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Quick evaluation of two pinniped observation sites for behaviour studies and photo-identification, from a tourist point of view, in Skjálfandafljót near Húsavík, Iceland.

David Milesi-Gaches*, Alexandre Lhériau

* Corresponding author, e-mail: milesi.david@gmail.com

Abstract

With the decline of the pinniped population in Iceland alongside increasing wildlife watching tourism, monitoring seal colonies is of critical concern. Close to the world-class whale watching spot of Húsavík, sandbanks in the river Skjálfandafljót serve as hauling area to a colony of Harbour seals (*Phoca vitulina*, Linnaeus, 1758). Located in both banks of the river, two observation sites were documented for behaviour studies and photo-identification (PID) suitability. Seal watching, as a touristic activity, was specifically considered. Indeed, pinnipeds were not observed with specific equipment designed for science but with equipment tourists and amateurs might use. This pilot observation was designed around a 2-days fieldwork, simulating the length of stay tourists might spend near Skjálfandafljót. Data processing revealed that both sites appear to be poorly suitable to accurate and comprehensive behavioural studies (e.g., unfavourable for nursing behaviour) or amateur/general public PID. Access through a private area or distance from the bank to pinnipeds being the more important limiting factors. However, specific equipment might allow a proper PID alongside alternative way to approach the colony. We recommend only conducting basic behavioural studies or population monitoring. Seal watching tourism might also be considered despite the necessity to keep this activity low, according to local specificities, or the potential threats to biodiversity tourism can lead to.

Keywords

ecology, harbour seals, *phoca vitulina*, Iceland, photo-identification, tourism

1 Introduction

In Iceland, the population of Harbour seals (*Phoca Vitulina*, Linnaeus, 1758) has been observed to decline over the years, with many factors contributing to this trend. Despite the underlying causes to this decline lacking sufficient evidence, interactions with fisheries and tourism were reported as principal threats (Clack, 2016; Kovacs et al., 2012). In Iceland, tourism increased by 150% in 2013, compared to the previous decade (Óladóttir, 2013). One of the main reasons being the increase in opportunities to observe wildlife, such as whale watching, which attracts tourists. With no official seal watching guidelines, the impact of tourism on pinnipeds remains unframed despite the recommendations of the Icelandic Seal Centre (Selasetur Íslands) and the possibility for wildlife watching boats to agree to a voluntary code of conduct (Clack, 2016; Selasetur Íslands, 2011). Consequently, tourists or local communities might lack proper information and good practises on how to observe and interact with pinnipeds. Especially since tourism can significantly foster the decline of pinniped populations. Habitat loss, overfishing or deteriorations were, for example, reported as threats suffered by monk seals (Johnson and Lavigne, 1999). Pinnipeds usually suffer from direct and indirect anthropogenic disturbance and might change their behaviour (e.g., increased vigilance, avoid encounters) or

their hauling pattern in consequence. In the case of Harbour seals, anthropogenic disturbance might decrease their resting or foraging time. Likewise, separation between mother and offspring was observed, thus leading to starvation of the young (Granquist and Sigurjonsdottir, 2014). Then, monitoring pinniped population remains a prerequisite to proper development of management and conservation strategies.

In Iceland, the population of pinnipeds is evaluated by a yearly aerial survey (Hauksson, 2010). Seals are counted all along the coastline, despite visibility bias being described since 1987. Indeed, vegetation, weather, rocks, observer fatigue or the type of camera (when applicable) are factors that can lead to missed animals (Pollock and Kendall, 1987). Hence, land-based or boat-based observation of pinnipeds remain possible solutions to study animal behaviour and the underlying regional specificities and variations. Thus, assessing observation sites might provide alternative options to the main aerial counting method in Iceland, and allows to record the characteristics of observation sites near Icelandic pinniped hauling areas. Moreover, land-based observation remains the most likely activity to be experienced by tourists, compared to recreational aviation.

