

Identifying areas of potential conflict between seabirds and wind power development

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Abstract

This project was designed to provide a proof-of-concept example of the utility of using conservation planning tools in a geographic information system (GIS) to guide decisions for long-range land management and coastal management in British Columbia in the context of renewable energy development. Marine bird data were chosen as an indicator of biodiversity and conservation concern. Coastal wind energy development was selected as an alternative energy industry and its requirements were used with the marine bird data to indicate where areas of importance to marine birds may overlap with areas of high suitability for wind energy development offshore.

Introduction and statement of purpose

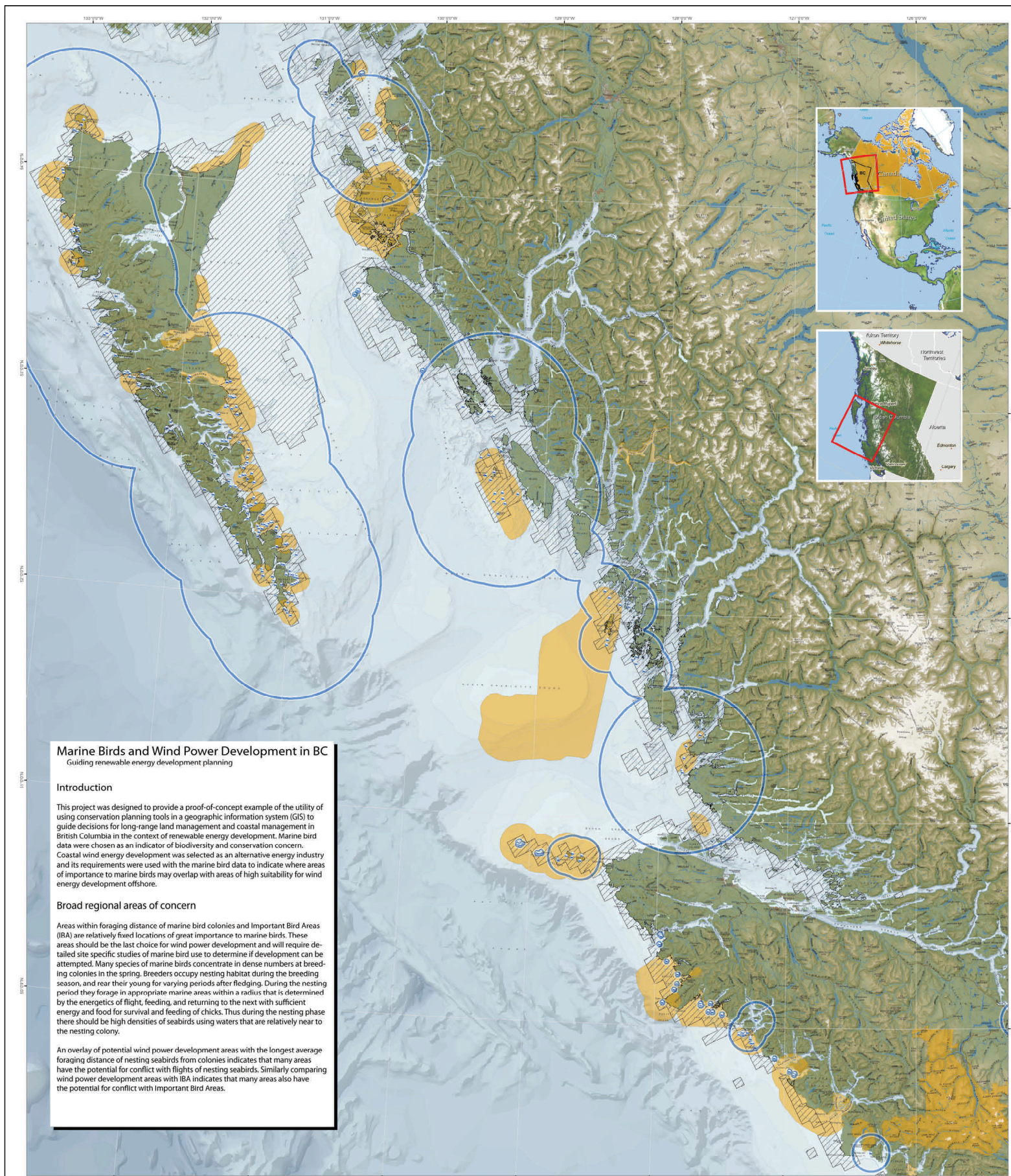
The Province of British Columbia has set a target of reducing annual greenhouse gas emissions 33% by the year 2020 in order to reduce the pollution that causes global warming. Government actions are focused on many sectors of the economy, one of which is providing sustainable energy solutions and minimizing the impacts of fossil fuel energy production and consumption. In the rush to develop 'green energy' the David Suzuki Foundation is concerned that the impacts of wind and other renewable energy developments on biodiversity may greatly increase. The potential conflict between renewable energy and biodiversity conservation poses a serious threat to the expansion of much needed renewable energy sources in BC and also a serious risk to the conservation of biodiversity if environmental safeguards are relaxed. To address these concerns two studies were developed in partnership with the Craighead Environmental Research Institute (Dr. Lance Craighead), the Raincoast Conservation Foundation (Caroline Fox, Des Kawai) and independent collaborators (Rick Tingey and Dr. Mark Kramer). A Literature Review on marine birds examined the state of knowledge and data for the coast of British Columbia and provided the background for a Technical Report. The Technical Report presents a geographic information system (GIS) analysis of areas of potential conflict between wind energy development and seabird distribution and nesting colonies for a study area centered on Hecate Strait.

