



Killer whales and their prey in Iceland

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Letter to Volunteers

Dear Earthwatch volunteers,

Our second year of the “Killer whales and their prey in Iceland” expedition was our most challenging yet but thanks to your help and participation we were able to successfully keep monitoring this population - we are so happy to have welcomed you to our project!

This was our second year running an extended field season from June to August and we were very curious to see if we would find some of the same patterns as in the previous year. Unfortunately very poor weather conditions throughout the entire summer in Iceland influenced our ability to collect data and we had significantly less boat and land surveys than in previous years. Yet, we were so happy with your motivation to help with other research tasks, such as analysis of killer whale sounds and photographs collected for photo-identification. We were able to find killer whales throughout the summer and we sighted a number of other cetaceans, including the closest encounter we ever had with a huge aggregation of pilot whales!

We really appreciated the enthusiasm and dedication that you demonstrated for participating in all aspects of the work, from the boat to the land station and office. In all, and despite the bad weather, we were able to continue our monitoring project and collect valuable new information about species occurrence in the area, as well as killer whale feeding behavior throughout the summer months.

We feel very privileged to have shared this experience with you and we sincerely hope that you enjoyed the experience of sub-arctic fieldwork, even with all its challenges! Thank you for all your help and for being a part of our team, takk fyrir! Our very best wishes to you all.

Filipa Samarra

SUMMARY

This was the second field season of the “Killer whales and their prey in Iceland” project and we were joined by 5 teams totaling 29 volunteers. Through land- and boat-based observations during June, July and August we were able to confirm that killer whales occur in the Vestmannaeyjar archipelago (South Iceland) throughout the summer, mostly observed feeding on herring. We also observed other cetacean species, including several sightings of pilot whales interacting with killer whales and once again towards the end of the season we saw blue whales travelling in the distance. This data will help us assess the feeding ecology of killer whales and, more broadly, the importance of this marine ecosystem for marine mammals.

GOALS, OBJECTIVES, AND RESULTS

Understanding the vulnerability of top predators to environmental changes requires understanding their ecology and diet preferences. Killer whales are apex predators that can have significant impacts on the ecosystems they inhabit (e.g. Estes et al. 1998). Although generalist as a species (Hoyt 1994), killer whale populations usually specialize on specific prey types, such as fish or marine mammals (Ford et al. 2000; Ford and Ellis 2006), and the survival of some killer whale populations is dependent on the abundance of specific target prey species (Ford et al. 2010).

Killer whales have long been known to commonly occur in Iceland but the Icelandic Orca Project represents the first long-term research program dedicated to understanding their ecology, behaviour and conservation status.

Our work to date suggests that within this population there are remarkably different feeding strategies; while some whales appear to follow the herring migration and feed specifically on it, others appear to switch between herring and other prey types, including marine mammals (Samarra and Foote 2015; Samarra et al. 2017a, b). Such prey switching is unlike the specialization characteristic of many other killer whale populations. A generalist feeding strategy might be advantageous if prey resources vary substantially in time and space and individuals adopting such a strategy may be better adapted to a changing ecosystem. However, the extent to which different whales may be adopting different strategies is unknown.

Understanding if a large proportion of the Icelandic killer whale population is herring specialist is particularly relevant in the face of changing environmental conditions and will impact our ability to predict how these whales might be able to cope with future climate change or other human impacts.

This project aims to understand variations in the behavioural ecology amongst killer whales observed in Iceland, as well as the importance of herring as prey. This information is crucial to the assessment of the Icelandic killer whale population and will allow us to evaluate which proportion of the population is highly dependent on herring stocks and consequently the threats this population may face. More broadly, the monitoring of different cetacean species will also allow us to help characterize the local marine ecosystem, as well as its importance for different top predators. The Vestmannaeyjar archipelago is not only an important ground for various fish species but also home to the Surtsey Nature Reserve, a UNESCO World Heritage site and thus an area of significant cultural and biological importance.

In this section we report the preliminary findings of the second field season of this project, relative to each of the main goals.

1) Monitor the overall temporal and spatial variation in presence of killer whales in the study area

Weather had a large effect in the data collection this year and was the main limiting factor affecting data collection. Land-based observations occurred in a total of 27 days resulting in over 138 hours of observation (Figure 1). Once again, killer whales were observed throughout the season, suggesting little temporal variation in occurrence. However, observations suggested differences in the number of whales sighted throughout this period; some days involved observations of large aggregations of whales (>50) and in other days only smaller groups were found. Further analysis will investigate variations in the spatial occurrence of whales throughout the season. Other species observed included harbor porpoises (*Phocoena phocoena*), white-beaked dolphins (*Lagenorhynchus albirostris*), long-finned pilot whales (*Globicephala melas*), humpback whales (*Megaptera novaeangliae*), minke whales (*Balaenoptera acutorostrata*) and blue whales (*Balaenoptera musculus*).



