Case Study:
OceanRiot | CIDCO | DeepSense

AI for Benthic Species Detection: Mapping Seafloor Resources for Sustainable Fisheries Management

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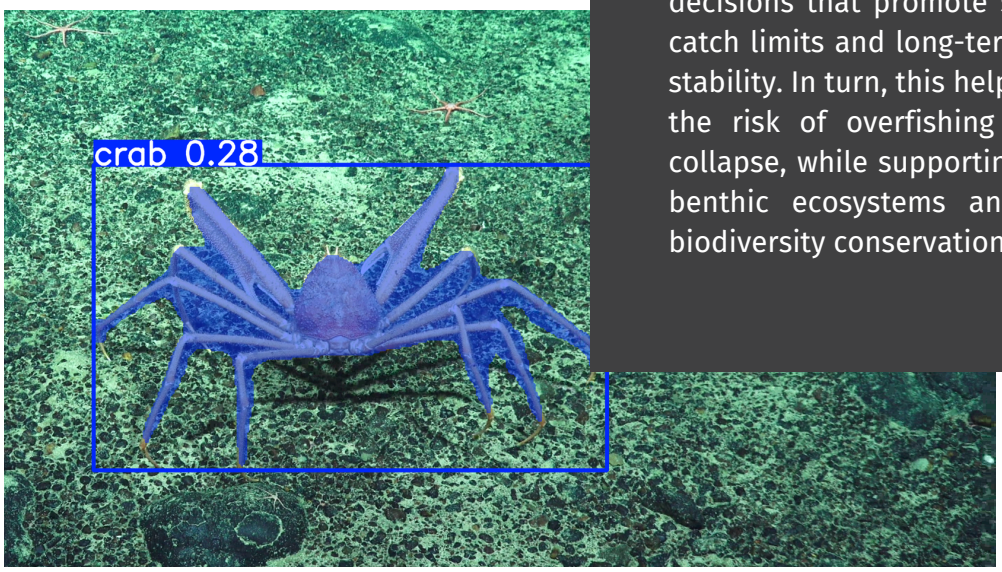
At a glance

AI for Benthic Species Detection: Mapping Seafloor Resources for Sustainable Fisheries Management

Ocean observations are critical to understanding the marine environment and managing the valuable resources it provides. Therefore, effective fisheries management requires regular stock monitoring to ensure sustainable harvests for generations to come. Unfortunately, traditional approaches are time-consuming and costly, often resulting in limited and patchy data. The fishing industry lacks monitoring tools that provide reliable stock assessments at high spatial and temporal resolution.

OceanRiot has developed an AI system for commercial fisheries to monitor benthic species by combining marine robots and instance segmentation. Using image data collected from autonomous underwater vehicles, the model can detect, measure, classify, and count target species on the seafloor, providing fisheries managers with highly accurate stock assessments.

By enabling more frequent, precise, and affordable stock assessments, OceanRiot supports regulators and harvesters in making informed decisions that promote sustainable catch limits and long-term resource stability. In turn, this helps minimize the risk of overfishing and stock collapse, while supporting healthier benthic ecosystems and stronger biodiversity conservation.



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The Problem

With access to three oceans at our fingertips, Canadians have long relied heavily on the fishing industry as a source of food and income. Today, Canada's fishing industry is one of the largest in the world, contributing approximately $4-9 billion annually to the economy. However, human activity in the oceans (including fishing) and changing environmental conditions are impacting the abundance and health of fish stocks at national and global levels. According to Fisheries and Oceans Canada's 2025 national stock assessments, 35% of Canadian fish stocks are classified as overfished, and 57% are fully exploited. Additionally, many new stocks added in recent years still have an uncertain status. This indicates insufficient information to assess the status of certain stocks reliably.