The maps in this poster session summarize some of the results of the GIS analysis.

Photos of places discussed

Photos of the study area in Coastal British Columbia are displayed with the posters.





Marine Birds and Wind Power Development in BC
Guiding renewable energy development planning

Introduction

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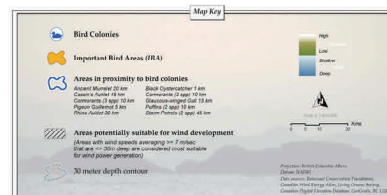
Broad regional areas of concern

Areas within foraging distance of marine bird colonies and Important Bird Areas (IBA) are relatively fixed locations of great importance to marine birds. These areas should be the last choice for wind power development and will require detailed site specific studies of marine bird use to determine if development can be attempted. Many species of marine birds concentrate in dense numbers at breeding colonies in the spring. Breeders occupy nesting habitat during the breeding season, and rear their young for varying periods after fledging. During the nesting period they forage in appropriate marine areas within a radius that is determined by the energetics of flight, feeding, and returning to the nest with sufficient energy and food for survival and feeding of chicks. Thus during the nesting phase there should be high densities of seabirds using waters that are relatively near to the nesting colony.

An overlay of potential wind power development areas with the longest average foraging distance of nesting seabirds from colonies indicates that many areas have the potential for conflict with flights of nesting seabirds. Similarly comparing wind power development areas with IBA indicates that many areas also have the potential for conflict with Important Bird Areas.

Analyzing Spatial Patterns of Habitat Use by Marine Bird Species on British Columbia's Central Coast

Important Bird Areas (IBA), Areas in Proximity to Marine Bird Colonies, and Areas Potentially Suitable for Wind Development



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Methods or tasks involved

We used Canadian government datasets to develop a set of marine analysis units or "benthic units" based upon the ecosystem structure variables of substrate, exposure, current, slope, depth, bottom temperature, and roughness. Each benthic unit represents a unique combination of values for each of these variables. There are 264 unique units in the initial database. This study represents a brief snapshot in time. The marine environment is much more dynamic than terrestrial systems and subject to greater variability over time. The marine bird transect data used in this study, which were the best data available, represent only 3 seasons of data. Additional data from subsequent years should reveal changes in bird distribution and abundance as changes occur in the marine environment.

