

Use of local ecological knowledge to investigate endangered baleen whale recovery in the Falkland Islands



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ABSTRACT

Baleen whale populations have increased around the world after the end of commercial whaling in the 1980s. Anecdotes from local inhabitants of the Falkland Islands tell of an increase in whale sightings after an almost complete absence. However, no long-term monitoring exists to assess such recovery. With increasing maritime activities around the Islands, local managers need to understand the status and distribution of baleen whales to avoid impeding the potential recovery process. In the complete absence of scientific data, harvesting local ecological knowledge (LEK) from residents could provide means to assess whether whale numbers are increasing. We collected historical knowledge and mapped historical observations through structured interviews with 58 inhabitants and filtered observations for the highest reliability. We also collated existing historical catch and sighting data to compare species composition in inshore and offshore waters. A total of 3842 observations were compiled from the 1940s to 2015. This collation of information provided first-time evidence on the return of the whales in the Falkland Islands' waters. There was a clear increase in numbers of whales sighted, from no observations in the 1970s to 350 observations between 2010 and 2015 for similar effort, mostly of endangered sei whales (*Balaenoptera borealis*) and fin whales (*Balaenoptera physalus*). We mapped contemporary whale sighting hotspots to inform current marine spatial planning efforts. The use of LEK is highlighted here as a useful way to gain a better understanding of changes in the status of threatened species when no scientific monitoring has been conducted.

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1. Introduction

Since the end of the commercial whaling era in the 1980s and added protection through international legislations, there has been evidence of whale populations increasing worldwide (Carroll et al., 2014; Magera et al., 2013; Paterson et al., 1994; Scott et al., 2005; Stevick et al., 2003). The protection of humpback whales (*Megaptera novaeangliae*) in the 1950s and 1960s, for example, has caused this population to increase from a few thousand individuals, to over 60,000 individuals, shifting from an Endangered IUCN conservation status in the 1980s to Least Concern by 2008 (Hoffmann et al., 2011; Reilly et al., 2008). Fin whales (*Balaenoptera physalus*), as another example, had decreased in number by over 70% during the commercial whaling era, and since their protection in the 1980s, has increased in abundance in both hemispheres (Edwards et al., 2015). Further, the southern right whale (*Eubalaena australis*) has, after over 40 years, returned to its former New Zealand mainland calving grounds (Carroll et al., 2014). Knowledge on these and other recovering whale populations is important, as they can

contribute to the essential understanding of a species' global distribution and status (Edwards et al., 2015).

The Falkland Islands and its surrounding waters (Fig. 1) are hosts to at least three endangered baleen whale species (suborder Mysticeti): the blue whale (*Balaenoptera musculus*), fin whale and sei whale (*Balaenoptera borealis*; Otley, 2012). Other baleen whales that have been reported in these waters are the minke whale (*Balaenoptera* spp.), the southern right whale and the humpback whale (Otley, 2012). Similar to other islands in the South Atlantic, the Falkland Islands' waters were historically used by the commercial whaling industry (Jones, 1969). Sperm whales (*Physeter macrocephalus*) and southern right whales were initially targeted in these waters, as they were easier to capture (Salvesen, 1914; Smith et al., 2012). As these species' numbers eventually dwindled and technology advanced, the target shifted to blue, fin, and sei whales in the late 1860s (Salvesen, 1914). By the early 1900s, the stock of whales in these waters further diminished to unprofitable numbers, evidenced by the limited success of the New Island whaling station (Fig. 1; Bonner, 2007; Salvesen, 1914), which had a low seasonal yield compared to other southern whaling industries (e.g. the South Shetland Islands and South Georgia), and was closed within six years of its establishment (Vamplew, 1975).

In recent years, anecdotes heard from long-term local aircraft pilots have indicated that more and more baleen whales have been spotted in

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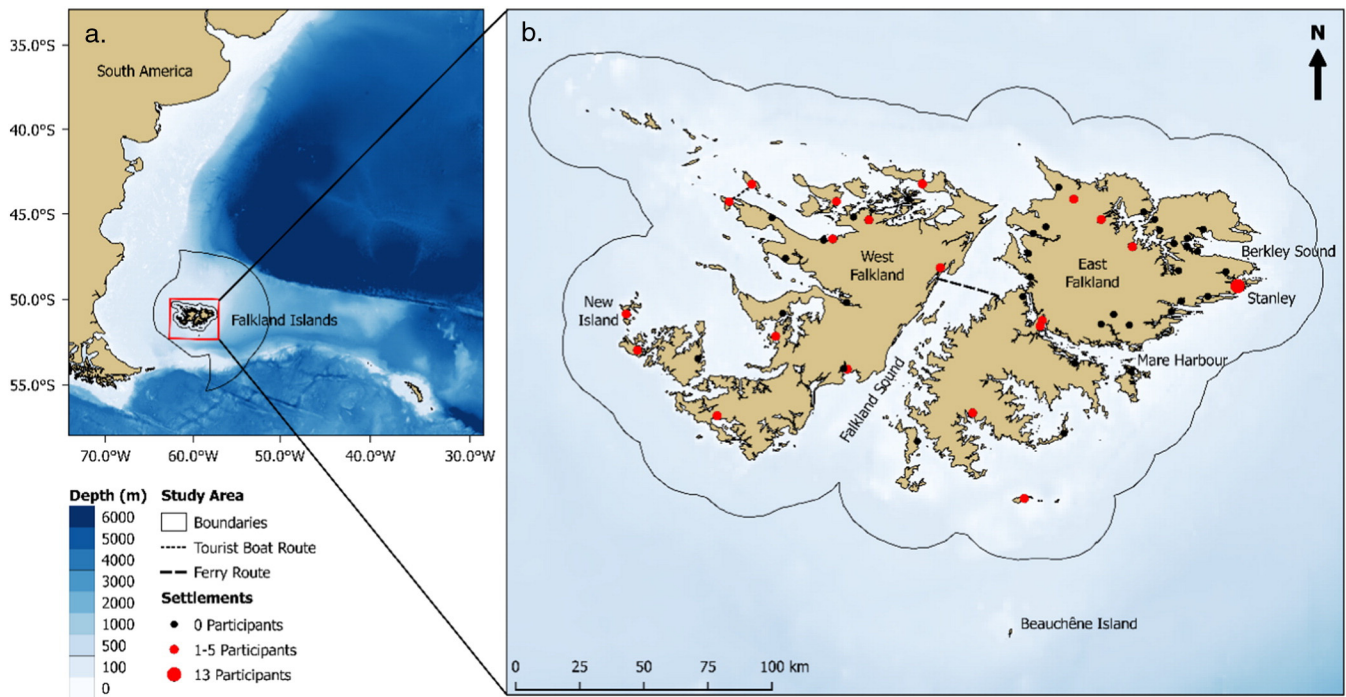