In Canada, we have seen firsthand the impacts of overfishing, including the infamous collapse of the Atlantic Cod fishery in 1993, which reduced the population to 1% of its original size. It is no surprise that effective management is the most powerful tool for conserving fisheries resources. Therefore, to safeguard our fisheries and ensure a sustainable harvest, we need to adapt our fishing strategies as climate change drives socioeconomic change. By harnessing the power of marine robotics and artificial intelligence (AI), fisheries can track the status of the stock and adjust management accordingly through evidence-based decision-making.

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The Situation

A new initiative from OceanRiot, Interdisciplinary Centre for the Development of Ocean Mapping (CIDCO), and DeepSense is attempting to address this challenge by transforming how we monitor benthic commercial fisheries (specifically lobster, crab, sea urchins, and scallops). Leveraging autonomous underwater vehicles (AUVs) and advanced imaging sensors, OceanRiot collects high-resolution seabed data across fishing grounds. AI-powered computer vision models then analyze this imagery to detect, measure, classify, and count target species on the seafloor. This automated approach enables rapid, accurate, and repeatable stock assessments, offering a scalable alternative to traditional diver-based surveys that are costly, time-consuming, and limited in coverage.

So far, the team has achieved:

- Over 100K samples trained and integrated into the model
- Current tests are reaching over 95% accuracy

OceanRiot delivers game-changing insights into marine resource management by using AI to conduct precision inventories of aquatic organisms, discover spatial trends, and obtain key information for strategic planning.

CIDCO is a marine geomatics and hydrospatial research and development organization, based in Rimouski. Dedicated to the enhancement of state-of-the-art technology for hydrospatial data acquisition, management, and graphic representation, CIDCO is a not-for-profit organization answering the needs of the industry and the community at large.

DeepSense, based out of the Faculty of Computer Science at Dalhousie University, rapidly delivers industry-ready applied AI solutions that enhance efficiency, increase productivity, and unlock new opportunities for growth. Through its projects, companies gain access to advanced AI capabilities while students acquire hands-on experience addressing complex, real-world challenges.

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The Background

Canada's oceans are home to some of the world's most unique ecosystems, providing habitat for extraordinary biodiversity. Healthy oceans are critical to fighting climate change and protecting marine life. To support the long-term sustainability of our oceans, Canadians are working together across regions and sectors to interact with the ocean in a way that is ecologically resilient, economically valuable, and socially responsible.

Ocean observations are the backbone of our understanding of the state of the oceans and how they are changing over time. Essential ocean variables, like physical, chemical, and biological data, can provide early warnings to protect ocean ecosystems and their societal benefits. However, despite decades of ocean observations, much of the available data remains publicly inaccessible and/or inconsistent across seasons and large areas. Traditional approaches (manual surveys) often come with challenges, including limited access to remote locations, high costs, and safety risks. There is a notable absence of scalable, affordable, and repeatable monitoring tools that can deliver reliable assessments at high spatial and temporal resolution.

To fill this gap, OceanRiot has created an AI model called the Benthoscope to detect key benthic species with high accuracy. Monitoring benthic species is essential because they are key economic drivers for coastal communities and play critical roles in supporting ocean health. Accurate monitoring of these organisms supports sustainable fisheries harvests and strengthens long-term food security for communities.

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The Solution

OceanRiot is developing an integrated monitoring platform that combines AI, marine robotics, and advanced imaging systems. This online portal enables users to visualize their data and identify species, locations, sizes, and other geospatial trends.

The Benthoscope was conceived through close collaboration with fishers, scientists, and fishery managers who identified the need for more efficient, safer, and scalable survey methods. Building on existing expertise in hydrography, ocean robotics, and data science, the OceanRiot and CIDCO team designed AUVs capable of collecting high-quality seabed imagery in diverse environmental conditions.

The data collected from the ROVs are processed using custom AI models trained to recognize and quantify key benthic species with up to 95% accuracy. Through multiple field trials, industry feedback, and continuous model refinement, the system has been progressively improved to meet real operational needs. By collaborating with stakeholders and end users throughout system development, OceanRiot enhanced the model's value proposition, delivering a practical and reliable system aligned with fisheries management priorities.

