Wind farm projects near cetacean critical habitat in Chile: a case study

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INTRODUCTION

Although there has been a rapid expansion of marine renewable-energy developments worldwide, there is little to no information understanding potential adverse impacts on the marine environment. In particularly, it has been reported that there is a significant risk of negative consequences for cetacean species (Simmonds and Brown, 2010).

In recent years, the Scientific Committee of the International Whaling Commission (IWC) has given increasing attention to marine renewable energy resources and their impacts on cetaceans. The Committee recommended for more research into this matter (IWC, 2009), strongly recommended that countries co-operate to limit impacts on marine wildlife from marine renewable development (IWC, 2010) and agreed to conduct a special workshop to addresses these issues in 2012 (IWC, 2011).

Last year, the IWC Scientific Committee received information on a large-scale wind farm project planned to be built on the shoreline in Isla de Chiloe, southern Chile, considered a critical habitat for several whale species. The Committee strongly recommended the urgent development of a full environmental impact assessment of this proposed development (IWC, 2011).

In this paper, the development of renewable energy in Chile is reviewed, its potential impact on coastal ecosystem and species are identified and an updated case study on wind farm developments near a blue whale feeding area off southern Chile is presented.

DEVELOPMENT OF RENEWABLE ENERGY IN CHILE

Chile is above the average carbon intensity per energy use of Latin America, the Caribbean and OECD members. Therefore, one goal of the 2012 National Energy Strategy is to more than double in the next decade, the current contribution of non-conventional renewable energy (NCRE) in Chile's energy matrix. The marine energy potential along Chile's coast has been estimated in hundreds of gigawatts; in particular, coastal areas and some valleys in the interior have natural conditions favorable for the development of wind energy (CTF, 2012).

Information on the location and scale of wind farms was gathered through a survey of governmental web-based resources provided by the Environmental Evaluation Service. Excluding projects withdrawn by the company, there are currently 50 NCRE projects proposed, approved or operational in the country. Locations of these wind farms and number of structures per project are shown in figure 1.

During the past decade, the country has been experiencing a rapid expansion and major increase in the size of windfarm developments. To date, no offshore wind farm developments have been proposed. However, 58% of proposed locations are within 5 km of the shoreline.

Several large wind farm projects have been proposed for areas with reported cetacean critical habitat and high productivity, including northwestern Isla de Chiloe (Galletti Vernazzani *et al*., In Press), southern Chile, and Isla de Chanaral in northern Chile, (Capella *et al*., 1999; Perez *et al.*, 2004; Galletti Vernazzani *et al*., 2012).

A CASE STUDY: WIND FARM PROPOSED DEVELOPMENTS OFF NORTHWESTERN COAST OF ISLA DE CHILOE

In 2010, Ecopower S.A.C. initiated a process to get environmental permits for a wind farm project consisting of 56 wind towers, 344 feet of height that generate 112MW. The site selection, Mar Brava, located at northwestern Isla de Chiloe, southern Chile, included more than 10km of coastline, from the shoreline to 2km inland. In addition, the company was planning to build a new port to disembark the devices.

The area proposed is formed primarily by fragile ecosystems such as wetlands and sand dunes among others, even though the European Union guidelines (2010) recommend avoiding these types of sites for the development of wind farm projects.

Fragile ecosystems are important for the rarity and vulnerability of the habitats as well as for their ecological importance as a feeding, breeding or hibernating place for species. In peatlands, the damage caused to the natural drainage system may also lead to the deterioration of other related habitats, such as other water courses located down-stream. On other dynamic habitat systems, such as sand dunes, wetlands or partially submerged sand banks, it may lead by soil compaction, clearance of vegetation, drainage, etc. to severe erosion and habitat degradation over a wider area. (EU, 2010)

The proposed location will also have an adverse effect on Quilo, an invaluable location of archeological sites with the most ancient remains of coastal human settlements in South America (Aspillaga *et al.,* 1995; Rivas *et al.,* 1999), as well as on the great diversity of coastal birds, including migratory species, and several terrestrial endemic and protected species (CECPAN, 2010).

In addition, the adjacent coastal and marine environments are fragile ecosystem that support a number of cetacean populations described below. A modeling design of the Mar Brava wind mills is shown in figure 2.