Figure 1. One of the many groups of pilot whales we observed this season.

2) Assess inter-individual or inter-group differences in behavior and how that relates to age/sex class and sighting history

We collected a total of 22,624 photographs over 10 boat survey days where occasionally we could use two vessels. To date the photo-identification catalogue contains over 400 whales (Samarra et al. 2017c) and the data collected during the summer of 2018 will now be added to the long-term sighting history dataset to understand how often individuals are seen (sighting frequency). This will allow us to analyse the site fidelity of different whales and groups. Behavioural observations onboard the research vessel were collected on 11 days, 5 of which included observations suggesting feeding behaviour.



Figure 2. Photograph of whale IS055 seen in the summer of 2017 and again in the summer of 2018. Note the features used for photo-identification are the dorsal fin shape and nicks or notches, as well as the saddle patch pattern (the light grey area below the dorsal fin) and scars.

3) Assess individual temporal residence in the area and how that correlates with sighting history

Once the photo-identification analysis has been completed we will calculate the amount of time the study area was used by different individuals (i.e., the temporal residence). This will provide information on the importance of this area and how habitat use may vary across different individuals. Together with the behavioural observations of feeding events and prey collected, this will allow us to assess likely specialization upon herring.

4) Understand if the observed whales strictly feed on herring

Poor weather conditions influencing the amount of days we could do boat surveys affected the collection of fish and biopsy samples. We collected 3 prey samples consisting of whole fish, all of which were of herring. No biopsy samples were collected. Using the patterns of site fidelity and prey samples collected, complemented by biological sampling previously collected which will provide long-term dietary markers, we will be better able to assess if killer whales observed are long-term herring specialists. This will form the basis for our assessment of the vulnerability of this population to fluctuations in prey availability and the threats it may face.

PROJECT IMPACTS

1. Increasing Scientific Knowledge

a) Total citizen science research hours

Volunteers were trained for a period of about 1.5 days at the start of the project. From then onwards, on average, work days started at 9am and finished at 6pm and volunteers were involved in working in the field (boat or land-based) or in the office every day, except for the recreational day.

b) Peer-reviewed publications

The second Earthwatch expedition season was conducted this year and in-depth analysis will continue on much of the data collected. This season will contribute towards the long-term study that we have been carrying out in this area, which has resulted in several publications to date (see <http://www.icelandic-orkas.com/#publications>). Further publications are planned for 2019.

c) Non-peer reviewed publications:

Technical reports, white papers, articles, sponsored or personal blogs

Several social media posts updating on the project's work have been published on the project's Facebook page (<https://www.facebook.com/icelandic.orkas/>). The project's work has also been featured in media.

d) Books and book chapters

e) Presentations:

Indicate if this was an invited paper, panel presentation, keynote speech, plenary address, or other.

An overview of the foraging ecology of killer whales in Iceland was presented at the Icelandic Ecological Society conference in Reykjavik in March 2018 by Filipa Samarra.

2. Mentoring

a) Graduate students

This summer we had several students visiting our project and involved for different periods of time doing research towards their degrees and one PhD student.

Student Name	Graduate Degree	Project Title	Anticipated Year of Completion
Tatiana Marchon	Ph.D.	Social and behavioural context of the acoustic communication of Icelandic killer whales	2021

b) Community outreach

Most outreach to date has been through the project's social media pages for the broader audiences. We are also working towards building a permanent exhibition about killer whales with local partners in our study area. This will be a form of information sharing with the local community and also with tourists, raising awareness about killer whales in Iceland.

Name of school, organization, or group	Education level	Participants local or non-local	Details on contributions/ activities

3. Partnerships

Partner	Support Type(s) ¹	Years of Association (e.g. 2006-present)
Páll Jónsson, þekkingarsetur Vestmannaeyja	Provides logistical support, as well as office space where we are based	2008-present
Icelandic Research Fund (RANNIS)	Funding	2012-present

¹ Support type options: funding, data, logistics, permits, technical support, collaboration, academic support, cultural support, other (define)

4. Contributions to management plans or policies

At the moment, there is no estimate of population size of killer whales in this area, or in Icelandic coastal waters, making it very difficult to assess its conservation status or whether any management plans or policies might be needed. In 2018 the first ever assessment of all species of mammals occurring in Iceland, including cetaceans, was completed. Based on a population size of 5-7 thousand killer whales estimated for a large area of ocean including Icelandic and surrounding waters, the species is considered at little risk. However, this estimate does not take into account diverse ecological strategies that may separate the total number of whales into separate communities, thus a more thorough understanding of population structuring within these waters is necessary to provide a better understanding of the conservation status of killer whales. One of the primary goals of this project is to collect the information that will contribute to this assessment, allowing us to understand the local conservation status for this species. Blue whales, which appear to occur regularly in the study area, are classified as vulnerable and future monitoring of the occurrence of this and other species will help towards our understanding of the importance of this area to top predators such as marine mammals.

