

## RESEARCH PAPER

## Birds in Medieval Norway

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Whilst modern avian distributions in Scandinavia are well studied, how past events and processes have shaped modern bird communities in the region remains poorly known. This is mainly due to the fact that work on post-glacial avian assemblages has been done mostly from an archaeological perspective, and on a site-specific basis. Therefore, in order to understand the history of bird species in Scandinavia, there is a clear need to collate data on the past occurrences and abundance of birds within the region. Here we present data on the presence of bird species within 21 Norwegian Medieval (1030–1537 CE) assemblages. Despite climatic fluctuations and the rise of urban centres, our re-examination and compilation of bird bone assemblages from Medieval Norway found no evidence to suggest that the Medieval bird fauna differed from the modern one. The most common birds in Medieval assemblages are Galliformes. In urban sites these are mostly domestic fowl, whereas on rural sites wild species are dominant. Our data indicates an introduction of domestic fowl in the early Medieval period and a slightly delayed introduction of domestic geese, with both species becoming more abundant during the mid to late Medieval period. This appears to be later than other Scandinavian countries. Interestingly, species that are now ubiquitous in urban areas, such as pigeons, corvids and gulls are mostly absent from Medieval urban centres. In addition, we found a bias towards the use of female *Accipiter gentilis* in falconry, while *Falco* species may have been exported. This is the first time that data on past avian occurrences for any period are reviewed and collated for Norway. In addition, our work highlights the importance of birds and bird exploitation in Medieval Norway.

**Keywords:** Birds; Zooarchaeology; Scandinavia; Middle Ages; Falconry; Domestic fowl

**Introduction**

Norway hosts at least 259 breeding bird species (Gjershaug et al. 1994). Recent ornithological work has shown that 22% of all breeding birds within Norway are declining in numbers, with three species likely to disappear within the next decade (Shimmings & Øien 2015). Some of the most vulnerable species are seabirds, birds in agricultural landscapes, and montane birds (Henriksen et al. 2015). Whilst modern avian distributions in Scandinavia are well studied, how past climate events and environmental processes have shaped modern bird communities in the region remains poorly known.

Work on post-glacial Scandinavian birds has been done mostly from an archaeological perspective and on a site-specific basis. Mannermaa's (2003) work in Finland collates data on avifaunas from archaeological sites, focusing on the Mesolithic through to the Bronze Age. The most recent work conducted in Denmark is by Gotfredsen (2013; 2014) looking at subsistence and cultural implications of species represented from specific sites. For Sweden, Ericson and

Tyrberg (2004) summarised all available data from subfossil and written sources on the Swedish avifauna covering the last 14,000 years (Weichselian-19<sup>th</sup> century). Although their work is descriptive only, it is the most comprehensive study of the history of a Scandinavian avifauna thus far. In addition, we have consulted work conducted on bird remains from the Scottish Isles, of which there is a wealth of information (Serjeantson 1988; Best & Mulville 2010; Best & Mulville 2013; Best & Mulville 2014; Serjeantson 2014).

For Norway, work on subfossil and archaeological avian assemblages has been site-specific only (for example; Olsen 1967; Undheim 1985, Unpublished report, see Supplementary Material File 1 (SMF 1); Marthinussen 1992, Unpublished thesis, see SMF 1). Some work has focused on specific species such as Montevecchi and Hufthammer's (1990) work on Northern Gannets (*Morus bassanus*) and Northern Fulmars (*Fulmarus glacialis*), as well as the Great Auk (*Pinguinus impennis*) (Hufthammer 1982; Bengtson 1984). Other than these works there are no studies on long-term patterns and processes that have shaped current distributions of birds in Norway. This leaves a clear need to collate research on the past occurrence and abundance of birds within Norway and the Scandinavian countries. This would provide a temporal perspective, enabling us to draw comparisons with modern species distribution, to gather insights on avian biogeography in Scandinavia.

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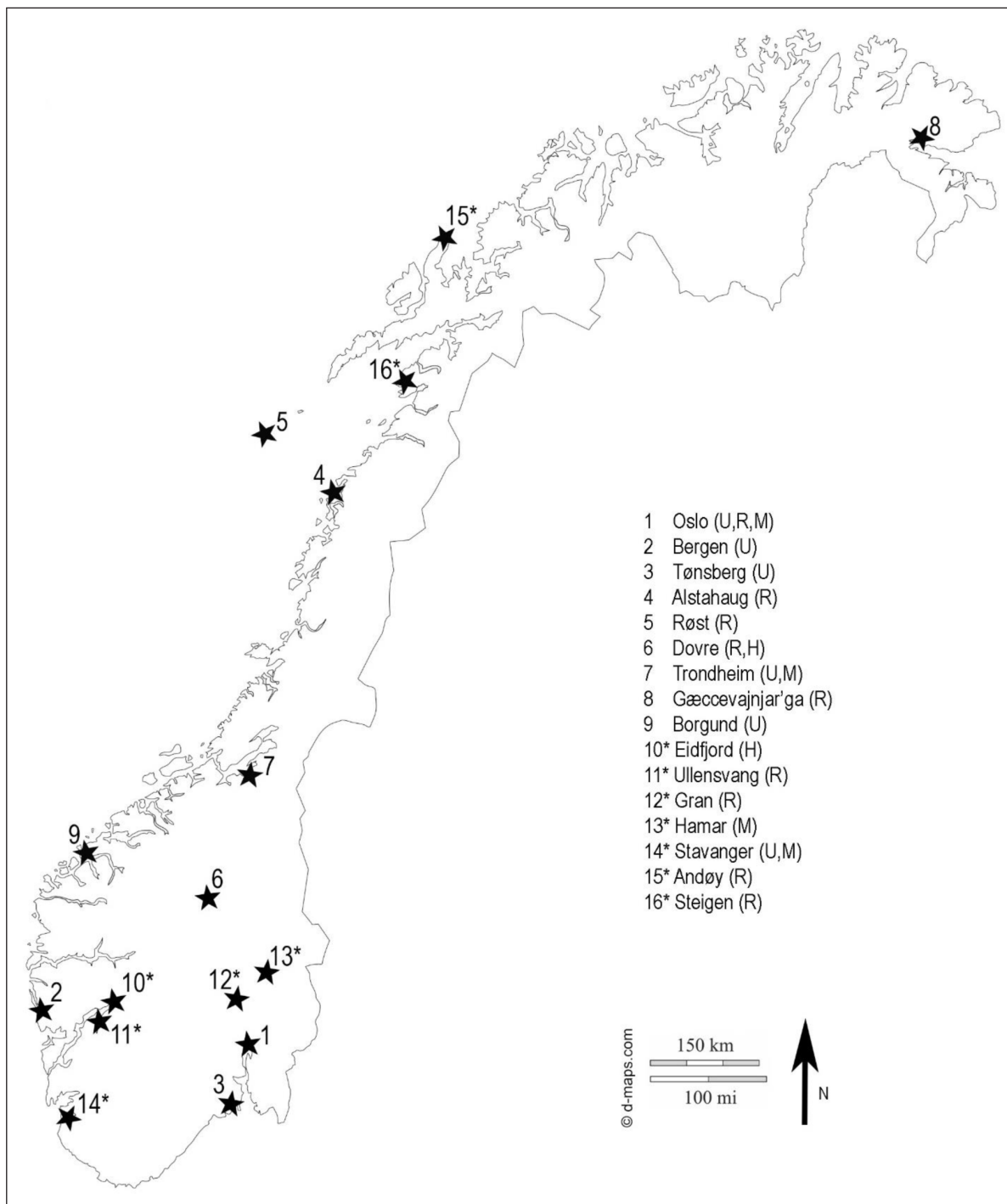
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Here, we present data on species representation within Norwegian Medieval bird bone assemblages stored within the University Museum of Bergen. This time period experienced summer temperatures 1–2°C warmer than the mean millennial temperature (Zawiska et al. 2017), and saw the rise of large urban centres in southern and central Norway. It is therefore expected that this period documents changes in avian species distributions and abundance related to human impact and climatic change. Furthermore, our work represents the first collation of bird bone material from Norway.

**Methods**

**Sites**

Avian bone material from 21 Medieval sites in Norway (Table 1; Figure 1; Supplementary Table 2) has been analysed. The majority of these sites have previously been analysed (see Table 1), however, we re-examined specimens from all sites. In order to prevent assemblages skewed towards one or two species, we selected sites with an avian assemblage of 50 or more bone specimens. In cases where large assemblages were not available, smaller assemblages with reliable dating were also included. All



**Figure 1:** Location of sites with Medieval bird bone assemblages in Norway. Sites marked with \* are supplementary assemblages which have not been re-examined. The types of site found are indicated next to the locations (U = Urban, R = Rural, M = Monastic, H = Hunting).

**Table 1:** Norwegian Medieval Sites that contain bird bones. The table includes all the Medieval sites which have been re-examined and all the supplementary sites we have considered. The table gives the sites name, the JS number assigned to the site (this is a catalogue number given by the University Museum of Bergen), information on whether the site has been re-examined or not, the avian NISP for the site, the location of the site, the date of excavation/range if it is over a number of seasons, the specific dates for a site, where known (contexts which are outside of the Medieval period have been excluded), the site type (urban, rural, monastic or hunting), information on sieving and any references to previous zooarchaeological reports and contextual dating sources. In many cases, the reports have not been published, these are listed in the unpublished sources reference list in the supplementary material (SMF 1).

Site name	JS Number	Re-examined	Avian NISP	Location	Date excavated	Date range of site	Site type	Sieved	Site references
Mindets Tomt	537	YES	1052	Oslo	1973	1025–1350 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Lie 1988)
Oslogate 7, Gamlebyen	599	YES	175	Oslo	1977	1150–1600 CE	Urban	No	Archive Natural History, University Museum of Bergen. (Lie 1979)
Nordre Felt II, Gamlebyen	702	YES	1640	Oslo	1982–1984	Medieval	Urban	Yes	Archive Natural History, University Museum of Bergen.
Bryggen	397,401, 406, 492, 529, 540	YES	911	Bergen	1959–1962, 1967, 1970, 1972	Medieval	Urban	No	Archive Natural History, University Museum of Bergen.
Dreggsalmenningen	630	YES	61	Bergen	1980	1170–1527 CE	Urban	No	Archive Natural History, University Museum of Bergen. (Undheim 1985, unpublished report, see SMF 1)
Vågsalmenning	1152	YES	3	Bergen	2000	Medieval	Urban	No	Archive Natural History, University Museum of Bergen.
Kroken 3	1168	YES	3	Bergen	1984–1985	Medieval	Urban	Yes	Archive Natural History, University Museum of Bergen. (Dunlop, unpublished report, see SMF 1)
Finnegården 3A	1237	YES	78	Bergen	1982	Medieval	Urban	Unknown	Archive Natural History, University Museum of Bergen. (Golembnik 1993, unpublished report, see SMF 1)
Bryggen Gullskoen	1280	YES	18	Bergen	1955–1979	Medieval	Urban	No	Archive Natural History, University Museum of Bergen.
Bryggesporden	1750	YES	23	Bergen	2016	Medieval	Urban	Yes	Archive Natural History, University Museum of Bergen. (Beijersbergen et al. 2018, unpublished report, see SMF 1)
Storgaten 35	563	YES	81	Tonsberg	1974	Before 1200–1400 CE	Urban	Unknown	Archive Natural History, University Museum of Bergen. (Eriksson 1975, unpublished report, see SMF 1)

(contd.)

