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# Proceedings of the National Marine Mammal Peer Review Committee.

## Nanaimo, Feb. 26 – March 1, 2003

**John D. Neilson, Chairperson**

Canadian Science Advisory Secretariat
200 Kent, Ottawa
Ontario, K1A 0E6

**October, 2003**

Canada

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## ABSTRACT

The National Marine Mammal Peer Review Committee (an entity of the Canadian Science Advisory Secretariat) met in Nanaimo, British Columbia, February 26 to March 1, 2003.

A main focus of the work of the committee was the preparation of a Marine Mammal Advisory Report on the status of Stellers sea lions on the Pacific Coast. Other major themes of the meeting included consideration of a strategy for dealing with marine mammal strandings and unusual mortality events, rehabilitation, harbour porpoise bycatch investigations, reference points for seal management and methods of marine mammal risk assessments. The committee also received reviews of SARSEP-funded research from regional investigators, and an update on Hudson Bay beluga research. Finally, the Committee considered options for a special advisory series reflecting marine mammal issues.

## RÉSUMÉ

Le Comité national d'examen par les pairs des mammifères marins (une composante du Secrétariat canadien de consultation scientifique) s'est réuni du 26 février au 1er mars 2003, à Nanaimo (Colombie-Britannique).

Les travaux du Comité ont surtout consisté à rédiger un rapport consultatif sur la situation de l'otarie de Steller sur la côte du Pacifique. Les autres principaux thèmes de la réunion étaient les suivants : stratégie concernant les échouages et les mortalités inhabituelles de mammifères marins, rétablissement de mammifères marins, études sur les prises accidentelles de marsouins communs, points de référence pour la gestion des phoques et méthodes d'évaluation des risques pour les mammifères marins. Des chercheurs régionaux ont aussi présenté au Comité des examens d'études financées par SARCEP et on a fait le point concernant la recherche sur le béluga de la baie d'Hudson. Enfin, le Comité a étudié les options pour une série spéciale de rapports consultatifs traitant des enjeux relatifs aux mammifères marins.

## OPENING REMARKS

The Chairman welcomed participants (Annex 1). He gave a brief presentation describing the meeting procedures, and the documentation requirements. The agenda (Annex 2) for the meeting was reviewed and adopted. The Chairman noted that there was excellent geographic representation at the meeting and the total number of participants (31) was the highest in the past three years. He also welcomed four external reviewers to the meeting: Dr. Pierre-Yves Daoust (Canadian Cooperative Wildlife Health Centre, Charlottetown), Mr. Steven Jeffries (Washington Department of Fish and Wildlife, Washington), Dr. Tom Loughlin (National Marine Fisheries Service, Seattle) and Dr. Steven Rafferty (British Columbia Ministry of Agriculture, Fisheries and Food). The meeting gained much from the active participation of these outside experts.

## PEER REVIEW OF WORKING PAPERS

### 1. TOWARDS A NATIONAL STRATEGY TO MONITOR AND INVESTIGATE MARINE MAMMAL STRANDING AND UNUSUAL MORTALITY EVENTS IN CANADA

Presenter: Ole Nielsen
Rapporteurs: Garry Stenson/Brigitte de March

Summary (Provided by the Author(s))

Throughout the world, governments have grown increasingly sensitive to the need to protect and monitor the health of marine mammal species within their jurisdictions. Public concern is often a driving force. Mass stranding of cetaceans and epizootics in seal populations are high profile events that are disturbing to scientists who study such events and to the lay person alike. The deaths of large numbers of bottlenose dolphins, *Tursiops truncatus*, on the east coast of the United States in 1987-88 was the trigger for the U.S. Congress to pass the Marine Mammal Health and Stranding Response Act in 1992. Until its implementation it was felt that US officials were inadequately prepared to respond to such events, explain their occurrence, and take corrective action. Approximately six such events occur in the USA each year. Similar mortality events in Europe have also led to action by a number of national governments. For example, following the seal distemper epizootic in the North Sea in 1988, the governments of Denmark, Germany and Holland co-operated in implementing the Joint Seal Project under the auspices of the 'Common Wadden Sea Secretariat'. Its goal was to provide 'favorable conditions for a successful recovery of the seal population'. As well, an explosion in the number of rehabilitation facilities (usually privately funded) to help care for sick and stranded animals have sprung up throughout Europe. At present there are 33 facilities in the United States that are rehabilitating marine mammals. Canada has been spared devastating mortality events and as a result we have lagged behind other jurisdictions in formulating response plans to meet the needs that such events obviously require. At present stranding investigations are done in most regions (Pacific, Central and Arctic, Quebec and Scotia Fundy) of Canada but there is no standardized sampling regimen, no national data base of events is maintained and little communication of the findings from such events are shared with colleagues in other regions or internationally. It is recommended that DFO, as part of its mandate to conserve and protect marine mammals adopt a national strategy to monitor the health of marine mammals and to investigate unusual mortality events – before a major die-off occurs.

Discussion:

The presentation dealt with the need for a formalized national approach to dealing with monitoring strandings, major mortality events and diseases. The approach was initially presented from a Central and Arctic and Quebec Region perspective.

Some monitoring of strandings occurs in all regions although the approaches differ. In British Columbia, DFO has been working with provincial veterinarians. A new pathologist will be hired soon using funds from both the federal government and the provincial governments. In BC it is recognized that here is a need to collect basic data (numbers of strandings, species), and compile a database of known mortalities. DFO is looking at developing a coordinating role to deal with agencies, NGOs, and individuals who will run the network. Resources may come from SARA.

A quasi formal stranding network has been setup in the Maritimes. It has been based at Dalhousie University. The primary contact is Canadian Coast Guard who take calls and then contacts a marine mammal coordinator who arranges for a response team. The network relies heavily on volunteers, mostly students. As a result there are times when it is difficult to find people to respond. In their experience, DFO must be cautious because such a network can take on a life of its own.

Response to strandings in Newfoundland has historically been split between seals and whales. Until recently whales, particularly entrapments have been dealt with by J. Lien (MUN) who decided which strandings to respond to. The whale entrapment program is now coordinated by Wayne Ledwell, funded under the habitat stewardship fund. In many cases strandings are reported to the entrapment network and a decision is made between Lewdwell and DFO as to the scientific usefulness of responding. Most of the reports of seal ‘strandings’ are made directly to DFO (Science or C&P). In most cases, actions are dealt first through C&P in the field who make an evaluation of the situation. Generally seals are left alone unless there is an obvious problem or they need to be moved to protect the public or the seals. Each call is dealt with on a case by case basis depending on the scientific usefulness of responding. For example, if an unusual species is sighted they will often respond, but if the animal is a seal (as an example), information is noted, but no response occurs. If necessary, the provincial veterinarians will assist.

It was noted that a distinction must be made between disease surveillance and the role of stranding networks. Disease surveillance can be done on the basis of necropsies of a selective subset of carcasses of marine mammals found ashore. It does not require the infrastructure of a stranding network.

It was noted that provinces already have veterinary laboratory establishments and that a network of wildlife disease specialists under the umbrella of the Canadian Cooperative Wildlife Health Centre (CCWHC) is in place at the four Canadian veterinary colleges. Further cooperation with these groups may be most effective. If

Canada does not wish to develop a large program, then maybe a continental program in terms of tissue banking may be an option.

In the USA, all stranding networks are coordinated by the National Marine Fisheries Service under Marine Mammal Protection Act guidelines. Most rely heavily on volunteers to respond. A number are coordinated and operated by aquariums (ie. New England Aquarium, SeaWorld are examples), or dedicated marine mammal response centres such as The Marine Mammal Center. Stranding networks may receive federal dollars directly from NMFS or via grants (Prescott Stranding Act). Typically, non-federal agencies or non-governmental organizations have dealt with stranding responses.

There were several components to the concept of a national approach to monitoring strandings and mortality events. There was the issue of dealing with normal or regular strandings, a proposal to monitor these strandings and to complete a thorough sampling protocol on these animals. There was also the issue of dealing with unusual stranding events.

It was felt that many of these issues deal more with public outreach and management rather than specifically with science. Mortality is something that does occur. The point was made that we should put more effort into trying to understand how many animals there are, identify where significant mortality occurs and to understand factors that affect the population such as reactions to changes in prey distribution.

Routine strandings should be documented as to species, location and numbers, but detailed sampling just for monitoring was not supported. If routine monitoring was to be conducted then it should be based on a sound scientific design and carried out within the framework of monitoring of ancillary information such as population parameters, changes in habitat conditions, prey distribution, and predator levels.

It was underlined that there is a risk that this could be an expensive and time consuming process, without clear objectives that would consume a considerable amount of the Department's resources without clear benefits being identified.

The need for a formal committee to coordinate monitoring and unusual mortality events was questioned. It was felt that improved coordination among people interested in this field be encouraged and that they develop similar approaches, standardize data collection methods, compile a list of people interested in tissue samples and develop emergency response plans. It was also felt that research programs should be developed with specific hypotheses to be tested or questions to be addressed. Under SARA there may be an increased interest in monitoring strandings, but these programs should target particular species and should address specific research questions or interests.

Summary

- Questions of health are part of MM research that is carried out by DFO in Canada.
- Comprehensive monitoring is not indicated.
- Research projects should be scientifically sound and case specific.
- Improved coordination among researchers across Canada can facilitate better research

## 2. MARINE MAMMALS AND "WILDLIFE REHABILITATION" PROGRAMS

Presenter: Lena Measures
Rapporteurs: Garry Stenson/Brigitte de March

Summary (Provided by the Author(s))

Rehabilitation of wildlife involves the rescue or capture, care and treatment of abandoned, orphaned, injured or sick wild animals. Usually, the goal is to return healthy individuals to the wild to resume presumably a normal life. It is usually justified as an animal welfare issue, rarely conducted for conservation purposes, but it can have serious consequences for conservation of species at risk. Rehabilitation of marine mammals has been carried out, mostly in industrialized countries since the late 1940's but has become well organized in the United States, and some European countries. Canada does not have a national policy on rehabilitation of marine mammals yet it is permitted by Fisheries and Oceans Canada in some regions with little or no formal regulation, evaluation or national standards to protect wild populations, especially endangered populations or species. This document is intended to provide an overview of rehabilitation as it pertains to marine mammals, to stimulate discussion within DFO in order to develop a national policy on rehabilitation. A brief overview of existing or proposed legislation involving responsible agencies in Canada, and to some extent in the United States, and international agreements pertaining to marine mammals, is provided including information on marine mammal stranding and mortality events, efforts at rescue, rehabilitation and release, advantages and disadvantages for wildlife and humans, with potential consequences and costs involved as well as transboundary issues. Recommendations involve prohibition of marine mammal rehabilitation in Canada to protect wild populations especially species at risk or strict regulation involving certification of facilities, regular inspection, minimum standards of veterinary care, adequate standards and training for qualified personnel, strict procedures on quarantine, disease control, use of antibiotics and other drugs, euthanasia, necropsy, carcass disposal, and development of release criteria using risk analysis and environment impact assessment. Post-release monitoring should also be required to document survival and reproduction. Due to a number of Canadian marine mammal species at risk, responsible agencies in the United States should be

informed of Canadian concerns about rehabilitation of marine mammals, especially transboundary species, rehabilitated in the United States.

