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The distribution of seabird wings recovered from Viking Age domestic midden deposits in Skagafjörður, North Iceland

Grace M. Cesario [a,*], John M. Steinberg [b]

[a] School of Humanities, Háskóli Íslands, Sæmundargata 2, 102 Reykjavík, Iceland
[b] Fiske Center for Archaeological Research, University of Massachusetts Boston, 100 Morrissey Blvd., Boston, MA 02125, USA

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ABSTRACT

Bird bones from domestic midden deposits on Hegranes, North Iceland, dating from AD 870-1104, are mostly puffin (*Fratercula arctica*) and guillemot (*Uria aalge*)—diving seabirds in the Alcidae family. We find that Alcidae wings are significantly overrepresented compared to legs, and that in particular, proximal wing bones are systematically more common than if whole birds were deposited in the middens. Trends in the wing-leg index and distal wing index suggest that while bird bones are commonly recovered from these domestic middens and generally make up about a quarter of the faunal assemblages, there is evidence for specific species selection between puffin and guillemot. The disproportionate number of wings in the Viking Age middens points to some kind of deposition strategy that favors wings over other body parts. Birds seem to be much more common in Viking Age archaeofaunal assemblages from Hegranes than those from other parts of Iceland. All of this suggests that more specialized butchery and disposal practice is derived from specific cultural practices.

1. Introduction

An overabundance of bird wings has been observed in many archaeological sites across temporal and geographic contexts (Bovy, 2012; 2002). In particular, the pattern of abundant seabird wings, and especially puffin and guillemot wings, has been observed at sites in the North Atlantic (Best and Mulville, 2010; Brewington, 2015), but until now, not in Iceland. Here, we examine the preponderance of bird wings recovered from domestic middens of the Settlement and the first part of the Commonwealth period (AD 870-1104) in Hegranes, North Iceland.

Historically in the North Atlantic, primary carcass processing of seabirds removes the wings in favor of keeping the meatier parts of the bird (Best and Mulville, 2010; Gotfredsen, 1997; Kristjánsson, 1987). In the summer, the birds were eaten fresh, and during the rest of the year they were eaten smoked, wind-dried, or preserved in whey (Fenton, 1978, p. 512; Guðmundsdóttir Beck, 2013). In Iceland, birds were salted whole after the 18th century, with their wings, heads, and feet removed (Guðmundsdóttir Beck, 2013, p. 36). If this primary processing happened at the hunting sites, that should leave fewer bird wing bones in the domestic middens; however, if this initial processing happened around households, that might be responsible for the overabundance of bird wings in the domestic middens.

The place of birds, especially seabirds, in early Icelandic society is not well established. Early Christian laws suggest that “birds that swim” (Dennis et al., 1980, p. 48) are not considered meat and may be eaten at any time. Furthermore, seabirds fall into the same category as fish and other foods that are allowed during religious holidays. It is also clear from these laws and later additions (Dennis et al., 2000, p. 146), that access to bird habitats and nesting sites can be restricted based on landownership rights. Thus, it is unclear, even from these much later Christian sources, if seabirds are a secondary or less preferred food source, if they are a valuable and important wild resource, or both.

This paper explores the Viking Age deposition of bones from seabirds in the Alcidae family and delves into potential reasons for the remarkable correlations seen in various metrics. The birds are clearly not deposited whole into the middens, as there are too many wing bones in the assemblages. This research address the pattern primarily in Iceland, but also includes interpretations from two other Viking Age Norse North Atlantic sites, contributing to the study of Norse movement across the North Atlantic and into new settlements. The overrepresentation of wing bones seems to indicate a culturally specific way of butchering birds, pointing to persistent culinary practices across space and time.

* Corresponding author.
E-mail address: gmc@hi.is (G.M. Cesario).

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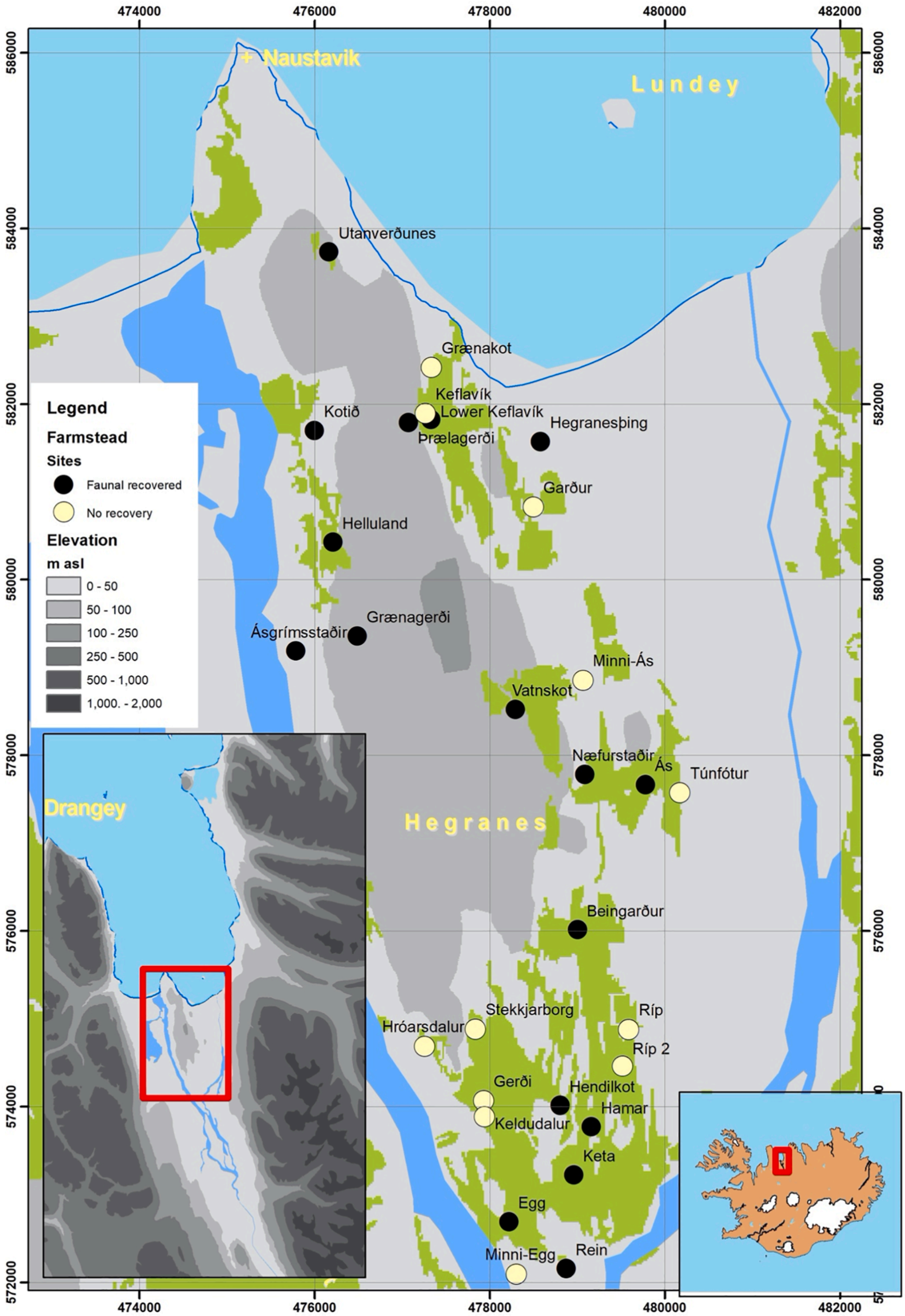

Fig. 1. Elevation map of Hegranes, with insets of Skagafjörður (left) and Iceland (right) with the locations of surveyed sites indicated by faunal recovery status. Green areas are permanent grassland.

