Slow down and save the whales

Article *in* Solutions · February 2016

CITATIONS
17

READS
1,032

6 authors, including:

Clément Chion
Université du Québec en Outaouais
55 PUBLICATIONS **518** CITATIONS
SEE PROFILE

Samuel Turgeon
Parks Canada
34 PUBLICATIONS **311** CITATIONS
SEE PROFILE

Nadia Ménard
Parks Canada
51 PUBLICATIONS **534** CITATIONS
SEE PROFILE

Guy Cantin
Institut Maurice-Lamontagne
29 PUBLICATIONS **893** CITATIONS
SEE PROFILE

Solutions
For a sustainable and desirable future

Published on *Solutions* (http://www.thesolutionsjournal.com)

Slow Down and Save the Whales

By: Lael Parrott, Clement Chion, Samuel Turgeon, Nadia Ménard, Guy Cantin, Robert Michaud

Volume 6: Issue 6: Page 40-47: Feb 02, 2016

In Brief:

The St. Lawrence River estuary is a busy maritime route through which ships transit to reach Canadian and American ports located along the river and in the Great Lakes of North America. It is also home to an endangered population of beluga whales and is used as a summer foraging ground by minke, blue, humpback, and fin whales. The high number of whale–vessel co-occurrences cause potential disturbance to the whales and also pose a risk of collisions. We describe how a multipartite group of stakeholders worked together to find a consensus solution to manage this risk. The process involved extensive analysis of data describing ship and whale movements in the region, leading to proposals for mitigation scenarios. An agent-based model of ships and whales in the estuary was used to simulate and test the scenarios to evaluate their effectiveness in meeting multiple objectives. In 2013, the group recommended voluntary measures for speed reduction and area avoidance to reduce whale exposure to vessels and decrease the risk of whale–vessel collisions. The measures are communicated to mariners each year by the Canadian Coast Guard and have received high compliance. This is a successful example of how nonregulated solutions can be achieved through collaboration and cooperation between diverse stakeholders.

Key Concepts:

- In the St. Lawrence estuary, almost 8,000 commercial ship transits per year cross through the critical habitat and foraging grounds of several species of large whales, leading to concerns about the potential impact of traffic on the whales.
- A multipartite working group used a participatory, agent-based modeling approach combined with spatial analyses and scientific expertise to assess scenarios to reduce whale exposure to vessels and manage the risk of collisions.
- The group's work has led to recommendations for voluntary speed reduction and area avoidance in the estuary since 2013.
- Including all stakeholders in the solution building process has led to high compliance and a greatly reduced risk of lethal collision between boats and whales.
- Such nonregulatory solutions, achieved through stakeholder collaboration and cooperation, can lead to positive and sustainable outcomes.

Many natural resource management and biodiversity conservation problems are so-called wicked problems.[1] Such problems involve multiple stakeholders with differing objectives and for whom the chosen solution will have a significant impact. There is no single solution for a wicked problem and no simple solution. Reducing the impact of commercial shipping on marine mammals in the St. Lawrence River estuary, Quebec, Canada, is an example of one such wicked problem. The estuary and associated Gulf of St. Lawrence is an area of exceptional oceanographic and biological diversity and is frequented by large whales that use the area as a summer feeding ground. Part of the estuary has been designated as one of Canada's first marine protected areas: the Saguenay–St. Lawrence Marine Park.[2] Established in 1998, the Marine Park is co-managed by Parks Canada and Parks Quebec. In addition, the waters surrounding the Marine Park have been selected as an Area of Interest (AOI) for potential designation as a Marine Protected Area (MPA) under the Oceans Act.[3] However, long before this marine park designation, the estuary was an important shipping route. The whale's main feeding ground is routinely transited by commercial shipping traffic heading to and from the Atlantic Ocean to the major ports along North America's Great Lakes (Figure 1). In addition, seasonal whale-watching boats supporting a vibrant tourism industry in coastal communities as well as other types of vessels such as ferries and pleasure craft, navigate the marine park waters on a daily basis in the summer season (Figure 1).[4] This heavy traffic poses numerous potential threats to marine biodiversity,

including the possibility of ship strikes on whales.[5-7]

Ceasing or reducing shipping activities along the St. Lawrence River, however, would have billions of dollars of economic impact and is not a realistic option for biological conservation. Marine transportation is also one of the most sustainable forms of transport due to its relatively low carbon emissions per ton of commercial goods moved. Marine shipping should therefore be favored over other types of transport on the basis of carbon footprint per ton-kilometer, and an increase in marine traffic on the St. Lawrence River is anticipated in the future. Reducing the exposure of whales to marine traffic and decreasing the risk of whale–vessel collisions while still maintaining essential marine transport activities is thus a wicked problem: any proposed solutions need to reconcile ecological and socio-economic objectives in a way that is acceptable to all stakeholders.