Discussion

There is little or no science value, but there is a public, ethical pressure in some parts of the country to rehabilitate 'stranded' marine mammals.

It was noted that the decision to license rehabilitation centres is a management decision. However, science can outline the positive and negative aspects that would be involved if management wishes to consider this activity; it does involve a feedback loop between management and science. For example, science could advise management that there are certain risks to other species or individuals within a population concerning disease transfer, while there may be little positive benefit to the overall population. Management may decide that rehabilitation was an activity worth considering, in which case science could works towards a means of assessing risk and performance rules that could be used to evaluate risk.

It was also noted that there are transborder issues involved. For example the US is involved in rehabilitation and release of animals that migrate to Canadian waters. There is little consideration for impacts of these releases on trans-border stocks.

Currently there appears to be a regulatory gap in how to deal with rehabilitation. It was suggested that it could be a very expensive program that needs to be assessed carefully. Among the concerns were that there is a need to examine the risks involved in removing the animal from the wild, the benefits of rehabilitation, the risks involved in disease transmission to other members of the population and to other species in the case of release, an evaluation of chances of survival, and if it is not to be released what will happen to the animal. It was felt that the question of rehabilitation could be handled within the context of conditions of license or through Introductions and Transfers Committees. However, there is a need for establishing criteria to allow capture, rehabilitation and release.

Because some groups are already involved in operating or planning rehabilitation centres, this is a question that DFO must consider. In the Quebec Region, it has already been decided that rehabilitation will not be allowed while the Pacific Region has allowed it to a limited extent. More inter-regional exchange of approaches would be useful.

Conclusions

- This is primarily a management issue but there are a number of scientific issues that DFO decision makers and other scientists be aware of. The WP presented outlines many of these issues and should be upgraded to a RES document

- Criteria for introductions and transfers of marine mammals need to be developed.

## 3. A PROPOSED FORMAT FOR A MARINE MAMMAL ADVISORY SERIES

Presenter: John Neilson
Rapporteurs: Garry Stenson/Brigitte de March

Summary (Provided by the Author(s))

The Stock Status Report Series of the Canadian Science advisory Secretariat is used as the primary means to communicate results of Departmental Scientific Research to user groups and decision makers. While the format has proven utility for harvest fishery situations, it is somewhat restrictive for the broader range of issues facing marine mammal scientists. In consideration of this, specifications of a new report series based on a modified Stock Status Report template is proposed.

Discussion

Stock status reports are meant to be a summary of the status of individual species agreed to following scientific review, presented in a manner suitable for the general public. The current format of the SSRs is suitable for some species, particularly those hunted, but that it is inappropriate for others. It was felt that with relatively small amendments the current stock status report could be modified to meet the needs of the marine mammal community. A revised format was proposed and its merits discussed. It was also proposed that these reports form a separate series for the current SSRs.

Structurally the proposed format would look very similar to the current SSR but allow for the inclusion of additional information relevant to marine mammal populations and the development of 'Advisory reports' that deal with topics related to multiple species (e.g. whale watching, seismic impacts). All agreed that a more flexible approach to the SSRs was needed. There was some discussion as to whether or not a separate document series was needed or if reports on 'general' issues should be written.

There was general support for more flexibility in the development of reports. The committee recommended that John Neilson write a letter to Jake Rice outlining what the proposed changes and highlight the concept that this series will deal with more issues than single species in order to determine the willingness of CSAS to accept changes.

## 4. INCORPORATING UNCERTAINTY IN POPULATION ASSESSMENTS

Presenter: Pierre Richard
Rapporteur: Don Bowen

Summary (Provided by the Author(s))

The best approach to minimize the risk of management or conservation failure is to incorporate uncertainty in assessments and use that to guide low risk management and conservation decisions. There is a wide array of methods for incorporating uncertainty and it is not always clear to the analyst which method should be used for a particular assessment. This paper looks at various methods that are used or could be used to incorporating uncertainty in assessments of marine mammal populations. It attempts to order those methods according to similarity and to give a short description of each of them. It presents examples of uncertainty methods used on marine mammal assessments and relevant methods used in other disciplines concerned with risk assessment. Pros and cons of each method are discussed. The paper concludes by addressing the question of whether there should be a limited set of methods used for DFO marine mammal stock assessments or whether methods should be chosen according to the circumstances. It concludes that the appropriateness of the various methods for incorporating uncertainty varies depending on the type of uncertainty and the information available.

Discussion

The desirability of incorporating sources of uncertainty into assessments of population status is now widely recognized. There are a number of approaches to the inclusion of uncertainty. There was some discussion of whether those different approaches could be used in combination. Although in principle combining different methods could be done and some methods, such as hybrid numbers, have attempted to do this, this is not a well-developed area. A question was asked about situations in which the use of worst-case scenarios might be used. Worst-case scenarios are usually very conservative and there are likely few situations where they would be preferred over other methods that explicitly use available information on the distribution of model variables.

An objective of the paper was to explore the question of the need to set standards for the way uncertainty would be included in marine mammal population assessments. Given the diversity of species, differences in the types of advice that might be sought, and quality of data available, there was consensus that it would be unwise to limit the tools for incorporating uncertainly to a subset of those available.

## 5. APPLICATION OF THE PRECAUTIONARY APPROACH AND CONSERVATION REFERENCE POINTS TO THE MANAGEMENT OF ATLANTIC SEALS: A DISCUSSION PAPER.

Presenter: Gary Stenson
Rapporteur: Don Bowen

Summary (Provided by the Author(s))

Canada has subscribed to the Precautionary Principle outline in the Rio convention. In Canada, there is no requirement to maintain specific population levels. Instead, management is concerned with conservation of the resource in general. Under guidelines established by the Privy Council Office, a primary concern is that activities will not cause serious or irreversible harm to the population. A key requirement of the precautionary approach is that Conservation, Precautionary and Target reference points and specific management actions will be established, to aid managers in managing the resource. A conservation reference point is the level of a resource that, if violated, is taken as *prima facie* evidence of a conservation concern and exists when there is an unacceptable risk of serious or irreversible harm to the resource. A precautionary reference point is a level of a resource at which a change in harvesting or fishing levels will occur to reduce the risk that the resource will decline and instead will increase the chance that the resource will remain above or increase above the Precautionary reference point. The intention is that if there is a high probability of complying with the Precautionary reference point, then we are confident that the conservation or limit reference point will not be violated.

Conservation and Precautionary reference points are intended to constrain harvesting within safe biological limits for both the target species and other components within the ecosystem. The Target reference is the level of the resource that has been identified by managers and stakeholders that the population should be kept at to meet management objectives.

In order to determine sustainable levels of removals of seals, current estimates of fecundity, mortality and abundance are needed. If these data are available the species could be considered 'Data Rich'. If they are not available the uncertainty associated with any management action will increase significantly and the species should be considered 'data poor'.

For data rich species we can identify three reference points, a conservation reference point ($N_{Critical}$) and two Precautionary reference points ($N_{Buf1}$ and $N_{Buf2}$) that identify 'buffer' population ranges within which different management control rules would apply. If a species is considered to be above the first buffer reference point management objectives can set target reference points based on socio-economic considerations. If a species is below the first buffer reference point, however, management will be required to address conservation of the species. In lower

'ranges' the degree of conservation required is greater. For a species below the conservation reference point, directed catches would not be allowed.

A number of different approaches have been used previously to identify reference points. These include general models discussed within the Fisheries (ICES\NAFO) literature based on the principle of Maximum Sustainable Yield (MSY), an approach developed within the COSEWIC/IUCN framework, reference points identified under the US Marine Mammal Protection Act, and the Revised Management Plan of the International Whaling Commission.

Within the fisheries literature, reference points have been established using estimates Maximum Sustainable Yield (MSY) and the lowest population observed. The use of MSY requires estimates of the carrying capacity and the density dependent responses of a species. Given the difficulties of estimating these and the need to assume that conditions have remained constant, the use of these reference points for Atlantic seals is questionable.

Designation of status within the COSEWIC/IUCN framework is based upon arbitrary levels identified as proportions of historic population size. Using this approach, the first 'warning' reference point N Buf1 could be set at 70% of the maximum observed (or inferred) population size while the second buffer point could be set at 50% and N Critical would lie at 30% of the maximum. It is recommended that this approach be applied to Northwest Atlantic harp seals. This approach relies on a previously established 'conservation' framework and avoids the potential difficulties of trying to establish MSY and the critical assumption that MSY will not change.

For species which are considered to be data poor (i.e. lack of current abundance estimates or information on population parameters) the uncertainty associated with the resource's status and the impact of a particular management action increases and more caution is required. If some data are available but is considered out of date, one approach could be to 'discount' acceptable removals with increasing time since the last estimate. Another option that could be adopted if several abundance indices do exist, but are all > 5 years old, may be for the population to automatically fall to the next lower management category, with appropriate harvest control rules.

For species for which there is very little information such as hooded and grey seals, the degree of uncertainty associated with any estimate is very large and a conservative approach should be taken. The current implementation of the US Marine Mammal Protection Act is an example of this approach. This is accomplished by identifying the maximum allowable removals that will ensure that the acceptable risk of the population falling below this reference point is 5%. This level has been referred to as the Potential Biological Removal (PBR) and is easily calculated using default values and an estimate of abundance. Since the only data required is an estimate of population size, it or a similar approach is appropriate for data poor species. The PBR approach has the added advantage that the simulation trials used to establish the appropriate population size ($N_{Min}$) ensured that the formulation was

robust when the model assumptions were relaxed and plausible uncertainties were included

Discussion

There was concern raised about the need to reconsider productivity curves based on data from a variety of species. In some species, such as harbour seals and killer whales, MNPL may be closer to 70-90% rather than the 60% calculated for northern fur seals. Also, given differences in data quality, life histories, and the nature of advice requested, there may be a need to have flexible reference points the could encompass advice with respect to eco-tourism, competitive interactions between marine mammals and fisheries, and harvesting.

The point was made that as carrying capacity (K) is not constant, and therefore there will be no single set of limit reference points. Therefore, would it not be better to base reference limits on $N_{min}$. However, it was noted that to use a proxy for K, say the largest observed population size, means the limit reference points will generally be more conservation. This seemed to provide reasonable justification for the approach outlined in the paper. Nevertheless, it was noted that there is a need for robustness simulation trials to explore the influence of the precision of estimates of vital rates and numbers, rates of population change, and forms of density dependence on the performance of the proposed limits.

It was noted that an advantage of the limit-reference approach is that it forces managers to pre-approve management action based on population size reference points. This approach also requires managers to comment to regular monitoring of vital rates and population size.

The U.S Potential Biological Removal (PBR) is a population assessment framework developed in response to conservation limits specified in the Marine Mammal Protection Act. Thus, PBR may not be entirely appropriate for situations where management decisions are with respect to a harvest.

