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Black guillemots, Eurasian oystercatchers, Herring and Lesser black-backed gulls, Great cormorants, and Northern fulmars census in Vigur island, Iceland.

Abstract

Known for its exceptional biodiversity, Vigur island (Westfjords, Iceland) welcomes each year several bird colonies. This 2km long island for a width of only 400m, also hosts an eiderdown farm and touristic visits from late June to September. Hence, the aim of this study was to create a baseline and count the population of black guillemots, Northern fulmars, great cormorants, both Herring and Lesser black-backed gulls, Eurasian oystercatchers and Atlantic puffins. Due to the conservation status of each species, a complete census was done by two observers walking around the island. Each population was counted five times and the geographical repartition was later represented. Owing to difficulties to identify puffins at sea, no counting was made for this specie. Similarly, Herring and Lesser-black backed gulls were counted together to avoid likely misidentifications. Then, potential differences form observers were addressed through a Wilcoxon-Mann-Whitney test. The results show that Vigur hosts 1092 Black guillemots, 28 oystercatchers, 19 cormorants, 120 fulmars and 58 gulls. The count for guillemots is up to three times higher than previous or local estimates. Comparison was impossible for the other species as no count was previously done. Consequently, this study is a baseline to monitor bird populations in Vigur. We recommend then to undertake to regularly update the census, in order to adopt appropriate conservation and tourism strategies.

Keywords

Conservation
Ecology
Ornithology
Seabirds
Tourism

Introduction

Located just South of the Arctic circle, Vigur island is a famous Icelandic touristic place in the Westfjords, known for being the home to several iconic Icelandic bird species, such as the Atlantic puffin (*Fratercula arctica*, Linnaeus, 1758), the black guillemot (*Cepphus grylle*, Linnaeus, 1758) or the common eider (*Somateria mollissima*, Linnaeus, 1758). Vigur is also part of the maritime heritage with Iceland's one of the oldest windmill, old buildings and a working boat. Moreover, the island has a long tradition of wild eider farming (circa 10,000 common eider): eiderdown is collected and cleaned before being sold to duvet or pillow manufactures. Own by a family living there year-round, this private island can be visited both for its historical heritage and its abundant wildlife. Famous for being home to 100,000 puffins (Hansen, 2019), a rare colony of black guillemots, nesting Arctic terns (*Sterna paradisaea*, Pontoppidan, 1763), Vigur also welcomes both harbour and grey seals (*Phoca vitulina*, Linneaus, 1758; *Halichoerus grypus*, Fabricius, 1791). The island attracts many tourists, photographers and nature lovers from all around the world (BirdLife International and Directorate-General for Environment (European Commission), 2015; Vigur Island, 2021).

Despite the fact that different tours can be proposed to the visitors, the average journey consists of boats coming from the nearby city of Ísafjörður, with groups of 10 to 60 tourists (Figure 1). With a pier located at the South-East, visitors immediately see seals, at low tide, before visiting the eiderdown workshop. They usually follow a guided tour during which they walk alongside the coast. There, they can observe and admire puffins, guillemots, common eiders and oystercatchers (*Haematopus ostralegu*s, Linnaeus, 1758) among other species. Between May and August, an Arctic tern colony is nesting close to the buildings, in the Southern part of the island. Known as very territorial, this specie does not hesitate to attack predators or humans coming close to the nests. Hence, visitors are given a wooden stick they hold above their head to avoid any direct attack from terns, while they walk on the pathway. Finally, they are invited to have coffee, to taste rhubarb jam, and traditional Icelandic sweets like happy marriage cake (Hjónabandssaela), kleinur and kókosbollur, all made on site.

Figure 1. Touristic circuit in Vigur island.

Depending on their condition and the time of the visit, some visitors are welcomed to 'free roam' on the island, where they can see Northern fulmars (*Fulmarus glacialis*, Linnaeus, 1761), great cormorants (*Phalacrocorax carbo*, Linnaeus, 1758), gulls, puffins and guillemots in wild landscapes. Two guest houses also give the possibility to visitors to stay overnight. With a length of 2km for a width of only 400m, Vigur is a place where different species cohabit close to each other, including vicinity with humans, in a context of tourism. Hence, monitoring bird populations is of critical importance, in order to evaluate the condition of each colony and develop appropriate management and conservation strategies, especially linked to the tourism activity. In this study, we decided to estimate the population of the following species of seabirds: Atlantic puffin (*F. arctica*), black guillemot (*C.grylle*), Eurasian oystercatcher (*H. ostralegus*), Northern fulmar (*F. glacialis*), great cormorants (*P. carbo*), European herring gull (Larus argentatus, Pontoppidan, 1763) and lesser black-backed gull (*Larus fuscus*, Linnaeus, 1758). The following three species are the most critically recorded in the IUCN Red List: puffins (Critically endangered), black guillemots (Endangered) and Arctic terns (Vulnerable) (Fuglavernd, 2021).