In this pilot study, two land-based observation sites were quickly assessed. Both are also accessible by row boats or zodiacs and are close to tourism accommodations (Figure 1). Located near Húsavík, often considered as the European capital for whale watching, the river Skjálfandafljót offers several sandbanks used by pinnipeds as hauling areas. Although the two observation sites are located in a remote area, they remain close to touristic activities and infrastructures, thus likely to be visited by tourists. The first site investigated was called ‘*Berg*’ after the eponym hostel close by. The second site, ‘*Björg*’ refers to the farm in which it is located. A farm which also welcomes tourists in a guest-house. Both the hostel and the guest-houses are located in a 500m radius of the sandbanks used by pinnipeds as hauling sites. Wildlife watching has been already documented as increasing in Iceland, even in remote areas such as the one investigated in this study (Hoover-Miller et

al., 2013). As a consequence, we took into consideration that the observation sites may be, if not already, of touristic and commercial interest, in addition to a scientific interest.

Then, we decided to allow only 2 days of observation to this study, in order to simulate the conditions in which tourists might observe pinnipeds in Skjálfandafljót. With an average length of stay of 6.5 nights (between July 2017 and June 2018), we make the assumption that it is quite unlikely that tourists spending roughly a week in Iceland will dedicate more than 2 days to seal watching (Óladóttir, 2018). Especially since the studied site remains close to Húsavík, which is a major touristic spot and provides different activities through organised and advertised touristic circuits, involving whale watching or geothermal activities, but often unaware of the proximity of these hauling sites (personal communication).

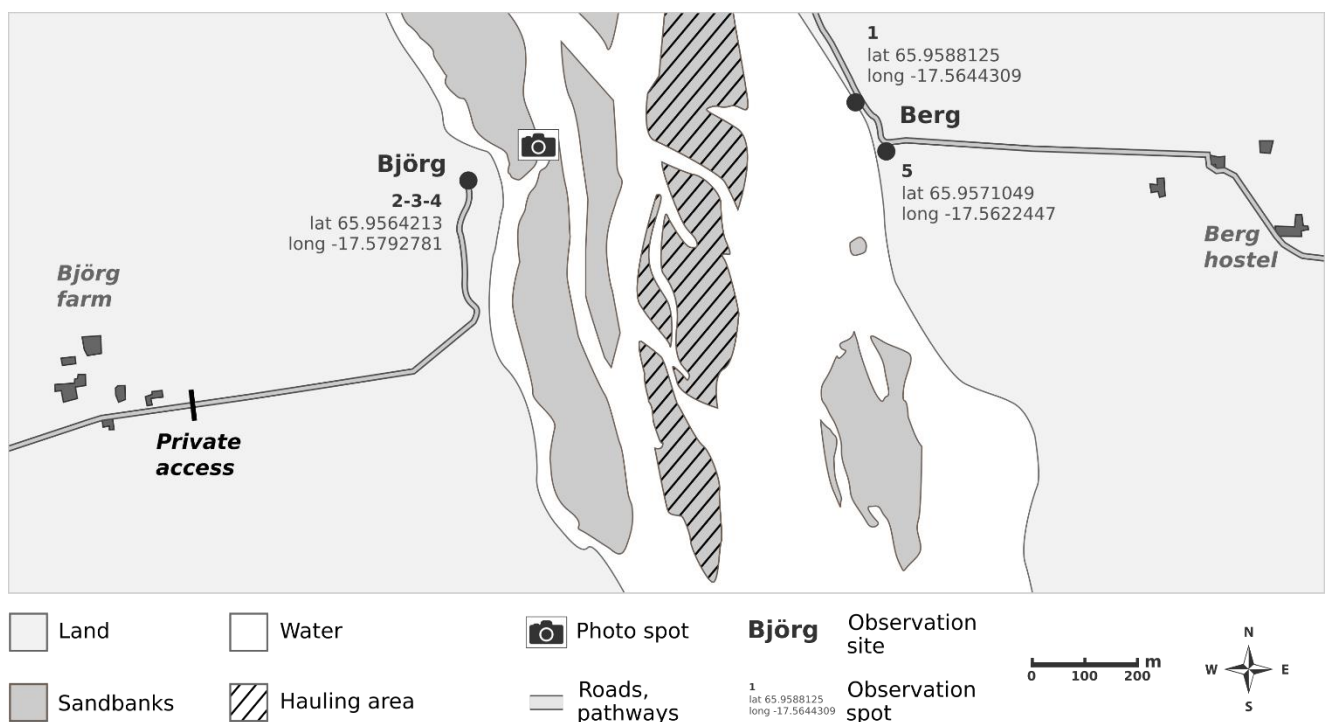


Fig. 1 Location of the 2 pinniped observation sites in Skjálfandafljót.