1.1. Viking Age settlement of Iceland

Iceland was one of the last large land masses to be settled by humans, starting in earnest in the late 9th century. The settlers were primarily of Norse and Celtic descent (Ebenesersdóttir et al., 2018). The island is at the margin of Norse agro-pastoralism and the settlers brought a Scandinavian subsistence package of animal husbandry, grass haying, and cultivation of domestic cereals such as barley (Edwards et al., 2005). The farmsteads established by the settlers are commonly continuously occupied from the settlement to the present. The main dwelling structures were built of turf and a substantial midden pile usually develops just downwind from these structures. The middens are primarily

Table 1
Hegranes sites with faunal material recovered from pre-CE 1104 cultural deposits sorted by total NISP. Sites in bold make up the case study. Birds category includes all birds, not just the alcids discussed here.

Site	Viking Age Cultural deposit excavated (L)	Domestic			Fish			Birds			Mollusks			Sea Mammals			Total NISP	NISP Density (#/L)
		Count	Den (#/L)	Percent	Count	Den (#/L)	Percent	Count	Den (#/L)	Percent	Count	Den (#/L)	Percent	Count	Den (#/L)	Percent		
Ásgrímsstaðir	256.0	2	0.008	50%	0	0.000	0%	2	0.008	50%	0	–	–	0	–	–	4	0.02
Rein	254.0	2	0.008	9%	12	0.047	55%	5	0.020	23%	2	0.008	9%	1	0.004	5%	22	0.09
Keta	341.0	17	0.050	74%	2	0.006	9%	4	0.012	17%	0	–	–	0	–	–	23	0.07
Helluland	452.5	5	0.011	17%	13	0.029	45%	10	0.022	34%	1	0.002	3%	0	–	–	29	0.06
Lower Keflavík	227.0	33	0.145	92%	2	0.009	6%	0	–	–	0	–	–	1	0.004	3%	36	0.16
Egg	746.5	32	0.043	65%	0	0.000	0%	17	0.023	35%	0	–	–	0	–	–	49	0.07
Hamar	354.0	59	0.167	86%	6	0.017	9%	4	0.011	6%	0	–	–	0	–	–	69	0.19
Beingarður	261.8	10	0.038	12%	5	0.019	6%	65	0.248	79%	2	0.008	2%	0	–	–	82	0.31
Ás	1182.5	58	0.049	67%	5	0.004	6%	23	0.019	27%	0	–	–	0	–	–	86	0.07
Hendilkot	237.5	25	0.105	28%	41	0.173	46%	21	0.088	24%	2	0.008	2%	0	–	–	89	0.37
Þrælagerði	340.0	6	0.018	6%	38	0.112	40%	50	0.147	53%	0	–	–	0	–	–	94	0.28
Hegranesþing	368.0	276	0.750	99%	0	–	0%	2	0.005	1%	0	–	–	0	–	–	278	0.76
Utanverðunes	695.8	11	0.016	2%	1	0.001	0%	489	0.703	97%	0	–	–	3	0.004	1%	504	0.72
Kotið	1390.0	333	0.240	17%	941	0.677	47%	683	0.491	34%	12	0.009	1%	21	0.015	1%	1990	1.43
Næfurstaðir	1323.3	175	0.132	8%	1611	1.217	76%	145	0.110	7%	200	0.151	9%	2	0.002	0%	2133	1.61
Grænagerði	1815.0	594	0.327	18%	1676	0.923	52%	843	0.464	26%	119	0.066	4%	2	0.001	0%	3234	1.78
Vatnskot	2226.0	452	0.203	8%	4856	2.181	84%	88	0.040	2%	392	0.176	7%	11	0.005	0%	5799	2.61

composed of fuel residues such as wood and peat ash, but they also contain substantial numbers of charred seeds, along with bones, turf, and other domestic waste. Remains of wild animal resources, such as fish and birds, are often recovered from these domestic midden contexts (e. g., Cesario, 2021; Harrison, 2013; McGovern, 2009).

2. Methods

All of the faunal remains were analyzed by the first author and utilized comparative collections at the Hunter College Zooarchaeology Laboratory, the comparative collection at Landbúnaðarháskóli Íslands (The Agricultural University of Iceland), and the zoological collections at Náttúrufræðistofnun Íslands (The Icelandic Institute of Natural History). Identification and recording followed the North Atlantic Biocultural Organization (NABO) protocols (e.g., Harrison, 2013; Hicks, 2019) to ensure that these collections are directly comparable to other North Atlantic collections analyzed by NABO scholars. Quantification (e.g., bone counts, and the derived densities, ratios, and percentages) makes use of the number of identified specimens (NISP). Bone modifications, such as butchery marks and burning, are recorded when they occur. For birds, wing and rear phalanges were rarely identified to the species or family level, except for the proximal phalanx of the second wing digit, due to its unique shape which sets it apart from other phalanges (see for example Cohen and Serjeantson's 1996 bird identification manual. which includes drawings to aid in species- or family-level identification of the proximal wing phalanx, but not the other phalanges). Skull fragments, vertebrae, ribs, and innominate fragments were likewise not identified to species, and rarely to family, due to the lack of distinguishing features (ribs and fragments) and to the difficulty of speciating birds of similar size and family based on bones with little to no landmarks preserved.

2.1. *Survey and excavation methods*

On Hegranes, a rocky promontory in the center of Skagafjörður, north Iceland, 31 sites were surveyed through coring and at least a single 1x1 meter excavation in a distinct midden at each site (Fig. 1). All excavations followed a single-context excavation strategy and all excavated material was sieved through 4 mm mesh, following the guidelines of Lucas (2003), which are standard protocol in Icelandic archaeology. Of the 31 excavated sites, 29 had cultural deposits, comprised of mostly domestic refuse and fireplace ashes, underneath an in-situ Hekla AD 1104 tephra layer (Wastegård et al., 2008; Þórarinsson, 1967) that is commonly identified in archaeological deposits in the valley (Steinberg et al., 2016). Thus, the faunal collections analyzed span from when a given site was occupied, sometime after the beginning of the Viking Age settlement of Iceland (in about AD 870), through CE 1104, unless it was abandoned earlier.