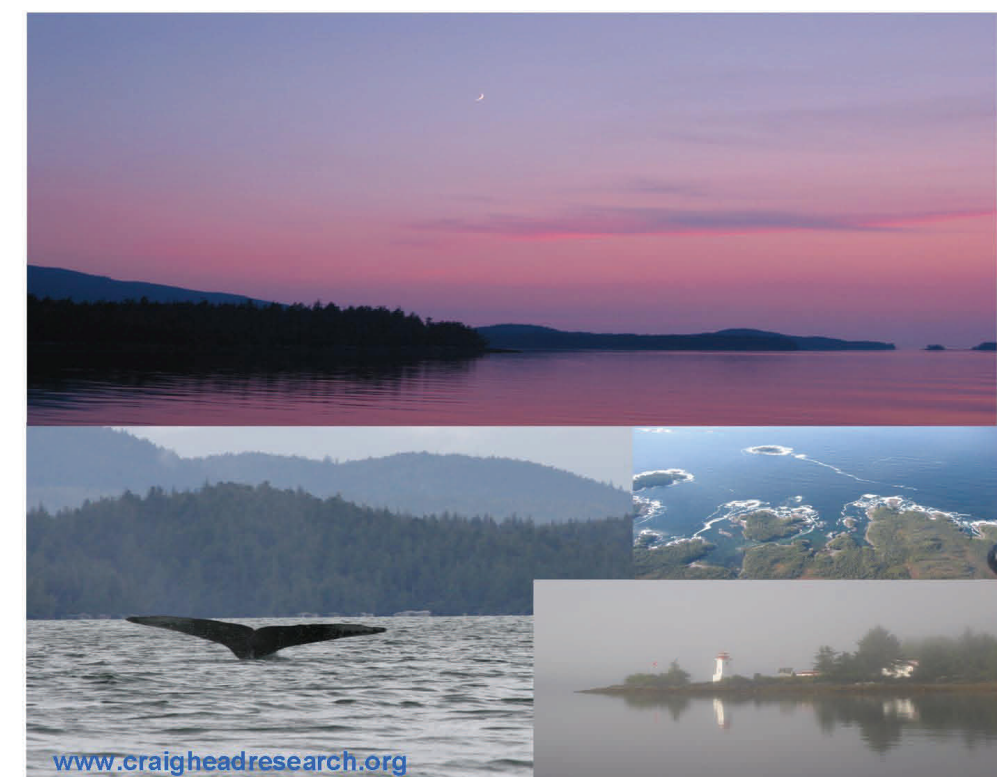
Results of research

Areas within foraging distance of marine bird colonies and Important Bird Areas are relatively fixed locations of great importance to marine birds. These areas should be the last choice for wind power development and will require detailed site specific studies of marine bird use to determine if development can be attempted. Because of their conservation status, Marbled Murrelets are an important consideration for wind farm development. Any sites within 2000 m of a shoreline should be carefully studied during the Marbled Murrelet breeding season to determine whether they use the area and whether they would be likely to have conflicts with wind turbines.

All species of loon may be at great risk from wind turbines because they fly at heights where they are susceptible to collisions and because they are slow, heavy fliers that cannot manoeuvre quickly. Densities have been estimated within a proposed wind farm site where some areas contained loons at over 50% of the maximum density of any cell measured: 39.2 birds per km². Our data indicate that Pacific loons use the proposed wind farm site at densities greater than would be expected during spring, summer, and fall. In addition cormorants, auks (murre, murrelets, gillmots, and puffins), shearwaters, and sea ducks (scoters, mergansers, oldsquaw, goldeneye, bufflehead, and harlequin), and Sandhill cranes either cruise at susceptible elevations (300-900 m) or could pass through wind farms while climbing or descending.

Implications to protected area stewardship

As wind energy development technology advances future wind farms will not be restricted to areas less than 30m in depth. Deeper turbine towers and floating turbine platforms are likely to be feasible in the near future. This study should also provide broad-scale guidance for areas where development further offshore is most likely to come into conflict with marine bird use and where protected areas or development restrictions may be warranted.