In order to observe as many individuals as possible, fieldwork was done in June, during the later part of the pupping season in Iceland (May-June) (Clack, 2016; Thompson et al., 1997). For two days, a colony of Harbour seals (*P.vitulina*) hauling on sandbanks in Skjálfandafljót was observed, using a scope, binoculars, and a camera. Particular attention has been paid to the use of equipment tourists or amateurs might possess, excluding de facto high-technology solutions which are less likely to be manipulated

by a wide audience out of the scientific community. Figure 1 delivers further details on the study site, as well as the two observation spots of Björg and Berg. The material and methods section describe how the fieldwork was conducted while the results section summarises the main output from the collected data. Finally, results, limitations of this study and potential future implications are discussed.

The aims of this pilot study were to:

- Provide researchers, policy-makers, the tourism industry, as well as a larger audience, information about two pinniped observation sites in Skjálfandafljót,
- See if it is possible to develop photo-identification, and behaviour studies,
- To provide basic recommendations to observe seals in this area,
- Collect data on seals behaviour,
- To encourage careful human-pinnipeds interactions, particularly in the context of tourism.

2 Material and methods

2.1 Selection of the two observation sites

The two observation sites were discovered by word of mouth. The information was cross-checked between the distribution of the hauling sites along the Icelandic coastline as described in Hauksson (2010) and the local knowledge from researchers from the Research Centre of the University of Iceland in Húsavík. One major hauling site was identified in the estuary of Skjálfandafljót, with a privileged spotting point on the right bank, near the Berg Hostel, later called ‘Observation site Berg’. The left bank, part of the Björg farm, was also investigated in order to assess any dissimilarities in the visibility and in accessibility. Both sites also host tourism facilities, despite no information about tourism patterns in the area, or profile of people staying overnight in close-by accommodations were found.

2.2 Selection of the time of observation

Decrease in the population through the day has been observed in Canada and Alaska as well, making early morning the best time to document pinnipeds behaviour (Calambokidis et al., 1987). However, we decided to select the time at which pinnipeds were observed according to the tide forecast in Húsavík (Tide Forecast, 2021). Each observation session started after the high tide since seals are expected to respond to tides, hauling at low tide and leaving around rising or high tide (Heber, 1967; London et al., 2012). However, the use of tide forecasts remains limited for the two observation sites as they are located inland. Therefore, the impact of the tide was expected to be low and delayed. Since Björg requires entering a private property and to drive through a sheep pasture, we decided not to conduct fieldwork late in the evening (later than 7.30 pm)

to avoid disturbing beyond reason both sheep and people living in and around the farm.

2.3 Behaviour

To properly document the behaviour and temporal trend of seals through the day, a herd of 20 to 30 seals was monitored over 2 days (19th and 20th of June 2021). Multiple parameters were considered throughout the day (Table 1). The minimum time of an observation session was set to 2 hours straight, up to 6 hours, duration equivalent to a full tidal change. Observations were made by two observers, each being assigned to a part of the colony, with regular inter-observer controls. The behaviour of each individual of the herd was monitored using Monk Nereus 7x50 binoculars and an Apo-Televid 77 scope on a tripod. Each recorded behaviour was given a time code and categorised in one of the nine different behaviour classes (Table 2). Nursing behaviour was recorded with duration and a distinction was made between pups, yearling and adults for playing behaviour when possible. Considering this study took place during the end of the nursing season, specific adults-pups interactions were expected, among which antagonism, tolerance or fear (Heber, 1967).

Table 1 Parameters measured during observations.

Parameter	Unit	Update frequency
Date	DD/MM/YYYY	Beginning of the observation
Time	HH:MM:SS	Beginning, end, events
Tide	Character string	Every hour
Weather	Character string	Every hour, visible change
Cloud coverage	Percent	Every hour
Geographical coordinate (observer)	Degree, decimal degree	Beginning of the observation
Distance to heard parts	Metres	Beginning of the observation
Angle to heard part	Degree to North	Beginning of the observation

Table 2 Definitions of seal behaviours
(amended from Granquist and Sigurjonsdottir, 2014).