## 6. HARVEST SIMULATIONS FOR 2003-2006 HARP SEAL MANAGEMENT PLAN.

Presenter: Gary Stenson
Rapporteur: Don Bowen

Summary (Provided by the Author(s))

Northwest Atlantic harp seals are harvested commercially in the Gulf of St Lawrence and off the coast of northeast Newfoundland and Labrador and are taken in subsistence harvests in the Canadian Arctic and Greenland.

In recent years the Canadian allowable harvest levels have been established with the underlying management objective that the population would remain relatively constant, with no increase or decrease in the estimated population size (referred to as Replacement Yield or Replacement Harvest). In 2001, the Eminent Panel on seal management suggested that the Department develop a management system based on a system of reference points more in line with a Precautionary Approach.

For the 2003 sealing season DFO seal management accepted the concept of using a combination of Precautionary and limit reference points set at 70%, 50% and 30% of the maximum population size of 5.5 million animals. This study examined the impact of a series of different proposed harvest levels and transfer of quotas among years on the NW Atlantic harp seal population (Table 1). The simulations were carried out by modifying the currently used harp seal model, programmed in SAS and adapting it to a spreadsheet environment (MS-EXCEL, @Risk) to allow rapid modification of model parameters and re-running of model simulations. The revised model performed in a similar manner to the SAS model which estimated numbers up to 2000. The Excel model was used to estimate abundance from 2000 through 2002 and to project future population size. Mortality of pups in the Gulf of St. Lawrence may have increased in 1998, 2000 and 2002 due to poor ice conditions. Pup mortality was assumed to have increased by 8% in 1998 and 2000 and 25% in 2002. For the future projections it was assumed that no changes in the age composition of the harvest, reproductive rates, undeclared mortality or size of the Greenland and Canadian Arctic harvests occurred. It was also assumed that there were no stochastic changes in mortality rates in future projections.

The Canadian commercial harvest accounts for over 60% of the total catch and is directed towards young of the year (>90%). Estimates of abundance are based upon periodic pup production surveys. Harp seal pups do not begin to reproduce until they are 4-5 years old, and surveys are only repeated at 5 year intervals. Simulations showed that changes in pup production may not bet detected until 10-15 years after a particular management strategy (TAC) had been implemented. Predicting population changes 10-15 years into the future is very uncertain. To incorporate some of this uncertainty the lower 60% confidence limit was used to illustrate predicted changes in population size. The lower 60% C.I. was also used to determine where the population was situated with respect to the N70 Precautionary Reference point.

The current (i.e. 2003) Replacement Yield was estimated to be 250,000 animals. All harvest scenarios examined, with the exception of the use of Potential Biological Removal and the Replacement yield caused the population to decline. The 2003 TAC has been set at a total of 975,000 allowed to be taken over a three year period, with no harvest in any season to exceed 350,000. These harvest levels, followed by annual harvest levels of 275,000 at the end of the 3 year period would cause the population to decline a population size of 3.85 million animals ($N_{70}$) by 2013. At that time harvests would have to be reduced to around 100,000 and remain at these low levels for some time to halt any further decline.

Further simulations are required to examine harvesting impacts and to examine the effects of bias and error in model parameters on estimates of population projections.

Table 1. Harvest scenarios, estimated replacement yield after a three year harvest period, a new quota assumed following the current management plan and the estimated year that the population would decline to $N_{70}$ under the assumed harvest regime.

| Total harvest over 3 year plan ('000s) | Annual Harvest 2003-2005 ('000s) | Replacement harvest after 3 years (000s) | Harvest level in 2006 and beyond (000s) | Year $N_{70}$ reached |
|---|---|---|---|---|
| 825 | 275, 275, 275 | 250 | 275 | 2014 |
| | 300, 300, 225 | 235 | 275 | 2014 |
| | 330, 330, 165 | 235 | 275 | 2014 |
| | 330, 330, 165 | 235 | 3 year plan repeated | 2013 |
| 900 | 300, 300, 300 | 225 | 275 | 2014 |
| | 330, 330, 240 | 230 | 275 | 2013 |
| | 360, 360, 180 | 230 | 275 | 2013 |
| 925 | 325, 325, 325 | 230 | 275 | 2013 |
| | 350, 350, 225 | 230 | 275 | 2013 |
| | 300, 300, 300 | 225 | 300 | 2012 |
| 990 | 330, 330, 330 | 220 | 330 | 2011 |
| 1,050 | 350, 350, 350 | 215 | 275 | 2012 |
| | 350, 350, 350 | 215 | 350 | 2010 |
| 1,500 | 500, 500, 500 | 175 | 275 | 2009 |

Discussion

The harvest simulations were done to provide preliminary results on the effect of different harvest levels on population trends. These simulations are preliminary in the sense that not all sources of variability were included in the various scenarios. A question was asked if all pregnant females give birth to live pups. Late-term pregnancy rates are used in the model as an estimate of birth rate, but pre-weaning mortalities are not accounted for in the model. This will introduce a small bias as about 1-3% of pups die before weaning. Density dependence is not currently included in the simulations, mainly because the functional form of density dependence is poorly known. Nevertheless, it was agreed that the influence on model projections of density-dependent changes in vital rates needs to be examined.

It was noted that the frequency of population estimates would affect the performance of the reference limit approach. Currently, the plan is to estimate abundance every

5 yr. Further discussion noted that at this frequency a large decline in the population could occur before it was detected. During this period of decline, more than one reference limit might have been passed before it was detected. Furthermore, long-lived species with delayed reproduction, such as harp seals, will have considerable demographic momentum. This means that even after harvest levels are reduced it will take some time before the pup production and 1+ population size may begin to recover.

It was also noted that long-term population projections are problematic – particularly for scenarios that predict increasing population size above the population size used as a proxy for K.

Finally, it was noted that the proposed system of reference limits might be more broadly applicable; for example, it might be applied to fish stocks.

## 7. IS ANALYSIS OF AN EXTENDED OR MODIFIED MITOCHONDRIAL DNA SEQUENCE WORTHWHILE FOR STOCK DISCRIMINATION OF HUDSON BAY BELUGAS (*DELPHINAPTERUS LEUCAS*)?

Presenter: B.G.E. de March
Rapporteur: John Ford

Summary: (Provided by the Author)

In this study we examined the value of an extended mitochondrial DNA haplotype region for discriminating stocks of belugas in Hudson Bay. The mitochondrial DNA (mtDNA) locus we previously described consisted of 234 nucleotides that which are found at the beginning of the d-loop region of the molecule (H-Type haplotypes). In 1999, we decided to analyse for a longer mtDNA sequence of 700 nucleotides (E-Type haplotypes) with the hope that that some of the common haplotypes in previous studies could be split into several haplotypes, and that these new haplotypes would assist in defining stocks in Hudson Bay.

The number of unique and uncommon haplotypes increased from 21% in H-Type haplotypes to 40% in E-Types haplotypes, but percentages of haplotypes with higher frequencies were reduced in E-type haplotypes. Population differentiation is notably improved with the E-type haplotypes. The many uncommon (not unique) haplotypes may in fact assist in defining relationships among populations. Another advantage of the use of the extended region is that several major H-Type haplotypes (H02, H18, and H17) have been split into major E-Types which characterize different geographic locations.

These results may mean that the summering locations of many of these belugas may be identified with more analyses and sampling.

Discussion

This progress report was presented for information purposes, rather than as a formal paper for consideration as a Research Document. There was general agreement that analyses of an expanded region of the mitochondrial D-loop appear to show promise and should be pursued to improve the resolution of stock structure within and between regions.

A question arose concerning the utility of this approach in determining whether belugas in the Sanikiluaq area constitute a distinct stock from others in eastern Hudson Bay. The author felt that additional samples would be needed to resolve this question. Comments were made that two of the largest beluga populations in Hudson Bay – James Bay and the Nelson River – were not represented in the samples analysed, nor were samples from western Hudson Bay and the Gulf of St. Lawrence. The author agreed that it would be desirable to include animals from James Bay and Nelson River in the study, but they have proved to be difficult areas from which to obtain samples despite considerable effort. Samples from western Hudson Bay and the Gulf of St. Lawrence have been collected but have yet to be analyzed due to a lack of funding.

## 8. HOW MANY STOCKS OF BELUGA ARE IN HUDSON BAY? AN EXAMINATION OF RESULTS OF A MODEL-BASED METHOD.

Presenter: B.G.E. de March
Rapporteur: John Ford

Summary: (Provided by the Author)

Management of Hudson Bay belugas and adjacent belugas requires that individual stocks are identified. Molecular genetics have become one tool that may assist in our ability to delineate stocks. In this document we examine the applicability of Pritchard et al.'s (2000) model-based clustering method which infers population structure from genotypes in the data and then assigns individuals to inferred populations.

In general, the inferred population structure from Pritchard et al.'s (2000) *structure* program is unsatisfactory. The inferred populations are not distributed in patterns expected from other analyses. It is possible that the program does not do what it claims when used with individuals that have both haploid and diploid data. It is suggested that appropriate programs be written specifically for our type of data.

Discussion

The author presented an overview of this study, but withdrew the report from consideration as a Research Document as it failed to yield useful results. No discussion was possible due to time constraints.

## 9. BY-CATCHES OF THE HARBOUR PORPOISE IN THE ESTUARY AND GULF OF ST. LAWRENCE IN 2001-2002.

Presenter: Veronique Lesage
Rapporteur: John Ford

Summary:

The incidental mortality of harbour porpoises as a by-catch of the gillnet fishery of the Estuary and Gulf of St Lawrence was evaluated using questionnaires to fishermen in 2000 and 2001, and At-sea Observers and Sentinel Fisheries programs in 2001 and 2002. Of the 2277 fishermen receiving the by-catch questionnaire, 215 (9%) responded, and 165 reported being actively fishing in 2000 or 2001. Of these, 34 (23%) and 45 (27%) fishermen recorded having taken a total of 181 and 291 harbour porpoises in 2000 and 2001, respectively. The largest takes were in July and August from zones 4R, Miscou and the North shore. These takes resulted in mean by-catch rates of 1.25 (SD = 5.0) and 1.76 (SD = 4.7) porpoises per reporting fisherman in 2000 and 2001, respectively. Extrapolation of these by-catch rates to the entire gillnet fishing fleet resulted in an estimated total by-catch of 2180 (95% CI 1012–3802) and 2478 (95% CI 1591–3464) porpoises for the Estuary and Gulf of St Lawrence in 2000 and 2001, respectively.