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Marbled Murrelets

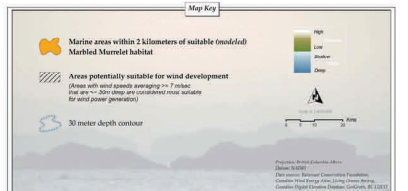
Marbled Murrelets have been an important species in resource management in British Columbia because of their biological requirements. They occur regularly throughout all of the nearshore waters of coastal BC and they may occur in flocks of hundreds where currents or tidal rapids concentrate food. With only a few exceptions, their nests are in old-growth forest (CIT 2004). In some areas of BC their populations have greatly declined and they are classified as a Species at Risk. Populations appear to be smaller in the region of Barkley and Clayoquot sounds where large oil spills, by-catch in gill nets, and logging of old-growth forests have all had potential impact. In the study region, the stresses on the population of murrelets appear to have been much less intense. There is no indication of decline but the population has never been studied in detail and its scale is largely a matter of conjecture. They were chosen as a focal species for the Ecological Spatial Analysis (ESA) of the Coast Information Team (CIT) due to conservation concerns over loss of nesting habitat, increased predation risk from forestry activity, and concern for the influences of human activity on their survival at sea. Because of their vulnerability they may be at risk from a population standpoint if additional developments such as wind farms increase mortality or reproductive risks. They were chosen for this analysis to demonstrate a proof-of-concept example of how detailed data, where available, can be used to identify areas of potential conflict with energy development for a single species.

Marbled Murrelet Potential Nesting Habitat
Potential habitat for Marbled Murrelet was modeled by the Coast Information Team (CIT) as part of the Ecological Spatial Analysis (ESA). The model provides a general picture of the distribution of murrelet nesting habitat along the coast of BC based upon forest cover data sets with information on age class, height class, and canopy closure class. We used the CIT model to identify areas of potential nest sites and created a buffer around these equal to the maximum foraging distance in order to identify potential marine areas used by murrelets during the nesting season. Because of their conservation status, Marbled Murrelets are an important consideration for wind farm development. Any sites within 2000 m of a shoreline should be carefully studied during the Marbled Murrelet breeding season to determine whether they use the area and whether they would be likely to have conflicts with wind turbines.

Analyzing Spatial Patterns of Habitat Use by Marine Bird Species on British Columbia's Central Coast



Areas in Proximity to Marbled Murrelet Habitat and Areas Potentially Suitable for Wind Development



