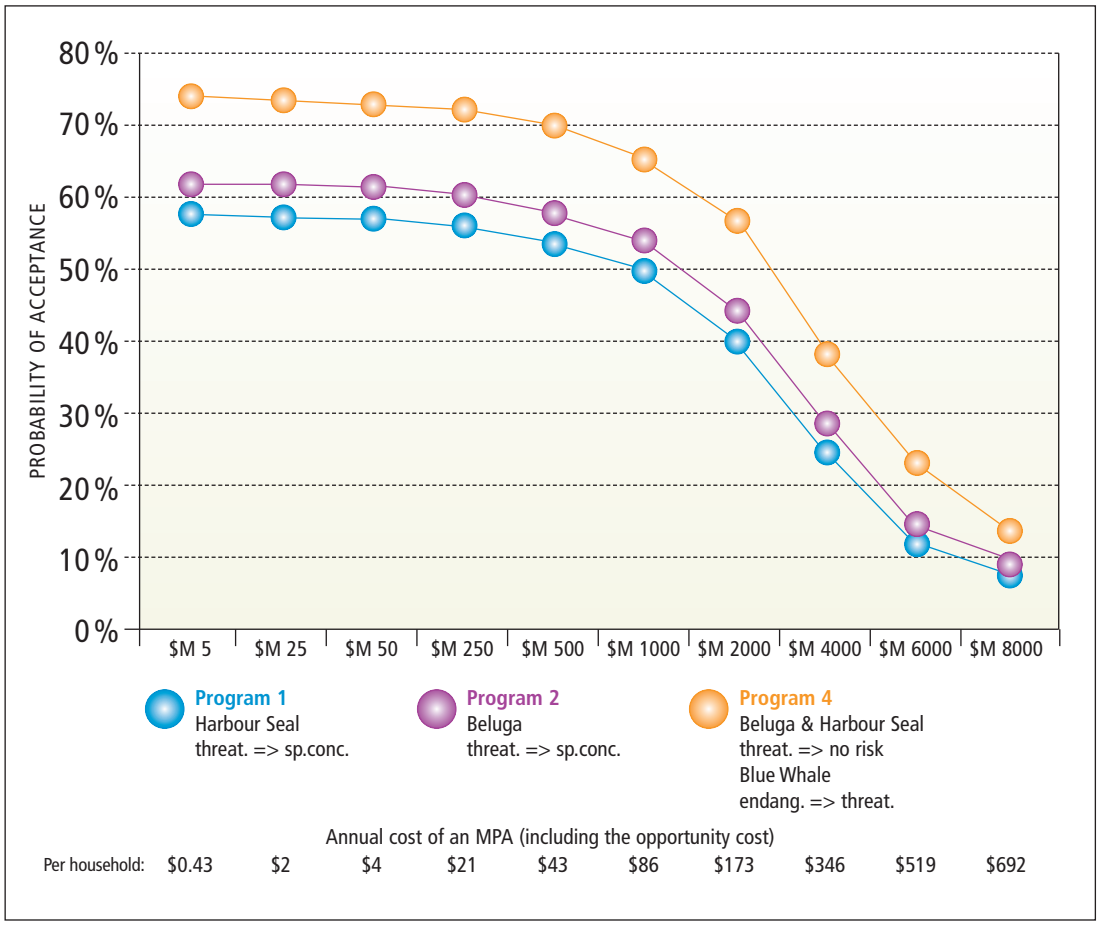
Figure 8: Marginal increase in the aggregate WTP per recovery program when that program is expanded to include additional recovery measures.



4.3.4 PROBABILITIES OF ACCEPTANCE OF A RECOVERY PROGRAMM.

A useful tool for the decision making process is the prediction of how many Canadians would vote for a proposed recovery program given its total annual cost. Figure 9 presents the probabilities of acceptance of programs 1, 2 and 4 for a very large range of potential annual costs. As this figure shows, if the program doesn't cost more than $M1,000 annually ($86/household), more than 50% of Canadians would support it. If, on the other hand, the cost exceeds this level, the support decreases dramatically. Standard errors of the predicted probabilities are presented in Appendix 9.

Figure 9: Probabilities of acceptance of a recovery program: a useful decision making tool.



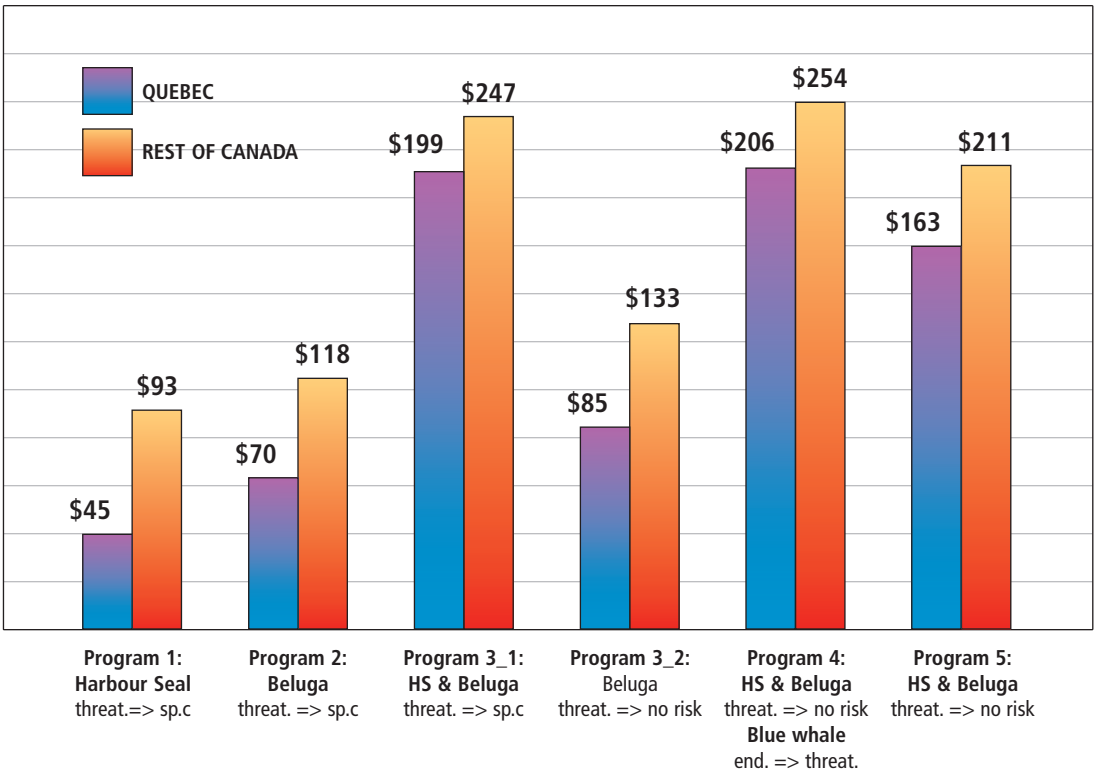
4.3.5 REGIONAL VARIATIONS IN WTP

As indicated from Model 2 in Table 6, Quebec residents are less likely to vote in favour of the recovery of marine mammals in the St. Lawrence Estuary than those living in the rest of Canada. This suggests that their willingness to pay for any recovery program is less than that of other Canadians. This difference probably arises from province specific economic, demographic and cultural differences.