For 2001 and 2002, a total of 786 and 882 bottom-set gillnet hauls that were monitored by At-sea observers recorded harbour porpoise by-catches of 4 and 6 individuals, respectively. At-sea observer activities were conducted in close conjunction with the Atlantic Cod and Greenland Halibut commercial fishery. However, the low number of hauls that were monitored by At-sea observers prevented the calculation of by-catch estimates for several zones and the study area as a whole, and provided only imprecise estimates for all other zones. Sentinel fisheries resulted in 86 and 77 by-catches in 2001 and 2002, respectively. Depending on the year, incidental takes of harbour porpoises by this fishery peaked in late August or early September, even though their activity peaked earlier, in late July to late August in 2001 and 2002, respectively. The number of takes per haul for the Sentinel fishery was higher than that reported through the At-sea observer program, even though the former was spread over a longer period, when target species of the fishery might have been less abundant. Significant differences in fishing behaviour were observed between commercial fisheries, commercial fisheries with At-sea observers on board, and Sentinel fisheries. Specifically, Sentinel

fisheries soaked nets of similar length but of smaller mesh, at deeper depths, for longer periods, and for a lesser quantity of landed fish than was the case for commercial fisheries with an observer on board. In addition, plotting the fishing locations in the Miscou area (NAFO 4Tn) indicated that at least in August and early September 2001, not only was there no overlap in fishing location between Sentinel fisheries and commercial fisheries under the Observer program, but there was also no overlap between commercial fisheries with observers on board and commercial fisheries not subject to an at-sea observation. Commercial and Sentinel fisheries generally followed the 60-m isobath, whereas fishing activities with At-sea observers on board occurred in shallower waters, inside Miscou bank. In 2002, periods of activity by At-sea observers and Sentinel fisheries in Area 4Tn did not overlap in time, but did overlap spatially.

Discussion:

Discussion regarding the methodological approach in this paper focused on the rather low number of responses to questionnaires sent to fishers, and on the comparability of data obtained from fisher questionnaires, commercial fishery observers, and sentinel fishery observers. Part of the reason for the rather low response to questionnaires may be due to the fact that questionnaires were sent to all licenced fishers, rather than just to active fishers. One suggestion from the review group was that the author might consider a follow-up study to determine 1) why non-respondents did not return the questionnaire, and 2) what proportion of non-respondents did in fact experience harbour porpoise by-catch. Newly reported by-catches, if interpreted carefully, may improve the overall precision of by-catch estimates. Some felt that higher response rates to questionnaires might be realized if an honorarium was offered for the return of a completed questionnaire.

With regard to the results of this study, there was discussion about the need to better understand the seasonal movements and abundance of harbour porpoise in the region in order to assess the significance of the apparent by-catch rates observed in this study. Surveys undertaken in the mid 1990s suggest that the minimum abundance may be approximately 26,000, but could be much higher if estimates are corrected for g(0). A question was raised about possible reasons for continued high by-catch rates, which are not unlike rates observed in earlier studies during a period of much greater fish production. The author commented that the fishing fleet may be reduced in size, but net soak times may be longer, resulting in comparable effort.

A variety of other comments and questions were raised regarding the results of this study. There was a question about fishing effort and success in deep waters, where increased rates of by-catch were apparent. The author noted that a previous study showed an increase in by-catch with depth, but a decrease in cod landings with depth. Another question was raised regarding the possibility that porpoise behaviour may be affected by number of boats actively fishing in certain areas. If boat

disturbance causes displacement of porpoises from an area of intensive fishing, higher densities of porpoise might be expected in areas with fewer boats.

The review group agreed that the author's conclusion that no reliable estimate of porpoise by-catch can be determined from this study was too cautious, and that the report does contain useful data on by-catch rates if appropriate qualifications are made. It is important to note the uncertainty in estimates in the report, but generally the by-catch rates appear to be cause for concern at the population level.

This report was recommended to be upgraded to a research document after revision.

## 10. AN EVALUATION OF STELLER SEA LION (*EUMETOPIAS JUBATUS*) PUP COUNTS FROM 35MM OBLIQUE PHOTOGRAPHS

Presenter: Peter Olesiuk
Rapporteur: John Ford

Summary: (Provided by the Author)

The precision and accuracy of Steller sea lion (*Eumetopias jubatus*) pup counts made from oblique 35mm aerial slides was assessed by comparing them to ground drive-counts and counts from aerial vertical medium-format images. DFO flew surveys using oblique 35mm photography within 2 days of ADF&G's ground drive-counts at Forrester Island, Alaska, in 1994, 1995, 1997 and 1998. In 1998 and 2002, aerial surveys were conducted at rookeries in B.C. and Forrester Island using both 35mm oblique photography and a vertical medium-format photographic survey system developed at SWFSC, which in an earlier assessment was shown to provide pup counts that were statistically equivalent to ground drive-counts (Snyder et al. 2001). As expected, ground drive-counts provided the most precise pup counts (*CV*=0.047) and are widely regarded as the most accurate method against which other techniques are generally validated. In an earlier study, Snyder et al. (2001) found that vertical medium-format images provided as good precision (*CV*=0.048) as ground counts on Alaskan rookeries. However, our initial counts of medium-format images for the B.C. survey in 1998 were less precise (*CV*=0.094) because one reader obtained counts that were consistently (8 of 10 sites) and significantly ($0.0001<P<0.0110$) greater than the other reader. The precision was improved (*CV*=0.056) by replacing the lower of the initial two reader's counts with those of a third reader, whose counts agreed closely with the higher of the initial two readers. There were no significant differences among readers and fairly good precision (*CV*=0.063) for the medium-format images of B.C. rookeries in 2002, leading to an overall *CV*=0.060 for the two medium-format surveys. Counts made from oblique 35mm slides were reproducible among readers (*CV*=0.085), and were similar for surveys replicated on different dates (*CV*=0.102), but appeared to be slightly biased.

Comparison of pup counts from oblique 35mm slides to ground drive-counts at Forrester Island indicated that the 35mm counts tended to be significantly lower ($P<0.0001$), with only about 80% of the pups seen on the ground evident in the 35mm slides. The degree of bias seemed relatively constant on a site-by-site basis (slope=0.797-0.813; 95% *CI* of 0.738-0.893) and between the 4 years (mean 79.7%; range 75.6-85.1%). Similarly, comparison of 35mm slide counts with medium-format counts at Forrester Island also indicated that only about 80% of pups seen in medium-format images were evident in the 35mm slides (slope=0.797-0.813; 95% *CI* of 0.693-0.891). For B.C. rookeries, however, the 35mm counts appeared to be less biased, with about 96% of pups in the medium-format images being evident in the 35mm slides. We suspect that the difference in accuracy of 35mm pup counts between Forrrester Island and B.C. rookeries may be due to differences in the size and topography of rookeries. At Forrester Island, the biggest aggregations of pups occurred on large, rocky sites with irregular terrain, which had to be circled at broader angles, resulting in photographs being taken at more oblique angles. At B.C. rookeries, pups tend to occur on smaller sites, which can be circled more tightly, resulting in photographs being taken at steeper angles. Moreover, the biggest aggregations of pups in B.C. are dispersed more linearly along flat rock shelves and pebble beaches, where pups are less likely to be obscured. We therefore recommend that a correction factor of 1.25 (95% CI of 1.12-1.44) be applied to pup counts made from 35mm slides at Forrester Island, and a correction factor of 1.05 (95% CI of 1.018-1.075) be applied to pup counts made from 35mm slides at B.C. rookeries, to account for pups that are obscured in photographs taken at oblique angles.

Discussion:

Discussion regarding the study's methodology focused on the use of correction factors to adjust counts obtained from 35mm photographs to those obtained from medium-format photographs. It was suggested to the author that it may be possible to use multivariate analyses using such variables as pup density and rookery topography to improve the precision of counts rather than by using correction factors. The author felt that this type of quantitative analysis would not be possible with existing data, but that it may be useful to explore in the future.

A question was raised about uncertainty due to variance in observer counts, but the author believed that such variability was incorporated in the regressions presented in the report, and in the confidence intervals and coefficients of variation for the overall correction factors.

The group agreed that the use of pup counts where they can be combined with life history data to estimate populations is a very effective approach. It was also noted by the author that new studies are planned to examine in detail the residency time of animals on haulouts and rookeries, in order to develop an independent means of estimating population sizes.

One reviewer suggested that regular surveys should be maintained to monitor population trends, but that the author should consider moving to the use of medium-format photographs to improve the precision of pup counts. The author explained, however, that this would be a very expensive and difficult approach due to the lack of available equipment and other logistical considerations. He also maintained that the 35mm and medium-format systems both yield high levels of precision that are not unreasonably dissimilar (coefficients of variations of 0.10 for 35mm, 0.06 for medium format).

There was considerable discussion regarding the author's suggestion that Steller sea lions are an effective indicator of ecosystem health and status, and that regular monitoring should be maintained to assess ecosystem change. He felt that this was particularly important in light of the major ecosystem shifts and population declines of Steller sea lions observed in western Alaska. Although many in the review group felt that it would be useful to pursue this possibility in the future, this proposal was not addressed in detail in the working paper and thus was not formally recommended.

The review group recommended that the report be upgraded to a Research Document, in order to provide background for the accompanying Marine Mammal Advisory Report.

## 11. RECENT TRENDS IN THE ABUNDANCE OF STELLER SEA LIONS (*EUMETOPIAS JUBATUS*) IN BRITISH COLUMBIA

Presenter: Peter Olesiuk

Summary: (Provided by the Author)

Recent trends in the abundance of Steller sea lions (*Eumetopias jubatus*) in British Columbia were assessed based on a series of 9 province-wide aerial surveys conducted in the breeding season (27-June to 06-July) during 1971-2002. Numbers of pups and non-pups both increased at an average rate of 3.2% per annum respectively, which has resulted in more than a doubling in abundance since the species was protected in 1970. In both cases, numbers appeared to be relatively stable during the 1970s and early 80s, with most of the increase in non-pups occurring since 1982, and most of the increase in pups since 1987. Although no new breeding areas were established, the number of year-round haulout sites increased from about 12 to 21. During the most recent survey in 2002, we counted 3,281 pups and 12,121 non-pups (5,439 on rookeries and 6,682 on haulouts). Applying a correction to account for pups obscured in oblique 35mm photographs (Olesiuk et al. 2003), pup production was estimated to be about 3,310 – 3,566. Based on life table statistics (Calkins and Pitcher 1982; Trites and Larkin 1996) and the relative distribution of animals in B.C. and SE Alaska, it was estimated that roughly 18,400 -19,700 Steller sea lions currently inhabit coastal water of B.C. during

the breeding season (which includes surplus non-breeding animals associated with rookeries in SE Alaska). Despite the population growth, the proportion of the total population occurring on breeding rookeries appears to have remained constant during the study at about 60% (range 51-66%), suggesting that numbers on rookeries provides a good index of total abundance. A review of historic data (Bigg 1985) indicated that control programs and commercial harvests conducted in B.C. during 1912-1967 eradicated one breeding area and reduced numbers on the remaining rookeries to about 25-30% of peak levels observed at the turn of the century prior to any large-scale kills. Abundance of Steller sea lions in SE Alaska has also increased in recent years, where 5 new rookeries have become established, including what is now the largest at Forrester Island just a few kilometres north of the B.C.-Alaska border (Calkins et al. 1999; Pitcher et al. 2003). These recent increases likely represent the recovery of populations from control programs and harvests, but abundance now appears to have surpassed peak historic peak levels by at about 50%. Given the recent declines in abundance of Steller sea lions in the Gulf of Alaska and Bering Sea, which have been designated as *endangered*, and since the species appears to be a good indicator of ecosystem status, it is recommended that the B.C. surveys be continued on a regular basis as part of the range-wide surveys every 4 years, the next of which is scheduled in 2006.