Fig. 1. Maps of the Falkland Islands and its position on the Patagonian shelf. Boundaries show the offshore study area (a) and inshore study area (b). The ship routes indicated are the ferry between East and West Falkland, and the tourist boat between Carcass Island and West Point Island.

the Falkland Islands' waters. It is possible that whale numbers are in the midst of recovery. However, little is known about the historical and contemporary composition and status of baleen whales in these waters (Otley, 2008). Apart from what can be gathered from whaling data (e.g. Adie and Basberg, 2009), stranding data (e.g. Otley, 2012) and two sparsely-conducted empirical surveys (e.g. Thomsen, 2014; White et al., 2002), there have not been many scientific studies on baleen whales in the Falkland Islands' waters. Understanding the historical change in whale numbers in the Falkland Islands can provide information to assess potential recovery and for management purposes. The Falkland Islands Government aims to maintain the protection of resident and migrating cetaceans in its waters, and recognises that a deficiency of information causes a high risk to biodiversity, especially with potential threats from increasing marine use through shipping, tourism, oil exploration and commercial fisheries (Otley, 2008). Ship strikes, for example, could be a concern for these recovering species (Berman-Kowalewski et al., 2010; Williams and O'Hara, 2010), making information on whale distribution and abundance an important component for marine spatial planning (Petruny et al., 2014). However, with no long-term cetacean monitoring in place, there is a lack in seasonal and decadal information on whale presence. Information on historical trends is therefore lost, and systematic surveys cannot be done in retrospect. This lack can, nevertheless, be substituted by an alternative source of information: local ecological knowledge (LEK).

LEK can be defined as ecological knowledge gained through experience or observations (Olsson and Folke, 2001). The person providing this knowledge is not necessarily an 'expert' in the ecological subject, but predefined factors (e.g. occupation or amount of exposure to the surrounding environment where the observation takes place) can contribute towards the credibility and reliability of such knowledge for its use in scientific fields. LEK has been beneficial to researchers, managers and policymakers in understanding complex systems and historical change when research over large or remote areas or over long periods of time have not or cannot be conducted (Brook and McLachlan, 2008; Drew, 2005). It can provide information on species occurrences for future management and research. It has been used in marine management contexts to define marine protected areas (e.g. Mellado et al.,

2014), and as a supplement in fisheries management (Pauly, 1995; Sáenz-Arroyo et al., 2005). It can also be used to infer species distributions (e.g. Frey et al., 2013), habitat suitability (e.g. Polfus et al., 2014), and historical population trends (e.g. McPherson and Myers, 2009). The Falkland Islands' small human population, with inhabitants scattered across the Islands in remote settlements and closely linked to their natural environment through their farming culture, allows for a wide distribution of year-round inshore observers in this remote area, and thus can be a valuable source of knowledge. Obtaining knowledge on baleen whale presence and historical change from this population could serve as an essential starting point for future research and management objectives in the Falkland Islands.

With at least three endangered baleen whale species occurring in the Falkland Islands' waters, it is important to assess the present status of these whales and compare it with their historical status to determine if they are in the midst of recovery. Here, we gather all possible evidence on whale presence in the Falkland Islands' waters by collating and analysing observations collected as LEK and supplementing them with the limited existing empirical sighting data, including historical commercial whaling catch data for comparison in species composition. We present here the first study on historical change in whale observations and nearshore distribution around the Falkland Islands to assess potential recovery and identify sighting hotspots to inform marine spatial planning and future research. This may also provide insights on the potential recovery of endangered baleen whales in the South Atlantic.

2. Materials and methods

2.1. Study area

The Falkland Islands is located in the South Atlantic at the southern end of the Patagonian Shelf, east of the South American continent (Fig. 1a). Its Exclusive Economic Zone (EEZ) covers an area between 51° and 53°S and 57° and 62°W. The islands have 3125 inhabitants (Falkland Islands Government Policy Unit, 2013), living in settlements throughout the archipelago. The largest settlement (2/3 of the population) is the only town, Stanley. There are two ports (Stanley and Mare

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