Although the mega wind farm project will be located in an extensive coastline area, the company has not conducted an Environmental Impact Assessment (EIA). The project submission was accompanied with baseline information on terrestrial species, impacts from noise, etc. (Ecopower, 2010) that do not comply with minimum requirements of an environmental impact assessment. Moreover, the Ecopower proposal did not included any analysis of impacts in the coastal-maritime boundary or the marine environment.

Cetacean Species off northwestern Isla de Chiloe

Isla de Chiloe has one of the most important aggregations of blue whales (*Balaenoptera musculus*) currently known in the southern hemisphere (Branch *et al*., 2007). Blue whales feed in coastal waters off southern Chile and have shown a significant site fidelity to the northwestern coast of Isla de Chiloe (Galletti Vernazzani *et al*., In Press). The species is classified as 'Endangered' by the International Union for the Conservation of Nature (IUCN) and this important feeding ground, a critical habitat for the life cycle of Chilean population, should be protected.

Southern right whales (*Eubalaena australis*) also are found in the coastal waters of northwestern Isla de Chiloe (pers. obs.). The eastern South Pacific population likely is composed of 50 mature individuals and has been classified as 'Critically Endangered' by IUCN. Maximum protection should be afforded to this species in order to avoid its extinction (Galletti *et al*., 2011).

Other cetacean species recorded in the area include but are not limited to Peale's dolphin (*Lagenorhynchus australis*), orca (*Orcinus Orca*), humpback whales (*Megaptera novaeangliae*), and sei whales (*Balaenoptera borealis*) (Galletti Vernazzani *et al.*, 2005, 2006, 2009, 2012).

Cetacean species and their habitats are protected under Chilean legislation by law 20.293 and are considered a natural patrimony (D.S.230/2008).

Potential Impacts

It is important to note that scientific evidence shows that noise produced by wind farm construction and some maintenance activities can have negative impacts on marine mammals, through, for example, disturbance and exclusion; effects that can extend considerable distances (Simmonds and Brown, 2010). Both in terrestrial and marine systems, noise affects the detection of sounds of predators and prey and may disrupt ''normal'' behavior such as feeding, resting, socializing and an onset of alertness or avoidance (Erber and Farmer, 2000).

Other potential impacts include habitat degradation during construction since debris from removal may impact inshore waters and pollution from leaks or spills (e.g. hydraulic fluids) may impact prey species. Such impacts still may affect marine mammals.

Furthermore, the associated construction of new ports in a fragile ecosystem that supports a number of cetacean populations is of great concern, particularly because it raises the probability of collisions with large vessels. In addition, noise pollution generated by large ships also can disturb the animals and generate masking effects that interfere in their communication system and behaviors, such as the ability to find food and mate.

One of the authors (Veirs) has developed a software model to calculate the propagation of underwater noise from ships. This model is used here to estimate zones of impact (Erbe and Farmer, 2000) on marine mammals due to anthropogenic noise using bathymetry local to the Playa Mar Brava area (northwest Grand Isla de Chiloe) and typical ship noise signatures.

A series of depth sections running from the shore off to up to 80 km show ship noise dB levels at various depths and ranges (Figure 3, 4 and 5). The blue bands around 120 dB designate the limits of a zone of 'disturbance' for marine mammals (Erbe and Farmer, 2000). If this zone applies to blue whales, it implies that any whales in the regions that range from blue through red would likely be 'disturbed' by the ship noise. At higher dB levels, there may be zones of physical injury at one extreme and at lower than 120 dB levels (green on the figures), are zones of masking of calls by conspecifics at the other extreme where communication between whales may be inhibited depending on the separation between the vocalizing whales.

One conclusion we draw from this modeling effort is that ships that are off the continental likely have little acoustic impact on whales in the vicinity of Playa Mar Brava but that single ships that are close to shore cause noise levels likely to disturb whales over zones within a few km of the ship and likely limit acoustic communication over a large fraction of the continental shelf sloping section out to about 15 km from shore while the ship is passing.