Site name	JS Number	Re-examined	Avian NISP	Location	Date excavated	Date range of site	Site type	Sieved	Site references
Storgaten 24–26	637	YES	13	Tonsberg	1979	Mid/late 1200–1350 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Lindh 1984, unpublished report, see SMF 1)
Tunsberghus	660	YES	25	Tonsberg	1981	1200–1500 CE	Urban	Unknown	Archive Natural History, University Museum of Bergen.
Baglergaten 2–4	664	YES	17	Tonsberg	1982	C.1200–C.1400 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Brendalsmo 1986, unpublished report, see SMF 1)
Blomsoy	151	YES	12	Alstahaug	1918, 1920	Medieval	Rural	No	Archive Natural History, University Museum of Bergen.
Husen	308	YES	26	Rost	1951	Medieval	Rural	Unknown	Archive Natural History, University Museum of Bergen. (Paul Simonsen, pers. comm.)
Toftom	710	YES	41	Dovre	1984–1985	900–1300 CE	Hunting	Unknown	Archive Natural History, University Museum of Bergen. (Lie 1994)
Vesle Hjerkins	712	YES	1352	Dovre	1984–1985	Medieval	Rural	No	Archive Natural History, University Museum of Bergen. (Lie & Fredriksen 2007)
Erkebispegården	845	YES	256	Trondheim	1992	Ca. 1250–1537 CE (Phases 4–7)	High status (Monastic)	Yes	Archive Natural History, University Museum of Bergen. (Hufhammer 1999)
Gæccevåjnar'ga	715	YES	43	Nesseby	1984	Medieval	Rural	Unknown	Archive Natural History, University Museum of Bergen. (Lie 1992)
Borgund	344, 357, 374, 410, 411, 430, 431, 432, 1699	YES	108	Ålesund	1955–1961, 2014	Medieval	Urban	No	Archive Natural History, University Museum of Bergen.
Kirke og Klosteruin	162	NO	9	Oslo	1919	Medieval	Monastic	No	Archive Natural History, University Museum of Bergen. (Ole Egil Eide & Alf Tore Hommedal pers. comm.)
Søndre Felt, Gamlebyen	577	NO	37	Oslo	1977	1025–1624 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Lie 1988)
Kanslergate. 10 Grøftgravninger	768	NO	13	Oslo	1987	1100–1700 CE	Urban	No	Archive Natural History, University Museum of Bergen. (Lie 1991)
Oslogate. 6	784	NO	236	Oslo	1987–1988	Ca. 1100–1624 CE	Urban	No	Archive Natural History, University Museum of Bergen. (Petter Molaug, pers. comm.)
Oslogate. 4 Grøftgravninger	798	NO	19	Oslo	1988	1225–1350 CE	Urban	No	Archive Natural History, University Museum of Bergen. (Lie 1991)

(contd.)

Site name	JS Number	Re-examined	Avian NISP	Location	Date excavated	Date range of site	Site type	Sieved	Site references
Nordre Felt I, Gamlebyen	809	NO	169	Oslo	1970s	Medieval and Post-Medieval	Rural	Yes	Archive Natural History, University Museum of Bergen.
Bispeborgen	1273	NO	10	Oslo	1983–1985	Medieval	Monastic	Unknown	Archive Natural History, University Museum of Bergen.
Arupsgate, Gamlebyen	1530	NO	14	Oslo	2007	Ca. 1050–1200 CE	Urban	Yes	Archive Natural History, University Museum of Bergen.
Follobanen, Gamlebyen	1675	NO	41	Oslo	2013	Medieval and Post-Medieval	Urban	Yes	Archive Natural History, University Museum of Bergen. (Sharpe 2014, unpublished report, see SMF1)
Bryggen 1958	380, 387	NO	7	Bergen	1958	Medieval	Urban	No	Archive Natural History, University Museum of Bergen.
Rosenkrantz gate 4	613	NO	12	Bergen	1978	Medieval	Urban	No	Archive Natural History, University Museum of Bergen. (Lindh 1980, unpublished report, see SMF1)
Nedre Langgate 25–27	631	NO	5	Tonsberg	1978	Medieval	Urban	Unknown	Archive Natural History, University Museum of Bergen.
Baglergaten 3	644	NO	52	Tonsberg	1979–1980	Late 1100–Early 1300 CE	Urban	No	Archive Natural History, University Museum of Bergen. (Brendalsmo 1983, unpublished report, see SMF1)
Kammegaten 10	696	NO	1	Tonsberg	1981	1100–1300 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Wienberg 1983, unpublished report, see SMF1)
Tollbodgaten 9–11/ Øvre Langgate 65–67	713,737	NO	32	Tonsberg	1983, 1985	Late 1100–Early 1200 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Flodin & Runeby 1986, unpublished report, see SMF1)
Storgaten 33/ Tjomegaten 1	763	NO	40	Tonsberg	1986	Mid 1200–1300 CE	Urban	Yes	Archive Natural History, University Museum of Bergen. (Nordman et al. 1986, unpublished report, see SMF1)
Essotomten Storgaten. 16–18	796	NO	19	Tonsberg	1988	Medieval	Urban	Unknown	Archive Natural History, University Museum of Bergen.
Sumtangen sites	1326, 1429, 1430	NO	9	Eidfjord	2004–2005	Medieval	Hunting	Yes	Archive Natural History, University Museum of Bergen. (Indrelid et al. 2007; Indrelid & Hufthammer 2011)
Gildestova	350	NO	2	Ullensvang	1955	Medieval	Rural	No	Archive Natural History, University Museum of Bergen.

(contd.)

Site name	JS Number	Re-examined	Avian NISP	Location	Date excavated	Date range of site	Site type	Sieved	Site references
Ulsrud Tuft 1	274	NO	1	Gran	1948–1949	Medieval	Rural	No	Archive Natural History, University Museum of Bergen.
Hamar Domkirkeruin	866	NO	36	Hamar	1992	Medieval	Monastic	No	Archive Natural History, University Museum of Bergen.
Stavanger Domkirke	493	NO	12	Stavanger	1967	Medieval	Monastic	No	Archive Natural History, University Museum of Bergen.
Stavanger Torg	1398	NO	26	Stavanger	2004	Medieval	Urban	Yes	Archive Natural History, University Museum of Bergen.
Haakon VII gate	1518	NO	7	Stavanger	2005	Medieval	Urban	Yes	Archive Natural History, University Museum of Bergen.
Gårdshaug, Blomsoy	818	NO	5	Alstahaug	1985	Medieval	Rural	Yes	Archive Natural History, University Museum of Bergen. (Berglund 1995; Hufthammer 1993, unpublished report, see SMF 1)
Gårdshaug, Tjøtta	819	NO	20	Alstahaug	1985	Medieval	Rural	Yes	Archive Natural History, University Museum of Bergen. (Berglund 1995; Hufthammer 1993, unpublished report, see SMF 1)
Gårdshaug, Røyen	820	NO	1	Alstahaug	1985	Medieval	Rural	No	Archive Natural History, University Museum of Bergen. (Berglund 1995; Hufthammer 1993, unpublished report, see SMF 1)
Gårdshaug, Alstahaug	824	NO	2	Alstahaug	1985	Medieval	Rural	Unknown	Archive Natural History, University Museum of Bergen. (Berglund 1995; Hufthammer 1993, unpublished report, see SMF 1)
Alstahaug 1992	865	NO	141	Alstahaug	1992	Medieval	Rural	Yes	Archive Natural History, University Museum of Bergen.
Televerkstomten	632	NO	114	Trondheim	1979	C. 1000–1590 CE (Phase 2–7)	Urban	No	Archive Natural History, University Museum of Bergen. (Marthinussen 1992, unpublished thesis, see SMF 1)
Bibliotekstomten	765	NO	115	Trondheim	1986	900-ca.1475 CE	Urban	Unknown	Archive Natural History, University Museum of Bergen. (Lie 1989, unpublished report, see SMF 1)
Andenes (Ts 4767)	328	NO	6	Andøy	1953	1300–1700 CE	Rural	No	Archive Natural History, University Museum of Bergen. (Paul Simonsen, pers. comm.)
Steigen gårdshaug	360	NO	16	Steigen	1956	Medieval	Rural	No	Archive Natural History, University Museum of Bergen. (Paul Simonsen, pers. comm.)

21 sites were from archaeological contexts dating to the Medieval period. The Medieval period, or Middle Ages, in Norway and Scandinavia (Norway, Denmark and Sweden) is the period after the Viking Age, from the Christianisation of Norway to the reformation in 1537 CE, and is generally accepted as 1030–1537 CE.

The sites included in this project were excavated between 1918 and 2016 (**Table 1**). Excavation methods have improved drastically over this time frame. One of the most important improvements is the introduction of systematically sieving contexts (Lyman 2012). In Norway, the Mindets Tomt excavations in 1973 (Lie 1988) were the first Medieval contexts to be sieved systematically. As a result, material from earlier excavations is likely to be biased towards larger species and thus less representative of the original species abundance.

The Erkebispegården assemblages have largely been unstudied, with the faunal material from only areas A and B being previously examined (Hufthammer 1999). We re-examined all the Medieval contexts from areas A and B. In addition to the 21 main sites examined in this study, data from a number of smaller sites are presented here separately for comparison. These supplementary sites ( $n = 33$ ) were generally of a smaller assemblage size, some with less secure dating and occasionally lacking archaeological reports. Despite this, these sites are considered here in order to provide a more comprehensive account of the Norwegian Medieval avifauna. The material from these sites has not been re-examined and faunal lists for these sites were considered as is.

### Faunal analyses

The faunal remains from the 21 sites were recovered by hand during field excavations and subsequently stored at the University Museum of Bergen. The current analyses of the avian material from the 21 sites was based on morphological comparisons of the subfossil material to skeletons of modern specimens in the University Museum of Bergen's comparative skeletal collection, which houses 4000 bird skeletons representing 95% of the current Norwegian avifauna. In addition, the large comparative skeletal collection at the Natural History Museum at Tring, England, was also consulted. The taxonomic framework throughout this paper follows the two volumes of the Handbook of Birds of the World (HBW) and BirdLife International illustrated checklist of Birds of the World (Non-passerines: del Hoyo & Collar 2014; Passerines: del Hoyo & Collar 2016), as does the English names for species. Osteological descriptions broadly follow Livezey and Zusi (2006).