At 17 of the 29 sites (59%), faunal material was recovered (Fig. 1, Table 1) from cultural deposits dated to the Viking Age settlement of Iceland (AD 870-1104). Bird bones were recovered from all but one site where there was zooarchaeological recovery on Hegranes and they are the second most ubiquitous category after domesticate bones. A total of five sites had an NISP over 500. Archaeologists generally accept that for domesticate-heavy assemblages, an NISP of 300 or more is sufficient to remove small sample bias and to undertake statistical analyses (e.g., Amorosi, 1996; Hambleton, 1998, pp. 68–71); however, as the collections in Iceland tend to include a variety of wild animal resources, we use a minimum NISP of 500 to account for the inclusion of wild species and make for more conservative statistics. These five sites—Utanverðunes, Kotið, Næfurstaðir, Grænagerði, and Vatnskot—-make up the presented case study.

2.2. *Quantification*

Using wings and legs as a proxy for the whole body allows for a

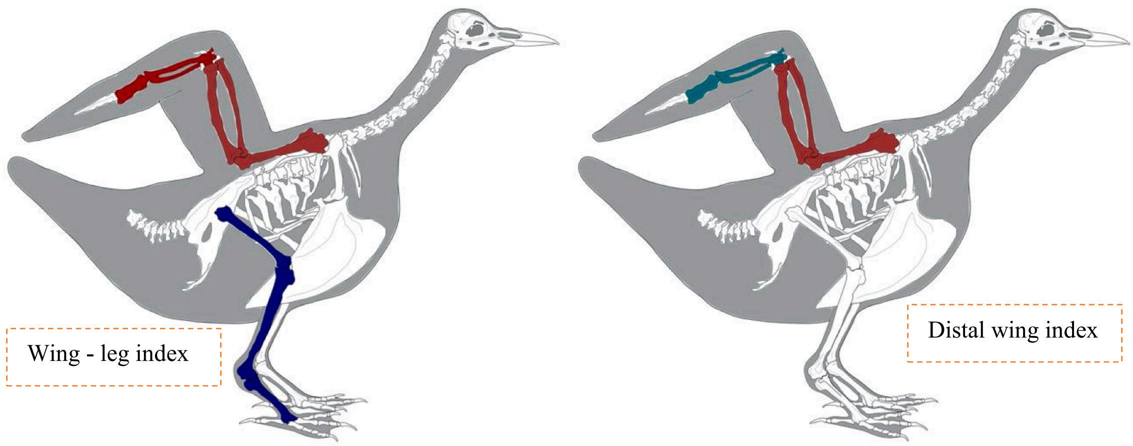

Fig. 2. Bird skeleton showing which elements are included in each calculation. The left image shows the wing-leg index. Wing elements included in this calculation—humerus, radius, ulna, carpometacarpus, and proximal phalanx of the second wing digit—are colored red. Leg elements—femur, tibiotarsus, and tarsometatarsus—are colored dark blue. The right image shows the distal wing index. Proximal wing elements—humerus, radius, ulna—are colored red, and distal wing elements—carpometacarpus and proximal phalanx of the second wing digit—are colored green. Base image ©Archeozoo, modified by Cesario.

Table 2
Distribution of bird species at the case study sites, by taxonomic group. For individual alcid species NISP, see Table 3.

Site	Birds that swim (Alcids*)	Gulls & terns	Ducks	Great cormorant	Red-throated diver	Ptarmigan & European golden plover	Total Identified	Unidentified
Utanverðunes	198	0	0	0	0	0	198	291
Kotið	295	4	11	5	15	2	332	351
Næfurstaðir	46	5	1	0	0	1	53	94
Grænagerði	553	5	0	0	0	3	561	285
Vatnskot	26	10	0	0	0	0	36	48

*puffin, guillemot, razorbill, black guillemot.

Table 3
Contingency table of guillemot and puffin NISP at the five case study sites with observed counts (black) and expected counts (green).

Site	Species		Total
	Guillemot	Puffin	
Utanverðunes	43	155	198
	121	77	
Kotið	125	166	291
	177	114	
Næfurstaðir	10	35	45
	27	18	
Grænagerði	482	68	550
	335	215	
Vatnskot	17	9	26
	16	10	
Total	677	433	1110

simple and effective method of showing if birds were deposited whole into the middens. One method for comparing wing bones to leg bones is the "wing-to-leg ratio," as outlined in Bovy's 2002 article (see also Lefèvre and Laroulandie, 2014; Montalvo et al., 2011). The wing-to-leg ratio counts specific elements from an archaeofaunal assemblage and then compares the results to an expected ratio based on the number of times each element appears in a whole bird. In this paper's calculation, we modify Bovy's wing count to include five paired elements—the humerus, radius, ulna, carpometacarpus, and the proximal phalanx of the second wing digit, hereafter called the "proximal phalanx" for simplicity. The leg count includes three paired elements—the femur, tibiotarsus, and tarsometatarsus. Thus, the expected ratio of the wing counts (10) to leg counts (6) in a whole bird is 10/6 or 1.66. A ratio above the expected means that there are more wings than there should be if a bird was deposited whole into the midden; a lower ratio indicates more legs than expected. The bones included are illustrated in Fig. 2. By comparing the variation in the wing-to-leg ratio, differences in use by taxa and assemblage can be assessed (Bovy, 2002).

While many of the figures in this paper make use of the wing-to-leg ratio to illustrate the bone quantities and their relationships, for the statistics, a wing-leg index is used instead. An index allows for the inclusion of samples where, for example, there are no legs. The wing-leg index uses the total number of wings divided by the total number of wings and legs, and so the expected index is 10/16 or 0.625.

The "distal wing to total wing index" (after Bovy, 2012, called the "distal wing index" throughout the rest of this paper) compares which parts of the wings are represented in an assemblage. The calculation shows if wings were deposited whole or if the distal or proximal portions are more common. For the distal wing index, the proximal wing is made up of three paired elements—the humerus, radius, and ulna—while the distal wing is comprised of two elements—the carpometacarpus and the proximal phalanx (Bovy, 2012, p. 2050). Fig. 2 highlights which bones make up each portion of the wing. The distal wing index is calculated by dividing the total number of distal wing elements by the total number of wing elements. Thus, in a whole bird, the index is 4/10 or 0.40. A distal wing index lower than this indicates more proximal wings are present than would be expected in a whole bird. An index higher than 0.40 means there are more distal wing elements.

The deviation of an archaeofaunal assemblage from an expected ratio or index can be measured and assessed using several different methods. In this paper, a one sample *t*-test is used to assess if sites tend to fit the expected wing-leg index and distal wing index. The one sample *t*-test privileges each site, giving them equal weight regardless of sample size or amount excavated.