Once trained, the Benthoscope can detect benthic life faster than manual surveys and reduce human error and environmental constraints. Geospatial trends identified by the AI can estimate specimen size and generate value-added data for the area of study by determining which organisms are commercially viable while systematically avoiding immature specimens. This maximizes potential profit while minimizing environmental damage and ensures that marine resources are sustainably harvested.

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The Methodology

The development of the Benthoscope began with a series of field trials, completed with the assistance of CIDCO. As a leader in marine robotics, CIDCO played a pivotal role during this phase, contributing its expertise in the deployment and operation of AUVs. Their involvement ensured that high-quality seabed imagery data was collected safely and efficiently across a wide range of challenging and variable ocean conditions.

With the training data, the Benthoscope was built with advanced computer vision and machine learning techniques designed specifically for underwater environments. At its core, OceanRiot developed an AI model for object detection, instance segmentation, and species classification, enabling the system to identify and count benthic organisms in complex seabed imagery. These models are based on state-of-the-art architectures adapted for low-light, low-contrast, and high-noise underwater conditions.

The OceanRiot team implemented domain-specific data augmentation, transfer learning, and semi-supervised learning techniques to improve the model's robustness and accuracy. OceanRiot also developed custom annotation pipelines to process data and quality-control tools to support large-scale model training and validation. This expands the Benthoscope's scale for use across ecosystems, rather than limiting it to a single species in a specific region.

Many fisheries often lack timely, fine-scale information on ecosystem changes to support adaptive management. The Benthoscope advances practical AI deployment in fisheries by delivering end-to-end pipelines for conducting and interpreting operational stock assessments and supporting decision-making processes to ensure the sustainability of our fisheries.

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The Impact

The Benthoscope delivers measurable societal, ecological, and economic benefits by strengthening evidence-based fisheries management in Canada. By providing more frequent, accurate, and cost-effective stock assessments, the AI can help regulators and harvesters make informed decisions that support sustainable catch limits and long-term resource availability. This reduces the risk of overfishing and stock collapse, contributing to healthier benthic ecosystems and improved biodiversity protection.

Spotlight on key contributors

- CIDCO – Develops and operates AUVs and sensor systems that gather seabed imagery safely and efficiently across variable ocean conditions.
- Academia (Polytechnique, Laval University, DeepSense) – Builds and trains machine learning models that automatically identify and count benthic species from underwater images, enabling scalable stock assessments.
- Industrial Fisheries (Shipek Fisheries, Wolastoqiyik Wahsipekuk First Nation, Pessamit Innu Council, Regroupement des Pêcheurs Professionels du Sud de la Gaspésie) – Commercial harvesters and fishery managers who provide domain expertise, validate results in real-world fisheries, and help guide practical applications to modernize the industry.

The Benefits

Economically, the technology lowers monitoring costs, improves operational efficiency, and enhances the stability of high-value fisheries such as lobster, crab, sea urchin, and scallops, sectors that support thousands of coastal jobs nationwide. Socially, the project builds local technical capacity, promotes safer data collection practices, and fosters collaboration between researchers, industry, and Indigenous communities. Together, these impacts reinforce food security, regional economic resilience, and Canada's leadership in sustainable ocean innovation.