Bird populations were counted 5 times by eyes, with the help of binoculars. After 3 attempts using different methods (eye/binoculars counting and photograph counting with two cameras), we decided not to estimate Vigur's population of puffins, owing to the difficulties which would have led to poor and inaccurate results. Despite being counted, the estimation of lesser black-backed and herring gulls should be read with caution. Indeed, insignificant results, as well as practical difficulties met on the field to distinguish gulls made us count them as one group rather than two species. This is why the number of individuals for gulls species remains indicative. Linked to the eiderdown harvesting activity, common eider doesn't require the same process of counting, and then were left aside. Also present on the island, the Arctic tern colony will be the subject of a specific paper.

The aims of this study were to:

- Provide researchers, policymakers, conservation stakeholders, as well as a larger audience, estimation of different bird populations in Vigur island,
- To create a baseline for bird populations which were not counted prior to this study,
- To compare data gathered by local institutions.

Methods and materials

Prior to any counting, we performed two turns around the island in order to locate important nesting and resting spots, identify field specificities, potential difficulties and to finalize the design of our counting plan. The first observation around the island revealed that fulmars were nesting in highly visible cliffs. Likewise, cormorants, lesser black-back and herring gulls were found in apparently clearly defined spots. Oystercatchers were found randomly almost all around the island. And guillemots appeared to be present all around Vigur in relatively high number compared to other species (Figure 2). Therefore, we decided to split counting sessions in two types: sessions dedicated solely to guillemots and sessions dedicated to the five other species of birds. This, considering an Arctic tern colony nesting close to the buildings, and the need to lower potential disturbance, we started both sessions from the South-East, towards North-East; consequently walking through the tern colony at the beginning and at the end of the session (Figure 2). Guillemots were counted by two observers with the help of mental transects, mostly defined by topography (e.g. rocks, cliff or other geographical features) and benchmarks. GPS coordinates of 30 points, creating a belt pattern around the island, were recorded.

We also decided to adapt our methods and the time of counting according to the sun. Indeed, in the morning the sea appeared very bright due to reflectance, preventing us to distinguish, for example, guillemots from puffins. Especially since guillemots were suspected to be high in number and then, more difficult to count. Likewise, fieldwork was adapted according to the weather or tourist groups visiting the island, considering that guillemots can be found close to and on buildings that are visited.

Observations were made by eyes, using Observer Focus TM 10x34 binoculars and by sound if validated by sighting. The ‘double-observer’ approach was used in order to account for detectability (Sutherland, 2006; Voříšek, 2008). Results from counting points were recorded for later analysis and comparison between observers. For fulmars, gulls, as well as cormorants, location of sighting was recorded, creating species hotspots as they were often found flying, landed or nesting (especially in the case of the fulmar). Estimation of the puffin colony was considered, using 3 approaches: binoculars observation, counting from photographs (taken with a Sony DSC-HX400V camera, 20M pixels) and from a Nedis camera (16M pixels).

For the guillemots, collected data was analysed using R 4.1.0 prior to mixing them in order to discriminate any bias from the observers. To do so, dataset from both observers were compared using a Wilcoxon-Mann-Whitney test. Assuming the results from the prior mentioned test were non significant, data was used to estimate a mean and standard variation of each specie population. The results were then displayed using QGis 3.10.14.