Table 4
Wing-leg index and distal wing index for puffins & guillemot by site. The wing-leg index is calculated by dividing the total NISP of wing elements by the total NISP of leg and wing elements. The distal wing index is the total number of distal wings divided by the total NISP of wings.

Site	Species	Proximal wing			Distal wing		Leg			Total Legs	Total Wings	Wing-leg index	Total proximal wings	Total distal wings	Distal wing index
		Humerus	Radius	Ulna	Carpometacarpus	Proximal phalanx of second wing digit	Femur	Tibiotarsus	Tarsometatarsus						
Whole Bird		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**6**	**10**	**0.63**	**6**	**4**	**0.40**
Grænagerði	Guillemot	87	89	116	88	47	8	14	10	32	427	0.93	292	135	0.32
	Puffin	13	9	15	14	0	3	2	1	6	51	0.89	37	14	0.27
Næfurstaðir	Guillemot	2	0	1	0	0	0	1	1	2	3	0.60	3	0	0.00
	Puffin	9	2	3	2	0	3	2	0	5	16	0.76	14	2	0.13
Vatnskot	Guillemot	4	2	1	3	0	2	0	2	4	10	0.71	7	3	0.30
	Puffin	1	2	2	2	0	0	1	0	1	7	0.88	5	2	0.29
Kotið	Guillemot	23	13	21	9	2	6	17	0	23	68	0.75	57	11	0.16
	Puffin	30	19	46	19	7	9	10	4	23	121	0.84	95	26	0.21
Utanverðunes	Guillemot	7	9	5	10	0	0	3	1	4	31	0.89	21	10	0.32
	Puffin	22	40	37	35	0	0	6	5	11	134	0.92	99	35	0.26

3. Results and analysis

3.1. Taphonomy and distribution of bird taxa

None of the pre-CE 1104 bird bones from the five case study sites showed any evidence of butchery such as cutmarks or gnawing by carnivores or rodents. Only 4.8% of the bird bones from the case study sites were burned (SD = 5.4). The identifiable birds are dominated by diving seabirds (Alcidae, Table 2), which make up 86% (SD = 11.2) of the identified birds in the assemblages. The two most commonly identified alcids are puffin (*Fratercula arctica*) and guillemot (*Uria aalge*). Both birds are quite populous on the nearby islands of Drangey and Lundey (Fig. 1), where they are still hunted today. Other birds present in the collections include various species of gulls, ducks, and other taxa in very low numbers.

Alcids are not evenly distributed across the domestic middens at the case study sites (conditions, chi-square (4) = 356.77, p = 0.000, Table 3) and this uneven distribution points to site-specific bird species choice. Grænagerði, with the highest total bird NISP count (n = 843) sees guillemot substantially overrepresented (57% of the bird bones are guillemot), while puffins are underrepresented (only 8% of the bird bones). Conversely, the assemblages recovered from Kotið and Utanverðunes have puffin slightly overrepresented (24% and 32% respectively) and guillemot underrepresented (18% and 9% respectively). The alcid collections from Næfurstaðir and Vatnskot are small, but even they hint at site-specific bird species choice.

The site characteristics and occupation sequences also suggest some sort of specific bird species choices. Grænagerði, with so many guillemot bones and Kotið, with so many puffin bones are remarkably similar sites. Both are located on the west side of Hegranes, in relatively barren landscapes, and are probably short-lived. Both sites have small middens (roughly 2x2m in their entirety) with high densities and percentages of bird bones in their respective assemblages. Both were settled quite early in the settlement sequence and were no longer occupied after CE 1104, and neither seems to have been continuously occupied during the AD 870–1104 time period (Catlin, 2019). Næfurstaðir saw the most activity during the period from settlement through CE 1104, but has limited evidence of activity until about CE 1300. Vatnskot may have experienced periods of abandonment but saw much activity from settlement (before CE 1000) through CE 1104 and is currently an active farm. Utanverðunes has also been utilized since its settlement (before CE 1000) until the present. Utanverðunes seems to have been continuously occupied during the AD 870–1104 period and is still in use today as a working farmstead. However, most of the bird bones recovered from Utanverðunes were concentrated at the bottom of the AD 870-1104 midden sequence, below several floor deposits, and the upper layers of the sequence contain relatively few bones of any type. Utanverðunes is close to the open fjord coast and on the property is the boat landing, called Naustavík (Fig. 1), located at the north tip of Hegranes, which was used for centuries before being abandoned. Both its location and developmental sequence suggest that Utanverðunes may have started out as a specialized site, perhaps one directly related to bird hunting. Even discounting Utanverðunes, there appears to be site-specific bird species choice at the case study sites that does not correlate with obvious site characteristics.

3.2. Wing-Leg index

The results of the wing-leg index indicate that, for both puffin and guillemot, wings are generally overrepresented compared to legs (Table 4). This pattern is also seen in archaeological contexts elsewhere in the world, including other Norse North Atlantic sites (Best and Mulville, 2010; Bovy, 2002; Brewington, 2015; Gotfredsen, 1997; Steadman and Intoh, 1994).

For both puffin and guillemot, the average combined wing-leg index for all case study sites in the Viking Age (M = 0.817, SD = 0.103) is