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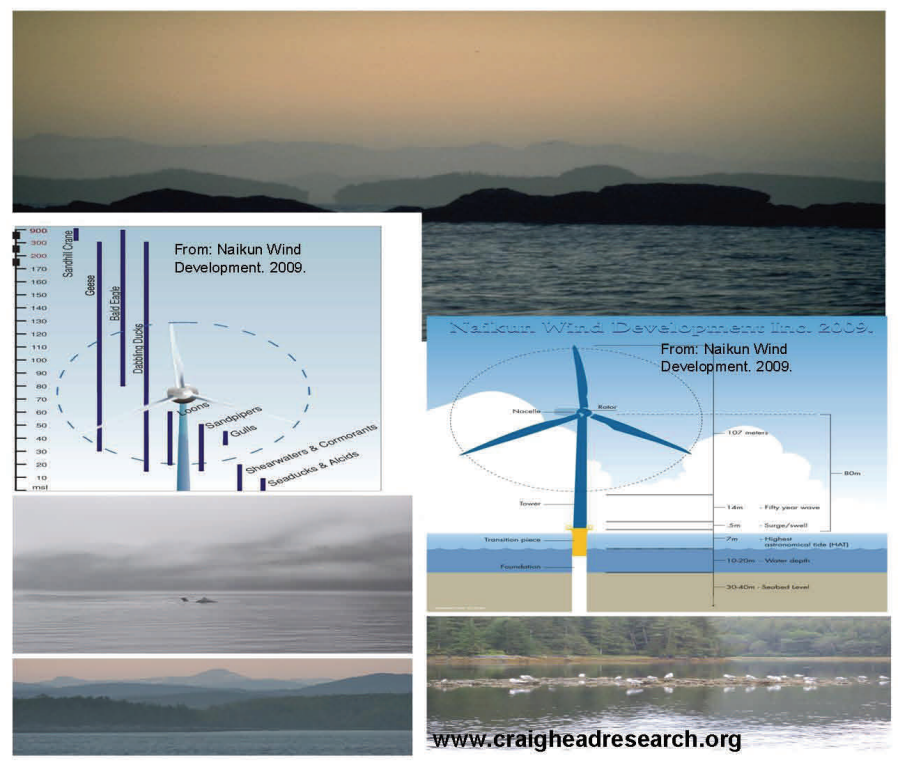
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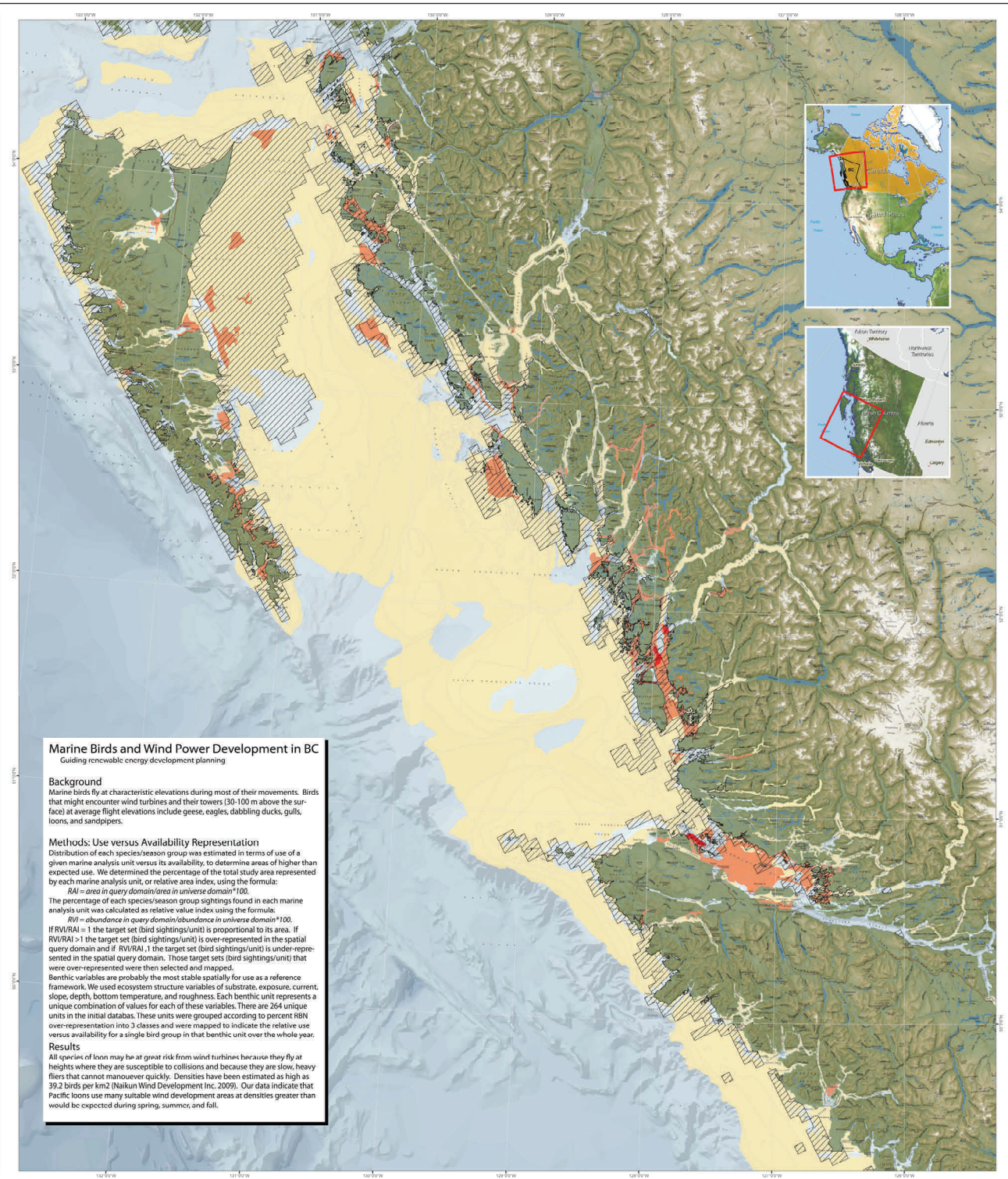
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Background
Marine birds fly at characteristic elevations during most of their movements. Birds that might encounter wind turbines and their towers 30-100 m above the surface at average flight elevations include geese, eagles, dabbling ducks, gulls, loons, and sandpipers.