The likelihood ratio test described in Appendix 7 provides a more formal test of the hypothesis that Quebecers voted differently than Canadians residing in other provinces for marine mammal recovery programs in the St. Lawrence Estuary. Essentially, this test compares two models: one identical to Model 1 and the other similar to Model 1, but with one additional dummy variable for Quebec residency. The test result gives additional confirmation that Quebecers did vote differently (i.e., the expanded model 1 fits the data better than the original model 1).

We then estimated the willingness to pay for each program separately for Quebec and the rest of the Canada. As shown in Figure 10, estimated WTP is consistently lower in Quebec. For example, Quebec residents are willing to pay $206 for program 4, which is the best program in terms of marine mammal benefits, while the rest of Canada is willing to pay $254.

Figure 10: Mean WTP per recovery program in Quebec and in the rest of Canada.



We employed another likelihood ratio test to determine if, within the province of Quebec, the respondents' WTP varies as a function of the distance between their place of residence and the St. Lawrence Estuary. This was used to examine whether the WTP of residents living near the Estuary (local residents) was different than that of Quebecers living further away from the Estuary. We grouped Quebec respondents into 3 categories: those living within a 200 km radius of Tadoussac (the most popular site for whale watching in the Estuary), those living in the range of 200 to 400 km from Tadoussac, and those living at least 400 km away from Tadoussac. As shown in Appendix 8, the test results indicate there are no differences in WTP among respondents inside Quebec. In contrast to other studies which have found that passive use value declines with increasing distance between residence and the location of the environmental improvement (see Loomis 2000), this study finds that the passive use value does not vary by distance from the Estuary.

4.4 VALIDITY OF THE ESTIMATED WTP: THE SCOPE TEST

The use of contingent valuation methods (CVM) for the assessment of oil spill damage from the 1989 Exxon Valdez accident generated much controversy over the reliability of contingent valuation in providing estimates for passive use values. While this controversy has not dissipated, practitioners using the method have gained more confidence in CVMs' abilities. The Blue Ribbon Panel, a group assembled by the U.S. National Oceanographic and Atmospheric Administration (NOAA), played an important role in establishing several guidelines that contingent valuation studies should follow in order to ensure the reliability and usefulness of their results. One of these guidelines involves testing for scope. The scope tests used in this study aim to verify that respondents understood and responded to the different program attributes when making their votes (Banzhaf et al. 2004). **These tests assess whether people are willing to pay more for additional or "larger" environmental improvements. If this holds true, then one can assume that some rationality must underlie peoples' responses.**

If people are willing to pay more for increasing environmental benefits, then the WTP per program should be positively related to the level of improvements in the marine mammal populations provided by the programs. Figure 7 shows the ranking of the programs by level of environmental benefits (for a detailed presentation of these benefits see Appendix 5). Based on this ranking, various hypotheses regarding predicted differences in the average WTP per program can be put forward (see Table 10). An intuitive verification of these hypotheses can be done by simply comparing the average WTP for different programs estimated under the hypothesis that model parameters are constants. The WTP for each program was estimated only for the first vote. As such this first vote is not contaminated with information or responses to previous votes because there are no previous votes. This comparison serves as a scope test since the programs were presented to each respondent at random; the program for the first vote in the sequence was randomly drawn from the set of six programs used in the study. These estimates are presented in Table 9 and show that all except one hypothesis have chances to be confirmed.

A more formal verification of the hypotheses can be conducted by applying the Krinsky and Robb procedure (1986) along with the two sample mean comparison test. The Krinsky and Robb procedure involves estimating WTP for 10,000 random draws of the parameters from a multivariate distribution where the parameter vector represents the mean and the covariance matrix the variances. The mean and variance from the resulting vector of WTP estimates for each program can be compared using the two sample mean test. As shown in Table 10, the original hypotheses were all validated, except for the hypothesis that WTP for program 4 would be higher than WTP for program 3_1. Since there is almost perfect correspondence between the WTP estimates and the ranking of the program environmental improvements, it can be concluded that the **WTP estimates are both robust and credible**.

To illustrate that people are willing to pay more for more environmental benefits, consider programs 4 and 5. Table 10 indicates that people are willing to pay more for program 4 than for program 5 and the description below shows that program 4 offers substantially more benefits than program 5:

Program 4:

- 4,000 more belugas
- 9,000 more harbour seals
- 750 more blue whales

Program 5:

- 1,500 more belugas
- 0 more harbour seals
- 0 more blue whales

Figure 11: Ranking of the programs by level of marine mammal benefits.

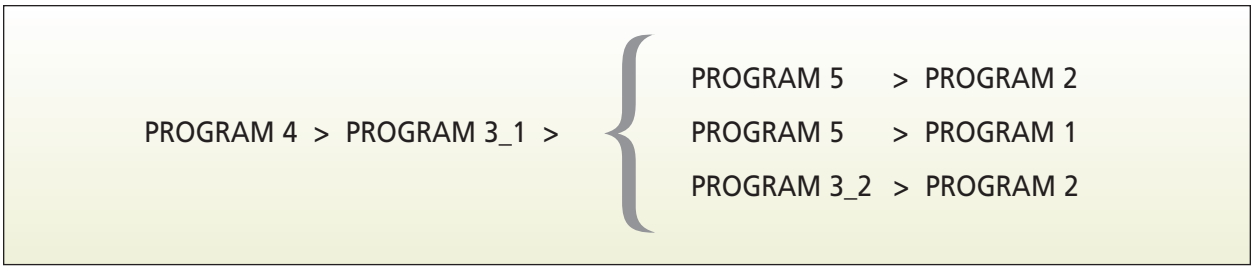


Table 9: Average WTP per program when that program was presented as a respondent's 1st vote (Canadian sample).