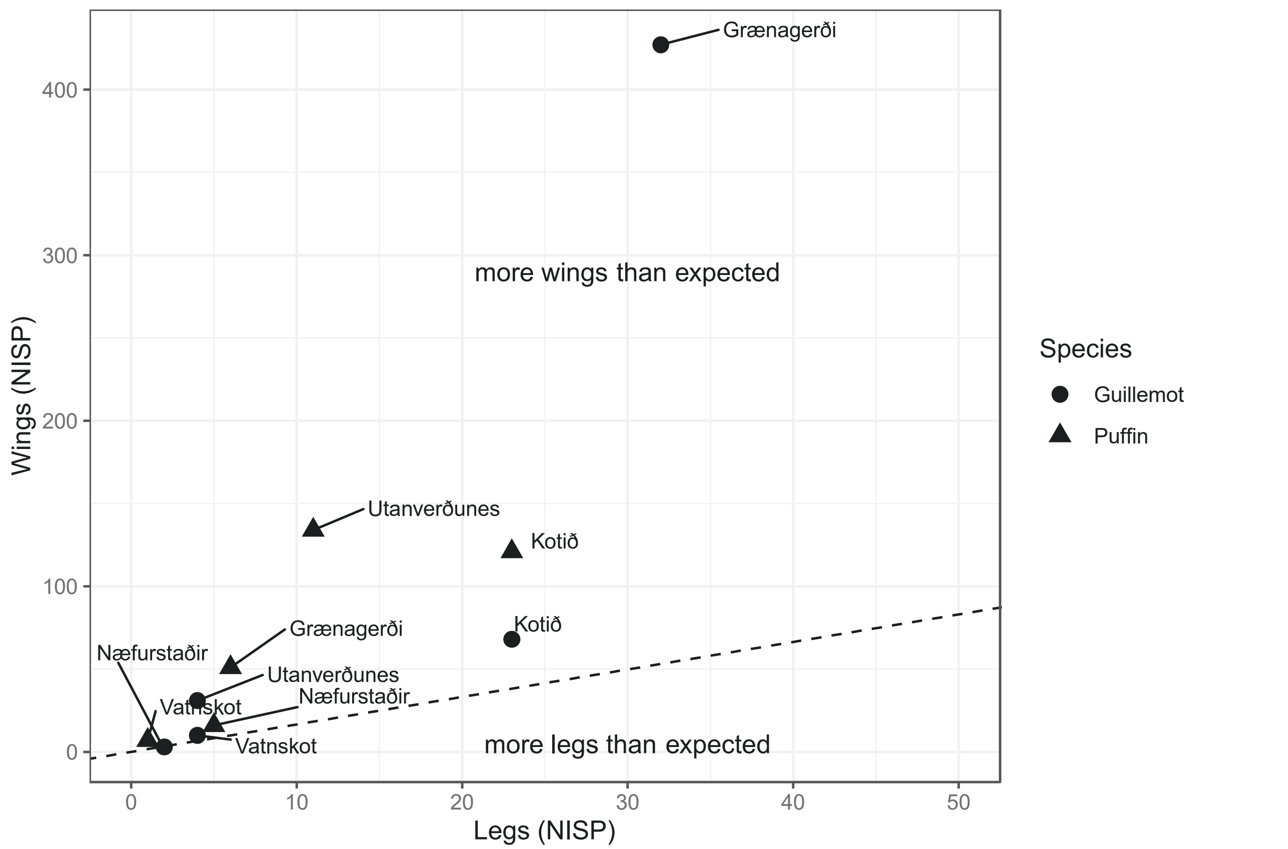

Fig. 3. Scatter plot of total wing elements compared to total leg elements for puffin and guillemot at each site. The "expected" line shows where the data points should fall if whole birds were represented, based on the wing-to-leg ratio (1.66).

significantly higher than the expected index of 0.625 (conditions $t(8) = 5.645$, $p = 0.000$). For puffins and guillemot individually, the means are still much higher than the expected—the puffin mean index is 0.232 (SD = 0.066) and the guillemot mean index is 0.220 (SD = 0.140). Puffin is significantly different than expected ($t(4) = 8.399$, $p = 0.001$) but guillemot, while lower, is not significant ($t(4) = 2.518$, $p = 0.065$). Thus, the broad trend from Viking Age midden deposits is a higher-than-expected wing-leg index.

The wing-leg index from both puffin and guillemot at the five sites indicates that there are substantially more wing bones than should be expected if the birds were deposited whole into the midden (Fig. 3). That there are uniformly more wing bones than expected for almost all the case study sites and taxa suggests that, while there may be site-specific bird species choice, the same basic depositional processes are taking place at the case study sites without regard to species.

3.3. Distal wing index

The distal wing indices for both puffin and guillemot are significantly lower than expected. This means that proximal wings are more common than distal wings in all cases where the index can be calculated.

For both species, the average combined distal wing index at all case study sites (M = 0.238, SD = 0.0677) is significantly lower than the expected index of 0.40 (conditions $t(3) = -6.736$, $p = 0.000$). When taking puffins and guillemot individually, their means (puffin mean ratio = 0.2175, SD = 0.063; guillemot mean ratio = 0.260, SD = 0.037) are also significantly lower than the expected, (puffin $t(3) = -5.706$, $p = 0.011$; guillemot $t(3) = -3.810$, $p = 0.032$).

By comparing the variation in the distal wing index, differences in use between taxa and sites can be assessed. Again, like with the wing-leg index, the case study alcids have more proximal wings than expected, similar to what Bovy (2012) found—that archaeological alcid remains from the Watmough Bay site on the Northwest Coast are represented by more proximal wing elements. Again, there are uniformly more proximal wing bones than expected at all the case study sites and for both species (Fig. 4). Again, these results suggest that the two different species are processed in the same way, though this may not be surprising since they are so closely related.

3.4. Comparison of indices

There is a positive correlation between the wing-leg index and the distal wing index for puffin and guillemot at the five case study sites (Fig. 5). As the index of wings to legs goes up (even more wings), the distal wing index also rises (more distal wings). Even though the distal wing index rises with an increase in the wing-leg index, there are still fewer distal wings than there should be if whole birds were deposited. For the five sites and two species, the correlation is strong and significant (R^2 (8) = 0.6258, $p = 0.006$). The significance holds for puffins (R^2 (4) = 0.8357, $p = 0.030$) but not for guillemot (R^2 (4) = 0.680, $p = 0.086$). There is no obvious reason that the wing-leg index and the distal wing index should be correlated. Other factors, such as bone density or amount excavated are not correlated with either of the indices. All of this suggests that the correlation of the two indices is a result of purposeful human behavior.

4. Discussion

Birds are much more common in Skagafjörður than in other parts of Iceland (Fig. 6). In fact, the Hegranes assemblages look much more like the assemblages from the Faeroes than from other parts of Iceland. That being said, while birds are found in many assemblages, generally fish