A number of criteria were recorded for each bone specimen, including species, element, side, zones present (Cohen & Serjeantson 1996: 110–111) and percentage of completeness. Taphonomic markers which were recorded include presence/absence of evidence of erosion (possibly weathering), modern breaks, concretions, surface staining, gnawing, digestion, puncture marks, evidence of burning, cut marks, and any pathologies. Sexing data was recorded where possible based on the presence of medullary bone in females, and for *Gallus gallus*, the presence of spurs on the tarsometatarsus of males (although

spurs have also been observed in a number of cases for female *G. gallus* (Serjeantson 2009)). Medullary bone was recorded for specimens that had an exposed cross section of the shaft. Medullary bone is a useful indicator of sex, and informs us about the presence of breeding females within a locality (Serjeantson 2009). The absence of medullary bone does not necessarily indicate a male specimen, as females not in lay will not produce medullary bone. Therefore, bone specimens without medullary bone were not sexed. The Western Capercaillie (*Tetrao urogallus*), the Peregrine Falcon (*Falco peregrinus*), the Northern Goshawk (*Accipiter gentilis*) and Eurasian Sparrowhawk (*Accipiter nisus*) are sexually dimorphic species for which it was possible to record sex, with little to no osteological overlap between males and females. The presence of juveniles was recorded based on ossification stages.

Measurements were based upon Von Den Driesch (1976). Additional measurements were taken from Kraft (1972) and Erbersdobler (1968). Species abundance is quantified here based on the Number of Identified Specimens (NISP). In order to prevent over-representation of species, ribs, vertebrae and phalanges were not included in this study. It is worth noting that very few Associated Bone Groups (ABGs) were identified, and these were included within the NISP counts in **Table 4**. For a breakdown of ABGs by species, they are mentioned within the species accounts in the results and within the supplementary material table (ST2). Every effort has been made to identify the species where possible. However, particular importance was placed on knowing when it is not possible to reliably identify a specimen, reducing the number of misidentifications. A number of species are particularly hard to separate based upon morphological characteristics. This is particularly true for *Lagopus lagopus* (Willow Grouse) and *Lagopus muta* (Rock Ptarmigan). Both species are year round residents in Norway, but do have different habitat preferences. Morphologically, the only elements that can accurately be separated are the cranium and mandible. Kraft (1972) highlights a number of morphological differences; despite this, we found those to not be overly reliable in the Norwegian modern specimens. Stewart (2007) also notes the unreliability of these morphological differences, preferring to split *L. lagopus* and *L. muta* based on measurements. The most significantly different skeletal elements based on size belonged to the lower limb, in particular the tarsometatarsus (Stewart 2007). For the Norwegian material we have used linear measurements to compare postcranial elements, specimens which fell into the overlap between *L. lagopus* and *L. muta*, have been grouped at a higher taxonomic level of *Lagopus* in this study.

Due to the assemblages being Medieval in age, along with the urban location of specimens, we have assumed that *Anser anser* identifications are likely to represent domesticated individuals. Despite this, it is possible that some of these specimens are wild *A. anser*. Further work is needed on the separation of the domesticated and wild forms of *A. anser*. Other *Anser* and *Branta* species are morphologically very similar, and have been placed into the broader category of *Anserini* sp. The same has

been done for ducks; when they could not be identified to tribe, they were placed into the broader Anatinae species group. Within the Alcidae, it was often not possible to separate *Uria aalge*, *Uria lomvia* and *Alca torda*, and these were grouped as *Uria aalge/lomvia/Alca torda*. Similarly, *Larus argentatus* and *L. fuscus* are difficult to separate and were grouped as *Larus argentatus/fuscus*. Passerines are particularly hard to identify due to the small number of diagnostic elements (humerus, cranium and mandible). In order to prevent misidentifications within this order we have taken a cautious approach by placing species into size groups when diagnostic elements are not available. The Turdidae family has been placed into two size groups; small *Turdus* sp. (*Turdus iliacus* and *T. philomelos*) and large *Turdus* sp. (*Turdus pilaris*, *T. torquatus*, *T. merula* and *T. viscivorus*).

Where specimens were not identifiable to taxa, they were placed into broad size categories, based on those used by Ayres et al. (2003). Three size categories were used: 'unidentified small bird' (almost exclusively passerine fragments), 'unidentified medium bird' (specimens larger than a passerine but not as large as *A. anser*), 'unidentified large bird' (specimens in the size range of *A. anser* and beyond). If specimens could not be placed into a size category, they were recorded as 'unidentified bird'.

To obtain an indication of how reliable previous identifications were, we assigned all our identifications to five distinct categories, namely 'maintained identification' (original identification is unchanged), 'newly identified' (where the specimen has not previously been identified), 'more accurately identified' (this is where it has been possible to further attribute either family, genus or species, e.g. a Galliformes specimen newly identified to *L. tetrix*), 'more cautiously identified' (when a specimen has been placed over-confidently into a family, genus or species, e.g. previously identified *L. muta* re-identified to *Lagopus* species) and 'different taxon' (where the identification is changed completely, e.g. Falconidae species changed to Accipitridae species).

## Results

### Taphonomy

Birds generally make up less than 5% of the faunal bone assemblages at Medieval sites in Norway (Table 2). Mammals make up the bulk of the faunal assemblages, with fish also being well represented. The only exceptions in this study are the sites of Husen on the island of Rost, where birds make up 65%, and the Borgund site, where fish are dominant and birds are poorly represented (0.03%). However, the assemblages from these sites are small, and do not represent the general patterns we have observed across Norway during the Medieval period.

Overall, the Medieval bird bone assemblages show very good preservation, with relatively few taphonomic markers identified (Table 3). Many of the bones are complete or have at least one epiphysis present. This high level of preservation is reflected by the fact that 54% of the material could be identified to species or family. The cortical surface preservation was generally good, with only 254 (4%) specimens displaying surface cracking, flaking, or general cortical surface damage. A total of 93 specimens exhibited

**Table 2:** Bird representation. The table shows the percentages of bird bones represented within the faunal assemblages for a given area. The NISP figures used to calculate these percentages can be found in Supplementary Table 1 (ST1).

Location (County)	Bird %
Oslo (n = 3)	2
Bergen (n = 7)	3
Tonsberg (n = 4)	1
Alstahaug (n = 1)	3
Rost (n = 1)	65
Borgund (n = 1)	0.3
Dovre (n = 2)	5
Trondheim (n = 1)	3
Finnmark (n = 1)	12

**Table 3:** Taphonomy identified. The table shows the main Taphonomic markers observed within the Norwegian Medieval assemblages.

Taphonomic marker	No. specimens	Overall %
Butchered	393	6.6%
Modern breaks	66	1.1%
Eroded/weathered	254	4.3%
Gnawed	93	1.6%
Digested	2	0.03%
Concretions	5	0.08%
Charred/Burnt	25	0.4%
Puncture marks	26	0.4%

signs of gnawing, evidenced by small parallel striations, indicative of rodent gnawing, but also some small puncture marks, possibly from an avian predator or cat/dog gnawing. Taphonomic markers related to burning were only visible on 25 of the identified specimens. Evidence of digestion was recorded on only two specimens. While these figures are very low, the majority of taphonomic damage was present on the unidentified material, many of which were eroded or burnt, preventing identification.

Butchery was observed on 393 specimens (6.6%). This was the most common taphonomic feature observed. Generally, the butchery marks were in keeping with removal of the elements that provide the least meat, such as the tarsometatarsus and phalanges. Other butchery marks, especially to the sternum, likely represent filleting. The majority of the butchery was on *Gallus gallus* bones, in total 291 specimens. Butchery was recorded on 20 different species, and details of these are presented, where relevant, within the species accounts.

### Species representation

From the 21 sites that were analysed, 5938 bird bones could be identified to species, genus or family (Table 4), with 55 different species being represented, from 15 dif-



**Table 4:** Species representation. Here the re-examined sites (n = 21) have been grouped by locations, for a full breakdown of species per site see Supplementary Table 2 (ST2). A column of all the species represented on the supplementary sites (n = 33) has also been added, for a full breakdown of species by supplementary site see Supplementary Table 3 (ST3). All figures are based upon Number of Identified Specimens (NISP).

Taxa	Oslo sites (n = 3)	Bergen sites (n = 7)	Tønsberg sites (n = 4)	Alstahaug sites (n = 1)	Røst sites (n = 1)	Borgund, Ålesund (n = 1)	Dovre sites (n = 2)	Trondheim sites (n = 1)	Finnmark sites (n = 1)	Norway re-examined total (n = 21)	Norway previously identified total (n = 33)	Norway Medieval total (n = 54)
<b>Galliformes</b>												
<i>Galliformes</i> sp.	127	14	11	–	–	–	33	36	1	222	131	353
cf. <i>Galliformes</i> sp.	8	–	–	–	–	–	3	–	–	11	1	12
<i>Gallus gallus</i>	1870	739	97	1	–	18	23	109	–	2857	556	3413
cf. <i>Gallus gallus</i>	42	4	1	–	–	2	2	1	–	52	0	52
<i>Lyrurus tetrix</i>	63	26	2	–	–	–	9	3	–	103	18	121
cf. <i>Lyrurus tetrix</i>	6	1	–	–	–	1	–	–	–	8	0	8
<i>Tetrao urogallus</i>	134	6	1	–	–	–	23	12	1	177	72	249
cf. <i>Tetrao urogallus</i>	8	–	–	–	–	–	–	1	–	9	0	9
<i>Lagopus</i> sp.	7	2	1	–	–	1	1083	3	33	1130	31	1161
cf. <i>Lagopus</i> sp.	1	–	–	–	–	–	132	–	–	133	0	133
<i>Lagopus lagopus</i>	–	–	–	–	–	–	28	–	2	30	3	33
<i>Lagopus muta</i>	–	–	–	–	–	–	–	–	–	0	27	27
<i>Bonasa bonasia</i>	4	–	1	–	–	–	–	5	–	10	0	10
cf. <i>Bonasa bonasia</i>	1	–	–	–	–	–	1	–	–	2	0	2
<b>Anseriformes</b>												
<i>Anseriformes</i> sp.	–	1	–	–	–	–	–	–	–	1	20	21
<i>Anserini</i> sp. ( <i>Anser/Branta</i> sp.)	6	2	–	–	–	–	–	10	–	18	0	18
<i>Anser</i> sp.	17	7	1	2	–	–	–	1	–	28	8	36
<i>Anser anser</i>	286	64	16	1	–	5	–	10	–	382	144	526
cf. <i>Anser anser</i>	21	4	–	–	–	–	–	–	–	25	0	25
<i>Anser fabalis</i>	–	–	–	1	–	–	–	–	–	1	1	2
<i>Anser brachyrhynchus</i>	–	–	–	–	–	–	–	–	–	0	1	1

(contd.)