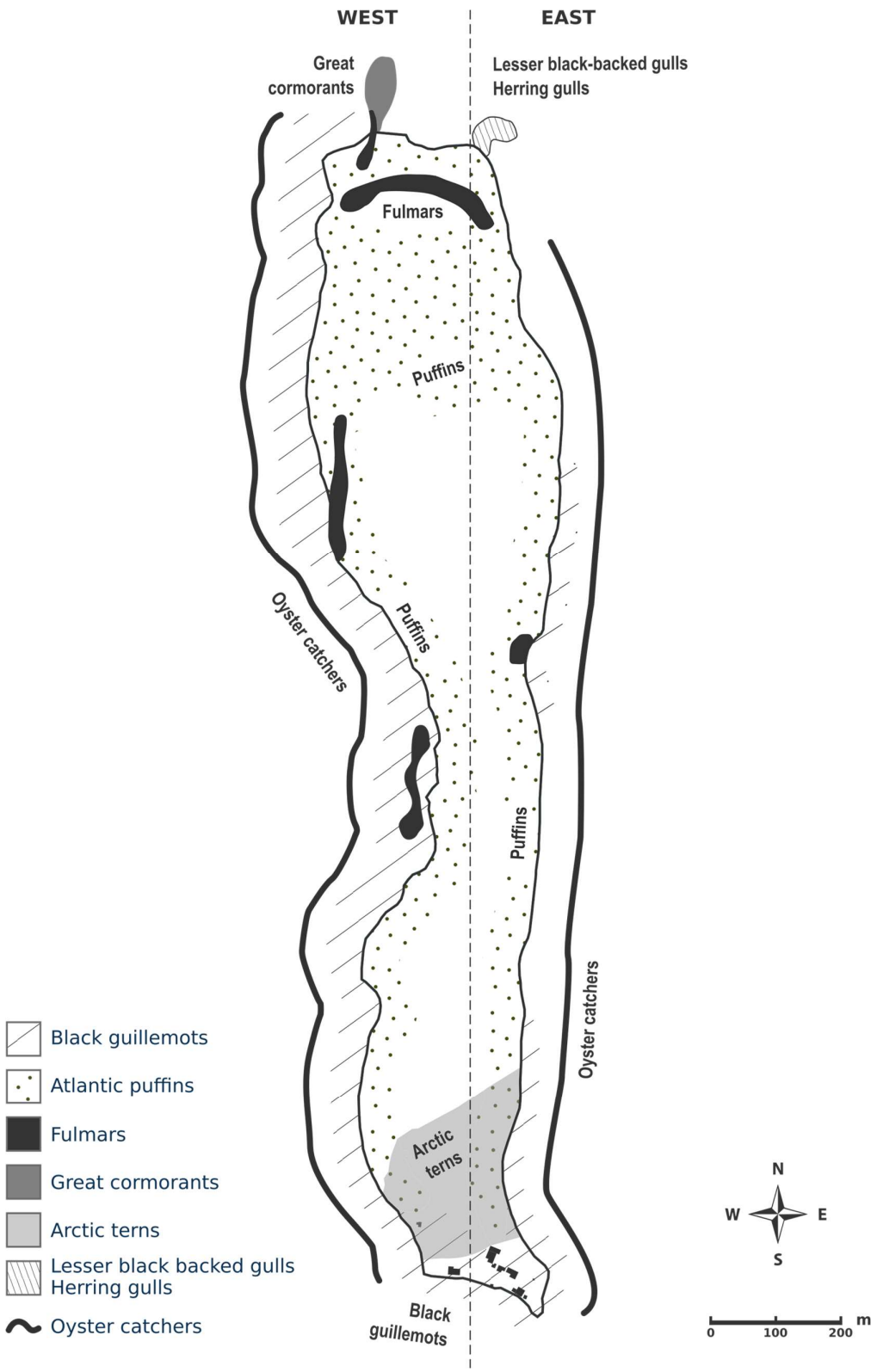

Figure 2. Schematic distribution of the main species. Map of the seabird population counted during the census on Vigur Island.

Results

After 5 counting sessions, means for each session and each specie were calculated, with standard deviation (Table 1). The census of the 6 birds species around Vigur island showed clear dominance of black guillemot *C.grylle* with 1092±246 individuals present around the island. The other populations were significantly less abundant, with 128±34 *F.glacialis*, 38±18 *L.fuscus*, 24±10 *H.ostralegus*, 20±15 *L.argentatus*, and 19±8 *P.carbo* (see Table 1). While the black guillemot and the oystercatcher were present all around the island, all other species where localized in specific spots for nesting and/or resting. For Atlantic puffins, binoculars counting led to unusable results. Puffins were too high in number all around the island to perform an accurate, reliable and relevant population estimation, regardless of the method used. Attempts to count birds from photographs led to similar results, with poorly identifiable and distinguishable puffins among other birds, such as gulls or eider ducks.

Table 1. Vigur sea birds population census results.