Behaviour	Definition
Resting	Lying either on the back, the stomach or on the side, without moving and with the head down.
Play	Playing with one or more other seals, no visible aggressive reaction.
Nursing	Pup laying with head close to the teats of the mother.
Vigilance	Lifting the head up with eyes open and/or moving the head from side to side.
Vocalizing	Any vocal manifestation (e.g., crying, growling).
Antagonism	Fighting, biting, hitting with head/tail/flippers.
Locomotion	All visible movements within the colony, where an individual was moving from one place to another on land or in/out of the water.
Leaving	All visible movement where an individual is leaving the hauling area/colony without visible signs of stress, haste.
Flush response	Rushing to the water.
Other	All other behaviour.

The number of patches and spreading of the herd was also quantified arbitrarily to evaluate the age and/or relation between individuals. Close couples presenting an important size difference and nursing behaviour were categorised as Mother and Pup observation, Groups of three and more individuals with less than 1 metre in between, possibly exposing playing behaviour, were categorised as Yearlings in accordance with Heber (1967). Finally, individuals more than 2 metres from each other were considered Adults (Heber, 1967; Hamilton et al. 2014).

2.4 Photo-identification (PID)

In addition to behaviour monitoring, each individual hauling was photographed using a Canon EOS7D Mark2 camera with a 100-400mm lens. Each photograph aimed to show specific patterns on the fur of *P.vitulina* for identification. The photographs were later sorted by date and individuals to visualise any redundancy (A.K.A. identification) over the sampling period.

3 Results

The two sites present both similarities and important differences (Table 3). While Berg is accessible through a public dirt road, access to Björg requires permission from the owner of the farm. The observation site can only be reached by crossing a sheep pasture seemingly occupied all-summer long.

Table 3 Characteristics of the two observation sites.

Characteristics	Berg	Björg
Latitude	65.9588125	65.9564213
Longitude	-17.5644309	-17.5792781
Type	Land-based	Land-based
Access	Dirt road	Grass road
Permission to access	Public	Private
Tourism activity	Hostel	Guesthouse
Sight quality	Medium	Excellent
PID suitability	Poor	Poor

Other than Hauling and Leaving, 10 specific behaviours were recorded on the 19th and 14 on the 20th (Figure 2.A). Despite being more freely accessible, Berg does not allow proper observation because of the relief of the sandbanks. Observing the colony from Berg precluded us from seeing many individuals. All behaviours and actions taking place close to the water were almost impossible to observe. Expectedly, the 8 occurrences of nursing were only observed from Björg, where we had a clear visibility of the colony (Figure 2.B). A X^2 test of repartition was impossible to do considering the Cochran theorem was not respected (Table 4). As a consequence, a Fisher test of repartition was made to determine if the behaviour might have changed from one day to the next, yet was not significant. The behaviours are judged similar between the 2 observation days (p-value= 0.2857). The distribution of behaviours depending on the sites is not as even as for the dates. For Berg, only 7 specific behaviours (i.e., excluding leaving and resting) were recorded, whereas 17 were recorded from Björg side. Despite that, the specificities of each site did not appear as statistically significant using R.4.1.0 (p-value= 0.1429).

Table 4 Occurrences of each behaviour.

Behaviour	Berg	Björg	19-06	20-06
Antagonism	3	5	4	4
Flush response	1	3	1	3
Leaving	24	27	25	26
Locomotion	4	0	2	2
Nursing	0	8	2	6
Other	1	2	2	1
Play	1	2	2	1
Resting	23	24	17	30