(Editor's Note) *The NMMRC then provided a detailed review of the Steller Sea Lion draft Marine Mammal Advisory Report. The author agreed to deal with the required changes and circulate a revised Advisory Report by email through the Chairman. The Chairman received the revised draft and circulated it for final comments. The final document is now available on the CSAS web site.*

## 12. FIELD INVESTIGATION OF DISTURBANCE OF RIGHT WHALES BY COMMERCIAL VESSELS, ECOTOURISM, AND SCIENTIFIC RESEARCH.

Presenter: Lei Harris

Summary: (Provided by the Author)

North Atlantic right whales are among the most endangered cetacean species in the world. Up to 2/3 of the remaining population use the Bay of Fundy as a summer feeding area and nursery. There is much vessel traffic in the vicinity of these right whales, including whale watchers, recreational boaters, research vessels, and fishing boats. Vessel traffic may be adversely affecting the right whales and yet unlike in other countries, such as the United States, Argentina, Australia, and South Africa, there are no regulations on the minimum distance vessels must keep from right whales in Canadian waters. This study proposes to describe and quantify, through observational studies, the disturbance to the right whales due to vessel traffic. The results will provide a quantitative and qualitative definition of 'disturbance' for use in the Marine Mammal regulations, whale-watching regulations,

and to establish reasonable, precautionary terms for the management of research activities involving right whales in Canadian waters.

In order to determine how whales respond to vessels we will record whales both in the presence of and in the absence of other vessels. We will examine surfacing, ventilation, and dive patterns (SVD), course and orientation, swimming speed, and activity level. In August 2002 we conducted a 14-day pilot study to test the study design and equipment and to collect preliminary data. A remotely operated camera was mounted below a 1500-cubic foot aerostat to passively record right whale behaviour in the Bay of Fundy. The advantages of this overhead video system include real time information, increased accuracy of behavioural data, a unique perspective, and the ability to locate a whale up to 5 metres below the surface. Due to the remote characteristics of the aerostat, close vessel approaches were not required.

During our pilot study we found that this methodology has additional applications such as photo-identification and documentation of scars and marks. It also proved useful in the assessment of a whale prior to a disentanglement effort. The overhead perspective allowed us to see the entire whale, even those parts submerged, for a more thorough assessment of its condition, and, unlike other aerial photography methods, it provided real-time information to the disentanglement team. The video system also allowed us to visually follow the whale when making shallow dives thus keeping track of it's location. This could not be done from the boat. Our experiences in the pilot study will allow us to make refinements prior to 2003 field season.

Discussion (Provided by the Author)

In response to a question that concerned the possible disturbance from the vessel, the presenter noted that they could not be absolutely sure that they do not disturb the whales, but they tried to minimize possible disturbance in several ways. They made a slow controlled approach when first setting up, avoiding any changes in

engine noise. The aerostat/remote camera set-up allows the investigors to keep some distance from the whales without compromising the data. They also cut the engines while they worked. The investigors did not note any obvious reactions to the vessel while they were working.

One reviewer noted that experimental controlled approaches would be useful in identifying disturbances. In response, the presenter noted that they were not planning on that approach originally since there are many boats near the whales already. However, they were considering it for the upcoming field season since it will enable them to get more accurate information on the distance between whale and vessel. Several other researchers have offered to make controlled approaches.

It was also asked if there was an acoustic component to this project, noting that vocalisation rates would be a useful indicator of disturbance. In response, the presenter noted that at the moment there is no acoustic component. This is something that the investigors would like to explore in the future to augment the current results.

Other questions dealt with the technical aspects of the operation.

## 13. SEALS AND SALMON: COMMENTS ON THE RESULTS OF A RIVER OBSERVATION PROGRAM IN NEWFOUNDLAND AND LABRADOR

Presenter: Becky Sjare

Summary: (Provided by the Author)

There are six species of seals present in Newfoundland and Labrador waters including harp, hooded, harbour, grey, ringed and bearded seals. All are known to opportunistically feed on salmon; however, only two incidences of salmon have been documented in the stomaches of harp seals and nothing for any other species (n=7,000 stomaches). Presently there is growing concern from resource users and the general public that seals may be responsible for the declining returns of salmon in many Newfoundland and Labrador rivers. To address this issue, a River Observation Program was implemented in 1999 to identify which rivers have seal/salmon interactions and to document the frequency of occurrence and nature of the interactions. Also a questionnaire dealing with a wide range of seal/salmon concerns related to the commercial fishery in Labrador was conducted in 1997 (n=89 participants). The occurrence of schooling bait fish (i.e. capelin, smelt or juvenile herring) in a river estuary during the smolt or adult salmon run appears to be an important factor in determining when and where seal/salmon interactions will occur (particularly in the case of harp seals). Whether the seal predator is a migratory or a more resident species also appears to influences the nature and frequency of occurrence of a predation incident. There is also evidence that recent warm winter temperatures have altered coastal ice coverage enough to allow seals access to

river and estuarine habitats that were traditionally protected by ice during the early winter and spring. These findings emphasize the importance of having a good understanding of the ecological factors influencing the distribution, seasonal migration patterns and feeding behavior of the seal predator in question and it's preferred prey.

## 14. PILOT SURVEYS FOR CETACEAN SPECIES-AT-RISK IN BRITISH COLUMBIA, 2002

Presenter: John Ford

Little is known of the current status of most cetacean species off the west coast of Canada. A number of large whale species were severely depleted by commercial whaling, which ended in British Columbia in 1967. No dedicated survey effort to assess the abundance of these species has been undertaken in the post-whaling era. North Pacific right whales, blue whales, and sei whales are all listed as Endangered by COSEWIC, and thus are priority species for assessment and recovery efforts under the recent Species at Risk Act. Other listed cetaceans in the region include humpback whales (Threatened) and killer whales (Endangered, Threatened, or Special Concern, depending on population).

In order to begin the assessment of cetacean populations in British Columbia waters, a research program at the Pacific Biological Station was implemented in 2002. There were two main approaches in this research program in 2002: 1) undertake a series of ship-based visual, photographic and acoustic pilot surveys to develop and refine methodology for future surveys, and 2) develop and test an Autonomous Recording Package (ARP) for monitoring seasonal occurrence of cetaceans in offshore waters.

**Ship Surveys:**

A total of three ship surveys were completed in 2002, as follows:

Survey 1: Northwest coast of Vancouver Island and Moresby Island

A combination of line-transect, acoustic and photo-identification surveys were undertaken from the 40-m CCGS *Vector* and 50-m CCGS *Gordon Reid* during 28 May to 10 June. Survey effort was focused off the northwestern coast of Vancouver Island, and along the shelf break between Vancouver Island and the Queen Charlotte Islands. These waters were historically among the most productive whaling areas off the BC coast. Visual surveys were undertaken by two observers situated in the bridge wings of the ships, using 7X50 Fujinon binoculars. Distance and bearing to each whale sighting was recorded. On-effort survey shifts were 2 hours in duration, and were rotated through the 6-person survey crew. A specially-designed two-element passive hydrophone array towed 250 m behind the ship was

monitored continuously throughout the survey to detect vocalizations of toothed whales and dolphins (baleen whale vocalizations occur at frequencies that are too low for detection on the array due to masking ship noise).

When distant whales were sighted and identification was uncertain, they were approached to determine species (closing-mode survey). When concentrations of whales were encountered and conditions permitted, a 5-m long Rigid Hull Inflatable boat (RHIB) was deployed from the survey ship in order to collect photographs for individual identification. This was a particular priority for killer whales, humpback whales, and blue whales, for which extensive photo-identification catalogues already exist in the region or in adjacent US waters.

A total of 1965 nautical miles of survey effort was completed during Survey 1, during which 689 individuals representing 10 cetacean species were counted (Table 1). A total of 58 humpback whales were individually photo-identified using tail flukes, 17 of which were matched to photo-IDs collected and catalogued previously in BC waters.

Table 1. Numbers of cetaceans sighted by species during 2002 pilot surveys off BC coast.

| Species | Survey 1 | Survey 2 | Survey 3 | Total |
|---|---|---|---|---|
| Humpback whale | 151 | 98 | 85 | 334 |
| Fin whale | 44 | 20 | 8 | 72 |
| Blue whale | 2 | 0 | 0 | 2 |
| Sei whale | 1 | 0 | 0 | 1 |
| Sperm whale | 10 | 3 | 0 | 13 |
| Gray whale | 0 | 33 | 2 | 35 |
| Unidentified large cetacean | 27 | 24 | 4 | 55 |
| Killer whale | 15 | 7 | 42 | 64 |
| Dall's porpoise | 95 | 64 | 100 | 259 |
| Pacific white-sided dolphin | 343 | 57 | 2615 | 3015 |
| Harbour porpoise | 0 | 8 | 0 | 8 |
| Common dolphin | 0 | 0 | 2 | 2 |
| Unidentified dolphin/porpoise | 1 | 4 | 1 | 6 |
| **Total cetaceans sighted** | 689 | 318 | 2859 | 3866 |

Survey 2: Northwest coast of Vancouver Island and Moresby Island (Queen Charlotte Islands)

This survey was conducted in collaboration with Cascadia Research Collective (Olympia, WA, USA) on board the 30-m vessel *Curve of Time* during 1-8 August. Both line-transect and photo-identification surveys were conducted during this cruise, which covered 593 nm of on-effort distance. Again, a variety of cetaceans were encountered, including killer, humpback, sperm, grey, and fin whales (total of 318 cetaceans counted). A total of 35 humpbacks were photo-identified, 7 of which

matched to previous photos. Skin and blubber biopsies were collected from humpback whales and a sperm whale to contribute to collaborative genetic and contaminant studies with US researchers.

Survey 3: Central and north mainland coast

This fall survey (22 October – 2 November) aboard the CCGS *Vector* was focused on collecting photo-identifications of humpback whales in the mainland inlets along the BC coast north of Vancouver Island. Eight species of cetaceans were seen, including killer whales, humpback whales, fin whales, grey whales, Pacific white-sided dolphins, common dolphins (third record for BC), harbour porpoise and Dall's porpoise (2859 cetaceans counted, 893 nm surveyed). A total of 53 humpbacks and 42 killer whales were photo-identified. Biopsies were collected from 11 humpbacks for contribution to collaborative genetic and contaminant studies with US researchers. Prey samples were also collected from the vicinity of feeding humpbacks.

**Acoustic Monitoring:**

A prototype Autonomous Recording Package (ARP) was developed and assembled in collaboration with the Ocean Acoustics group at the Institute of Ocean Sciences. This unit is designed to collect low-frequency sounds (<500 Hz) of baleen whales on an hour-on-hour-off duty cycle over a 10 month period, as well as high frequency sounds from killer whales when triggered using a custom voice recognition algorithm. The ARP was deployed on a trial basis approximately 700 nautical miles off the BC coast (50ºN, 145ºW) in September, 2002, and will be retrieved in June 2003. This instrument will be modified as needed based on the data collected during the trial period, and redeployed along with a second ARP off northern and southern Vancouver Island later in 2003.

