2024 CANADIAN CONSULTING ENGINEERING AWARDS

smartWhales

WSP

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Innovation

Since 1970, North Atlantic right whales (NARW) have been at risk of extinction. Collisions with vessels and entanglements with commercial fishing gear are the main causes of mortality in these animals.

WSP is leading one of the five consortiums that participate in smartWhales, an initiative led by the Canadian Space Agency (CSA), in collaboration with Fisheries and Oceans Canada and Transport Canada. This three-year program aims to develop solutions using satellite data and other types of information to help detect and monitor the presence of these whales, as well as to predict their movements within the Gulf of St. Lawrence.

WSP and DHI Water Environment collaborated in creating a Decision Support System (DSS) to help final users make decisions that will ensure the preservation of NARWs. The DSS features a web-based interactive map interface that provides visuals of the forecasting models' results, which are required for the spatiotemporal assessment of risks of collision and entanglement. The predictions, which cover a twelve-hour span, are based on dynamic vessel positioning data (AIS), as well as other data.

The application and integration of predictive ecological models and the complex real-time data management system **can be considered as a significant breakthrough in conservation science**. This system is based on integrated academic and commercial models. The technology behind these models was tested based on historical data.

The project itself is innovative. The CSA chose to issue a request for proposals led by a consortium of private and academic sector members, which has yielded positive results. The consortium, led by WSP and including DHI, is partnered with the Canadian Whale Institute (CWI), Dalhousie University and the Institut des sciences de la mer de Rimouski (ISMER). It has led to several innovations in hydrodynamic models (ocean currents, water temperatures, etc.), dynamic habitat models, agent-based models (whales), marine traffic forecasting models, and ecological risk models.

The combination of all these models helped to produce collision and entanglement risk models, the results of which are shown in the interactive map. The entire project is highly innovative, and the interactive map it produces is so far unique.
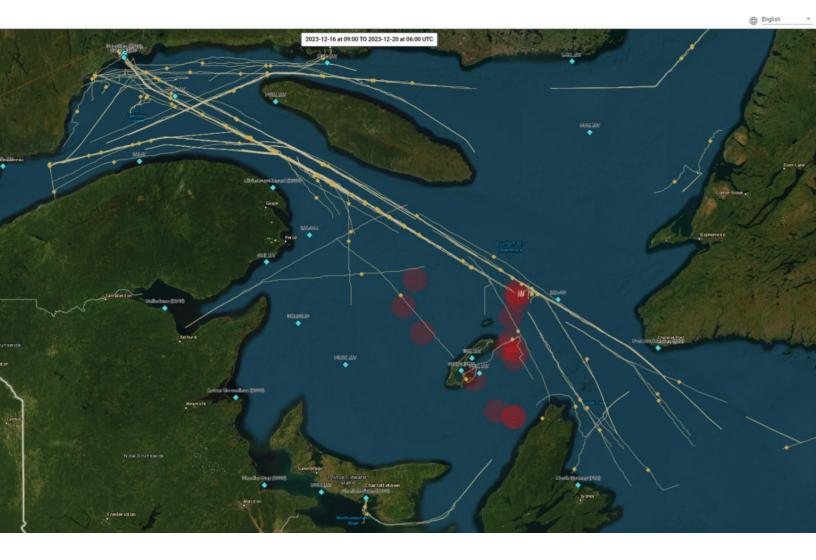
Complexity

The project's complexity lies in the coordination between the various partners and experts in different areas. Indeed, to accurately predict the whales' movements in the Gulf of St. Lawrence and the risks of collisions and entanglements, behavioral patterns as well as environmental and ocean-related factors must be taken into consideration. This is what makes the DSS such an ambitious project; it requires experts familiar with cutting-edge technologies in marine ecology, oceanography, artificial intelligence, and modelling.

For the project to achieve its goals, the team was required to manage and analyze this data, as well as other information gathered from various sources, such as that from in situ stations, and other data on atmospheric forcing and ocean conditions. They were subsequently able to produce a baseline for hydrodynamic modelling.

An in-depth analysis of the literature, which was supported by the recommendations of the CWI, was then produced to determine the parameters and thresholds that must be integrated into the model simulating the whales' movements and behaviors. These efforts promoted the development of advanced retrospective forecasting models that allowed for the reconstructing of the whales' dynamic habitats and provided information in near real time on the expected whales' presence and the potential for contact with vessels.