	WTP ($)
Program 1	208.32
Program 2	196.70
Program 3_1	432.37
Program 3_2	339.80
Program 4	425.35
Program 5	397.35

Table 10: Hypothesis made in order to test if people pay more for more environmental benefits (Canadian sample).

Hypothesis	Two sample mean comparison test (√ = validated, X = not validated)
WTP 3_1 < WTP 4	X
WTP 5 < WTP 4	√
WTP 2 < WTP 4	√
WTP 1 < WTP 4	√
WTP 3_2 < WTP 4	√
WTP 5 < WTP 3_1	√
WTP 1 < WTP 3_1	√
WTP 2 < WTP 3_1	√
WTP 3_2 < WTP 3_1	√
WTP 2 < WTP 5	√
WTP 1 < WTP 5	√
WTP 2 < WTP 3_2	√
WTP 1 < WTP 3_2	√

5. Summary and conclusions

To the best of our knowledge, this paper presents the first estimates of the economic values associated with the recovery of marine mammal populations in Canada. The results are useful as an input into the cost-benefit analysis of recovery programs; in this case, the proposed recovery program was the establishment of a Marine Protected Area in Canadian waters.

The scope tests show that the WTP estimates are robust and credible. Respondents paid attention to votes, understood the scenarios, and, as a consequence, acted as expected: they more often voted in favour of programs that offered higher protection for marine mammals in the St. Lawrence Estuary. The average WTP for different recovery programs ranges from $82 to $242 annually per household with a standard error ranging from $12.21 to $19.11. In other words, as a society Canadians are ready to annually pay $948 to $2,798 million to help recover marine mammals in the St. Lawrence Estuary (with a standard error ranging from $141 to $221 million). The WTP for protection measures that might recover marine mammals from their present at-risk status to the next level are quite high, while the WTP for additional recovery beyond this level (i.e. elimination of the risk of extinction) are quite small. The latter finding has considerable policy relevance. Economic valuation can play an important role in the appraisal of optimal recovery programs or the assessment of recovery programs that provide the highest net benefits. In this case, recovery programs that provided benefits above the threshold of "threatened" were not highly valued, suggesting that approaches that minimize the cost of achieving this threshold are most desirable from an economic efficiency standpoint.

This paper also explored regional differences in passive use value estimates. We found that Canadian residents living outside the province of Quebec are willing to pay more for the recovery of St. Lawrence marine mammals than residents within the province of Quebec. This difference is most likely explained by province specific economic, demographic and cultural differences, rather than by distance from the St. Lawrence Estuary. In fact, within the province of Quebec, WTP for marine mammal recovery did not vary significantly with increasing distance between a Quebecer's place of residence and the St. Lawrence Estuary.

Many topics still remain to be explored. Budget and time constraints preclude exploration of additional scenarios, further scope tests and additional investigations of the economic benefits of alternate recovery programs. Sensitivity analyses on factors like specification of the logit model, use of the uncertainty question responses and scenario rejection have yet to be explored. In addition, detailed analysis of cost effectiveness of alternative recovery programs, and analysis of the distributional impacts of recovery plan options would be useful information to policy makers when choosing recovery program options. As with all stated preference valuation exercises there are concerns about the extent to which the values elicited would correspond to an actual referendum or allocation decision if such actions took place. While significant effort was put into checking for robustness and reducing hypothetical bias these issues remain important areas for further research. Nevertheless, this initial investigation of the passive use values of marine protected areas and marine mammals provides significant insights into the economic importance of these species and programs to Canadians.

Bibliography

Adamowicz W., Boxall P., Williams M. and Louviere J. 1998. *Stated preference approaches for measuring Àpassive use values: choice experiments and contingent valuation*. American Journal of Agricultural Economics 80(1), 64-75.

Banzhaf S., Burtraw D., Evans D. and Krupnick A. 2004. *Valuation of Natural Resource Improvements in the Adirondacks*, Resources for the Future Press, September 2004.

Bergeron N., Romain R. 2004. *Étude sur la valeur socio-économique et environnementale des mammifères marins en péril dans l'estuaire du Saint-Laurent –Phase 1. Rapport final*. Cahiers de recherche du CRÉA, SR.04.03-2, Mach 2004.

Blumenschein, K., M. Johannesson, G. C. Blomquist, B. Liljas, and R. M. O'Connor. 1998. *Experimental Results on Expressed Certainty and Hypothetical Bias in Contingent Valuation*. Southern Economic Journal. 65(1): 169-177.

Cummings, R. G. and L. O. Taylor. 1999. *Unbiased value estimates for environmental goods: A cheap talk design for the contingent valuation method*. American Economic Review 89(3): 649–665.

Freeman A.M. 2003. *The Measurement of Environmental and Resource Values: Theory and Measurement*. Resources for the Future Press, Washington, DC.

Haab T. C. and McConnell, K. 2002. *Valuing Environmental and Natural Resources. The Econometrics of Non-market Valuation*. Series New Horizons in Environmental Economics, Series Editors Oates W. E., and H. Folmer.

Hanemann W.M. 1991. *Willingness to Pay and Willingness to Accept: How much can they differ?*, American Economic Review, 81, 635-47.

Harrison, Glenn W. 2005. *Hypothetical Bias Over Uncertain Outcomes*. In J.A. List (ed)., Using Experimental Methods in Environmental and Resource Economics. Northampton, MA: Elgar, 2005.

Krinsky, I. and A. L. Robb 1986. *On Approximating the Statistical Properties of Elasticities*. Review of Economics and Statistics. 68(1986): 715-719.

List, J.A. 2001. *Do Explicit Warnings Eliminate the Hypothetical Bias in Elicitation Procedures? Evidence from Field Auctions for Sportscards*. American Economic Review 91: 1498-1507.

Loomis, John B. 2000. *Vertically Summing Public Good Demand Curves: An Empirical Comparison of Economic and Political Jurisdictions*. Land Economics 76(2): 312-321.

Murphy, J.J., T. Stevens & D. Weatherhead. 2005. *Is cheap talk effective at eliminating hypothetical bias in a provision point mechanism?* Environmental and Resource Economics. 30:327-343.