**Conclusions**

The pilot vessel surveys undertaken in 2002 were very successful. They helped to identify areas of concentration of large cetaceans in offshore waters, which will be useful in the design of future surveys. The CCGS Vector is an adequate survey platform, but due to its small size is restricted to < 50 nm offshore. The larger CCGS Gordon Reid was more suitable for offshore conditions, and had the added benefit of a hydraulic ramp launching system off the ship's stern which facilitated deployment of the RHIB in all conditions for whale photo-identification.

It is unlikely that sufficient time on DFO Science ships will be available in the future to undertake visual line-transect surveys over the entire coast of British Columbia during a single season. Over the next three years, is our intention to utilize available dedicated Science ship time and time on DFO 'Platforms of Opportunity' (e.g., Search and Rescue ships and 'piggybacking' on Science cruises dedicated to other research programs) to better define areas of cetacean concentration and to focus efforts on photo-identification for Mark/Recapture population abundance estimation.

We also plan to build and deploy a total of three ARPs at strategic offshore locations to determine the seasonal occurrence of blue, fin, and right whales in western Canadian waters.

## 15. DIGITAL CAMERA TRIALS IN THE CENTRAL AND ARCTIC REGION

Presenter: Pierre Richard

A panchromatic digital line imager was rented from and operated by Borstad and Associates during Arctic cetacean surveys in the Arctic this summer. The objective was to develop experience with this alternative (and less expensive) means to count and photograph cetaceans from aerial platforms. The line imager produced images which were counted by two analysis technicians and later compared to a visual observer's observations (P. Richard) made through the camera port during the line imager's operation. The linear density of narwhal observations was found to be less than half the counts made by the visual observer. The images produced by the line imager's are less distinct than what is available to the observer's eye. One problem is they are still images and the image reader does not benefit from movement cues or blows seen by the visual observer. A second problem is with the line pattern created when lines of digital data are stacked to make an image. This affects the detectability of whales to some extent. A 2D imager would not suffer from that problem, as we have seen in recent Greenlandic experiments. I recommend further tests with a 2D imager. Digital cameras are potentially very useful to photograph large groups, to make body length measurements and to monitor the track line during visual line transect surveys. The latter is important when there are not enough visual observers to dedicate one to the camera port. Also, observing vertically down can be quite challenging on some observers' stomach if the flight is turbulent, especially if the camera port is at the tail end of the aircraft. Prior calibration of camera counts with an experienced visual observer's count is essential if a camera is to be used operationally. This is likely to vary with cetacean species and sea state.

## 16. CETACEAN SURVEYS IN THE GULF OF ST. LAWRENCE

Presenter: Jean-Francois Gosselin

Pilot projects to increase the capacity of DFO to evaluate distribution and abundance of cetaceans were funded by SARCEP in 2002-2003. The distribution of cetaceans in the Gulf of St Lawrence was assessed through 4 vessel-based platform of opportunity surveys from May to November 2002. Marine mammals observers were added to the crew of already existing scientific missions conducted by DFO in Quebec Region.

The observers were deployed on scientific missions to extend the effort on a long time period and to provide a wide coverage of the estuary and Gulf of St Lawrence. The ice forecast missions conducted on the "Martha L Black" covered the entire Gulf of St Lawrence, from the head of the Laurentian channel, to Strait of Belle Isle and Cabot Strait, in both spring (26 May to 4 June) and fall (26 October to 8 November). The survey for mackerel eggs conducted on the "Martha L. Black" in June (14 to 19 June), systematically covered the southern gulf of St Lawrence. Observers also embarked on the "F.G. Creed" for three days (11 to 13 July) during a systematic hydroacoustic survey of the head of the Laurentian channel.

On each mission, line-transect protocol was followed by a team of 3 or 4 observers on a platform 18 m above water level on the "Martha L. Black" and 4 m above water on the "F.G. Creed". Observations were done from dawn to dusk on passing mode at speed of 10-12 kt. Detections were done by naked eyes and 7 x 50 binoculars were also used for species identification and group size estimation. Weather conditions were recorded every half-hour or sooner if noticeable changes in observation conditions were detected.

A total of 6,138 km of transect lines were actively covered during daylight hours. The ice forecast surveys provided early spring and late fall observations, seasons for which published information on cetacean distribution is limited for the gulf and estuary. Unfortunately, these missions did not provide a geographic coverage nearly as good as the southern gulf mackerel egg survey. Part of the difference in the efficiency of geographic coverage between the missions was also the result of better weather conditions in summer. The hydroacoustic mission provided good systematic coverage of a very small geographic area for which cetacean distribution is known. However, the information acquired will be useful to compare with the fine scale distribution of cetacean preys collected as the main objective of the mission.

A total of 587 groups of cetaceans, seals or sharks wee detected between the four surveys. These sightings included species of concern for COSEWIC. A total of 9 blue whales were seen in spring, summer and fall in the St Lawrence estuary. Eighteen belugas were all seen in the estuary in summer. One hundred and nine fin whales were seen from May to November in the estuary, and along the Gaspe peninsula and the Western coast of Cape Breton in summer. One hundred and ninety-five harbour porpoises were seen. They were seen in all areas from spring to fall, but the effective coverage for this small species is very sensitive to weather conditions as sightability rapidly decreases when sea state conditions increase. Seventeen humpback whales were seen along the Gaspe coast from June to November, the western coast of Cape Breton in June and in the estuary in summer.

## 17. PILOT CETACEAN SURVEYS BY NEWFOUNDLAND AND QUEBEC REGIONS

Presenter: Jack Lawson

With funding from SARCEP to Jack Lawson (NF Region) and Jean-Francois Gosselin (Quebec Region), researchers from DFO's Newfoundland and Quebec Regions conducted a pilot cetacean aerial survey for two weeks in early September of 2003. While flying was hampered during the first week by hurricane Gustav, virtually all of the transects planned initially for the survey were flown. In addition, we were able to conduct two days of flying along the Labrador coast, reaching as far north as Nain. Over the course of the survey, the aircraft flew from St. Anthony (Newfoundland), Goose Bay (Labrador), Deer Lake (Newfoundland), and Stephenville (Newfoundland).

Except for the coastal strip transect flown along the Labrador coast, the transects were straight lines flown at a ground speed of 110 knots and an altitude of 500 feet ASL (see §2. *Sighting Effort*). This combination of altitude and airspeed provided a good opportunity to view cetaceans in the water; for example, sightings of harbour porpoise, harp seals, mackerel and dovekies (small seabirds) were made during a variety of sighting conditions.

Depending on survey conditions, location of nearest airports, and transit time to the survey area, the aircraft was flown for approximately three to five hours between re-fueling stops. Since the transect lines were 10 nautical miles apart, there was a period of approximately 10-15 minutes between the time observers went off-effort at the end of one line and on-effort at the start of the next. The refueling stops, plus the off-effort time when flying between transects, gave the observers sufficient rest to limit fatigue.

All survey transects were flown in a Cessna 337 Skymaster twin-engined aircraft on contract from Hicks and Lawrence Ltd. (Ontario). This particular aircraft was equipped with an extended range fuel system enabling it to fly up to seven hours with no reserve. It was capable of flying in IFR conditions, but did not possess weather radar. This aircraft was equipped with piston engines and thus required Avgas 100LL fuel. This was available at many airports along both shores of the Strait of Belle Isle, but not along the coast of Labrador.

Four crew flew during the survey: the pilot (Captain Mario Tcheon), a navigator/recorder in the co-pilot's position (Jack Lawson, Newfoundland Region), and two marine mammal observers in the rear positions (Jean-Francois Gosselin [Quebec Region]; Denis Wakeham [Newfoundland Region]). Each day the positions taken by Gosselin and Wakeham were decided randomly based on a coin toss prior to flight.

Dr. D. Palka of the National Marine Fisheries Service (NMFS) provided DFO with the survey software (VOR) used to navigate along the transect lines, record sightings and sighting positions. The VOR survey programme was run on a Toshiba laptop computer. GPS information derived from a GARMIN S76 handheld GPS unit was transferred to the laptop using an RS232 cable. A Compaq iPAQ PDA with a Navman GPS unit and eastern Canadian digital maps was used as a backup navigation system (which also recorded the altitude, ground speed and tracklines of the survey aircraft).

During the survey, the aircraft would fly along the pre-planned transects and the rear observers would search for cetaceans visible at or just below the sea surface. The pilot and navigator/recorder would not alert the observers to cetaceans they had sighted. If the navigator/recorder sighted an animal that was not seen subsequently by the rear observers (a rare event), he noted the time and approximate sighting angle in the field notes. These off-effort sightings was not used in the sighting summaries.

If an observer sighted a cetacean or cetacean group, he would alert the navigator/recorder. The observer would either measure (using a handheld inclinometer) or estimate the angle of inclination of the sighting position from the trackline. The observer called out this measure, plus the species, number in sighting, direction of swim, sighting cue, reaction (if any), and whether the animal(s) were diving. If a cetacean could not be positively identified while on-effort, the crew would go off-effort and either (1) circle back to the sighting position for further viewing, or (2) fly out to a distant sighting (such as the blow of an unidentified large whale). In some cases repeated overflights were made of a sighting location to count or photograph animals; at times these were as flown as low as 100 feet ASL.

The navigator/recorder would also record survey conditions during the flight. These included cloud cover, glare, wind speed, sea state (as agreed amongst the three DFO staff), and a rating of the overall sightability (from excellent to poor). All electronic data was recorded on the laptop and later copied to ZIP disc for backup. The raw data were reviewed for errors each day during and after the flight, and entered into either ArcView or MapInfo for mapping.

A Nikon D1H digital camera with 80-200 mm zoom lens, and a Sony digital video camera, were employed to document the survey. The photographs from the aircraft were not as good as they could have been had we been able to open the side windows (see §4. *Review of Negative Aspects of Methodologies Employed*).

The total cost of this pilot survey, including aircraft charter, fuel, aircraft deployment fee, hotel and meal costs, staff overtime, slightly exceeded the $35,000 allocated for the effort (the overrun to be covered by other funds). Considering the weather conditions at the start of the project, and the total area covered, this was a very cost-effective survey.

*Sighting Effort*

During the survey period, the aircraft spent approximately 43.7 hours aloft (with transit flight time to and from transects included). During this time the aircraft flew along 3,200 km of transect lines, plus slightly less than 1,000 km along the Labrador coast. Visual observation covered a total area of approximately 62,000 $km^2$. Based on measurements taken on the ground, during flight it was estimated that a strip with a width of approximately 33.2 m located immediately below the aircraft could not be seen by the observers. That is, the area from the trackline to about 16.6 m from the trackline was not visible to the rear observers during flight at 500 ft. ASL.