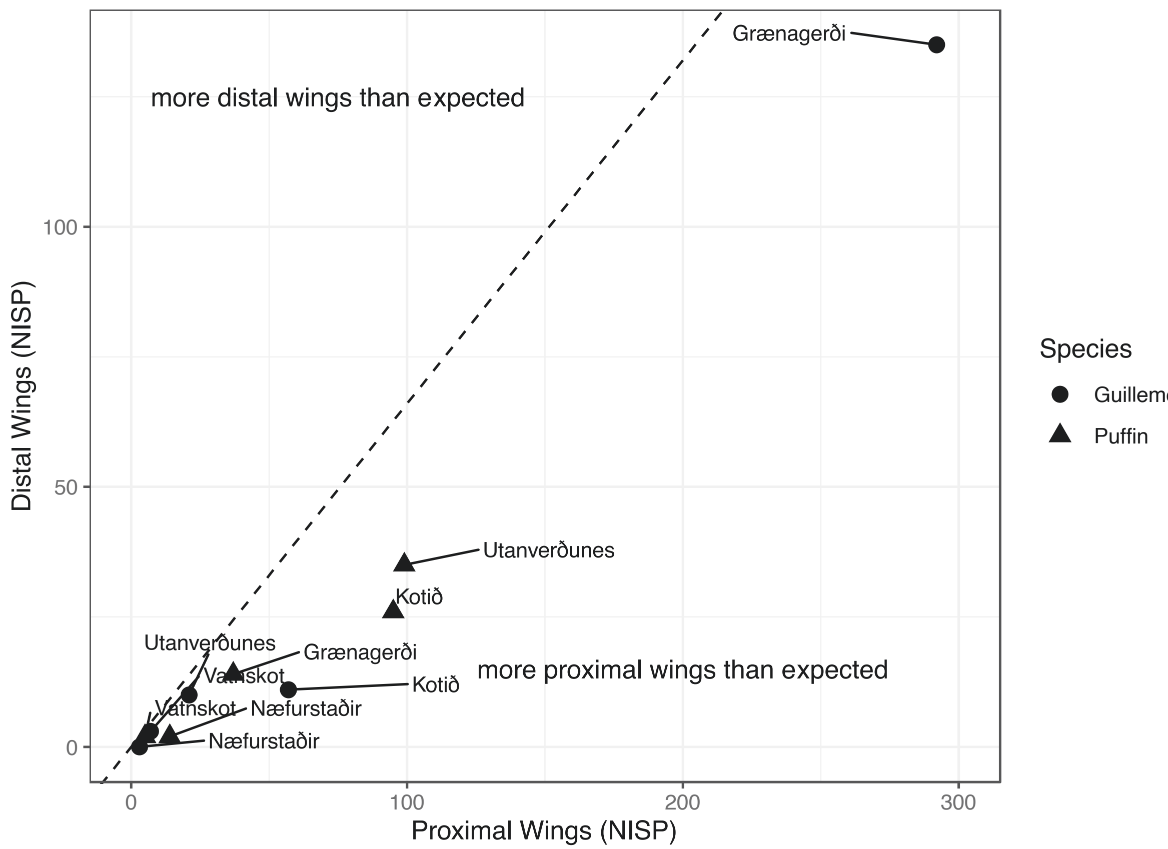

Fig. 4. Scatter plot of total distal wing elements against total proximal wing elements. The "expected" line indicates where the data points would fall if whole wings were being discarded.

and domestic mammals dominate most other assemblages. The importance of differential preference of alcid species on Hegranes and the patterned recovery of wings and proximal wings then could be a result of a more specialized exploitation.

The results presented above make it clear that wings in general, and more specifically proximal wings, are overrepresented to a statistically significant extent. Taphonomy and recovery do not seem to have played a part in the disproportionate number of bird wing bones. All sites had similar midden composition and similarly good preservation, and as they were excavated under the same protocols, there is no recovery bias (Cesario, 2021). What follows is an exploration of various potential human factors to help explain why proximal wings are more common in these domestic midden contexts than bones from the rest of the body.

Human behavior is the most parsimonious explanation for the presence of too many wing bones in the domestic middens. Birds were a familiar (Best and Mulville, 2010; Brewington, 2015; Keller, 2010, p. 20; Kristjánsson, 1987) and abundant resource, and were probably unwary of the first humans to arrive in Iceland (e.g., Frei et al., 2015), as the birds have few natural predators on the cliffs where they nest. This would have made them particularly easy to exploit by settlers during the Viking Age. The two species can be found nesting near each other, with puffins burrowing in the ground and guillemot nesting on cliff edges. Adult birds of both species are hunted, as are juvenile puffins, while guillemot eggs are collected but juveniles are not (Petersen, 2005). Hunting these birds is a dangerous activity that requires community cooperation, "which in manpower normally extended outside the realms of one farm" (Petersen, 2005, p. 205). These birds were most likely hunted during their summer breeding season, since that is when they congregate and are therefore the most easily accessible (e.g., Serjeantson, 1998, p. 24).

While it is always a bit questionable to impose the ethnographic present onto the past, we have culture continuity from settlement to the present, and the continuity of seabird use in Iceland lends itself well to using ethnographic analogies as possible explanations for past patterns.

4.1. Primary processing

Brewington (2015) finds alcid (puffin, guillemot, and razorbill) wings to be overrepresented in the Viking Age assemblage from Undir Junkarinsfløtti in the Faroes. He proposes that primary carcass processing is the most likely explanation for this pattern. Historically in Iceland, alcids are taken whole and further processed away from the hunting sites, usually on the household level (Kristjánsson, 1987). Processing at the household begins with women plucking the birds, then men continue the butchering by removing the wings and legs and discarding them (Kristjánsson, 1987, p. 356). Primary processing of the carcass, for consumption or other activities, is the most likely reason for the deposition of primarily bird wings into the middens. The removed wings, while not particularly useful for meat, may have been used for other purposes (see below).

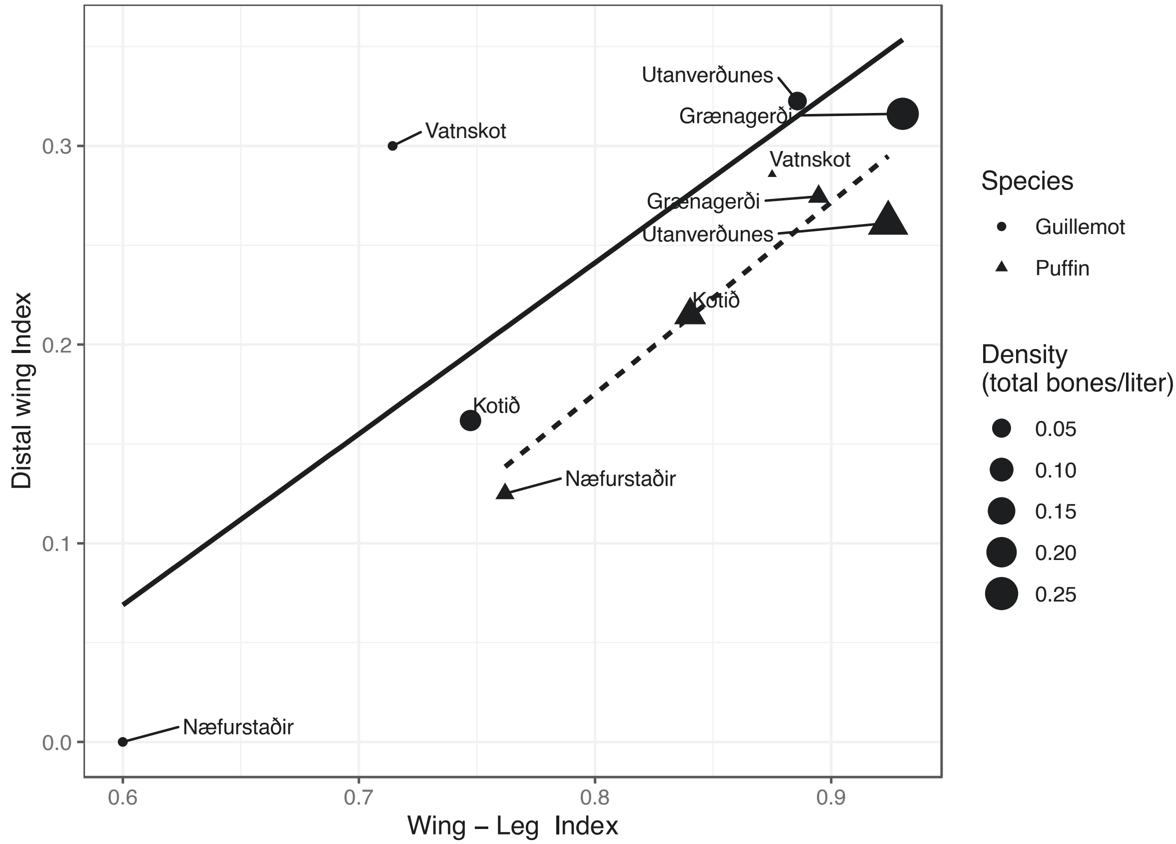

Fig. 5. Comparison, by site and species, of the wing-leg index and distal wing index for both puffin and guillemot. The linear correlation ($R^2 = 0.680$) of guillemot (circles) is indicated by a solid line. The linear correlation of the indices for Puffin (triangle, $R^2 = 0.8357$) is indicated with a dashed line.