Social and Economic Impact

This project has many economic benefits. By predicting the whales' movements in eastern Canada, stakeholders can better plan their activities.

The project will be beneficial to commercial activities, as it will contribute to their continuity in the Gulf of St. Lawrence. If it becomes possible to prevent collisions between whales and vessels, Canadian companies' ability to navigate Canadian waters and reach their destinations will be improved, which will in turn be beneficial to their bottom lines. The conservation of whales is even profitable for the fishing industry, as cetaceans contribute to the improvement of fish stock in the ocean food chain, and to ecotourism. In addition to these economic benefits, the International Monetary Fund (IMF) estimated that the contribution of only one whale to the environment could amount to over two million dollars. This illustrates the importance of each whale and of the imperativeness of saving them from imminent extinction.

The fishing industry in eastern Canada is bound to benefit from this project as well, as it also reduces the risks of collision between whales and fishing vessels. The entire research community will benefit from this study, as it will foster parallel research on Earth observation sciences and ecology modelling.

Environmental Impact

An important environmental benefit of our project is its contribution to the conservation of marine biodiversity and the reduction of greenhouse gases by supporting the North Atlantic right whale (NARW) in the context of a shift in their suitable habitat.

Whales play a critical role in nutrient transfer by increasing the production of phytoplankton, which is vital to the ocean food chain and the absorption of atmospheric carbon dioxide. Phytoplankton is a major contributor to the Earth's oxygen supply, underscoring the importance of whales as an umbrella species whose protection benefits numerous marine species and ecosystems.

Our Decision Support System (DSS) platform uses advanced models to predict and monitor hospitable habitats for NARW, a species affected by climate change. One of the main challenges to their conservation is the shifting of their habitat due to climate change. Warmer water temperatures can affect phenological changes in the marine habitat. For example, warming bottom temperatures in the Gulf of Maine have negatively impacted the availability of a particular species of zooplankton, Calanus finmarchicus, the primary prey of the NAWR. This has caused, among other things, a shift in the NAWR's feeding area in the Gulf of St. Lawrence.

By identifying potential new habitats through in situ observations, DSS supports both existing conservation efforts and exploration of new areas where NARW are migrating. This approach not only supports current conservation areas, but also adapts to changing marine environments, ensuring effective management and mitigation of environmental impacts during project implementation.

Meeting and Exceeding Owner's/Client's Needs

The project's main goal was to study and develop a spatial solution as well as other sources of information to contribute to the protection and the environmental management of NARWs in Canadian waters while supporting the durability of economic activities.

WSP was called upon to provide an analysis of the solution that includes the Application Readiness Level (ARL) system, which is a scale that rates the readiness level of the smartEarth initiative's applications. The scale ranges from 1 (exploratory and conceptual level) to 9 (product ready for the market).

This is where the team stood out. By the end of the project, the project reached a readiness level between 6 and 9. This indicates that not only is it possible to predict the risk of collisions between whales and vessels, but that the platform would be operational and almost ready for use. The platform's interface is designed for efficient communication and decision-making regarding risks.

The DSS could initially be considered as a supplemental conservation tool and, with continuous investments in control analyses and system refinements, the platform will be continuously improved. This tool could also offer new opportunities to improve conservation efforts in other fields. For example, offshore wind power initiatives could benefit from a similar tool to ensure that key marine habitats and migratory paths are adequately considered.

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Appendix A.1
Company Presentation

Company Presentation

As one of the world's largest professional services firms, WSP provides consulting, engineering and design services to clients in various sectors, namely transportation, infrastructures, Earth and environmental sciences, building, energy, resources and industry. Our vast expertise includes engineers, consultants, technicians, scientists, architects, planners, as well as environmental, design, program and construction project management specialists, who work hard to attract, develop and retain top talent. Our regional and international agility lies in our ability to adapt to our clients' cultures, local markets and work environments, while promoting collaboration, diversity and inclusion. We are the sum of our collective passion, vision and expertise. We deliver sustainable, high-quality projects wherever our clients are, with a focus on creating innovative solutions to meet the potential challenges the future will bring. This compels us to remain curious, as well as to act locally while thinking globally. We are WSP in Canada.