Rollins K. and Lyke A. 1998. *The Case for Diminishing Marginal Existence Values*. Journal of Environmental Economics and Management 36: 324 – 344.

Statistics Canada 2001. *Canadian families and households. 2001 Census*. Available at the following Internet address: **http://www12.statcan.ca/english/census01/products/analytic/companion/fam/canada.cfm**.

Appendices

APPENDIX 1: EXAMPLE OF A CHOICE SET

ALTERNATIVES

ATTRIBUTE LEVELS

ATTRIBUTES

	CURRENT situation Expected levels in 50 years	PROPOSED program Expected levels in 50 years
St. Lawrence Belugas	**THREATENED** 1,000 Belugas	**THREATENED** 1,000 Belugas
St. Lawrence Harbour Seals (*No official status yet. Hypothetical status based on the low number of individuals.)	**THREATENED*** 1,000 Harbour Seals	**SPECIAL CONCERN*** At least 2,500 Harbour Seals
Atlantic Blue Whales	**ENDANGERED** 250 Blue Whales	**ENDANGERED** 250 Blue Whales
MPA size	**NO MPA**	**SMALL MPA**
Regilations on SHIPPING and WHALE WATCHING	**CURRENT REGULATIONS**	**Additional** minor restrictions focused on **harbour seals** that **might**: · Reduce jobs · Reduce tourism revenues · Increase the cost of goods shipped in the St. Lawrence seaway
ADDITIONAL annual cost to your household in: · Federal Income Taxes · Increased Prices for Goods	**$0**	**Each respondent randomly received one of the following prices: $5, $15, $50, $100, $350**

APPENDIX 2: ATTRIBUTES AND ATTRIBUTES LEVELS USED IN THIS STUDY

Attribute	Number of levels	Attribute levels for the proposed recovery programs
Belugas	3	1,000 2,500 5,000
Seals	3	1,000 2,500 10,000
Blue whales	2	250 1,000
MPA size	2	Small MPA Large MPA
Regulations	2	Additional **minor** restrictions Additional **major** restrictions
Price	5	$5 $15 $50 $100 $350

APPENDIX 3: NEED FOR ACTION IN EIGHT ISSUES CANADIANS FACE

CANADIAN SAMPLE

	N	Minimum (Do a lot less)	Maximum (Do a lot more)	Mean	Standard deviation
1) Improve health care and prevention	1606	.00	4.00	**3.6638**	.6187
2) Reduce air and water pollution	1606	.00	4.00	**3.5853**	.6880
3) Improve education	1606	.00	4.00	**3.4645**	.7352
4) Improve roads and highways	1606	.00	4.00	**3.4247**	.7663
5) Encourage economic growth and jobs	1606	.00	4.00	**3.3350**	.7821
6) Protect species at risk	1606	.00	4.00	**3.2671**	.8444
7) Reduce taxes	1606	.00	4.00	**3.2105**	.9792
8) Maintain parks and wildlife reserves	1606	.00	4.00	**3.1669**	.8336

QUEBEC SAMPLE

	N	Minimum (Do a lot less)	Maximum (Do a lot more)	Mean	Standard deviation
1) Improve health care and prevention	767	.00	4.00	**3.6780**	.6062
2) Reduce air and water pollution	767	1.00	4.00	**3.6754**	.5895
3) Improve education	767	.00	4.00	**3.6441**	.6462
4) Improve roads and highways	767	1.00	4.00	**3.5476**	.6623
5) Encourage economic growth and jobs	767	.00	4.00	**3.4055**	.7552
6) Protect species at risk	767	.00	4.00	**3.2282**	.8326
7) Reduce taxes	767	.00	4.00	**3.2034**	.9629
8) Maintain parks and wildlife reserves	767	1.00	4.00	**3.1395**	.8490

APPENDIX 4: FACTOR AND RELIABILITY ANALYSIS FOR THE CONCEPTS "ENVIRONMENTAL PROTECTION" AND "SOCIO-ECONOMIC WELFARE" (Canadian sample)

CONCEPT: ENVIRONMENTAL PROTECTION (Reliability alpha = 0.7653 > 0.6)

	Factor weighting	Alpha if item deleted
Reduce air and water pollution	0.753 (> 0.6)	0.7640 (< 0.7653)
Maintain parks and wildlife reserves	0.807 (> 0.6)	0.6618 (< 0.7653)
Protect species at risk	0.844 (> 0.6)	0.6014 (< 0.7653)

CONCEPT: SOCIO-ECONOMIC (Reliability alpha = 0.6739 > 0.6)

	Factor weighting	Alpha if item deleted
Improve roads and highways	0.745 (> 0.6)	0.6036 (< 0.6739)
Encourage economic growth and jobs	0.722 (> 0.6)	0.5780 (< 0.6739)
Improve health care and prevention	0.565 (< 0.6)	0.6234 (< 0.6739)
Improve education	0.502 (< 0.6)	0.6303 (< 0.6739)
Reduce taxes	0.644 (> 0.6)	0.6804 (> 0.6739)

Rules for constructing concepts using factor and reliability analysis:

1) A factor can be included in the concept if its weight is higher than 0.6 and the reliability alpha is higher than the "alpha if item deleted".
2) The reliability alpha should be higher than 0.6.

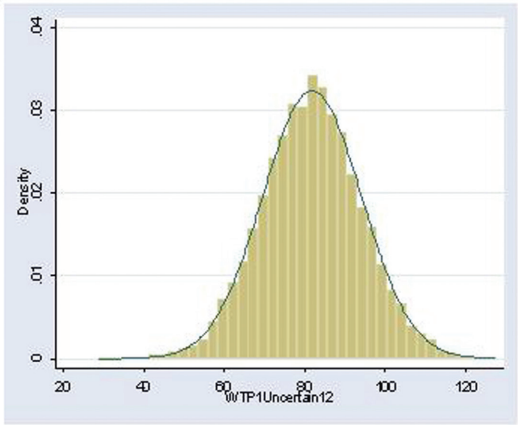
APPENDIX 5: DESCRIPTION OF THE BENEFITS OFFERED BY THE RECOVERY PROGRAMS (comparison with the current situation)