Here, we describe how a multipartite group of key stakeholders from industry, government, and not-for-profit research and academic organizations came together to seek solutions to reduce the impact of marine transportation on marine mammals in the St. Lawrence River estuary. The group has formed a sustained partnership, the Working Group for Maritime Transportation and Marine Mammal Protection (referred to as simply the Working Group hereafter), and has adopted the mandate to identify options to reduce the risks posed by commercial shipping to marine mammals in the St. Lawrence estuary, accounting for ship operation constraints, and without compromising safety at sea.

Context

Almost 8,000 merchant and cruise ship transits occur through the St. Lawrence estuary each year. About 4,000 of these take place from May to October, the season when migratory whales are present.4,5 In 2012, prior to the implementation of the mitigation measures developed by the Working Group, these ships moved at average speeds of around 14 knots, with 17 percent of them exceeding 16 knots on average (Figure 2). Data show that collisions between vessels and whales at speeds of 14 knots have a greater than 60 percent probability of being lethal, with this probability increasing to 90 percent at speeds of 16 knots.[8] The ships are traversing the main foraging grounds of baleen whales as well as beluga whales' critical habitat (listed as endangered by the Committee on the Status of Endangered Wildlife in Canada). While the number of reported whale–vessel collisions in the estuary over the past decade is low, any collision is one too many. For many endangered species, such as the blue whale or the beluga, the loss of a single individual due to a collision may have detrimental effects on population recovery. The Canadian Department of Fisheries and Oceans has assessed collisions to be a medium-high threat to the recovery of the Northwest Atlantic Blue Whale population and a medium threat to the Fin Whale Atlantic population. 6 In addition to collision risk, marine traffic noise and congestion are known to disturb and possibly stress marine mammals, with potential cascading effects on their feeding success or reproductive activities.[9] For these reasons, biologists and wildlife conservation managers working in the estuary have been seeking solutions to reduce the impact of all categories of navigation activities on marine mammals in the estuary.

In 2011, a multipartite working group was established to assess possible mitigation measures that could reduce the impact of maritime transportation on marine mammals in the estuary, with an initial emphasis on reducing the probability of fatal whale–ship collisions. The working group is co-chaired by representatives from the Federal organizations, Parks Canada, and Fisheries and Oceans Canada, and includes participants from a range of sectors, including industry, government, academic, and not-for-profit research organizations.

Initial meetings of the Working Group were focused on establishing a shared understanding of the economic and operational constraints of the maritime transport industry and of the ecological conditions of the estuary, including the seasonal patterns of movement and use of the study area by marine mammals. Group members shared relevant data, information, and knowledge from their respective realms and explained their organization's use of the estuary or their role in managing human activities. For many organizations, this was the first time that they'd had the opportunity to interact closely with organizations from different sectors. The group therefore focused many of its initial meetings on relationship building. This sharing of perspectives contributed to a better understanding of each organization's mandate and operating constraints. It also helped establish a sound collaboration based on trust and understanding between the different group members.

The group acknowledged the heavy overlap between whales and marine traffic in the study area that may lead to numerous impacts on whales, including risks of collision. Managing the risk of collision and reducing overall exposure of whales to ships was the initial objective of the group. The group identified a series of possible traffic management scenarios (e.g. speed limits, off-limit areas, and traffic deviation schemes) that might reduce the risk of ship strikes on whales and which were perceived as feasible within known ship operation constraints. These traffic management scenarios were developed using a combination of expert knowledge, long-term monitoring data, and geographic information for the region.