Straight-line transect coverage extended from the northern end of the Strait of Bell Isle to the Quebec north shore in the southwest to the Newfoundland southwest coast in the southeast (Fig. 1). Off-effort sightings during transits to and from transect lines were also noted.

*Sightings*

During the survey there were 139 on-effort sighting events: 132 were of cetaceans and 11 were of other large marine species (Tables 1a and b). The most commonly sighted cetaceans were common dolphins and humpback whales, with fewer sightings of minke whales, harbour porpoise, and Atlantic white-sided dolphins. Harp seals, basking sharks, leatherback sea turtles and oceans sunfish were also seen (Table 1b).

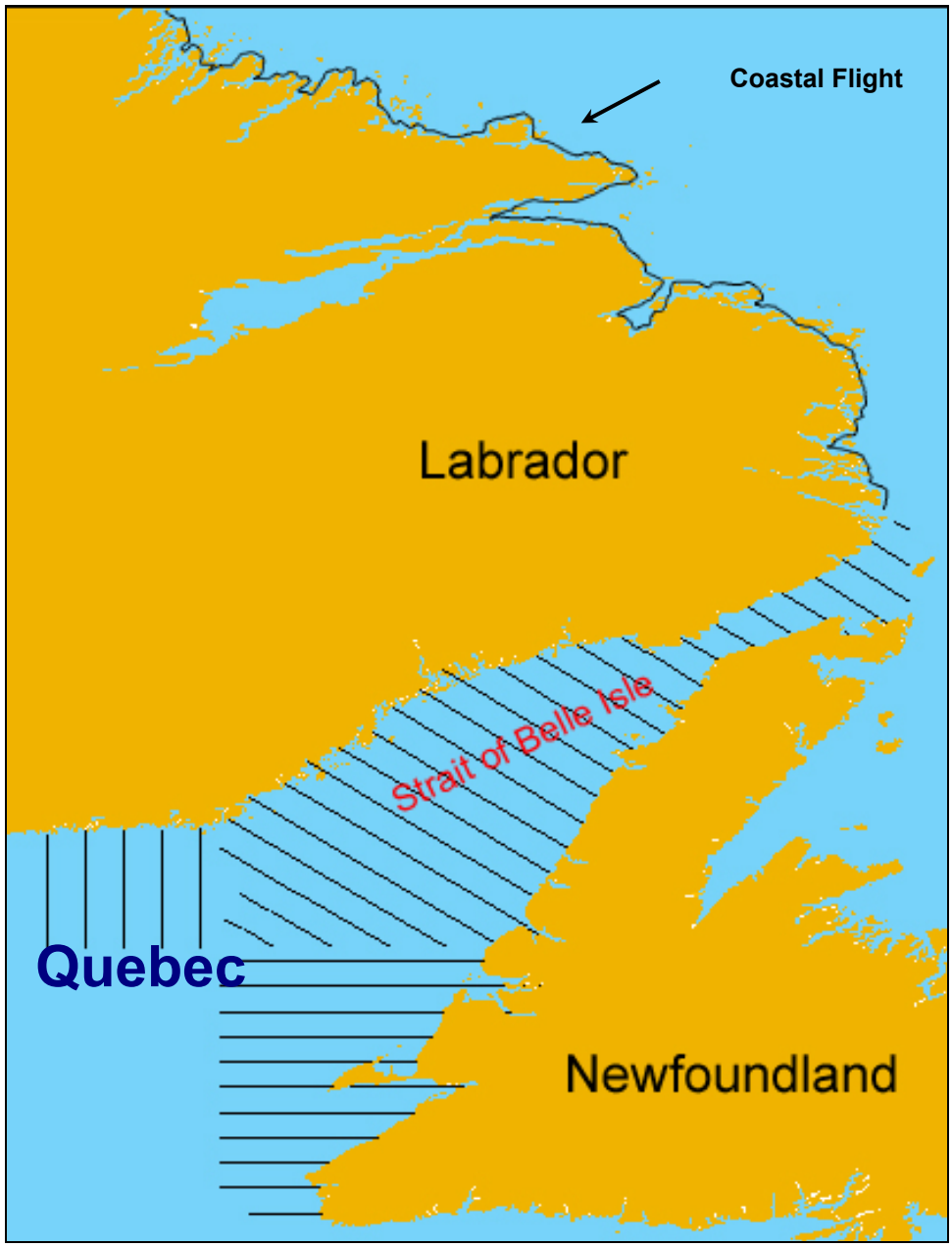


Figure 1. Map of pilot survey area showing transect lines flown (straight black lines), and the coastal strip survey flown from southern Labrador north to Nain (black irregular line).

Table 1a: Number of cetacean sighting events during the 2002 cetacean pilot survey conducted in Atlantic Canada.

| Observer | Minke Whale | Common Dolphin | Beluga Whale | Atl White-sided Dolphin | Humpback Whale | Harbour Porpoise | Unk Dolphin | Unk Whale | Unk Cetacean | Total Sighted |
|---|---|---|---|---|---|---|---|---|---|---|
| **Wakeham** | 4 | 21 | 1 | 5 | 17 | 5 | 4 | 1 | 1 | **59** |
| **Gosselin** | 10 | 23 | | 5 | 18 | 7 | 8 | 2 | | **73** |
| **Total** | **14** | **44** | **1** | **10** | **35** | **12** | **12** | **3** | **1** | **132** |

Table 1b: Number of large marine species sighting events during the 2002 cetacean pilot survey conducted in Atlantic Canada.

| Observer | Basking Shark | Harp Seal | Unk Seal | Leatherback Turtle | Ocean Sunfish | Total Sighted |
|---|---|---|---|---|---|---|
| **Wakeham** | | 2 | 1 | 1 | | **4** |
| **Gosselin** | 2 | 2 | | 1 | 2 | **7** |
| **Total** | **2** | **4** | **1** | **2** | **2** | **11** |

During the sighting events, 394 individual cetaceans and 12 other individual large marine animals were observed. The greatest proportion of individuals sighted were common dolphins, with fewer humpback whales, Atlantic white-sided dolphins, harbour porpoise, and minke whales (Table 2a). Two leatherback sea turtles were also sighted on separate occasions in the southern portion of the Strait. (Table 2b).

Table 2a: Summary of individual cetaceans sighted during the 2002 cetacean pilot survey conducted in Atlantic Canada.

| Observer | Minke Whale | Common Dolphin | Beluga Whale | Atl White-sided Dolphin | Humpback Whale | Harbour Porpoise | Unk Dolphin | Unk Whale | Unk Cetacean | Total Sighted |
|---|---|---|---|---|---|---|---|---|---|---|
| **Wakeham** | 5 | 119 | 1 | 14 | 25 | 15 | 4 | 1 | 2 | **186** |
| **Gosselin** | 10 | 129 | | 12 | 32 | 9 | 14 | 2 | | **208** |
| **Total** | **15** | **248** | **1** | **26** | **57** | **24** | **18** | **3** | **2** | **394** |

Table 2b: Summary of individual large marine species sighted during the 2002 cetacean pilot survey conducted in Atlantic Canada.

| Observer | Basking Shark | Harp Seal | Unk Seal | Leatherback Turtle | Ocean Sunfish | Total Sighted |
|---|---|---|---|---|---|---|
| **Wakeham** | | 2 | 1 | 1 | | **4** |
| **Gosselin** | 2 | 3 | | 1 | 2 | **8** |
| **Total** | **2** | **5** | **1** | **1** | | **12** |

As expected the distances at which cetaceans were sighted from the trackline (as reflected in the angle of inclination measured by the observers) was related to their size and the conspicuousness of their blows. Humpback whales were sighted on average much farther from the trackline than the much smaller harbour porpoise (Table 3).

Table 3: Average sighting angle (inclination, in degrees), where the horizon equals $90^0$, for marine animal sighting events during the 2002 cetacean pilot survey conducted in Atlantic Canada.

| Observer | Minke Whale | Basking Shark[a] | Common Dolphin | Beluga Whale | Atl White-sided Dolphin | Humpback Whale | Harp Seal | Harbour Porpoise | Overall Average[b] |
|---|---|---|---|---|---|---|---|---|---|
| **Wakeham** | 50.25 | | 54.29 | 55.00 | 51.80 | 77.59 | 55.00 | 33.00 | **60.21** |
| **Gosselin** | 65.00 | 47.00 | 55.00 | | 50.00 | 80.06 | 56.00 | 49.71 | **63.22** |
| **Average** | **60.79** | **47.00** | **54.66** | **55.00** | **50.90** | **78.86** | **55.50** | **42.75** | **61.86** |

[a] Both basking sharks were swimming below the sea surface.
[b] Includes angles for sightings of unknown species.

Geographically, most cetacean sightings occurred in the northwest side of the Strait of Belle Isle, with other sighting clusters in the southern centre of the Strait, and off the southwestern coast of Newfoundland (Fig. 2). Many of the sightings in the northern section of the Strait were humpback whales, and most of these were observed travelling northwards. While most sightings were of single individuals, or single species groups, there were several occasions when a group of cetaceans contained several species. In one case, a group of animals swimming rapidly northwards in the Strait contained humpback whales, a single minke whale, and a common dolphin (seen bowriding one of the humpbacks).

A single adult beluga was sighted during the coastal flight in Labrador on September 14th at 53.57 $^o$ N and 55.94$^o$ W. It was swimming northwards within 100 meters of the shoreline.

In most cases large whales did not react to the overflight of the survey aircraft. In contrast, reactions (usually a vigorous dive) were seen in a number of common dolphins and Atlantic white-sided dolphins.

*Review of Positive Aspects of Methodologies Employed*

Cessna 337 Skymaster Aircraft

The Cessna 337 Skymaster aircraft could be operated at a significantly lower cost than a DeHavilland DHC-6 Twin Otter. On standing offer to DFO, Hicks and Lawrence Ltd. supplied the aircraft at an off-season rate of $285 per hour (versus more than $1,000 per hour for a Twin Otter).
With its extended range option, the Skymaster used in this survey had greater range than a standard model Twin Otter and could fly for up to seven hours with no reserve. The aircraft utilized Avgas 100LL fuel which was available at many airports along both shores of the Strait of Belle Isle.
Designed for use as a military spotter aircraft during the Vietnam war, the Skymaster is a highly maneuverable aircraft, with excellent capabilities for aerial photo-identification while circling tightly. While it was not a STOL aircraft like the Twin Otter, the

Skymaster offered reasonable handling abilities at lower flight speeds, and could also operate from relatively short, unprepared runways.