	Oslo sites (n = 3)	Bergen sites (n = 7)	Tønsberg sites (n = 4)	Alstahaug sites (n = 1)	Røst sites (n = 1)	Borgund, Ålesund sites (n = 1)	Dovre sites (n = 2)	Trondheim sites (n = 1)	Finnmark sites (n = 1)	Norway re-examined total (n = 21)	Norway previously identified total (n = 33)	Norway Medieval total (n = 54)
<i>Branta bernicla/leucopsis</i>	–	2	–	–	–	–	–	–	–	2	0	2
<i>Cygnus cygnus</i>	7	1	–	–	–	1	–	–	–	9	0	9
cf. <i>Cygnus cygnus</i>	1	–	–	–	–	–	–	–	–	1	0	1
Anatinae sp.	9	1	–	–	–	–	2	1	–	13	0	13
<i>Anas platyrhynchos</i>	1	1	–	–	–	1	–	1	–	4	1	5
<i>Anas crecca</i>	–	1	–	–	–	–	–	–	–	1	0	1
Anatidae sp.	–	–	–	–	–	–	–	–	–	0	1	1
<i>Somateria mollissima/spectabilis</i>	–	–	–	–	–	–	–	–	–	0	2	2
<i>Somateria mollissima</i>	3	40	1	3	–	2	–	–	1	50	14	64
cf. <i>Somateria mollissima</i>	–	1	–	–	–	–	–	–	–	1	1	2
<i>Somateria spectabilis</i>	–	–	–	–	–	–	–	–	–	0	1	1
<i>Clangula hyemalis</i>	–	–	–	–	–	–	4	–	–	4	1	5
<i>Melanitta fusca</i>	1	–	–	–	–	–	–	–	–	1	2	3
<i>Melanitta nigra</i>	–	–	–	–	–	–	–	–	–	0	1	1
<i>Mergus serrator</i>	1	1	–	–	–	–	–	–	–	2	0	2
<i>Bucephala clangula</i>	–	–	–	–	–	–	1	–	–	1	0	1
<i>Mergini</i> sp.	–	–	–	–	–	1	2	–	–	3	0	3
<i>Anas</i> sp.	1	–	–	–	–	–	1	–	–	2	0	2
<i>Aythya</i> sp.	1	–	–	–	–	–	–	–	–	1	0	1
<b>Gaviiformes</b>												
<i>Gavia</i> sp.	–	–	–	–	–	–	–	–	–	0	2	2
<i>Gavia arctica</i>	6	1	–	–	–	–	–	–	–	7	1	8
cf. <i>Gavia arctica</i>	1	–	–	–	–	–	3	–	–	4	0	4
<i>Gavia stellata</i>	–	1	–	–	–	–	–	–	–	1	1	2

(contd.)

	Oslo sites (n = 3)	Bergen sites (n = 7)	Tønsberg sites (n = 4)	Alstahaug sites (n = 1)	Røst sites (n = 1)	Borgund, Ålesund sites (n = 1)	Dovre sites (n = 2)	Trondheim sites (n = 1)	Finnmark sites (n = 1)	Norway re-examined total (n = 21)	Norway previously identified total (n = 33)	Norway Medieval total (n = 54)
<b>Procellariiformes</b>												
<i>Fulmarus glacialis</i>	3	2	-	-	-	2	-	-	-	7	8	15
<i>Puffinus puffinus</i>	-	-	-	-	-	2	-	-	-	2	0	2
<b>Ciconiiformes</b>												
<i>Ciconia nigra</i>	-	1	-	-	-	-	-	-	-	1	0	1
<b>Suliformes:</b>												
<b>Phalacrocoracidae</b>												
<i>Phalacrocorax aristotelis</i>	-	5	-	-	-	8	-	-	-	13	3	16
<i>Phalacrocorax carbo</i>	-	6	-	-	-	2	-	-	-	8	2	10
<b>Suliformes: Sulidae</b>												
<i>Morus bassanus</i>	-	3	-	-	-	10	-	-	-	13	4	17
<b>Pelecaniformes</b>												
<i>Ardea cinerea</i>	1	3	-	-	-	-	-	5	-	9	2	11
<b>Accipitriformes</b>												
<i>Accipiter gentilis</i>	107	29	-	-	-	-	-	1	-	137	4	141
<i>Accipiter nisus</i>	1	1	-	-	-	-	-	-	-	2	0	2
<i>Buteo buteo</i>	-	-	-	-	-	-	-	-	-	0	1	1
<i>Buteo lagopus</i>	-	-	-	-	-	-	-	-	-	0	2	2
<i>Haliaeetus albicilla</i>	22	32	-	-	-	6	-	11	-	71	20	91
cf. <i>Haliaeetus albicilla</i>	2	1	-	-	-	-	-	-	-	3	1	4
<i>Pandion haliaetus</i>	-	-	-	-	-	-	-	-	-	0	2	2
<i>Aquila chrysaetos</i>	2	5	-	-	-	-	-	1	-	8	0	8
<b>Falconiformes</b>												
Falconidae sp.	2	-	-	-	-	-	-	-	-	2	3	5
<i>Falco peregrinus</i>	-	2	-	-	-	-	-	-	-	2	0	2
<i>Falco rusticolus</i>	-	6	-	-	-	-	-	-	-	6	4	10

(contd.)

	Oslo sites (n = 3)	Bergen sites (n = 7)	Tønsberg sites (n = 4)	Alstahaug sites (n = 1)	Røst sites (n = 1)	Borgund, Ålesund (n = 1)	Dovre sites (n = 2)	Trondheim sites (n = 1)	Finnmark sites (n = 1)	Norway re-examined total (n = 21)	Norway previously identified total (n = 33)	Norway Medieval total (n = 54)
<b>Strigiformes</b>												
<i>Bubo bubo</i>	-	2	-	-	-	-	-	-	-	2	1	3
<b>Gruiformes</b>												
<i>Grus grus</i>	-	1	-	2	-	-	-	-	-	3	0	3
<b>Charadriiformes: Scolopaciidae</b>												
Charadriiformes sp.	1	-	-	-	-	-	-	-	-	1	0	1
<i>Scolopaciidae</i> sp.	1	-	-	-	-	-	-	-	-	1	0	1
<i>Scolopax rusticola</i>	5	-	-	-	-	-	-	-	-	5	0	5
<b>Charadriiformes: Haematopodidae</b>												
<i>Haematopus ostralegus</i>	-	-	-	-	-	-	-	-	-	0	2	2
<b>Charadriiformes: Charadriidae</b>												
<i>Pluvialis apricaria/squatarola</i>	-	-	-	-	-	-	-	-	1	1	0	1
<b>Charadriiformes: Alcidae</b>												
Alcidae sp.	1	1	-	-	-	-	-	-	-	2	5	7
<i>Fratercula arctica</i>	1	1	-	-	26	1	-	-	1	30	6	36
<i>Cephus grylle</i>	-	-	-	-	-	-	-	-	-	0	2	2
cf. <i>Cephus grylle</i>	-	1	-	-	-	-	-	-	-	1	0	1
<i>Uria aalge/Alca torda</i>	9	-	-	-	-	-	-	-	-	9	4	13
cf. <i>Uria aalge/Alca torda</i>	4	-	-	-	-	-	-	-	-	4	0	4
<i>Uria aalge/lornvia/Alca torda</i>	-	2	-	-	-	6	-	-	3	11	4	15
<b>Charadriiformes: Laridae</b>												
Laridae sp.	-	41	-	-	-	1	-	-	-	42	15	57
<i>Larus argentatus/fuscus</i>	6	11	-	-	-	28	-	-	-	45	35	80

(contd.)

	Oslo sites (n = 3)	Bergen sites (n = 7)	Tønsberg sites (n = 4)	Alstahaug sites (n = 1)	Røst sites (n = 1)	Borgund, Ålesund sites (n = 1)	Dovre sites (n = 2)	Trondheim sites (n = 1)	Finnmark sites (n = 1)	Norway re-examined total (n = 21)	Norway previously identified total (n = 33)	Norway Medieval total (n = 54)
<i>Larus marinus</i>	4	11	-	2	-	1	-	-	-	18	6	24
<i>Larus canus</i>	-	2	-	-	-	-	-	-	-	2	6	8
cf. <i>Larus canus</i>	-	2	-	-	-	-	-	-	-	2	0	2
<i>Rissa tridactyla</i>	1	1	-	-	-	1	-	-	-	3	4	7
cf. <i>Rissa tridactyla</i>	2	-	-	-	-	-	-	-	-	2	0	2
<i>Sterna</i> sp.	-	-	-	-	-	-	1	-	-	1	0	1
cf. <i>Sterna hirundo</i>	1	-	-	-	-	-	-	-	-	1	0	1
<b>Columbiformes</b>												
<i>Columba palumbus</i>	6	-	-	-	-	-	-	-	-	6	0	6
<i>Columba livia/oenas</i>	-	-	1	-	-	-	-	-	-	1	1	2
<b>Apodiformes</b>												
<i>Apus apus</i>	-	-	-	-	-	-	-	-	-	0	1	1
<b>Passeriformes:</b>												
<b>Corvidae</b>												
Corvidae sp.	-	-	-	-	-	-	-	-	-	0	1	1
<i>Corvus corax</i>	21	3	2	-	-	8	-	2	-	36	24	60
<i>Corvus monedula</i>	5	-	-	-	-	-	-	3	-	8	0	8
cf. <i>Corvus monedula</i>	1	-	-	-	-	-	-	1	-	2	0	2
<i>Corvus corone</i>	16	2	-	-	-	-	-	34	-	52	3	55
<i>Pica pica</i>	1	-	1	-	-	-	-	5	-	7	4	11
<b>Passeriformes:</b>												
<b>Turdidae</b>												
<i>Turdus</i> sp.	-	-	-	-	-	-	6	-	-	6	1	7
<i>Turdus pilaris</i>	-	-	-	-	-	-	2	-	-	2	2	4
Large <i>Turdus</i> sp.	-	-	-	-	-	-	20	-	-	20	0	20
Small <i>Turdus</i> sp.	3	-	-	-	-	-	8	-	-	11	0	11

(contd.)