Program 4 : 4,000 more belugas, 9,000 more harbour seals and 750 more blue whales
Program 3_1 : 4,000 more belugas, 9,000 more harbour seals and 0 more blue whales
Program 5 : 1,500 more belugas, 1,500 more harbour seals and 0 more blue whales
Program 3_2 : 4,000 more belugas, 0 more harbour seals and 0 more blue whales
Program 2 : 1,500 more belugas, 0 more harbour seals and 0 more blue whales
Program 1 : 0 more belugas, 1,500 more harbour seals and 0 more blue whales

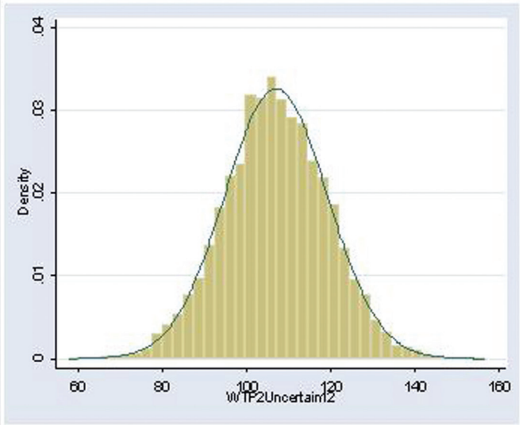
Current situation	Program 1	Program 2	Program 3_1	Program 3_2	Program 4	Program 5
THREATENED 1,000 Belugas	**THREATENED** 1,000 Belugas	**SPECIAL CONCERN** At least 2,500 Belugas	***TOWARDS*** **NOT AT RISK** 5,000 Belugas	***TOWARDS*** **NOT AT RISK** 5,000 Belugas	***TOWARDS*** **NOT AT RISK** 5,000 Belugas	**SPECIAL CONCERN** At least 2,500 Belugas
THREATENED* 1,000 Harbour Seals	**SPECIAL CONCERN*** At least 2,500 Harbour Seals	**THREATENED*** 1,000 Harbour Seals	**NOT AT RISK*** At least 10,000 Harbour Seals	**THREATENED*** 1,000 Harbour Seals	**NOT AT RISK*** At least 10,000 Harbour Seals	**SPECIAL CONCERN*** At least 2,500 Harbour Seals
ENDANGERED 250 Blue Whales	**ENDANGERED** 250 Blue Whales	**ENDANGERED** 250 Blue Whales	**ENDANGERED** 250 Blue Whales	**ENDANGERED** 250 Blue Whales	**THREATENED** 1,000 Blue Whales	**ENDANGERED** 250 Blue Whales

* No official status yet. Hypothetical status based on the low number of individuals.

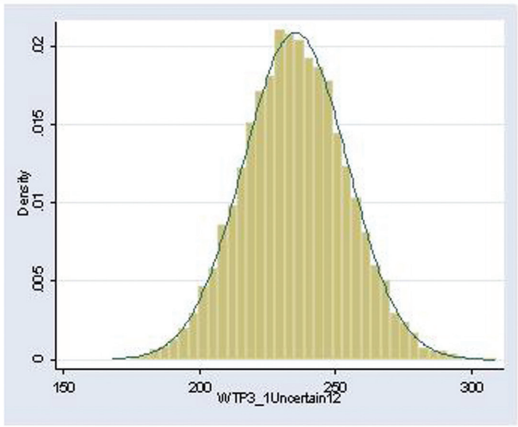
APPENDIX 6: DENSITY FUNCTIONS OF THE WTP PER RECOVERY PROGRAM



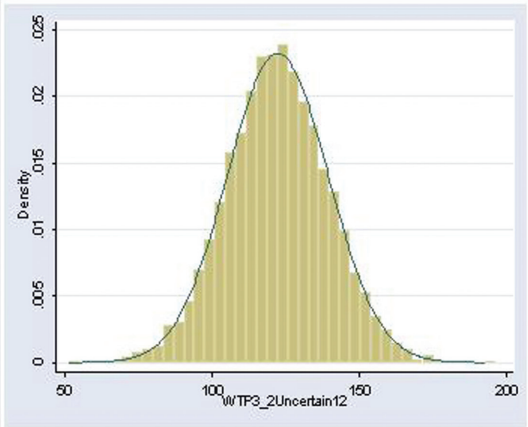
Program 1



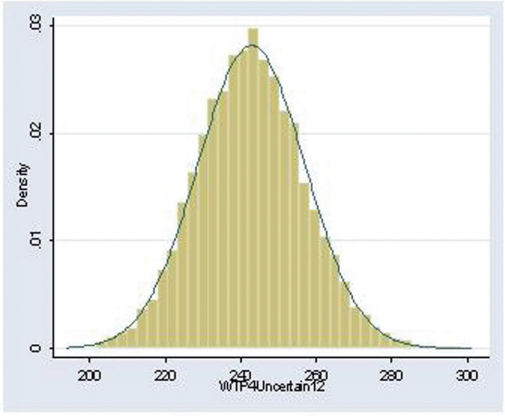
Program 2



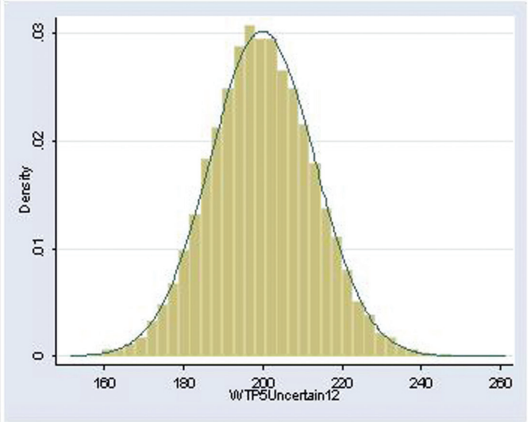
Program 3_1



Program 3_2



Program 4



Program 5

APPENDIX 7: LIKELIHOOD RATIO TEST FOR DIFFERENCES BETWEEN THE WTP OF QUEBEC RESIDENTS AND OF THE REST OF CANADA

H_0 : No difference between the WTP of Quebec and of non Quebec residents

(Model A fits the data as well as Model B)