Plan/Policy Name	Type ²	Level of Impact ³	New or Existing?	Primary goal of plan/policy ⁴	Stage of plan/policy ⁵	Description of Contribution

² Type options: agenda, convention, development plan, management plan, policy, or other (define)

³ Level of impact options: local, regional, national, international

⁴ Primary goal options: cultural conservation, land conservation, species conservation, natural resource conservation, other

⁵ Stage of plan/policy options: proposed, in progress, adopted, other (define)

5. Conserving natural and sociocultural capital

a) Conservation of taxa

- i. List any focal study species that you did not list in your most recent proposal

Species	Common name	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source

- ii. In the past year, has your project helped conserve or restore populations of species of conservation significance? If so, please describe below.

Species	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source	Description of contribution	Resulting effect ⁶

⁶. Resulting effect options: decreased competition, improved habitat for species, range increased, population increase, improved population structure, increased breeding success, maintained/enhanced genetic diversity, other

b) Conservation of ecosystems

This project will contribute in the long term to the assessment of the status of the Icelandic killer whale population and also its potential impacts on the local ecosystem. More broadly, by monitoring the occurrence of other marine mammals in this area we will also provide a better understanding of the local ecosystem, which includes the Surtsey nature reserve and UNESCO World Heritage site. Understanding the species that occur in this habitat, as well as their use of the habitat, will help towards assessing its conservation needs.

In the past year, has your project helped conserve or restore habitats? If so, please describe below.

Habitat type	Habitat significance ⁷	Description of contribution	Resulting effect ⁸

⁷. Habitat significance options: nursery, breeding ground, feeding site, corridor, migration path, refuge, winter range, summer range, spring range, fall range or other (define)

⁸. Resulting effect options: extent maintained, condition achieved, restored, expanded, improved connectivity or resilience

c) Ecosystem services

- Food and water
- Flood and disease control
- Spiritual, recreational, and cultural benefits
- Nutrient cycling

Details:

In this project, we monitor the occurrence of marine mammals in the study area. As top predators that can act as sentinels for environmental change, monitoring such species allows us to improve our knowledge of changes in the ecosystem. This could include changes in economically important fish stocks, such as herring. Although we are not directly studying these ecosystem services, sharing information on the occurrence of marine mammals in the area with the local community supports recreational activities and tourism, as well a more in-depth understanding of the biodiversity of the sea that surrounds the islands.

d) Conservation of cultural heritage

We are working towards building a permanent exhibition about killer whales with local partners in our study area. This will be a form of information sharing with the local community and also with tourists, raising awareness about killer whales in Iceland. Sharing our findings with the local community through our exhibition will also raise awareness locally of the wildlife richness inhabiting their seas, which we hope will contribute to an increased interest in the environment and its protection.

Cultural heritage component ⁹	Description of contribution	Resulting effect

⁹. Cultural heritage component options: traditional agriculture, artifacts, building(s), hunting ground or kill site, traditional ecological knowledge and practices, monument(s), oral traditions and history, spiritual site, traditional subsistence living

RESEARCH PLAN UPDATES

Report any changes in your research since your last proposal/annual report. For any 'yes' answers, provide details on the change in the 'Details' box. This section will not be published online.

- 1) Have you added a new research site or has your research site location changed? ~~Yes~~ No
- 2) Has the protected area status of your research site changed? ~~Yes~~ No
- 3) Has the conservation status of a species you study changed? ~~Yes~~ No
- 4) Have there been any changes in project scientists or field crew? Yes ~~No~~

Details - provide more information for any 'yes' answers

- 5) Provide details on any changes to your objectives, volunteer tasks, or methods, include reason for the change.

ACKNOWLEDGEMENTS

We would like to firstly thank all the Earthwatch volunteers that joined us at the Icelandic Orca Project this summer, for supporting our research and for their tremendous help in the field. This research is truly a joint effort and would not be possible without the support from the local community and, in particular, the local research center and especially Páll Jónsson and Georg Skæringsson. Finally, we sincerely thank the Icelandic Research Fund for providing research funding for the project.