	Oslo sites (n = 3)	Bergen sites (n = 7)	Tønsberg sites (n = 4)	Alstahaug sites (n = 1)	Røst sites (n = 1)	Borgund, Ålesund (n = 1)	Dovre sites (n = 2)	Trondheim sites (n = 1)	Finnmark sites (n = 1)	Norway re-examined total (n = 21)	Norway previously identified total (n = 33)	Norway Medieval total (n = 54)
<b>Passeriformes:</b>												
<b>Sturnidae</b>												
<i>Sturnidae/Turdidae</i> sp.	1	-	-	-	-	-	2	-	-	3	0	3
<i>Sturnus vulgaris</i>	-	-	-	-	-	-	1	-	-	1	0	1
<b>Passeriformes:</b>												
<b>Motacillidae</b>												
<i>Anthus pratensis</i>	-	-	-	-	-	-	1	-	-	1	0	1
<b>Passeriformes:</b>												
<b>Passeridae</b>												
<i>Passeriformes</i> sp.	2	-	-	-	-	-	2	-	-	4	4	8
<i>Passer domesticus</i>	1	-	-	-	-	-	-	-	-	1	0	1
cf. <i>Passer domesticus</i>	1	-	-	-	-	-	-	-	-	1	0	1
<b>Total identified</b>	<b>2867</b>	<b>1097</b>	<b>136</b>	<b>12</b>	<b>26</b>	<b>108</b>	<b>1393</b>	<b>256</b>	<b>43</b>	<b>5938</b>	<b>1229</b>	<b>7167</b>
Unidentified Large Bird	105	2	5	2	-	1	28	6	-	149	0	149
Unidentified Medium Bird	203	24	29	2	1	-	690	16	17	982	0	982
Unidentified Small Bird	-	2	-	-	-	-	-	-	-	2	0	2
Unidentified Bird	434	19	15	-	1	-	786	72	7	1334	997	2331
Bird?	2501	18	47	-	-	-	37	11	4	2618	0	2618
<b>Total unidentified</b>	<b>3243</b>	<b>65</b>	<b>96</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>1541</b>	<b>105</b>	<b>28</b>	<b>5085</b>	<b>997</b>	<b>6082</b>
<b>Total</b>	<b>6110</b>	<b>1162</b>	<b>232</b>	<b>16</b>	<b>28</b>	<b>109</b>	<b>2934</b>	<b>361</b>	<b>71</b>	<b>11023</b>	<b>2226</b>	<b>13249</b>

ferent orders. The remaining 5085 specimens were unidentifiable beyond Aves, of these, 2618 bone fragments were identified as probably Aves. Of the remaining 2467 unidentified fragments, 149 were considered to be large birds, 982 fragments were placed into the medium birds category, and only two fragments were placed into the small birds group. The remaining 1334 specimens were placed in the unidentified bird category.

Of the 5938 identifiable specimens examined in this study, a total of 1300 (22%) specimens have had the original identification changed to some degree (**Table 5**). Only 276 (4.6%) specimens were previously identified a different taxa. In addition, 1024 (17.3%) were either more cautiously or more accurately identified. A further 867 (14.6%) newly identified specimens were also recorded. This leaves 3771 (63.5%) specimens where the previous identification was maintained. The most common issue was the over identification of the *Lagopus* species, where we have adopted a more cautious approach. In addition, Anseriformes are also prone to misidentification, as it is not always possible to identify beyond the tribe. The confidence level of identifying certain gulls and auks to species level has also been a problem with previously identified material, which we have tried to prevent by placing species into broader groups covering a number of morphologically similar species.

#### Galliformes (Pheasants and Grouse)

Galliforms form the bulk of the avian material recovered from the Medieval sites with 4744 specimens identified within this order (80% of NISP). It was not possible to assign 233 specimens to a taxonomic level beyond Galliformes.

#### Domestic Galliformes

Domestic fowl (*Gallus gallus* var. *domesticus*) is the most common bird species represented in Medieval Norway. In total 2857 specimens were positively identified with a further fifty-two cf. *G. gallus*, forming 49% of the represented Medieval avian specimens. *Gallus gallus* is fairly ubiquitous and present on 17 sites. However, the dominance of this species does vary; whilst it contributes heavily to sites in Oslo, Bergen, Tønsberg and Trondheim, it has little importance on sites in Alstahaug, Ålesund and Dovre, and does not occur on Røst or the Finnmark site of Gæccevajnjar'ga.

There is a fairly even distribution of elements with a slight dominance of wing and leg bones and a lack of small, less dense bones. Medullary bone was identified within 42 individuals with varying degree of cavity fill (<50% fill of shaft cavity n = 29, <100% fill of shaft cavity n = 8 and 100% fill of shaft cavity n = 5). In addition, 98 tarsometatarsi lacked a spur, indicating a total of 140 females. It is important to note that, while uncommon, juvenile males sometimes do not show indications of a spur (Serjeantson 2009). A hundred and twelve tarsometatarsi were identified as male. Fourteen of these only have a spur scar, and not a fully developed spur. Age at death was based upon the ossification of epiphyses; 2642 (93%) were fully developed adult individuals. Only 26 (1%) specimens were just

**Table 5:** Identification changes. This table shows the amount of specimens in each identification category, the final three rows show the amount of previously misidentified specimens. Descriptions for the categories can be found under the methods-faunal analysis section. Figures are based upon Number of Identified Specimens (NISP).

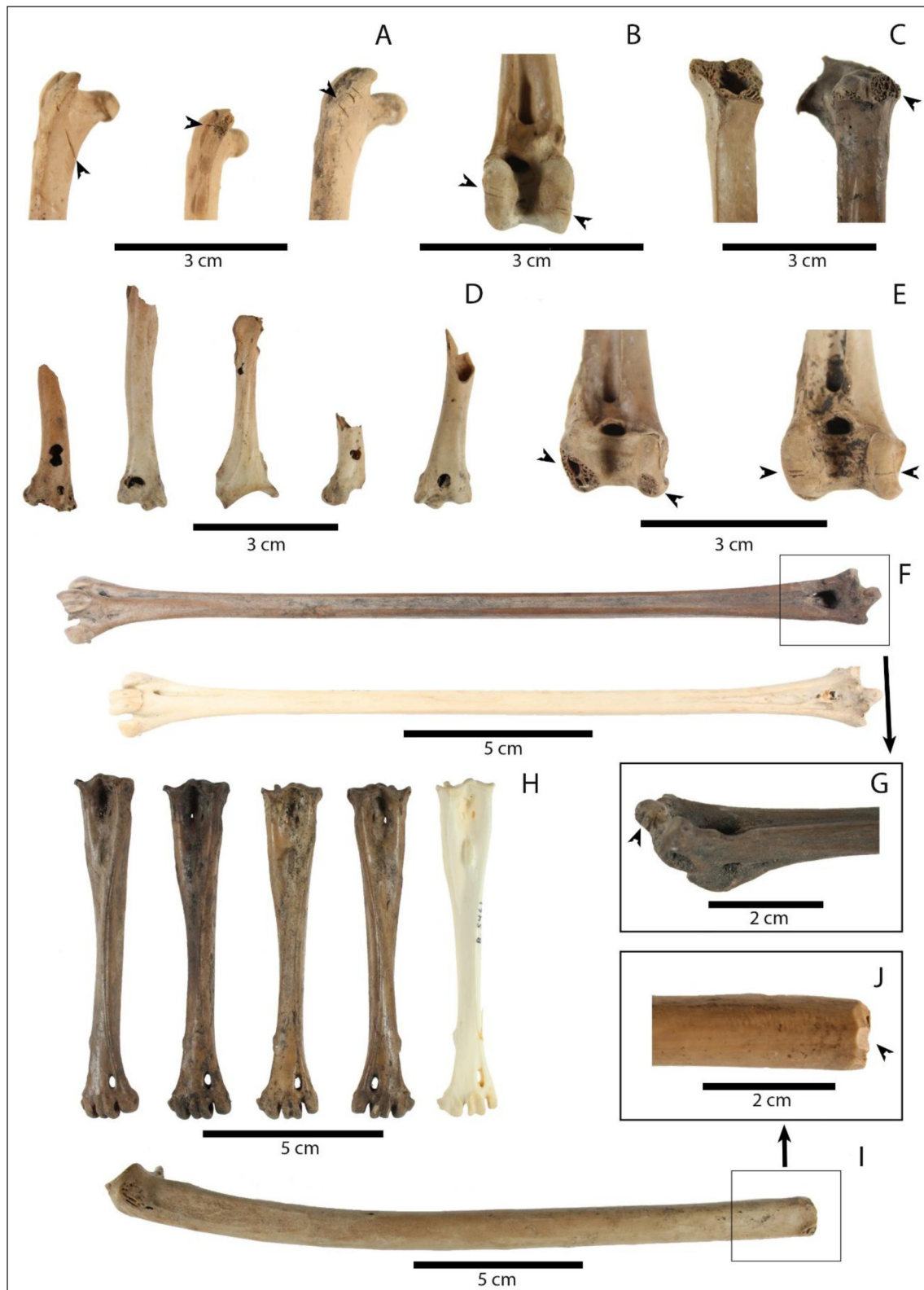
Category	NISP	NISP %
Maintained identification	3771	63.5%
More accurately identified	598	10.1%
More cautiously identified	426	7.2%
Different taxa	276	4.6%
Newly identified	867	14.6%
Total	5938	

ossified and classified as sub-adult. Sixty-six (2%) specimens were not ossified and therefore juvenile, whilst 123 (4%) showed no indicators of age.

Butchery marks were identified on 291 (10%) of the *G. gallus* bones, and predominantly found on the femur and tibiotarsus (201 specimens). Specific patterns of butchery observed on these elements were fine diagonal cut marks across the trochanter femoris (**Figure 2A**), fine transverse cut marks across the distal lateral and medial condyles of the tibiotarsi (**Figure 2B**), and some heavier chops to the proximal articular facets of the tibiotarsi (**Figure 2C**). The amount of butchery observed varied greatly: in Bergen 25% (n = 188) of the *G. gallus* bones showed sign of butchery, in Trondheim 10% (n = 12) and in Oslo only 4.5% (n = 86). On all other sites, cut marks were observed on one or two *G. gallus* bones. Pathological markers were recorded on *G. gallus* specimens more than on any other species. Nevertheless, this was still a relatively small number of the total domestic fowl specimens, only 42 (1.5%). The most common pathology was periosteal new bone growth on the mid-shaft of the tarsometatarsus, 20 specimens (48%) fell into this category, predominantly on male (i.e. spurred) individuals (n = 17). Ten (24%) specimens showed indications of periosteal new bone growth around the articular surfaces of long bones, often on the femur. Healed fractures were identified on four (9%) specimens. The remaining eight (19%) specimens showed various pathologies not falling into these three main categories.