Social and Legal Processes

After Ecopower initiated the process, several organizations expressed their opposition on the selected location of the wind farm project. In 2011, the IWC Scientific Committee strongly recommended the urgent development of a full environmental impact assessment of this proposed development (IWC, 2011). In addition, more than 50 whale research experts delivered a letter to the President of Chile, Sebastian Pinera, requesting the company relocate the wind farm project and conduct an Environmental Impact Assessment. However, in August 2011, the Regional Environmental Commission unanimously approved the development of the project without an Environmental Impact Assessment.

Parliamentarians, along with representatives of civil society and indigenous communities, presented several appeals to the Court of Puerto Montt to override the resolution that approved the project.

The case passed to the Supreme Court of Chile and in March 2012 the Court ruled against the project approval, after welcoming an appeal presented by indigenous communities of Isla de Chiloe, southern Chile. The decision shows that the approval of environmental permits without an environmental impact assessment was an "arbitrary act of the Environmental Commission" since it did not conduct a proper consultation process to the indigenous community[1].

Although this project currently is cancelled, there is a second and third proposed project underway for this small area and authorities continue to consider that projects in coastal boundaries will not have an adverse effect on cetaceans and/or coastal and marine ecosystems.

[1] Resolucion Corte Suprema Tercera Sala, 22/03/2012

CONCLUSIONS

Potential impacts of marine renewable energy developments could be site-specific. Baseline data are required to understand the abundance and distribution of species and local habitat use, so that the developments are not located in sensitive areas such as breeding and feeding grounds, or on migratory routes (Simmonds *et al.*, 2010).

Although wind farm projects in Chile are expected to be installed on shore, several impacts still may affect marine mammals on a case by case basis. It is of great concern that more than half of the projects proposed are concentrated along the shoreline and many around cetacean critical habitat. Also of concern is that this is a new issue in Chile and the proliferation of similar projects – without the implementation of EIA – is expected to expand along the country coastline during upcoming years.

One example is the project in northwestern Isla de Chiloe, which is currently cancelled but the company is seeking to develop an environmental impact assessment for the project in the same location. Furthermore, this large project constitutes only the first phase of several that plan to utilize most of the northwestern coastline of Isla de Chiloe for wind farm development.

Impacts from coastal developments of wind farms should not be disregarded. Careful consideration should be given to the selection of locations for wind farm and port constructions in order to guarantee that sensitive areas and species are not affected. Moreover, coastal projects shall include an analysis of the impacts in the coastal-maritime boundary and/or the marine environment and when cetacean critical habitats are identified, an environmental impact assessment should be mandatory.

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Figure 1 – Proposed Wind Farms in Chile