Common name	Scientific name	Counted population (mean)	Standard deviation	Coefficient of variation
Atlantic puffin	*Fratercula arctica*	**NA**	NA	NA
Black guillemot	*Cepphus grylle*	**1092**	246	22.5
Eurasian oystercatcher	*Haematopus ostralegus*	**28**	8	28.5
Great cormorant	*Phalacrocorax carbo*	**19**	8	42.1
Northern fulmar	*Fulmarus glacialis*	**120**	34	28.3
Lesser black-backed and Herring gull	*Larus sp.*	**58**	20	34.4

The Atlantic puffin and the black guillemot monopolize a great part of the area, with puffins getting far inland up to Borg, while *C.grylle* stays along the shore. Similarly, oystercatchers can be witnessed around the shore but only periodically, and in far lesser number. The gulls (indifferently Lesser black-backed or Herring) can be seen flying or at sea, with a preferred gathering spot on the far Northeastern point of the island. Symmetrically, the far Northwestern spot is claimed by *P.carbo*. The population of Northern fulmars present on Vigur has chosen the North face of Borg, as well as some specific cliffs along the Western shore, and one unique spot of 12 individuals on the Eastern side (Figure 2).

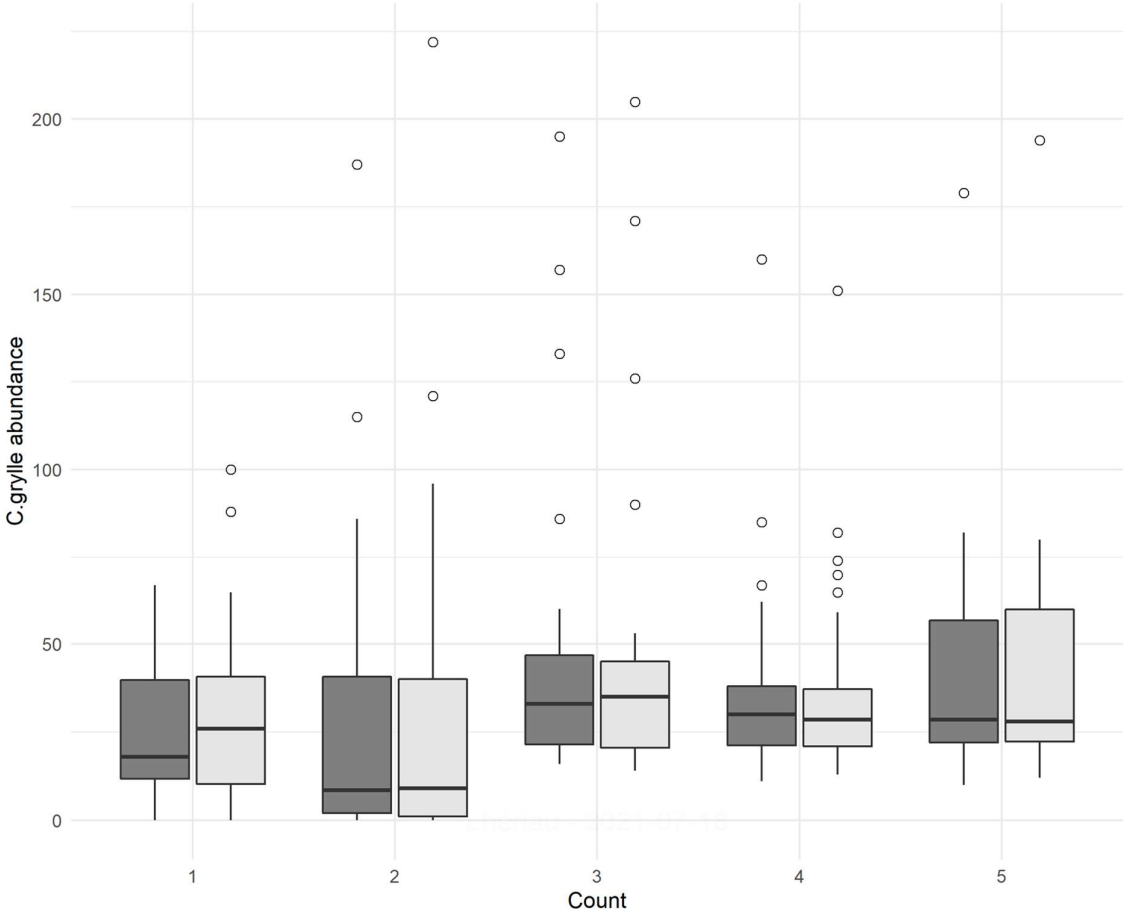

Figure 3. Boxplot representation of the number found during *C.grylle* counting on Vigur. Dark grey: Observer 1; Light grey: Observer 2; the outliers are represented by black circles.