Model A : Quebec votes differently

```
. logit vUncertain12 vpr dummy2 dummy3_1 dummy3_2 dummy4 dummy5 idQC dummy2QC
> dummy3_1QC dummy3_2QC dummy4QC dummy5QC

Iteration 0:   log likelihood = -5504.5408
Iteration 1:   log likelihood = -5168.6221
Iteration 2:   log likelihood = -5167.7485
Iteration 3:   log likelihood = -5167.7484

Logit estimates                                   Number of obs   =       8030
                                                  LR chi2(12)     =     673.58
                                                  Prob > chi2     =     0.0000
Log likelihood = -5167.7484                       Pseudo R2       =     0.0612
```

vUncertain12	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vpr	-.0042205	.0001925	-21.93	0.000	-.0045978	-.0038433
dummy2	.1445366	.0829975	1.74	0.082	-.0181356	.3072087
dummy3_1	.6130169	.1052705	5.82	0.000	.4066906	.8193432
dummy3_2	.1992267	.1011702	1.97	0.049	.0009367	.3975167
dummy4	.6698387	.0850283	7.88	0.000	.5031863	.8364912
dummy5	.5237884	.0842562	6.22	0.000	.3586494	.6889275
idQC	-.1608602	.1231621	-1.31	0.192	-.4022535	.0805331
dummy2QC	-.1651118	.174386	-0.95	0.344	-.506902	.1766785
dummy3_1QC	.1578198	.2159033	0.73	0.465	-.2653428	.5809825
dummy3_2QC	-.1366214	.2162791	-0.63	0.528	-.5605206	.2872777
dummy4QC	.0460508	.1771454	0.26	0.795	-.3011479	.3932494
dummy5QC	-.098167	.1752677	-0.56	0.575	-.4416853	.2453514
_cons	.3815894	.0610163	6.25	0.000	.2619997	.501179

Where, idQC = 1 if Quebec resident, 0 otherwise
dummy1QC = dummy1*idQC
dummy2QC = dummy2*idQC
dummy3_1QC = dummy3_1*idQC
dummy3_2QC = dummy3_2*idQC
dummy4QC = dummy4*idQC
dummy5QC = dummy5*idQC

Model B: Quebec votes as the rest of Canada

. logit vUncertain12 vpr dummy2 dummy3_1 dummy3_2 dummy4 dummy5

Iteration 0: log likelihood = -5504.5408
Iteration 1: log likelihood = -5176.8528
Iteration 2: log likelihood = -5176.0571
Iteration 3: log likelihood = -5176.0571

Logit estimates

Number of obs	=	8030
LR chi2(6)	=	656.97
Prob > chi2	=	0.0000
Pseudo R2	=	0.0597

Log likelihood = -5176.0571

vUncertain12	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
price	-.0042355	.0001922	-22.04	0.000	-.0046122	-.0038588
dummy2	.1070891	.072903	1.47	0.142	-.0357982	.2499763
dummy3_1	.649053	.0919234	7.06	0.000	.4688864	.8292196
dummy3_2	.1719143	.0893025	1.93	0.054	-.0031153	.346944
dummy4	.6802736	.0746169	9.12	0.000	.5340273	.82652
dummy5	.5002915	.0738019	6.78	0.000	.3556425	.6449405
_cons	.3463961	.0542663	6.38	0.000	.2400361	.452756

. estimates store LogitCS

. lrtest LogitQC LogitCS

likelihood-ratio test
(Assumption: LogitCS nested in LogitQC)

LR chi2(1)	=	13.26
Prob > chi2	=	0.0003

Prob > chi2 = 0.0003 < 0.05 => H_0 is rejected

APPENDIX 8: LIKELIHOOD RATIO TEST FOR DIFFERENCES IN THE WILLINGNESS TO PAY (WTP) INSIDE QUEBEC

H_0 : No differences in the WTP inside Quebec

(Model A fits the data as well as Model B)

Model A : Quebec residents near the St. Lawrence vote differently

. logit v vpr dummy2 dummy3_1 dummy3_2 dummy4 dummy5 nearSL lessnearSL

Iteration 0: log likelihood = -2074.0665
Iteration 1: log likelihood = -1924.009
Iteration 2: log likelihood = -1923.2773
Iteration 3: log likelihood = -1923.2771

Logit estimates

Number of obs	=	3010
LR chi2(12)	=	301.58
Prob > chi2	=	0.0000
Pseudo R2	=	0.0727

Log likelihood = -1923.2771

v	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vpr	-.0045182	.0003177	-14.22	0.000	-.005141	-.0038955
dummy2	-.0084806	.1198011	-0.07	0.944	-.2432866	.2263253
dummy3_1	.6794715	.1497081	4.54	0.000	.386049	.9728939
dummy3_2	.2171586	.147041	1.48	0.140	-.0710364	.5053536
dummy4	.8277104	.1233075	6.71	0.000	.5860321	1.069389
dummy5	.4898124	.1208897	4.05	0.000	.2528729	.7267518
nearSL	.2710233	.2148574	1.26	0.207	-.1500894	.692136
lessnearSL	-.0671178	.1097908	-0.61	0.541	-.2823037	.1480681
_cons	.2964781	.0909629	3.26	0.001	.1181941	.4747622

. estimates store LogitNL

Model B: All Quebec residents vote similarly

. logit v vpr dummy2 dummy3_1 dummy3_2 dummy4 dummy5

Iteration 0: log likelihood = -2074.0665
Iteration 1: log likelihood = -1925.0489
Iteration 2: log likelihood = -1924.3388
Iteration 3: log likelihood = -1924.3386

Logit estimates

Number of obs	=	3010
LR chi2(6)	=	299.46
Prob > chi2	=	0.0000
Pseudo R2	=	0.0722

Log likelihood = -1924.3386

v	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vpr	-.0045213	.0003176	-14.23	0.000	-.0051438	-.0038987
dummy2	-.0084298	.1197583	-0.07	0.944	-.2431519	.2262922
dummy3_1	.6839364	.1496061	4.57	0.000	.3907139	.9771589
dummy3_2	.2121666	.1469998	1.44	0.149	-.0759477	.5002809
dummy4	.8271935	.1232725	6.71	0.000	.5855839	1.068803
dummy5	.4893951	.1208322	4.05	0.000	.2525682	.7262219
_cons	.296634	.0891871	3.33	0.001	.1218305	.4714375