#### Wild Galliformes

The wild Galliformes are one of the best represented groups within the Medieval Norwegian avian assemblages with 1602 specimens (27%) identified, representing four different species of galliform. Of the wild Galliformes, the two *Lagopus* species are dominant, with 1293 (22% of the Medieval bird bones). The vast majority of these, 1243 specimens come from the two Dovre sites, Vesle Hjerkin and Toftom. The *Lagopus* specimens have been further identified as 1130 specimens into the broader taxonomic group of *Lagopus* sp., 133 specimens as cf. *Lagopus* species and 30 *Lagopus lagopus* specimens. No specimens morphologically matched *L. muta*. Linear measurements



**Figure 2:** Selected avian remains from Medieval sites in Norway. **A:** Butchery marks on the trochanter of *G. gallus* femora. **B:** Butchery marks on the distal condyles of *G. gallus* tibiotarsus. **C:** Heavy butchery marks on the proximal end of *G. gallus* tibiotarsi. **D:** Puncture marks on *Lagopus* specimens, puncture on the distal humerus on the far right is a puncture caused by ulna piercing via hyperextension. **E:** Butchery marks on the distal condyles of *A. anser* tibiotarsi. **F:** *Ciconia nigra* worked tarsometatarsus, comparative *C. nigra* specimen from the University Museum of Bergen (BM. 7896). **G:** Close up of the *C. nigra* specimen, showing cut marks to the eminentia intercondylaris. **H:** Four *A. gentilis* tarsometatarsi from Mindets Tomt, Oslo. Showing the large and robust nature of the Medieval specimens in comparison to the largest *A. gentilis* female (B. 5461) in the University Museum of Bergen's comparative collections. **I:** Worked *A. chrysaetos* ulna from Finnegården 3A, Bergen. **J:** Close up of the fine working to the distal shaft of the *A. chrysaetos* specimen.

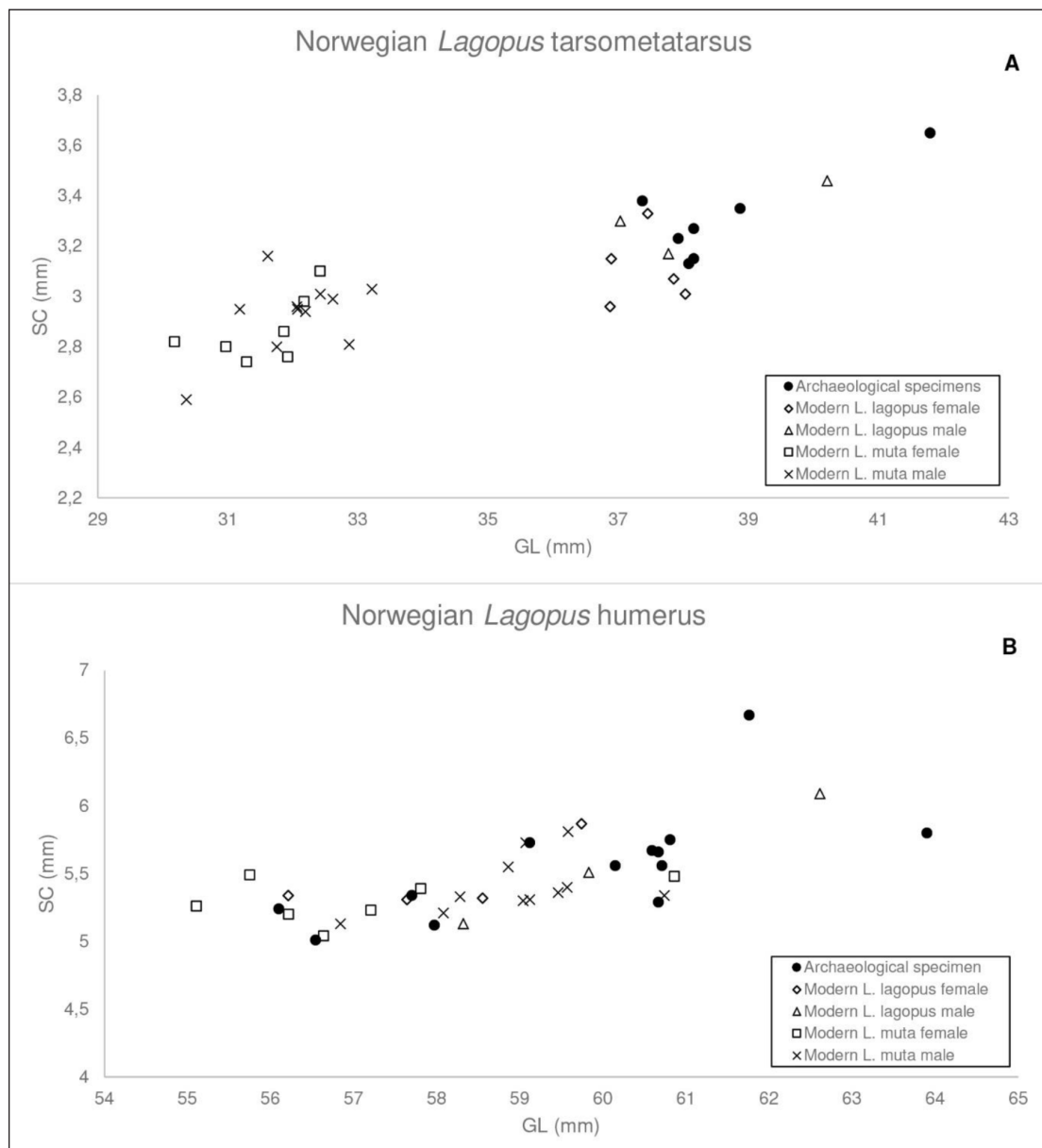


of seven *Lagopus* tarsometatarsi show that all seven specimens fall in the *L. lagopus* size range (**Figure 3A**). Linear measurements for upper limbs showed too much overlap between species to make any accurate identifications (**Figure 3B**). It appears from current analysis that *L. lagopus* was the most dominant of the *Lagopus* species within the Medieval Norwegian assemblages. It is unclear if any *L. muta* specimens are present in the assemblages. Some specimens appear to be smaller, but due to their fragmentary nature, no meaningful measurements could be taken. Puncture marks possibly caused by avian predators, and often located at the epiphyses (**Figure 2D**), were recorded for 11 *Lagopus* specimens.

The second best represented wild galliform is the Western Capercaillie (*Tetrao urogallus*). With 177 specimens confidently identified and a further nine specimens identified to cf. *T. urogallus*, this species accounts

for around 3% of the represented Medieval birds. Males dominated the assemblages (122 specimens, 69%) while 50 (28%) elements were identified as female, and five (3%) specimens as indeterminate. Butchery marks were observed on 11 (6%) specimens, predominantly on the wing elements ( $n = 7$ , 64%). Element representation shows an even distribution, with a very slight bias towards the wing elements. *Tetrao urogallus* has been identified on most sites, however, with varying abundance. It is most dominant on sites in Oslo and Trondheim, making up 5% of their respective assemblages, whilst in Bergen, *T. urogallus* only accounts for 0.5% of the bird bone assemblages.

The Black Grouse (*Lyrurus tetrix*) is also well represented within the Medieval bird bone material. A total of 103 specimens were identified as *L. tetrix* and a further eight were classified as cf. *L. tetrix*, contributing almost 2% to the overall NISP. This species was one of the more common



**Figure 3:** Plotted measurements of *Lagopus* tarsometatarsus and humerus. Greatest length (GL) and smallest breadth of the shaft (SC) of archaeological specimens from Norwegian Medieval sites. The modern measurements are from Norwegian individuals, measured from the Bergen University Museum and Tring Natural History Museum collections.

misidentifications, due to its similar size and morphology to *G. gallus*, yet there are a number of distinct characteristics to separate these species. In general, *L. tetrrix* is more slender, and its morphology is more pronounced. For instance, the facies articularis scapularis on the coracoid is far more distinct in *L. tetrrix*, along with a much more hooked angulus medialis coracoidei. The humerus in *L. tetrrix* also has distinct features, such as a more prominent condylus ventralis humeri. Butchery marks were observed on four elements, approximately 4% of the *L. tetrrix* bones. No irregular patterns were observed in terms of element representation. This species appears to follow a distribution pattern similar to *T. urogallus*, with a slightly better representation in Bergen, but still less abundant than in Oslo.

The Hazel Grouse (*Bonasa bonasia*) makes up a small amount of the total Medieval avian assemblages, with only 10 specimens and a further two specimens identified as cf. *B. bonasia*, totalling less than 0.2%. The majority of these have been identified from the Oslo and Trondheim sites, with very few occurring within assemblages across the rest of Norway.

#### Anseriformes (Ducks, Geese and Swans)

Anseriformes represent the most diverse order within the Norwegian bird bone material with a minimum of 12 species identified. A total of 550 specimens have been attributed to this order, forming 9% of the Medieval material. The most dominant species in this group is Greylag Goose (*Anser anser*) with 382 (6%) specimens identified. These are likely to be the domestic form (*Anser anser* var. *domesticus*). However, as mentioned in the methods, the wild counterpart cannot be ruled out, and this figure may include wild geese as well. A further 25 specimens were classified as cf. *A. anser* and 28 specimens were placed into the *Anser* sp. group. Element representation for *A. anser* showed a very even distribution, even more so than the smaller species. This is expected within larger species where there is a better recovery rate of the smaller skeletal elements. Butchery marks were identified on 37 specimens, just under 10% of the *A. anser* remains (**Figure 2E**). Pathologies were observed on seven specimens, which mainly consisted of periosteal new bone growth around articular facets. Similarly to *G. gallus*, *Anser anser* mainly occurs on urban sites and not on island and hunting locations. Other Anserinae species identified within the assemblages include a single specimen of Bean Goose (*Anser fabalis*), and two specimens of Brent/Barnacle Goose (*Branta bernicla/leucopsis*). The Whooper Swan (*Cygnus cygnus*) was present in Medieval contexts from Oslo, Bergen and Borgund, with a total of nine specimens and an additional cf. *C. cygnus* specimen. Eighteen specimens could not be identified beyond Anserini.

We identified 83 specimens as belonging to the Anatinae, representing at least eight different species. Fifty specimens, predominantly from Bergen, were assigned to the Common Eider (*Somateria mollissima*). The Mallard (*Anas platyrhynchos*) is only represented by four specimens, found in Oslo, Bergen, Borgund and Trondheim assemblages. Four specimens of Long-tailed Duck (*Clangula hyemalis*) were recovered from Dovre. The Red-breasted Merganser (*Mergus serrator*) was represented by two

specimens from Oslo and Bergen. Single specimens of Velvet Scoter (*Melanitta fusca*), Common Teal (*Anas crecca*) and Common Goldeneye (*Bucephala clangula*) were identified from Oslo, Bergen and Dovre respectively. A number of specimens could only be identified to genus level; two specimens to *Anas* sp., a single specimen to *Aythya* sp. In addition, three specimens were attributed to the *Mergini* tribe. A further 13 specimens were not identifiable beyond Anatinae.

#### Gaviiformes (Loons and Divers)

The Gaviiformes make up a very small percentage of the species represented with only 12 (0.20%) specimens identified, most of them from Oslo. The Black-throated Loon (*Gavia arctica*) was the most common of this order with seven specimens identified. In addition, four cf. *G. arctica* specimens were recorded. The Red-throated Loon (*Gavia stellata*) was the only other Gaviiformes represented in the Medieval material, with a single distal humerus recorded from Bergen.