4.2. Long-Term storage

Since alcids are only easily available during the late spring and summer, it is likely that they were hunted in large quantities during those seasons. Historically, in order to make use of all of the meat without waste, the birds are preserved in some way (Fenton, 1978, p. 512; Guðmundsdóttir Beck, 2013). This involves primary processing—removing the wings and perhaps other body parts—and preserving the rest of the carcass for later consumption. If this consumption took place off-site or if the bones were eaten along with the preserved bodies, this would explain the pattern of too many wings.

4.3. Feather collection

Bird feathers have historically been used in bedding and have been exported or traded from North Atlantic islands at least from the 17th century and into the recent past (Best and Mulville, 2010, p. 94; Kristjánsson, 1987; Petersen, 2005, p. 203). Best and Mulville (2010:94) suggest that the overabundance of puffin wings from their Viking Age Shiant Isles (Outer Hebrides) assemblage may signify curation for feather collection, as they observed butchery marks on the ends of the long bones that suggest feather removal. In Iceland specifically, once removed from the rest of the body, auk wings would be dried and then the feathers collected to make bedding and the bones are discarded (Guðmundsdóttir Beck, 2013, p. 37). Auks are in the same family as the puffin and guillemot in our assemblages, and it is quite possible that they were also used in this way in the Viking Age. More recent ethnographic accounts in Iceland detail the collection of prized feathers, especially from puffin chicks, and the removal of wings and legs after plucking (Kristjánsson, 1987, pp. 356-357).

5. Conclusions

Many sites on Hegranes do not have any faunal recovery at all. For those that do have faunal recovery the bone density is generally under one bone per liter excavated. The few sites with higher bone densities are dominated by fish bones. Fish bones are slightly less evenly distributed than bird bones and domestic mammals are the most evenly distributed (and were recovered at all sites with faunal recovery). Bird bones make up about a quarter of most of the faunal assemblages, regardless of whether an assemblage is dominated by fish or domestic animal bones (Table 1). A case study using five of the sites with large NISP indicate that while bird bones in general are evenly distributed, and the two dominant bird species, both in the alcid family, are present at the case study sites, there seems to be site specific preference for either guillemot or puffin. While specific species may be selected at a given site, there are almost universally too many wing bones present given the number of leg bones recovered. Complementing that trend, there are also universally too few distal wing bones given the total number of wing bones. At the case study sites, for the two alcid species, as the ratio of wing to leg bones increases, the number of distal wings also increases (Fig. 5). This positive correlation suggests that, while bird use and bone discard is common at domestic midden locations across Hegranes, there is some specialized processing of these species at the five case study sites.

Domestic midden deposits with higher densities and greater NISP may be biasing faunal collections against recovery of birds—seen in the negative correlation between fish bone density and bird bone density at the case study sites (Fig. 7 and Fig. 8). This inverse correlation suggests that fish and birds might not be processed and or consumed together, again pointing towards some specialized processing. While the inverse correlation between percentages of fish and birds from other regions

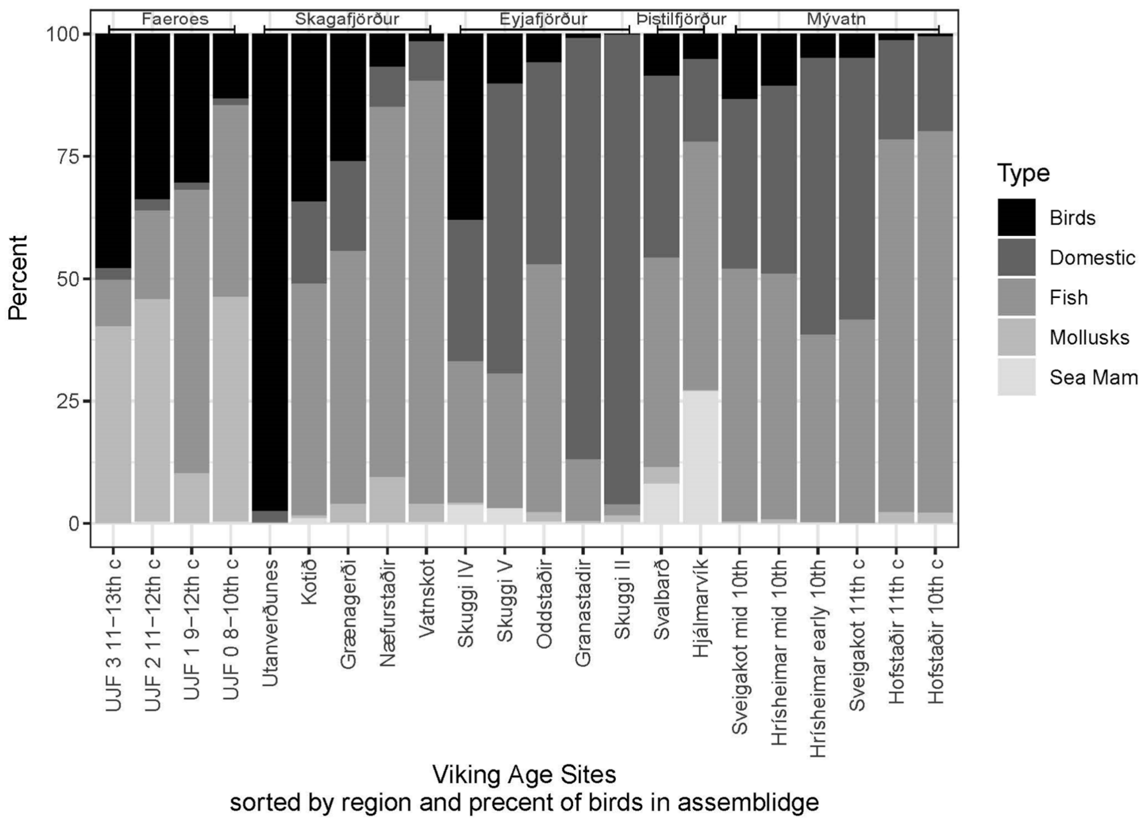

Fig. 6. Major taxa at various sites across the North Atlantic. Other than the Faeroes, the rest of the sites are located in various regions across Iceland. Data from the Faeroes comes from (Brewington, 2015); Skuggi and Oddstaðir data are in (Harrison, 2013) and Granastaðir numbers come from (Amorosi and McGovern, 1994); Svalbarð data is from (Dupont-Hébert, 2013) and Hjálmarvík from (Dupont-Hébert, 2017); data for Sveigakot are in (McGovern, personal communication), Hrísheimar from (McGovern et al., 2006), and Hofstaðir in (McGovern, 2009).