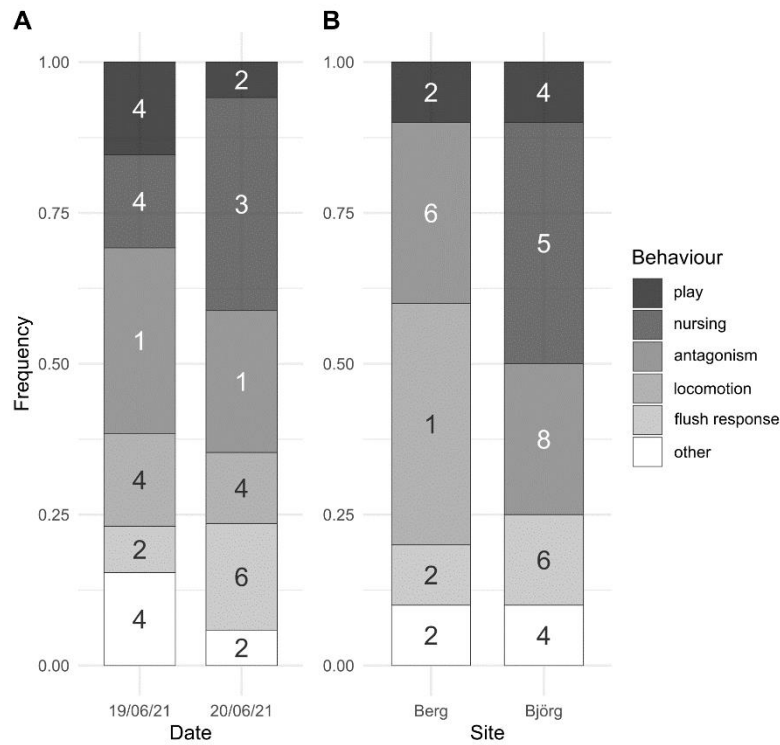


Fig. 2 Frequency and number of each observed behaviour (except resting and leaving) of *P.vitulina* in Skjálfafljót sandbanks depending on the day of observation (A) and the site of observation (B).

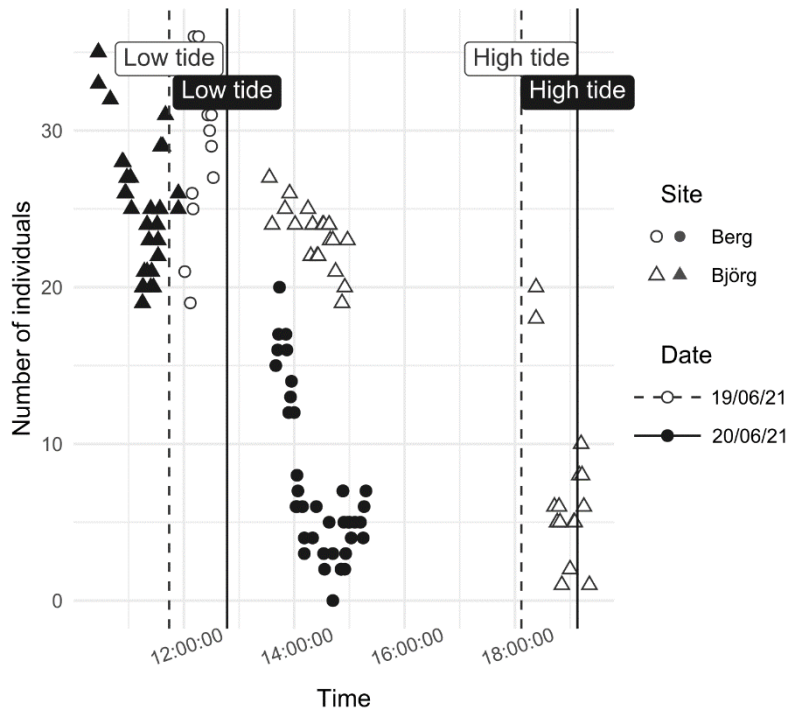


Fig. 3 Variation in the relative abundance of *P.vitulina* in Skjálfafljót sandbanks through time, depending on the observation point (circle: Berg; triangle: Björg). Low and high tide are indicated by vertical lines.

As shown in Figure 3, the herd located in Skjálfandafljót presented a steady number of individuals on both days and sites. Maxima of 36 and 35 individuals on the 19th and 20th respectively, with associated minima of 1 and 0 seals at the end of the observation period. As for the variation between sites, maxima of 35 and 36 seals were observed in Björg and Berg and respectively, along with minima of 1 and 0 individuals. The herd showed a steady decline as the tide rose.