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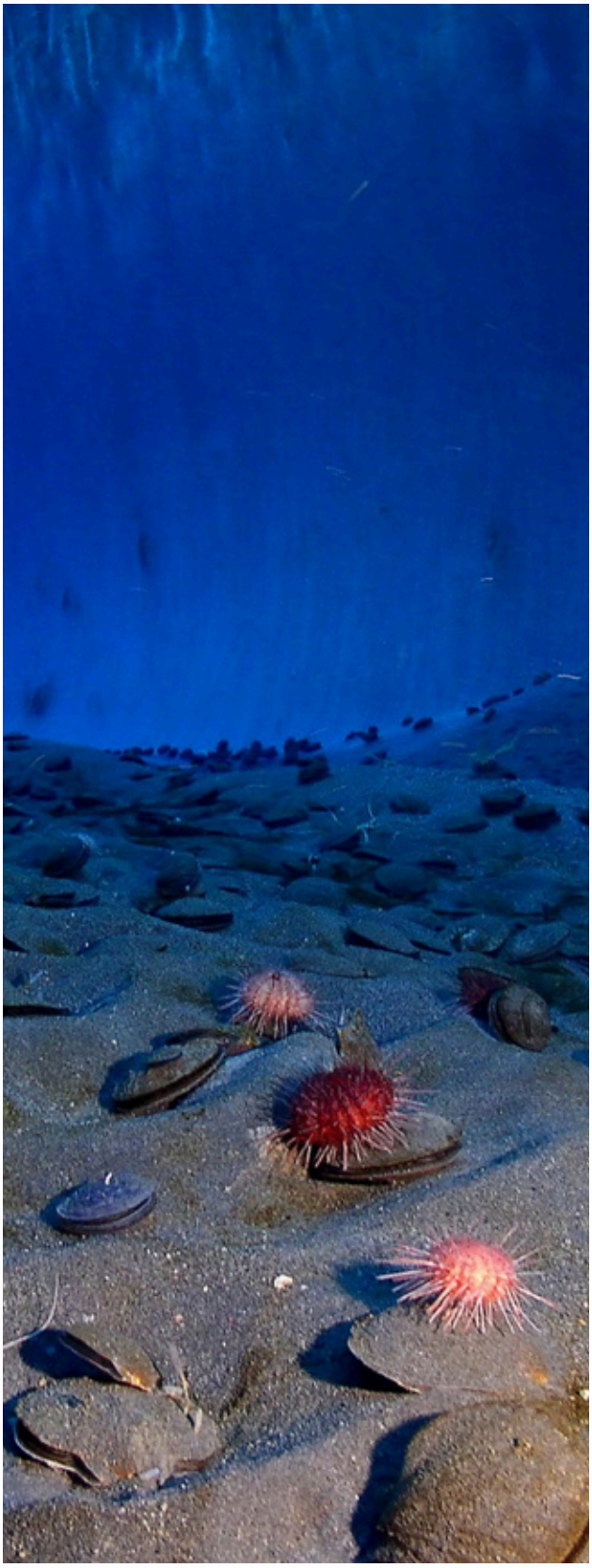
The Next Steps

OceanRiot's goal is to deliver a reliable, scalable, and widely adopted monitoring system that consistently produces accurate, timely, and trusted stock assessment data for industry and regulators.

In the short term, success includes validating the technology across multiple fishing areas, improving model accuracy, and integrating the platform into routine monitoring workflows with key partners.

In the longer term, success is defined by national-scale deployment across major Canadian fisheries, full integration into regulatory decision-making processes, and expansion to additional species and ecosystems.

The project aims to become a reference platform for automated benthic monitoring, supporting ecosystem-based management, climate impact assessment, and international collaboration. Ultimately, long-term success will be reflected in healthier marine resources, more resilient coastal economies, and sustained leadership in marine innovation.



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The Conclusion

OceanRiot demonstrates that AI technologies have reached a level of maturity that enables them to deliver truly transformative solutions to long-standing operational and environmental challenges. However, technology alone is not enough. The decisive factor in achieving meaningful impact lies in bringing together visionary partners who share a commitment to rethinking established practices and embracing innovation.

"Our experience highlights the importance of trust, collaboration, and a shared sense of purpose in driving successful technological adoption. We are deeply grateful to the partners and collaborators who chose to embark on this ambitious journey with us. Their openness, expertise, and determination have made this initiative possible. Together, we continue to explore new opportunities and remain inspired by the collective potential to create lasting value for sustainable ocean stewardship."

Guillaume Morissette, OceanRiot

oceanriot.com

CIDCO

cidco.ca

DeepSense deepsense.ca

Thank you to **DeepSense**, **OceanRiot**, and **CIDCO** for agreeing to be featured in this **Building Bridges** case study.