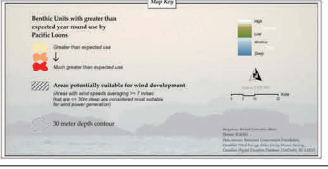
Methods: Use versus Availability Representation
Distribution of each species/season group was estimated in terms of use of a given marine analysis unit versus its availability, to determine areas of higher than expected use. We determined the percentage of the total study area represented by each marine analysis unit, or relative area index, using the formula:
 $RAI = \text{area in query domain} / \text{area in universe domain} * 100$
The percentage of each species/season group sightings found in each marine analysis unit was calculated as relative value index using the formula:
 $RVI = \text{abundance in query domain} / \text{abundance in universe domain} * 100$
If $RVI/RAI = 1$ the target set (bird sightings/unit) is proportional to its area. If $RVI/RAI > 1$ the target set (bird sightings/unit) is over-represented in the spatial query domain and if $RVI/RAI < 1$ the target set (bird sightings/unit) is under-represented in the spatial query domain. Those target sets (bird sightings/unit) that were over-represented were then selected and mapped.
Benthic variables are probably the most stable spatially for use as a reference framework. We used ecosystem structure variables of substrate, exposure, current, slope, depth, bottom temperature, and roughness. Each benthic unit represents a unique combination of values for each of these variables. There are 264 unique units in the initial database. These units were grouped according to percent RBN over-representation into 3 classes and were mapped to indicate the relative use versus availability for a single bird group in that benthic unit over the whole year.

Results
All species of loon may be at great risk from wind turbines because they fly at heights where they are susceptible to collisions and because they are slow, heavy fliers that cannot manoeuvre quickly. Densities have been estimated as high as 39.2 birds per km² (Naitun Wind Development Inc. 2009). Our data indicate that Pacific loons use many suitable wind development areas at densities greater than would be expected during spring, summer, and fall.



Analyzing Spatial Patterns of Habitat Use by Marine Bird Species on British Columbia's Central Coast

Benthic Units with Greater Than Expected Year-Round Use by Pacific Loons and Areas Potentially Suitable for Wind Development



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Background of Project
Wind power is the fastest growing source of energy in the world. The wind power industry creates new jobs, offsets emissions from fossil fuel-fired power plants and enhances security of the electricity supply. It also generates billions of dollars in revenue each year. Canada's wind power potential is one of the greatest in the world and has been conservatively estimated at 30,000 Megawatts. Research has shown that British Columbia has the second windiest coastline on the planet. In response to the Kyoto Protocol, the United Nations Climate Change Conference in Bali, and the Recommendations of the Intergovernmental Panel on Climate Change, the British Columbia government has set a goal of reducing greenhouse gas emissions by 30% by the year 2020. This will require a major emphasis on the development of renewable sources of energy, particularly wind energy. It is imperative that all renewable energy projects be planned with great care as there is a tremendous potential for negative environmental impacts.

Methods
We adapted an approach to identify representative or distinct areas based upon attributes of "ecosystem structure". Benthic variables are probably the most stable spatially for use as a reference framework. We used ecosystem structure variables of substrate, exposure, current, slope, depth, bottom temperature, and roughness. Each benthic unit represents a unique combination of values for each of these variables. There are 264 unique units in the initial database.
We used marine bird survey data collected by the Raincoast Conservation Society from marine bird transects which were surveyed during 2005 to 2008 across Iles Strait and Queen Charlotte Sound. Nearshore surveys were conducted in inlets, straits, and channels along the mainland and on the north and east coast of Haida Gwaii. Transects followed a similar pattern in all years. We determined areas of higher than expected use as described on the accompanying poster on Pacific Loons.

Results
Gulls preferred (higher use than expected due to availability) nearshore areas (inlets, straits, and channels) during all seasons surveyed although higher relative numbers were found in pelagic areas during summer. It is difficult to predict the effects of wind farms on gulls as a group; more species-specific data are needed.



Analyzing Spatial Patterns of Habitat Use by Marine Bird Species on British Columbia's Central Coast

Benthic Units with Greater Than Expected Year-Round Use by Gulls and Areas Potentially Suitable for Wind Development