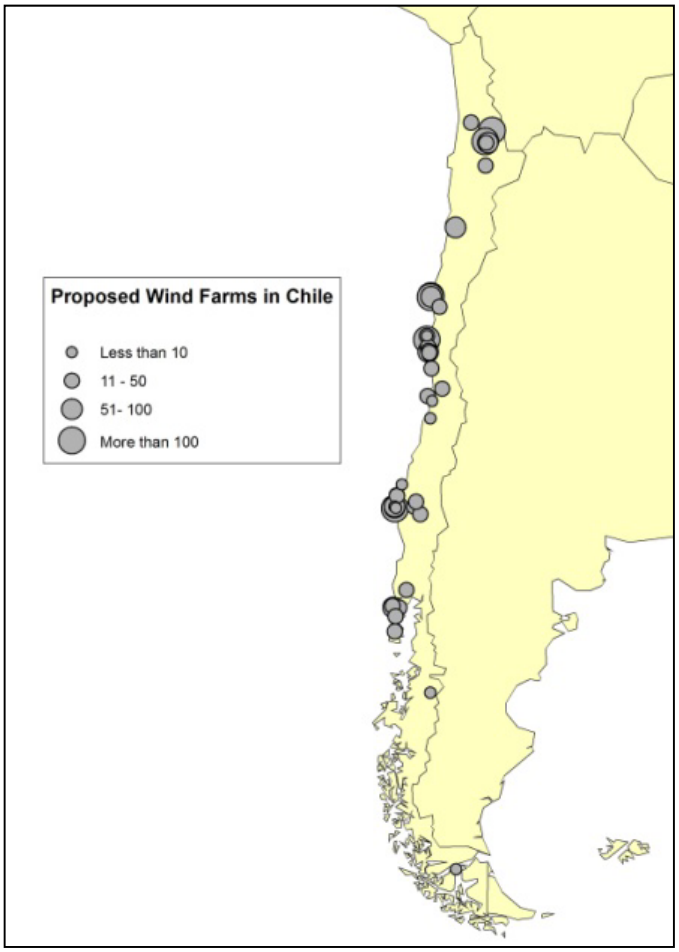

Figure 2 – North view of Mar Brava with windmills proposed location

Figure 3 - Ship (175 dB) at the Mar Brava continental shelf break, 65 km from shore. Frequency is 50 hz. Only a little noise energy propagates in near the shore. The zone that is above 120 dB is about 4 km wide. If this commonly used marine mammal disturbance threshold applies to blue whales then this implies that a blue whale in the deep water off the continental shelf would be 'disturbed' only when a ship was within about 2 km of the whale.

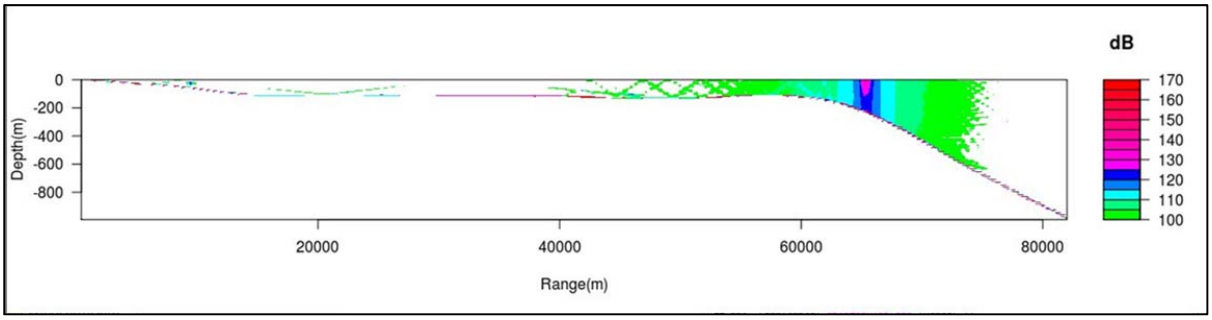

Figure 4 – If the ship is midway over the continental shelf. In this shallow water, the underwater noise is trapped alternately reflecting of the bottom and the top. In this case the energy does not spread out nearly as quickly as it does in the deep water off the shelf. Noise levels extend all the way to the bottom without changes with depth. Here the 120 dB zone of disturbance is about 6 km wide and the masking zone (green) propagates well up the sloping section toward the shore.

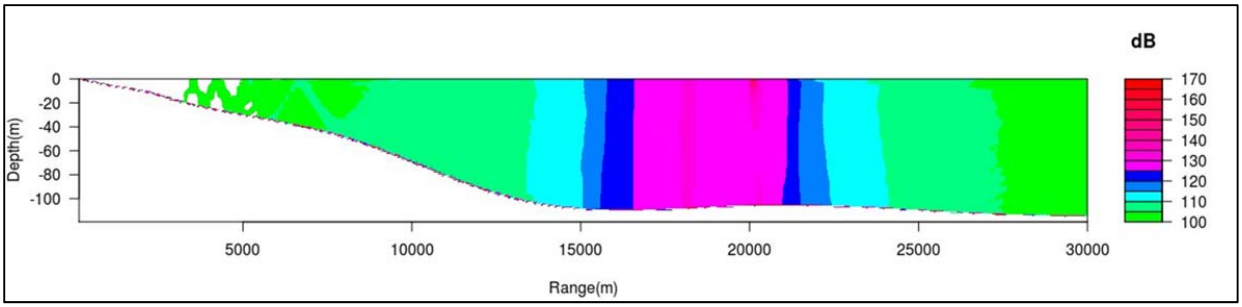

Figure 5 - If the ship moves over the sloping section closer to Playa Mar Brava, the noise is trapped in the wedge shaped section between the surface and the shallow, sloping bottom. Here the ship is at 5 km from shore, about a third of the way along the sloping section and the 120 dB zone of disturbance extends over a 2 km section near the ship and the masking zone extends from the shore out beyond 12 km.