The Figure 3 represents the differences between the observers during the black guillemot counting process. The two set of observation are similar according to a Wilcoxon-Mann-Whitney test (p-value=0.7916), allowing us to use all 10 counting in the calculation of the Table 1, much like the other five species considered in this paper.

Discussion

C.grylle counting were the only one being statistically analysed due to the sheer amount of them found notably at sea, not allowing proper communication between the observers as to where were missed individuals. Great cormorants and Northern fulmars were counted on their resting spots, making the communication quick and accurate, leading to equal counts between the observers. Gulls and oystercatchers being really vocal in the presence of humans were easy to spot using both hearing and visual perception, allowing equal counts as well.

An important difference in counts is observed between this study and previous countings reported by the local research institute (Náttúrufræðistofnun Íslands, 2021a). As mentioned above, counting Puffins revealed itself to be not feasible, as they were nearly 30,000 pairs according to Náttúrufræðistofnun Íslands (Icelandic Institute of Natural History, IINH) giving about 100,000 birds, including non-breeders (Hansen, 2019). Concerning the guillemot population, the number of pairs, according to the IINH, is less than half of what the present survey found (200 pairs or 400 individuals). This difference could be explained by different factors among which, the method used or the age of the last count (2000). Another explanation would be the population of guillemots fleeing the observers while they moved forward, thus resulting in double countings during this survey. However, since guillemots where counted on the shore (i.e. near their nest), this hypothesis is not privileged. As for the four other species (oystercatchers, gulls and Northern fulmars), no record could be found, making a comparison impossible.

The classification of the six species (seven with the Atlantic puffin) covered during this survey, as graded by the IUCN Red List, does not necessarily match the Icelandic nor EU classification (Náttúrufræðistofnun Íslands, 2021a, 2021b). Using the IUCN Red List classification, none of the species fall below the “Near threatened” category, except puffin, deemed “Vulnerable” (BirdLife International, 2018a,b,c,d, 2019a,b,c)(IUCN, 2019, 2018a, 2018b, 2018c, 2018d, 2018e, 2018f). Things change drastically when the classification is done according to the European Red List, where most of the species are either “Endangered” or “Vulnerable”. Apart from the gulls, guillemots and cormorants are all categorized as “Least Concern” (BirdLife International and Directorate-General for Environment (European Commission), 2015). Finally, at the Icelandic level, the image gets grimmer as only the cormorant stays at “Least Concern” level. All of the others are “Vulnerable” at best, with the Atlantic puffin being the lowest with “Critically Endangered”. Lack of data on the state of the gull populations in Iceland put them de facto in the “Data Deficient” category (Náttúrufræðistofnun Íslands, 2021b, 2021a). These important variations in the classifications make census like this one critical in the understanding and evaluation of seabird stocks around Iceland. It then remains vital to monitor wildlife in the case of a place like Vigur island, which is a keystone for both conservation and local tourism.

Despite being found at sea on different belts, with puffins usually the farthest, followed by the eider ducks, guillemots were sometimes hard to identify where the belts overlapped. Furthermore, additional factors such as bird density, or reflectance increased the risk of mistakes during countings. Likewise, countings were started and finished in areas of the island where a colony of Arctic terns was nesting. Consequently, the protective behaviour (shouting, attacks, etc.) was a hindrance to observers, leading to potential errors. Moreover, the time at which countings were made was impacted by tourism. The observers tried to adapt their schedule to tourism activities in order to decrease the impacts on their presence. With groups of 30 tourists on average, birds sometimes left their colony, and/or nest, creating stress for the chicks. Similarly, Arctic terns, were taking off regularly, thus alarming nearby

birds like guillemots or oystercatchers. Then, the flexibility on field was impacted by this necessary adaptation to tourism schedule, in addition to obvious parameters (weather, time, tide, observer fatigue). Among these latter parameters, the fatigue of observers remains of critical importance. With around 100,000 puffins, Vigur island possesses an equally huge number of puffins burrows, shaping the island in a poorly walkable way. Hence, the observers were required to watch the path more than usual, for obvious safety reasons. The specific topography might have led to missed individuals.

To ensure comparativeness with the existing estimations of the IINH, this study was done during the overlap between the different breeding seasons. To assess the accuracy of the present study, further surveys must be undertaken in the next years. As well, increasing the number of observers would lower the observer fatigue, accelerate the counting process and greatly increase the statistical accuracy.

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