Over a period of two years, the group analyzed the acceptability of the different scenarios, weighing the trade-offs between economic costs and conservation gains and revising scenarios as necessary to accommodate new information and results of the analysis. Also, traffic safety was always a background consideration, and St. Lawrence ship pilots were involved in every step of the process to ensure that proposed scenarios did not pose navigational risks. Evaluation of the scenarios was done with the aid of an agent-based model called 3MTSim.[10] 3MTSim simulates the movement of boats and whales in the estuary based on known movement patterns for the whales and ship captain decision-making while navigating (Figure 3). 3MTSim was developed as a collaborative project between a team of university researchers and biologists and managers at

Parks Canada, Fisheries and Oceans Canada, and the not-for-profit Group for Research and Education on Marine Mammals (GREMM). The model has been extensively calibrated and validated by field data collected as part of various monitoring campaigns carried out in the estuary since the mid-1990s. In addition, the model was developed in an iterative fashion with regular communication between model builders and end users to ensure that the model met management needs and that the rules and assumptions were clearly understood by end users. The active involvement of the St. Lawrence pilots also contributed to calibration of 3MTSim's ship movement module using realistic decision rules.[11-15]

The working group used 3MTSim to simulate the outcomes of 10 different traffic management scenarios on three key indicator variables. The variables predicted by 3MTSim were the following: the relative risk of collision between transiting vessels and each species of whale; total exposure of whales to ships (measured as the length of time that whales are in the presence of a ship within 1,000 meters); and ship transit time through the study area (an important variable linked to industry economic constraints and pilot operating constraints). The results of the simulations illustrated the complex trade-offs between conservation objectives and economics, since scenarios that reduced collision risk by slowing ship speed also resulted in economic costs due to increased transit times, and increased transit times increased overall whale exposure to ships (although reduced the risk of collisions). Additionally, solutions that sought to reroute ships away from the large whale's main feeding ground in the marine park by taking a more southern route raised concerns as to the impacts of increased exposure to beluga whale calving grounds. In the end, the results of the simulations contributed to illustrating which measures had the greatest gains for marine conservation, with negligible or acceptable impacts on maritime shipping.

The Working Group used the results of these simulations, as well as extensive analysis and cartography of existing spatial and spatiotemporal data collected for the estuary, to arrive at a recommendation for voluntary mitigation measures based on expert opinion and science (Figure 4). These mitigation measures were published by the Canadian Coast Guard in the "Notice to Mariners" in the spring of 2013 and have been published every year since.[16-18] (The "Notices to Mariners" are official Canadian Coast Guard publications that must be read by vessel navigation officers.) In 2014, results of a scientific advisory report on the potential impacts of increasing shipping in areas highly used by female and beluga calves was incorporated into the recommendation. The mitigation measures are to be taken by merchant vessels and cruise ships only when navigational safety is not jeopardized. The measures dictate that the entire estuary be considered an area of caution where ship captains and pilots should be on alert for whales and includes an area to be avoided (due to use by blue whales) as well as slow down area to reduce the chances of whale–vessel collisions and especially the probability of lethal collisions. The measure also contains a recommendation to navigate in the Laurentian Channel north of Île Rouge to avoid the beluga calving grounds.

Based on a consensus, the Working Group proposed voluntary, rather than regulatory, measures. In addition to avoiding a lengthy process that would require any such regulation being passed through the Canadian legal process, voluntary measures provide a degree of flexibility that does not exist within regulation. Most importantly, they allow for rapid re-adjustment and adaptation in response to new information (a key tenet of adaptive management). The approach also provides industry partners with an opportunity to demonstrate their voluntary willingness to make an effort for biological conservation, providing them with a positive environmental image. Lastly, voluntary measures provide the opportunity for compliance through cooperation and understanding, rather than enforced compliance through a coercive system. Such compliance is arguably more sustainable over the long term than a system based on penalizing offenders. However, to be effective, voluntary measures must be accompanied by an effective monitoring system to measure how well they are respected in order to confirm that this is the right approach to follow. In the Marine Park and surrounding waters, continual monitoring of ship transits is carried out using the Automatic Identification System (AIS). Data is compiled and analyzed by Parks Canada to assess compliance in midseason as well as at the end of the season. Results are communicated to the Working Group so any adaptive corrective measures can be taken if necessary.

