Mapping threats to marine birds to inform conservation and management in Atlantic Canada

**Alternative titles:**  
  
Mapping Anthropogenic Oil Spills, Vessel Traffic, and Light Pollution in Atlantic Canada to Inform Marine Conservation and Management

A Spatiotemporal Dataset of Anthropogenic Threats in Atlantic Canada: Oil Pollution, Vessel Traffic, and Light Pollution

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**Abstract**

Anthropogenic activities pose significant threats to marine ecosystems, with oil pollution, vessel traffic, and artificial light contributing to environmental risks across Canada’s Exclusive Economic Zone (EEZ) and adjacent waters. This study presents a comprehensive dataset of spatiotemporal threat layers, integrating a wide range of primary data sources to inform conservation, environmental response planning, and marine spatial management in Atlantic Canada.

The dataset comprises geospatial layers developed from various primary datasets, including open access and proprietary data shared for this project. These layers quantify petroleum pollution events, oil and gas infrastructure, vessel activity, and artificial light exposure across the annual cycle. Data sources include the Integrated Satellite Tracking of Pollution (ISTOP), National Aerial Surveillance Program (NASP), National Environmental Emergency Centre (NEEC), and Automatic Identification System (AIS) vessel data. Additionally, VIIRS satellite observations are used to capture artificial light and flaring activity.

These spatiotemporal threat layers were developed using reproducible workflows that integrate historical incident data and geospatial modeling. Petroleum pollution layers, for instance, evaluate the density of oiling events, while vessel disturbance layers quantify the intensity of different types of ship traffic and associated risks. All datasets were processed into a high resolution 1-km2 study grid covering Canada’s EEZ, using the WGS84 coordinate reference system (EPSG:4326), to allow resampling of the dataset to suit a range of future applications. The resulting data products are stored as Cloud Optimized GeoTIFFs (COGs), with comprehensive metadata documenting workflows and processing details. Openly accessible, this dataset supports diverse applications, including evaluating cumulative environmental impacts, informing environmental response planning, supporting recovery strategies for at-risk species, and enhancing marine spatial planning to mitigate threats. For example, this work provides a foundation for evaluating cumulative effects on vulnerable species, such as the Leach’s Storm-Petrel, which breeds in Canada but regularly forages beyond Canada’s jurisdiction.

By providing an integrated and high-resolution review of key anthropogenic stressors, this dataset bridges critical knowledge gaps in ocean management. It enables data-driven decision making for conservation practitioners, policymakers and researchers working to mitigate environmental threats and ensure the sustainable ocean management of marine resources within and beyond Canadian waters.

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*Key words/phrases:* Annual cycle, Light, Petroleum activities, Petroleum pollution, Marine birds, Marine threats, Shipping

Open Research: Data is available in Zenodo at https://doi.org/TO/ADD. Code is available in Zenodo at https://doi.org/TO/ADD.

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