. estimates store LogitCS

. lrtest LogitNL LogitCS

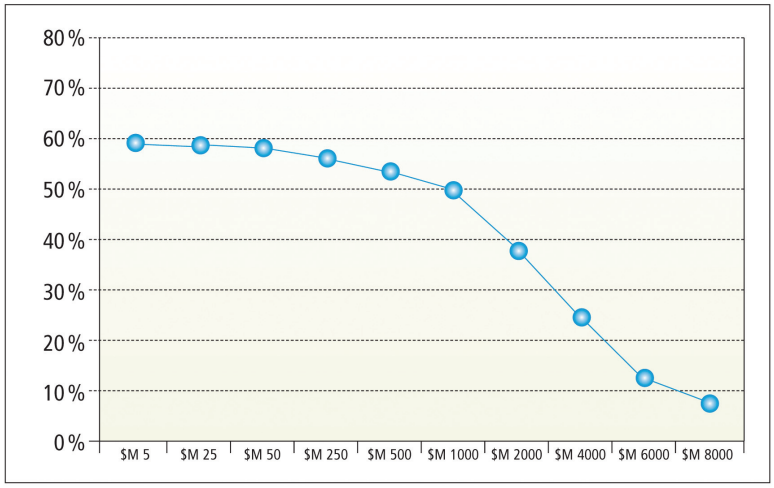
likelihood-ratio test
(Assumption: LogitCS nested in LogitNL)

LR chi2(2)	=	2.12
Prob > chi2	=	0.3459

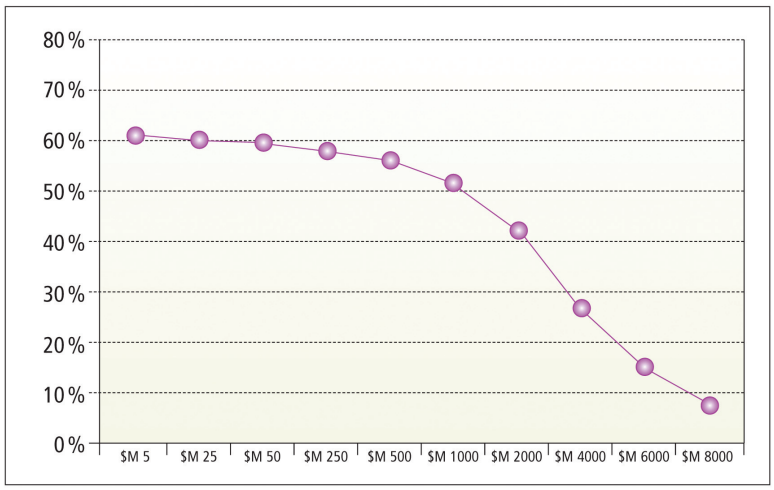
Prob > chi2 = 0.3459 < 0.05 => H_0 is accepted

APPENDIX 9: PROBABILITIES OF ACCEPTANCE OF THREE RECOVERY SCENARIOS AND THE ASSOCIATED STANDARD ERRORS

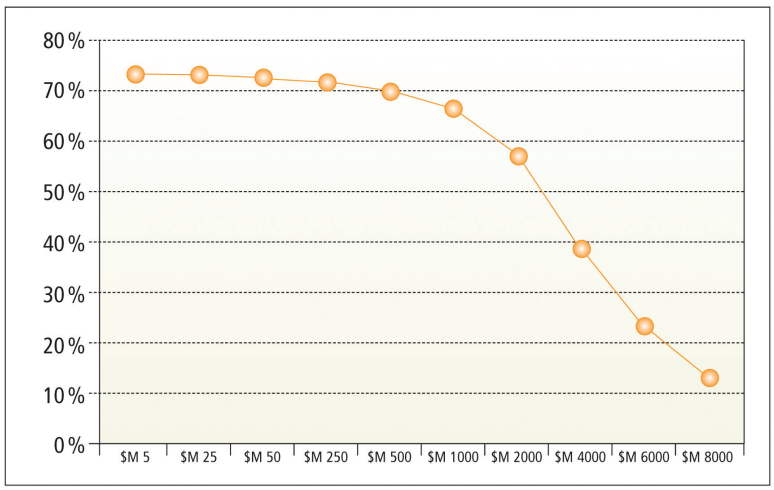
SCENARIO 1



SCENARIO 2



SCENARIO 3



APPENDIX 10: PREDICTIONS OF MARINE MAMMAL POPULATIONS OVER A 50 YEAR HORIZON WITH OR WITHOUT AN MPA, ANNUAL GROWTH RATES USED FOR THESE PREDICTIONS AND MAP REPRESENTING THE TWO HYPOTHETICAL SIZES OF THE ST. LAWRENCE ESTUARY MPA

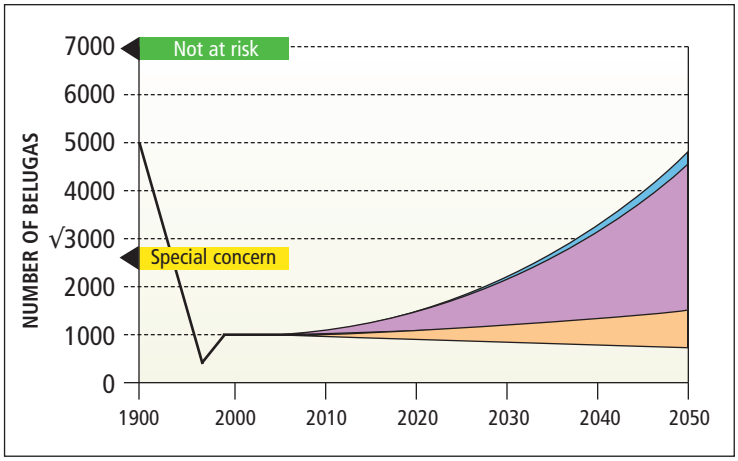
Potential annual growth rates used to predict marine mammal populations over a 50 year horizon.