Successful Results

Compliance to the voluntary measures has been very high, with a rapid adoption of the Working Group recommendations starting in their first year of publication (Figure 2). The result is an estimated reduction in the risk of fatal collisions between vessels and whales of 35–40 percent in the marine park.[19] Ship pilots significantly reduced their speed across the area, with 72 percent of the transits in 2014 occurring at speeds less than 11.8 knots compared to only 13 percent in 2012 prior to the implementation of the voluntary measures (Figure 2). Data also show that extreme high speeds have gradually decreased since 2012, greatly reducing the risk of fatal collisions. Since implementation of the measures, there have been no reported ship strikes on whales in the estuary. Lastly, ships have respected the recommendations by maintaining their traditional routes yet at slower speeds, rather than selecting the alternate southern route which passes through the beluga calving grounds.

This success has been made possible thanks to the shipping industry's and St. Lawrence pilot's active commitment throughout the process to find a feasible way to protect whales. The willingness to ground the Working Group's recommendations on sound science certainly helped to achieve consensus by relying on facts rather than perceptions. It should also be noted that a key element of success has been the fact that a large part of the area covered by the voluntary protection measures are mandatory piloted waters, which reduces the heterogeneity of stakeholders. The participation of the piloting association in the deliberative process was fundamental to ensuring that the proposed navigational measures were feasible and acceptable to the stakeholder group ultimately responsible for implementation. Pilots were extensively

consulted for feedback throughout the process, and after each year of implementation, to ensure the applicability and safety, particularly of the voluntary speed reduction. Follow-up consultations with noncompliant vessels have also been done to learn about circumstances leading to noncompliance. By understanding why these companies did not adopt the voluntary measures, the Working Group will be able to adjust its approach (e.g. communication, education) and enhance whale conservation. This ability to easily communicate with pilots, and having their professional organization within the Working Group, has greatly contributed to the success of the group's efforts.

While these results are encouraging, there remains room for improvement for the benefit of whale conservation. The initial work of the group has focused on managing the risk of whale–vessel collisions and reducing the exposure of whales, particularly the blue whale, to marine traffic. Other risks still exist, such as those related to noise propagation in the water, availability of sufficient prey for whales, and the potential of hazardous spills that may be addressed in the future. By understanding why these companies did not adopt the voluntary measures, the Working Group will be able to adjust its approach (e.g. communication, education) and enhance whale conservation.

Learning Outcomes

We describe how a negotiated solution was found to manage the risk of whale–vessel collisions and to reduce exposure of whales to ships in the St. Lawrence estuary. The use of modeling and GIS tools provided significant advantages to the decision-making process by providing quantitative support in the form of maps and simulation outputs. The approach facilitated open discussion and information sharing, leading to trust building amongst participants and an agreed-upon solution supported by science. Support of the recommendations by all parties has led to positive communication of the voluntary measures to ship captains and other affected stakeholders, which has most likely contributed to the high degree of compliance.

This work is one of several examples worldwide of how consensus decision making and sound science can be used to reduce the impact of marine shipping on whales. Similar successful outcomes have recently been achieved in the Bay of Fundy, Canada and in the Hauraki Gulf, New Zealand.[20,21] Similar to the St. Lawrence estuary, both of these examples involved extensive stakeholder involvement and collaboration between diverse groups to achieve a sustainable solution.

As for these other examples, the process carried out in the St. Lawrence estuary provides a concrete demonstration of marine integrated management that does not merely consult industry players on solutions to problems identified by the government but that involves those actors from the onset. Through teamwork, problems are dealt with and solutions are found. All the expertise and points of view combined, from marine transportation, marine environment conservation, and scientific research helped to develop effective and agreed-upon measures to manage collision risk and reduce whale exposure to vessels while taking into account the constraints of safety and economics. Such a consensus-based approach based on voluntary rather than regulatory measures arguably leads to more sustainable solutions over the long term, since it is grounded in cooperation and trust built between the affected parties. The group continues to meet and work together to monitor the effectiveness of the measures and to seek additional opportunities to reduce the impact of maritime transportation in the estuary on its rich marine environment.

Acknowledgements
We acknowledge the dedication and commitment of Jean Desaulniers (Parks Canada), who has co-chaired the Working Group with Guy Cantin (Fisheries and Oceans Canada). In addition to the authors, the following people contributed to building the 3MTSim model and to data analysis that supported model development: Philippe Lamontagne, Cristiane Martins, and Jacques-André Landry. Additional collaborators and contributors to the 3MTSim project are acknowledged on the project website at http://complexity.ok.ubc.ca/projects/3mtsim/.