3.2 Photo-identification (PID)

PID on the herd of Skjálfandafljót was not successful. Reason being the distance to the observer (over 200m) was too important, considering the equipment at our disposal, thus leading to a poor data collection as shown on Figure 4. In addition, the chances of PID using only a two-day sample are low. The constitution of a reliable photograph database would imply collecting high definition samples in which fur patterns must be easily recognizable. As well, photographs of each individual must be captured in different angles in order to increase the possibility to identify seals, regardless of their position. Despite moving from one site to the other one is possible on the same day, the journey represents approximately 35 km (circa 40 minutes drive), including gravel/dirt roads and frequent sheep encounters. Thus preventing PID data collection from both side of the river, in addition to the previously mentioned sandbank topography. Furthermore, an increase in traffic on the tractor path for touristic reasons could thus harm the herd and agricultural activity.



Fig. 4 Example of a photograph obtained for PID.

4 Discussion

This preliminary observation allowed us to describe the two main seal watching sites in Skjálfandafljót, and to assess their suitability for further investigations, studies or projects, such as PID. Among the two sites, Björg appears to be the most appropriate option to monitor the population

behaviours and to acquire photographs for a possible PID catalogue. Nevertheless the access to this site remains limited. Located in a private property, observing seals from Björg implies obtaining permission from the owner of the farm and paying special attention not to disturb the activities of the farm or the sheep herd. These parameters make the site unsuitable for daily surveys or tourism, yet the landowner was keen enough that a short time observation was permitted. The second site, Berg, remains the most accessible since it can be reached via a public pathway. However, it also implies using a dirt road which is not suitable for non 4x4 cars. Moreover, the relief of most sandbanks doesn't allow a proper observation of the colony. The landform was sufficient to prevent us from seeing nursing behaviours which occurred near the water, on the lowest part of the hauling area. This latter point is of critical importance for any further study which would like to evaluate nursing behaviour of this colony or to study pups who usually need to increase their hauling time since they are limited in their capacity to regulate body temperature (Henry and Hammill, 2001).

A specific aim of this pilot study was to determine if the two sites were suitable for PID of seals, in a way tourists or amateur photographers can contribute. Both from Berg or Björg, we were unable to come closer than 200m from the colony, thus leading to poor photograph quality as mentioned above. Moreover, an efficient PID would require to possess seal photographs from different sides, in order to catch fur patterns, and then, foster an easier identification of pinnipeds. While the arrangement of the two observation sites, each on a shore, could increase the chance to have enough suitable photographs for PID, the previously mentioned relief of the sandbanks impedes a proper collection of data. PID is still possible but should require equipment capable of producing quality photographs beyond 200m. Water reflectance, depending on the time of observation, can also affect photograph quality and should be taken into account. Further study should now evaluate the possibility of a science-driven PID, with more specific and efficient equipment. Another solution could be to come closer to seals with, for example, a row boat or a zodiac. However, approach and watching behaviour can be extremely stressful (Granquist and Sigurjonsdottir, 2014). Especially since the use of kayak to approach pinnipeds has already been assessed as a disturbance. Indeed, kayaks can come closer to the pinnipeds and might be perceived by the colony with a predator-like appearance (Hoover-Miller et al., 2013). This latter conclusion is to be taken into

consideration, whether for the PID or any study or observation requiring to reach Björg and Berg sites.

Hence, the sites of Berg and Björg are mostly adapted to basic observations of behaviours, to population monitoring, or, for example, punctual educational field-trips. But these observation sites remain quickly limited for seal watching tourism, PID studies or investigations which require long periods of data collection. Indeed, collecting data over an important period of time would imply to regularly access private property and disturb a sheep herd. Despite being publicly accessible, the access path to Berg is of significant length without cover or topographic structure able to break the sound. This difference of behaviour may provoke flush responses if the observers are not aware of the presence of seals, forcing the latter to flee to the sea or to search a new hauling site, less accessible to tourism or scientific observation. However, few anthropogenic sounds were recorded during the two days of observation. This latter point can be explained by the fact that both sites are located in remote areas. But the simple presence of human silhouettes might disturb the colony, or at least catch the attention of several seals. During the two days of fieldwork, our presence was sufficient to trigger vigilance and 'scanning' behaviour towards us during the first half hour to one hour after arrival. Said scanning behaviour was observed during the study but not documented as it was not the primary focus of the study. Nevertheless, a complete flush response (disappearance of the entire herd in less than a minute) was observed in the evening of the 19th, suggesting that one seal was triggered during its scan and provoked the fleeing response of the entire herd (Terhune, 1985). The origin of the flush response, however, remains unknown. Therefore, we recommend to any person going to Berg or Björg for seal watching to adopt an appropriate behaviour and to minimize any sound which can disturb seals or induce unusual responses and behaviours.