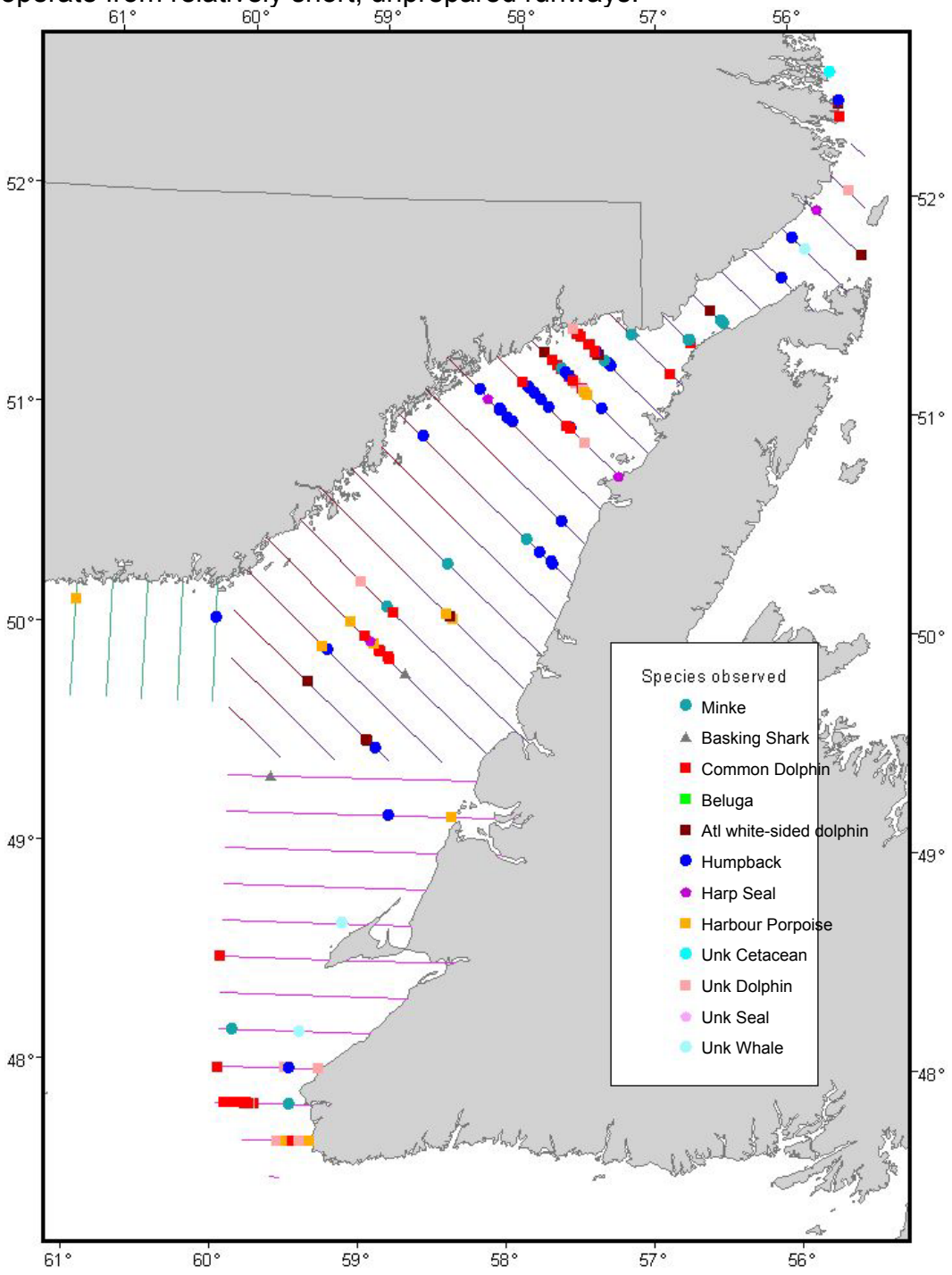


Figure 2. Map of pilot survey area showing transect lines flown (straight black lines), and the sightings (species denoted by shape and colour symbols). Several sighting aggregations are evident in the Strait of Bell Isle (see text).

The observers' and navigator/recorder's views from the aircraft were quite good, obstructed only by the small wing struts. The bubble windows afforded a better view downwards than flat windows alone (but see §4. *Review of Negative Aspects of Methodologies Employed*).

*VOR Survey Software*

The VOR survey software (written by Lex Hiby) was provided to DFO by Dr. D. Palka of NMFS. It is presently unsupported, and has limited documentation. Nonetheless VOR provided an excellent means to record and analyze survey data; comparable data is collected in other areas using this system). It was run on a laptop computer, and interfaced with a GARMIN S76 GPS unit via an RS232 cable.
The underlying map files for VOR were created using public domain vector data, over which the planned transect lines were displayed. During flight, the VOR map display could be zoomed to various magnifications to assist with navigation to transects, or to enable return to particular sighting locations.
During data entry, and during entry of sighting records, the user could use a variety of letter codes (e.g., "MN" for humpback whale). However, the accompanying Microsoft Access database[1] would error check the VOR output data based only on pre-approved codes. As we did not use the Access database to check the survey sighting data, we were free to employ our own species codes within VOR.
The VOR programme could also monitor and record input from an external thermal sensing device such as was used by NMFS to monitor sea surface temperatures during flights along the eastern seaboard. This capability was not employed during this flight.

*Review of Negative Aspects of Methodologies Employed*

Cessna 337 Skymaster Aircraft

In comparison with the Twin Otter, the Skymaster was a much smaller aircraft. On longer flight legs this resulted in some flight crew discomfort and fatigue (relative to the Twin Otter), limited installed equipment options, and rendered observer rotation during flight a potentially challenging contortion exercise.
While the rear bubble windows installed on this particular Skymaster were advantageous over flat windows, greater bubble depth would have reduced the estimated 33.2 m "blind spot" to exist along the transect line below the aircraft (Fig. 3). Unlike the Twin Otter, the Skymaster's landing gear were retracted in flight and did not obstruct the observers' field of view. Conversely, like the Twin Otter, the Skymaster's wing struts did obscure a small fraction of the rear observers' visual fields.

[1] The Microsoft Access database was written by NMFS staff and can be used to error-check the raw ASCII data files produced by the VOR programme. This Access file searches for and flags out-of-range values and misspelled variable codes. It then outputs Excel files that can be imported into mapping and statistical analysis programmes. Documentation for this database is available.

Figure 3. Jean-Francois Gosselin (Quebec Region) on-effort while observing through the starboard bubble window of the survey aircraft.

The lexan windows on this particular Skymaster aircraft were not adequate for unobstructed photography. However, several other Skymaster aircraft in the Hicks and Lawrence fleet have a small belly port modification. We would recommend using this option in future surveys with this platform.

The installed autopilot on this aircraft (Trimble GPS-based) was not sufficiently sensitive to permit unattended flying along transects. This necessitated frequent pilot and navigator intervention during the survey and was a source of fatigue. NMFS flies their Twin Otter survey aircraft with fully digital, programmable autopilots, coupled to radar altimeters. This facilitates navigation during transects and thereby reduces pilot fatigue. Such a system, or at least a more sensitive GPS system, should be considered for future surveys using this aircraft.

A 24 volt power inverter was required to produce the 115 volts of AC power needed for the laptop computer. With a single battery pack, the Toshiba laptop could operate for only approximately three hours without external power (the GARMIN S76 GPS unit was battery-powered). If AC power could not be obtained, additional batteries could be carried for the laptop.

*VOR Survey Software*

Since the VOR survey software is presently unsupported, and has limited documentation, it cannot be modified easily or enhanced. For example, the sizes of several of the text data entry fields were relatively small—the user could not record detailed (i.e., lengthy) comments associated with a sighting record. Similarly, in the "general notes" fields the limit to text length meant that the recorder might have to create multiple entry lines to accommodate a lengthy notation. This was not a significant limit so much as an occasional annoyance.
DFO is investigating the possibility of obtaining the programme source code and modifying VOR to enhance its flexibility, and to provide versions that are tailored for specific applications.

Jack Lawson and Jean-Francois Gosselin wish to thank SARCEP for providing funds for this pilot aerial survey.

This concluded the presentation of the SARCEP-funded projects. Andrew Trites then updated the group on the work of the COSEWIC- Marine Mammal Specialist Group, including identification of upcoming species of interest for the group.

## CLOSING REMARKS

The Chairman thanked all participants for their active participation in the meeting. He noted that this was a very successful meeting, with a broad range of subject material discussed. He stated that this meeting marked the end of his three year term, and thanked members of the NMMRC for their ongoing support. The Chairman encouraged members to consider candidates for the new Chairperson and provide any suggestions and feedback to him. Finally, possible venues for the 2004 meeting were discussed. There was general consensus that the next location should be one of the Atlantic labs. Possibilities mentioned included St. John's, Dartmouth (BIO) and St. Andrews. The new Chairperson should check with local scientists and the NMMRC to confirm availability of these proposed venues and make a final selection this fall.


1. Lara Cooper
2. Lena Measures
3. Veronique Lesage
4. Pierre-Yves Daoust
5. Linda Nichol
6. Brigitte de March
7. Don Bowen
8. Ian McQuinn
9. John Neilson
10. Grace Mellano
11. John Ford
12. Pierre Richard
13. Jack Lawson
14. Mike Hammill
15. Lei Harris
16. Miriam O
17. Graeme Ellis
18. Ole Nielsen
19. Jean Francois Gosselin
20. Mark Boysen
21. Larry de March
22. Andrew Trites
23. Garry Stenson
24. Monique Bournot-Trites
25. Peter Olesiuk
26. Jim Lee

Photo Credit: Jim Borrowman, skipper of the *Lukwa*.

## Annex 1. List of Participants

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## Annex 2. Agenda of NMMRC Meeting, Nanaimo, Feb. 26 – Mar. 1, 2003

| | ***Feb. 26 (Wed.)*** | ***Feb. 27 (Thu.)*** | ***Feb. 28. (Fri.)*** | ***March 1 (Sat)*** |
|---|---|---|---|---|
| | | | | |
| **0900-0930** | A1 (Nielsen & Measures) | B3 (Richard et al.) | Review of SSRs | |
| **0930-1000** | A1 (Nielsen & Measures) | B3 (Richard et al.) | Review of SSRs | |
| **1000-1030** | *Refreshments* | *Refreshments* | *Refreshments* | Field Trip |
| **1030-1100** | A1 (Nielsen & Measures) | B3 (Richard et al.) | C2 (Harris & Hain) | Details TBA |
| **1100-1130** | A2 (Olesiuk) | B4 (Stenson et al.) | C3 (de March et al) | |
| **1130-1200** | A2 (Olesiuk) | B4 (Stenson et al.) | C3 (de March et al) | |
| **1200-1300** | *Lunch* | *Lunch* | *Lunch* | |
| **1300-1330** | A2 (Olesiuk) | B5 (Sjare) | C3 (de March et al) | |
| **1330-1400** | B1 (Measures) | B5 (Sjare) | C4 (Cosens) | |
| **1430-1500** | B1 (Measures) | B6 (Lesage; Trippel) | extra time | |
| **1500-1530** | *Refreshments* | *Refreshments* | *Refreshments* | |
| **1530-1600** | C1 (Olesiuk) | B6 (Lesage; Trippel) | Plans for next | |
| **1600-1630** | B2 (Stenson & Hammill | B6 (Lesage; Trippel) | meeting | |
| **1630-1700** | B2 (Stenson & Hammill | B7 (Neilson) | Adjourn | |