It is important to note a misidentification of three specimens from Vesle Hjerkin, Dovre (Lie & Fredriksen 2007). Previously, the humerus, ulna and radius of a *Gavia* species had been identified as Common Loon (*Gavia immer*). However, after close examination and use of both the Bergen and Tring Natural History Museum modern reference collections these specimens have been re-identified as the Black-throated Loon (*G. arctica*). The Common Loon (*G. immer*) breeds in Iceland and predominantly North America, whilst *G. arctica* breeds throughout Norway and Scandinavia (Caboneras et al. 2019a; Caboneras & Garcia 2019).

#### Procellariiformes (Petrels and Shearwaters)

These pelagic species are not well represented. Seven (0.12%) specimens from Oslo, Bergen and Borgund have been identified as Northern Fulmar (*Fulmarus glacialis*). All remains identified were wing elements. In addition to *F. glacialis*, a single carpometacarpus and ulna of Manx Shearwater (*Puffinus puffinus*) were also identified from Borgund. The migratory *P. puffinus* is currently the most frequently found Shearwater species in Norway (Caboneras et al. 2019b).

#### Ciconiiformes (Storks)

A single Black Stork (*Ciconia nigra*) tarsometatarsus was identified from Dreggsalmenningen, Bergen (**Figure 2F, 2G**). This specimen represents the only Ciconiiformes species in the Norwegian Medieval bird bone material. Currently *C. nigra* is a vagrant species to Norway. The specimen recovered from Dreggsalmenningen is of particular interest; the foramen vasculare proximale has been worked into a larger hole, the proximal shaft has also been scraped, and fine transverse cut marks can be found just above the distal trochlea (see **Figure 3C**). It is clear that the specimen had some form of use and was possibly regarded as an important object. Magnus (1555) mentions the importance placed upon this species by people in the Medieval period, this could be the reason for the working of this specimen. The importance placed on the Black Stork may also indicate that this is a trade item rather than an indicator for the presence of *C. nigra* around Bergen.

### Suliformes (Cormorants and Gannets)

Suliformes are represented by 34 specimens, from 3 different species, forming 0.55% of the Medieval bird bone assemblage. The most abundant is the European Shag (*Phalacrocorax aristotelis*) with 13 specimens. The Great Cormorant (*Phalacrocorax carbo*) is represented by eight specimens. The Northern Gannet (*Morus bassanus*) is also an abundant species within this order with 13 bones positively identified. Six of these are from one individual excavated from Borgund. The elements from this individual are representative of the left and right wing. All Suliformes specimens were recovered from Bergen and Borgund. It is highly likely that all of these animals were a result of fishing by-catch, as these seabirds are likely to get caught in the fishing nets, and both Bergen and Borgund were fishing towns.

### Pelecaniformes (Hérons)

This order is represented by nine specimens identified as Grey Heron (*Ardea cinerea*). Five bone specimens are from one individual (ABG) recovered from Erkebispegården, Trondheim. They are all elements from the left wing. A sin-

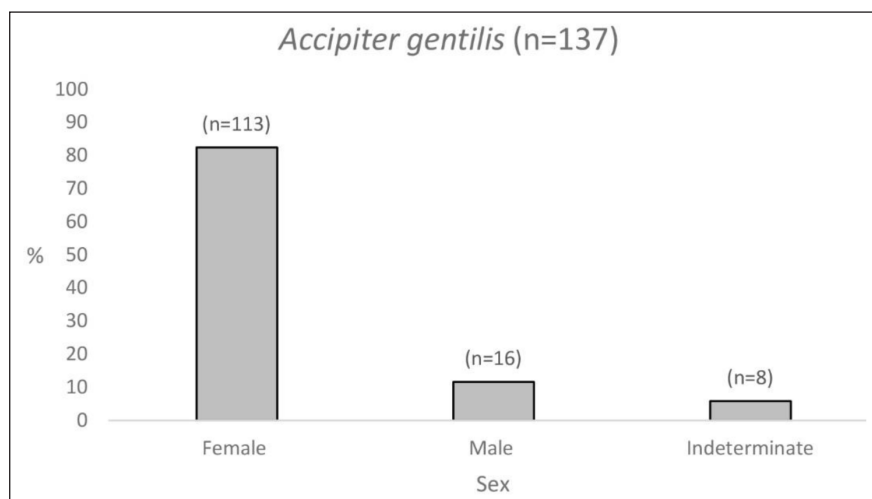
gle tarsometatarsus from Mindets Tomt (Oslo) was a juvenile. A complete humerus from Bryggen, Bergen, shows signs of butchery through hyperextension of the elbow causing the olecranon of the ulna to pierce the distal shaft of the humerus.

### Accipitriformes (Hawks and Eagles)

The Accipitriformes are the third best represented order, accounting for almost 4% of the overall species counts. The Northern Goshawk (*Accipiter gentilis*) is the most dominant species within this order with 137 specimens (2.3%). *Accipiter gentilis* has been identified in material from Oslo, Bergen and Trondheim. Seven *A. gentilis* Associated Bone Groups (ABGs) were identified within the material (**Table 6**). Almost all specimens were fully developed adults, apart from a single juvenile humerus and ABG No. 4, which represents a young adult. Around 83% of the specimens ( $n = 113$ ) were identified as females (**Figure 4**), 11% ( $n = 16$ ) fell into the male size range. For 6% ( $n = 8$ ), it was not possible to determine the sex. Overall, many of the female specimens from Medieval archaeological sites across Norway were examples of large individuals, often

**Table 6:** Associated Bone Groups (ABGs) of *Accipiter gentilis*.

Site	Species	ABG details
Bryggen (JS 397)	<i>Accipiter gentilis</i>	ABG No. 10. Adult female partial skeleton. Only the cranium, mandible and sternum represented.
Bryggen (JS 529)	<i>Accipiter gentilis</i>	ABG No. 12. Adult male right wing. Complete humerus, ulna and radius represented.
Mindets Tomt (JS 537)	<i>Accipiter gentilis</i>	ABG No. 8. Adult female partial skeleton. Right sided tarsometatarsus, tibiotarsus and radius. Fragment of the left side of the furcular.
Mindets Tomt (JS 537)	<i>Accipiter gentilis</i>	ABG No. 9. Adult female partial skeleton. Right side of the pelvis fused to a complete synsacrum. A right sided humerus, ulna and tibiotarsus.
Mindets Tomt (JS 537)	<i>Accipiter gentilis</i>	ABG No. 4. Young adult female partial skeleton. All bones are developed but have only just finished ossification. Elements present are left and right femur, tibiotarsus and humerus. Left coracoid and ulna. Right tarsometatarsus and carpometacarpus.
Nordre Felt II (JS 702)	<i>Accipiter gentilis</i>	ABG No. 6. Adult female partial skeleton. Includes left and right pelvis fused to the synsacrum. Left and right femur, partial cranium, left scapula, carpometacarpus and tibiotarsus.
Nordre Felt II (JS 702)	<i>Accipiter gentilis</i>	ABG No. 7. Adult female partial skeleton, found in one context along with humerus and scapula from a second adult female. Includes left and right humerus, left radius, scapula, femur, tibiotarsus and fibula.



**Figure 4:** Representation of male and female *A. gentilis* in Norwegian Medieval contexts.

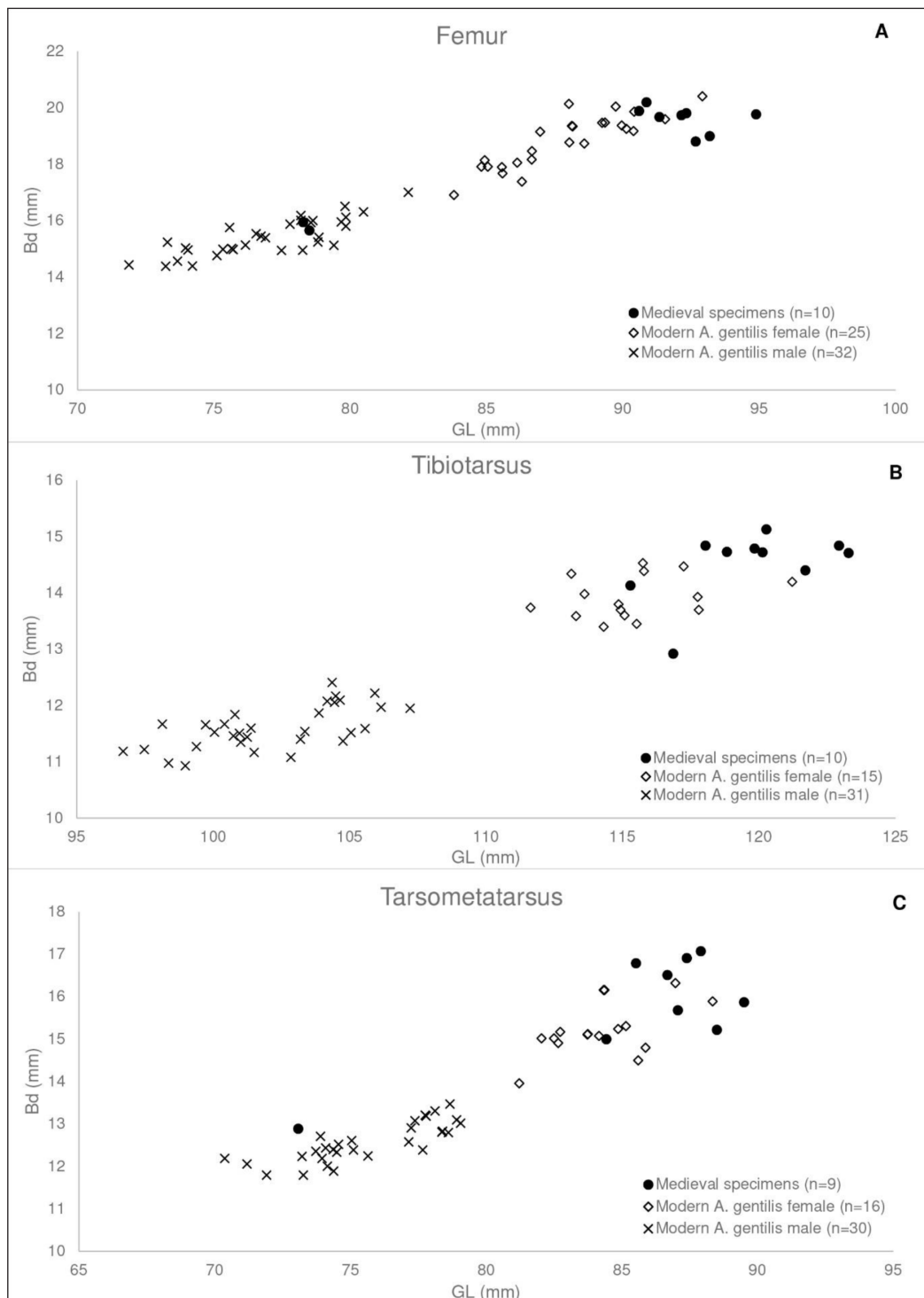
larger than the modern reference *A. gentilis* specimens held within the Bergen University Museum and the Natural History Museum at Tring (Figures 2H and 5).