All the data collected was processed through statistical analysis, in order to evaluate potential variation or patterns linked to the tide, the side of observation, or the weather. Nevertheless, none of the performed statistical analyses appeared to be significant. We suspect that the time of the study was too short to properly document any behavioural pattern on the Skjálfafljót herd. Withal, and despite a more extensive time of observation that would have led to more significant results, the collected data would not have been gathered using aerial survey (Hauksson, 2010). Counting the number of individuals in the herd was done extensively during the survey, every 5 min at least in order

to have an accurate depiction of the herd variation with time. Furthermore, as seals are counted all along the coastline during aerial survey, there is a high probability that the Skjálfafljót herd was not taken into account as its hauling site is located farther inland. Especially since it remains difficult to distinguish seals when they are close to other individuals, rocks or specific vegetation (Pollock and Kendall, 1987). Further studies should extend the time of observation and the number of sessions beyond two days. This could allow the identification of the Skjálfafljót herd specificities, potential regional variations, and lead to assess the relevance of monitoring the colony population through land-based methods instead of the yearly aerial survey. Our study is also limited by the quality of the equipment used. This fieldwork was designed with tourism activities in mind, in a way it can be reproduced by tourists and amateurs both on time and equipment. Despite being obviously limiting, the short time of 2 days of field observation aimed to simulate the time tourists might dedicate to seal watching, or the time amateurs can spend watching seals in a weekend, for example. This remains indeed unlikely to see tourists spending two days observing seals while the average length of stay is 6.5 days. Besides, the nearby city of Húsavík provides important touristic activities such as whale and dolphin watching, sailing tours and geothermal activity. Likewise, scientific fieldwork might also be quickly limited because of costs, material and research agenda. In that way, this pilot study highlights, through its short fieldwork, both the quantity and quality of data one can expect from a tourism-based research or from contributions from amateurs and nature lovers. Nevertheless, better equipment would have made the observation easier, particularly to distinguish seals which are resting close to another, to monitor individuals resting in remote areas of the sandbanks, or to conduct comprehensive research.

Hence, Björg and Berg sites offer a low quality environment for observers willing to undertake extensive and comprehensive studies of the pinniped colony. Both observation spots are however suitable for basic research such as hauling patterns of the colony, quick population survey or behaviour observation, particularly from Björg, although accessing the river bank requires obtaining the permission of the owner of the farm. Seal watching, as a touristic activity, is the same way possible but should be developed in the respect of both the Code of conduct for seal watching (Selasetur Íslands, 2011) and the local environment and residents. Despite being accessible

through a public pathway, the site of Berg can only be reached crossing the yard of a farm, thus generating disturbances at the local scale. Nevertheless, the impact of tourism around the two sites must be the object of further studies. With a hostel nearby Berg and a guest-house in Björg, the harbour seal colony might already experience encounters with tourists and be the object of seal watching, at least to a certain extent. The two days of observation of this study remain insufficient to assess any potential impact of tourism from customers of the above-mentioned touristic accommodations. During the fieldwork, the presence of tourists has not been documented, and no occurrence was observed. As well, further studies should be developed in order to evaluate, in a more holistic way, the potential of Skjálfafljót hauling area for research and seal watching taking into account the interactions with wildlife (other than pinnipeds), farming activity and local population. Identically, quantifying the extent to which seal watching can be developed as a commercial touristic activity, should be the subject of a dedicated study. While both the Skjálfafljót environment and the pinniped herd are poorly documented, we recommend not to expand activities other than research. Thereby, we invite visitors of the two sites to be respectful of the harbour seal colony and other animals observed in this habitat (e.g. birds), as advised in the Code of conduct for seal watching by Selasetur Íslands (The Icelandic Seal Centre).

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