References

1. Rittel, H.W.J. and M.M. Webber. Dilemmas in a general theory of planning. *Policy Science* 4, 155–169 (1973).
2. Parks Canada & Parcs Quebec. The Saguenay–St. Lawrence Marine Park [online] http://parcmarin.gc.ca/home.html.
3. DFO. Marine Protected Areas [online] http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/mpa-zpm/index-e...
4. Chion, C., S. Turgeon, R. Michaud, J.A. Landry, and L. Parrott. Portrait de la navigation dans le parc marin du Saguenay–Saint-Laurent: caractérisation des activités sans prélèvement de ressources entre le 1er mai et le 31 octobre 2007. 86 pages (2009).
5. Ménard, N., R. Michaud, C. Chion, and S. Turgeon. Documentation of maritime traffic and navigational interactions with St. Lawrence Estuary beluga (*Delphinaterus leucas*) in calving areas between 2003 and 2012. Fisheries and Oceans Canada [online] (2014) http://ponttadoussac.ca/wp-content/uploads/2015/03/belugastudy.pdf.
6. Beauchamp, J., H. Bouchard, P. de Margerie, N. Otis, and J.Y. Savaria. Recovery strategy for the blue whale (*Balaenoptera musculus*), Northwest Atlantic population. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada [online] (2009) http://www.registrelep-sararegistry.gc.ca/document/doc1773f/ind_e.cfm.
7. DFO. Recovery strategy for the beluga (*Delphinapterus leucas*), St. Lawrence Estuary population. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada [online] (2012) http://www.sararegistry.gc.ca/document/doc2309f/ind_e.cfm.

8. Vanderlaan, A. and C. Taggart. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine Mammal Science* 23, 144–156 (2007).
9. Bejder, L. et al. Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance. *Conservation Biology* 20, 1791–8 (2006).
10. Lefebvre, S.L., R. Michaud, V. Lesage, and D. Berteaux. Identifying high residency areas of the threatened St. Lawrence beluga whale from fine-scale movements of individuals and coarse-scale movements of herds. *Marine Ecology Progress Series* 450, 243–257 (2012).
11. Parrott, L. et al. A decision support system to assist the sustainable management of navigation activities in the St. Lawrence River Estuary, Canada. *Environmental Modelling & Software* 26, 1403–1418 (2011).
12. Chion, C. et al. Eliciting cognitive processes underlying patterns of human–wildlife interactions for agent-based modelling. *Ecological Modelling* 222, 2213–2226 (2011).
13. Chion, C. et al. Spatio-temporal modelling for policy analysis: application to sustainable management of whale-watching activities. *Marine Policy* 38, 151–162 (2013).
14. Chion, C. Réduction des risques de collisions mortelles de grands rorquals avec des navires marchands dans l'estuaire du Saint-Laurent en 2013. (2014).
15. Okanagen Institute for Biodiversity, Resilience, and Ecosystem Services, University of British Columbia. 3MTSIM: Marine Mammal and Maritime Traffic Simulator [online] (2015) http://complexity.ok.ubc.ca/projects/3mtsim.
16. Canadian Coast Guard. Notices to Mariners publication, Eastern edition, Vol. 40, No. 5 [online] (May 29, 2015) https://www.notmar.gc.ca/go.php?doc=eng/services/notmar/eastern-xhtml/ea....
17. Canadian Coast Guard. Notices to Mariners publication, Eastern edition, Vol. 39, No. 4, [online] (April 25, 2014) https://www.notmar.gc.ca/go.php?doc=eng/services/notmar/eastern-xhtml/ea....
18. Canadian Coast Guard. Notices to Mariners publication, Eastern edition, Vol. 37, No. 5 [online] (May 31, 2013) https://www.notmar.gc.ca/go.php?doc=eng/services/notmar/eastern-xhtml/ea....
19. Vanderlaan, A.S.M. and C.T. Taggart. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine Mammal Science* 23, 144–156 (2007).
20. The Marine GIS Group at the New England Aquarium. Right Whales and Shipping Lanes [online] (2012) http://www.marinegis.org/shippingLanes.html.
21. Constantine, R. et al. Mitigation of vessel-strike mortality of endangered Bryde's whales in the Hauraki Gulf, New Zealand. *Biological Conservation* 186, 149–157 (2015).