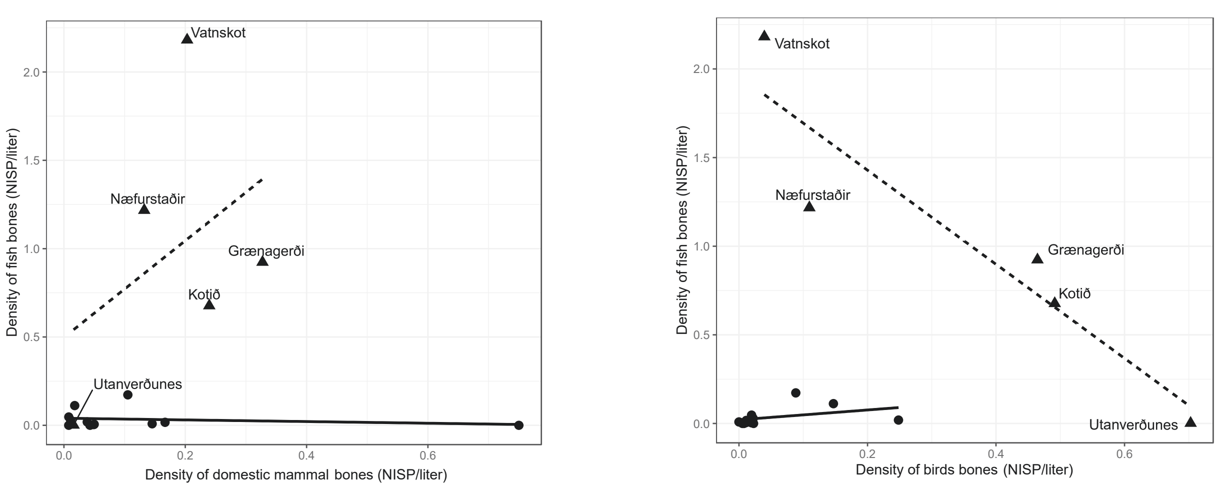

Fig. 7. Scatterplot of density of fish (bones/liter) against density of domestic animals (left) and density of birds (right) for the case study and low NISP sites. Lines are regressions for case study sites (dashed line & triangle) and other SCASS sites (circle).

(Fig. 8) is not as robust as the density correlations from Hegranes (Fig. 7), the pattern reinforces this idea of some specialized processing and consumption of bird and fish resources, potentially in different locations.

The implications for the almost ubiquitous distribution of bird bones across the Hegranes sites with faunal recovery suggest that birds, and in particular seabirds, were commonly utilized at a wide variety of sites from the Icelandic settlement to CE 1104. From this small sample, it seems that the overrepresentation of wings at the case study sites resulted from primary carcass processing and simple discard of the undesirable portions. It is unclear if the abundance of wings resulted from valuing those portions for a specialized purpose—such as producing pillows from the wing feathers—or if wings were unused and thus differentially discarded in household middens. Further comparative skeletal part analysis will help refine the potential value and function of birds in general and will help place seabird consumption in its socio-economic context during the first centuries of human settlement of Iceland.

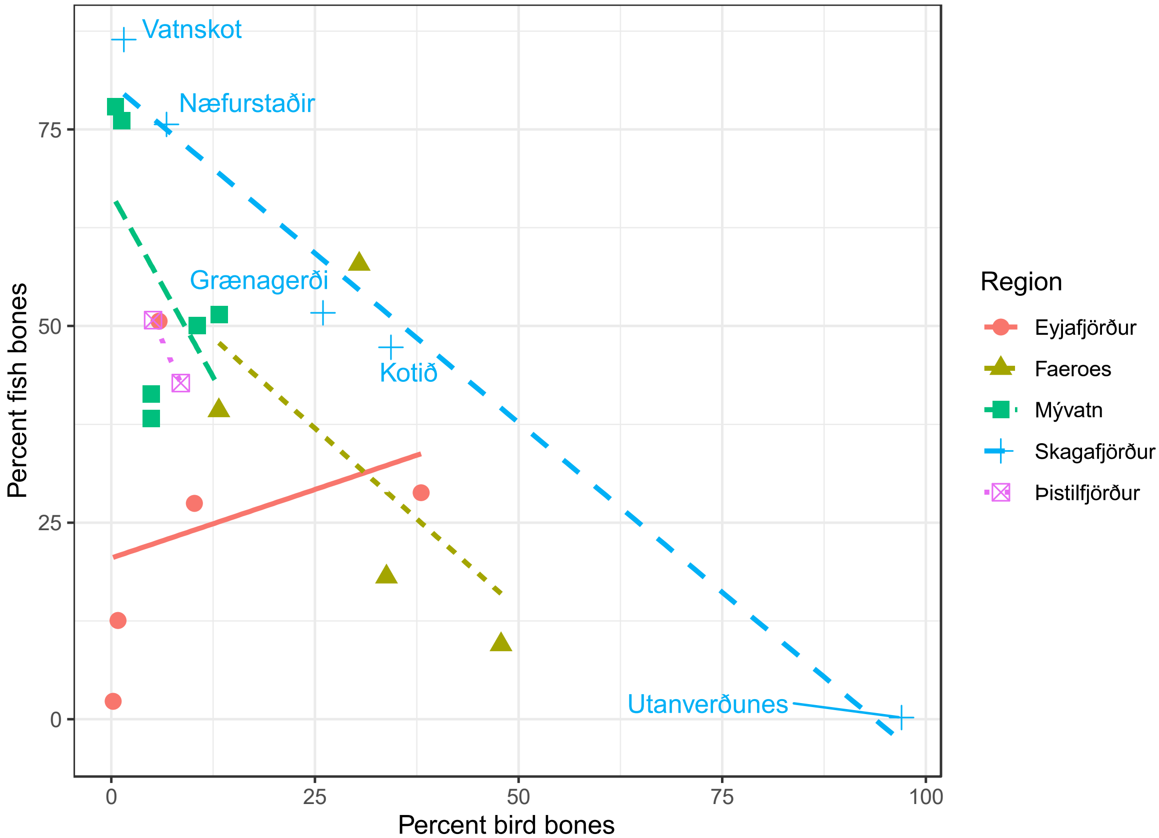

Fig. 8. Percentage of bird bones against percentage of fish bones in four regions in Iceland and one site in the Faeroes (Undir Junkarinsfløtti). The lines show the linear trends for each region. For data see Fig. 6.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jasrep.2022.103497.

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