	Minimum growth rate with NO MPA	Maximum growth rate with NO MPA	Maximum growth rate with a SMALL MPA	Maximum growth rate with a LARGE MPA
St. Lawrence belugas	-0.30 %	+1.50 %	+3.40 %	+3.60 %
St. Lawrence harbour seals	-1.20 %	+1.20 %	+6.50 %	+6.50 %
Atlantic blue whales	-0.50 %	+0.50 %	+3.75 %	+5.00 %

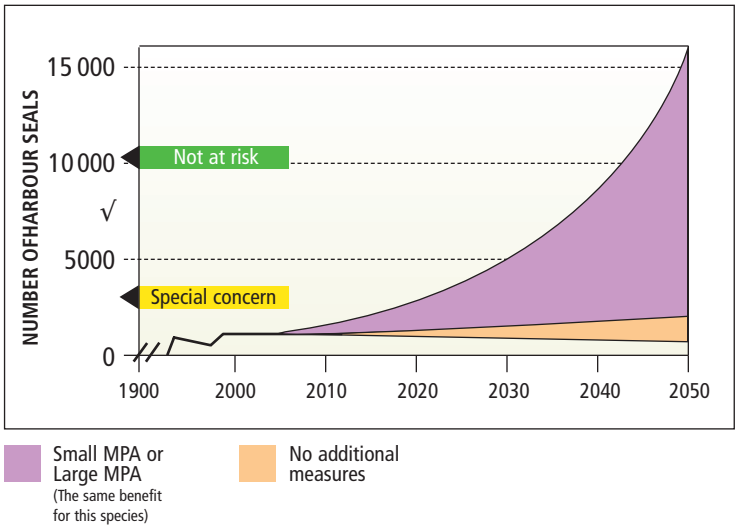
Existing Saguenay St. Lawrence Marine Park and two different sizes for Marine Protected Area (MPA).

The marine park is shown in blue.
Note that the large MPA includes the small one.

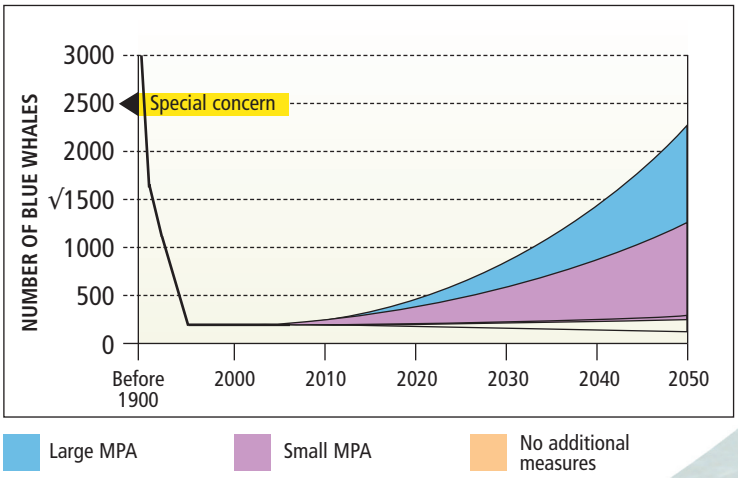
Possible improvements in the St. Lawrence ***belugas*** under different MPA scenarios

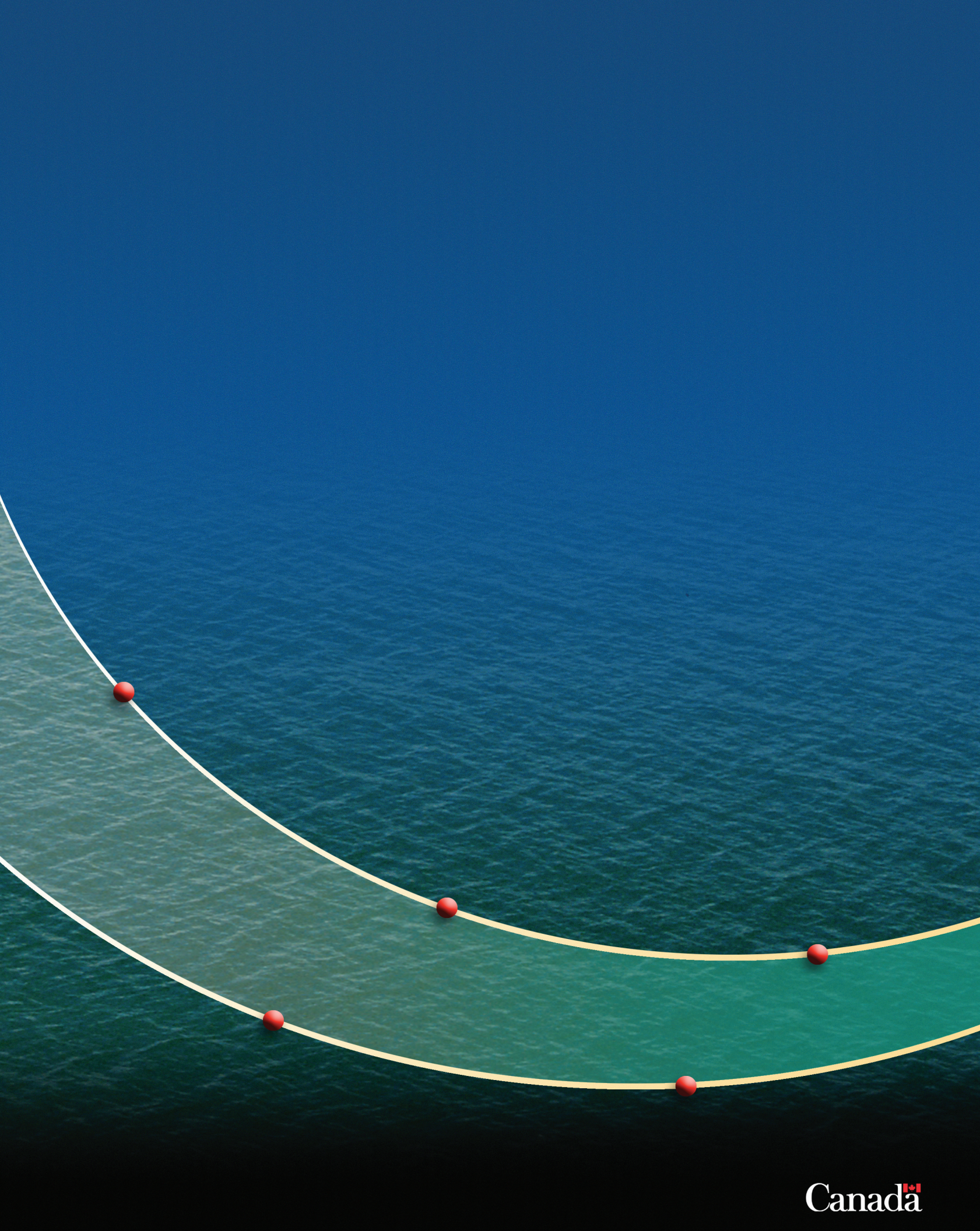


Possible improvements in the St. Lawrence ***harbour seals*** under different MPA scenarios



Possible improvements in the St. Lawrence ***blue whales*** under different MPA scenarios




Canada