Remains of the Eurasian Sparrowhawk (*Accipiter nisus*) were also present within the Oslo and Bergen assemblages but in very few numbers (n = 2, 0.03%). Both specimens were identified as females.

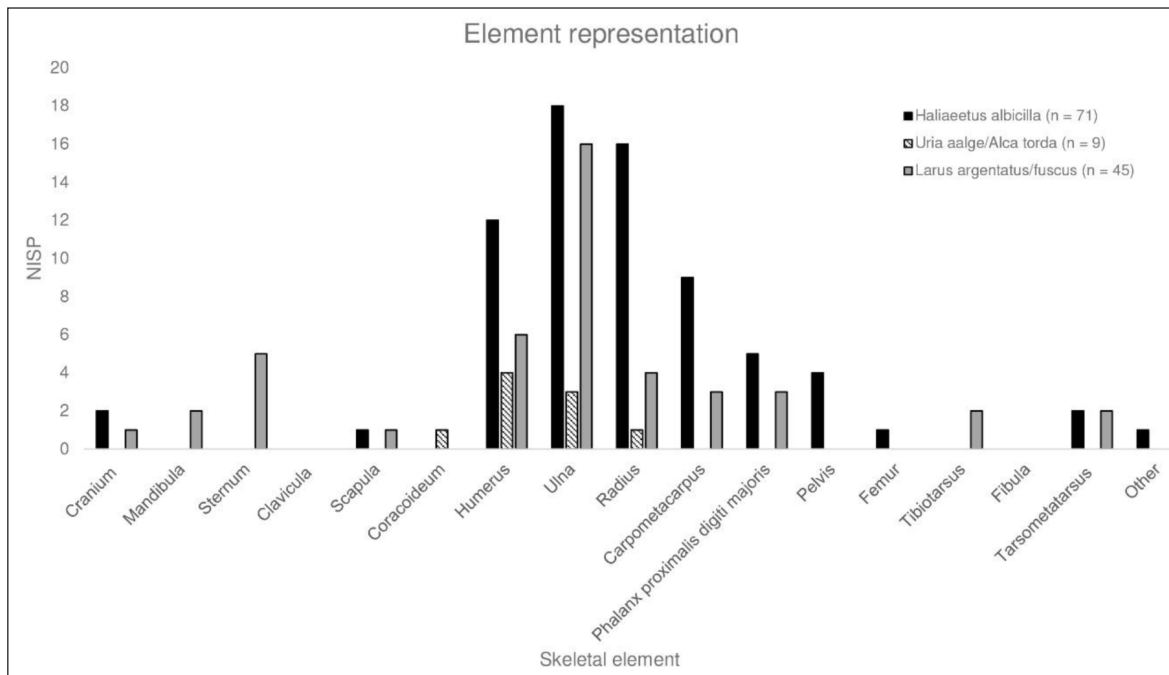
The White-tailed Sea-eagle (*Haliaeetus albicilla*) was identified on eight of the 21 sites, all sites from Oslo, Bergen, Borgund and Trondheim. *Haliaeetus albicilla* is represented by 71 specimens and three cf. *H. albicilla*

fragments (1.25%). Element representation shows that *H. albicilla* skeletal remains have a strong bias towards wing elements, with very few axial or lower limb remains being found within the assemblages (Figure 6).

The Golden Eagle (*Aquila chrysaetos*) was the third best-represented accipitriform, with eight specimens identified. All eight fragments (three humeri, two ulnae, two radii and one carpometacarpus) preserved are from the wing, similar to *H. albicilla*. These specimens were identified in Oslo, Bergen and Trondheim. Cut marks were observed on two ulnae specimens. One of the ulnae has



**Figure 5:** Plotted measurements (Breadth of the distal end (Bd) and Greatest Length (GL)) of modern Norwegian *Accipiter gentilis* specimens and the archaeological specimens from the Norwegian Medieval sites.



**Figure 6:** Element representation of *Haliaeetus albicilla*, *Uria aalge/Alca torda* and *Larus argentatus/fuscus*. Showing a dominance of the wing elements. Cf. specimens were not included in this figure.

fine cut marks around the olecranon and approximately three more cuts on the underside of the dorsal cotyle. The other specimen, recovered from the Finnegården 3A site in Bergen, is intriguing: a chop to the proximal end has removed the olecranon, with another chop through the distal shaft. The edges of the chopped distal end have been retouched, similar to the retouching observed on the edge of a flint tool (**Figure 2I, 2J**). Furthermore, scrape marks can be observed running the whole length of the specimen, possibly as a result of removing the feathers.

#### Falconiformes (Falcons)

Falconiformes are represented by only 10 specimens, 0.17% of the total Medieval bird bones. All of these specimens were found in either Oslo or Bergen. The Gyrfalcon (*Falco rusticolus*) was represented by six specimens, all from Bergen sites. The Peregrine Falcon (*Falco peregrinus*) is represented by two specimens from Bergen. Both specimens belong to a large female, and are probably from the same individual. A further two specimens were recorded within this order. It was not possible to identify them beyond Falconidae, but they fall within the size range of *F. peregrinus* and *F. rusticolus*.

#### Strigiformes (Owls)

Strigiformes are represented by only two specimens (0.03% of the bird bone assemblage). Both specimens are of the Eurasian Eagle-owl (*Bubo bubo*) and are found only within the Bergen assemblages. The first specimen is a complete ulna from Bryggen and the second a complete tarsometatarsus from Finnegården.

#### Gruiformes (Cranes)

Three specimens of Common Crane (*Grus grus*) were identified, contributing 0.05% to the Medieval bird bones. Cut marks were observed on a single tibiotarsus shaft from

Bryggen, Bergen. The other two specimens were a femur and humerus recovered from the Blomsøy excavations in Alstahaug.

#### Charadriiformes: Scolopacidae, Alcidae and Laridae

The Charadriiformes is a large and diverse order, and contributed a total of 181 specimens, making up 3% of the identified material.

#### Scolopacidae (Sandpipers, Snipes and Phalaropes)

It was only possible to positively identify one species within this family, the Eurasian Woodcock (*Scolopax rusticola*), with five specimens from sites in Oslo. In addition, a single distal radius fragment was identified as Scolopacidae sp. but could not be identified further.

#### Charadriidae (Plovers)

The Charadriidae within the Medieval Norwegian material are represented by a single carpometacarpus from Gæccevajnjar'ga, Finnmark. This specimen is assigned to *Pluvialis apricaria/squatarola*. Morphologically, the carpometacarpus of these two species cannot be separated from each other. The Eurasian Golden Plover (*Pluvialis apricaria*) breeds in Norway and migrates south in the winter (Wiersma et al. 2019a). Whilst the Grey Plover (*Pluvialis squatarola*) does not breed in Norway, it occurs during migration (Wiersma et al. 2019b), and its presence in Medieval times should not be ruled out. We therefore refer this specimen to *Pluvialis apricaria/squatarola*.

#### Alcidae (Auks)

In total 57 specimens were identified to the Alcidae family, contributing 1% to the overall Medieval identified count. Many of these were identified on the island of Røst, but with a number identified from Oslo, Bergen, Borgund and Finnmark. Skeletal remains of Common Murre (*Uria aalge*),

Thick-billed Murre (*U. lomvia*) and Razorbill (*Alca torda*) are similar in size and morphology. Furthermore, these three species are often found in mixed colonies in northern Norway. To prevent over-identification of any one species, 11 specimens have been grouped as *Uria aalge/lomvia/Alca torda*. The majority of these specimens were from Borgund. Current *Uria lomvia* only breed in easternmost Finnmark and winter in the Barents sea (Nettleship et al. 2019). This makes the Bergen and Borgund specimens more likely to be *Uria aalge* or *Alca torda*. Nine specimens from the Oslo sites (Mindets Tomt, Oslogate 7 and Nordre Felt II) were grouped as *Uria aalge/Alca torda*, with a further four cf. *Uria aalge/Alca torda* specimens from Nordre Felt II. All of the specimens within this group are wing elements (**Figure 6**). Remains of the Atlantic Puffin (*Fratercula arctica*) are more distinct than the Murre and Razorbill species, making it easier to distinguish them. A total of 30 specimens were identified, most of them from Rost. The odd specimen was also identified in Oslo, Bergen, Borgund and Finnmark. The only other Alcidae species which we were able to identify was a Black Guillemot (cf. *Cephus grylle*) specimen, represented by a single femur from Bergen.

#### Laridae (Gulls, Terns and Skimmers)

In total 116 bones were assigned to Laridae. The Great Black-backed Gull (*Larus marinus*) is the largest of the gull species, and 18 specimens were identified from sites in Oslo, Bergen, Alstahaug and Borgund. Wing bones were the dominant elements here. As with the Alcidae, there are a number of similar sized and morphologically similar Laridae species which are residents in Norway. Consequently, remains of European Herring Gull (*Larus argentatus*) and Lesser Black-backed Gull (*Larus fuscus*) could not be separated and have been placed into one group. This group was the most numerous, with 45 specimens. Once again, these are predominantly wing bone elements (**Figure 6**). Other species of Laridae were also identified but in smaller numbers. Three specimens of Black-legged Kittiwake (*Rissa tridactyla*) with an additional two cf. *Rissa tridactyla* specimens. The Mew Gull (*Larus canus*) was represented by two specimens, and a further two cf. specimens, from Bergen sites. One specimen of a *Sterna* species was identified from Dovre. A single ulna from Oslo was identified as cf. *Sterna hirundo* (Common Tern). Forty-two specimens were placed into the wider Laridae sp. category, 40 of these were from a single context at the Finnegården 3A, Bergen. This assemblage consisted of 20 tarsometatarsi, 19 tibiotarsi and one maxilla fragment. The epiphyseal ends were missing from every specimen, with crenulated edges indicative of gnawing, making it difficult to identify to species. However, they most likely fall into the *Larus argentatus/fuscus* category. This characteristic of missing epiphyseal ends has also been observed in Greenland, and has been interpreted as being chewed by humans (Gotfredsen 1997).

#### Columbiformes (Pigeons and Doves)

Pigeons and doves are not common in the archaeological material for the Medieval period in Norway, with just seven specimens (0.1%). The Common Woodpigeon

(*Columba palumbus*) is represented by six specimens from sites across Oslo. In addition, a single ulna specimen from Tonsberg has been identified to *Columba livia/oenas*. It is highly likely that this specimen represents a Stock Dove (*C. oenas*) which is currently a breeding visitor to south-eastern Norway (Baptista et al. 2019). In addition, there is little evidence to suggest the presence of *Columba livia* in Norway prior to the Post-Medieval period.

#### Passeriformes

A total of 155 specimens from five different families were identified to this order, accounting for 2.6% of the identified counts. The results for this order have been separated into families. Four specimens could not be identified beyond Passeriformes. In addition, a further three specimens were only identifiable to Sturnidae/Turdidae sp.

#### Corvidae (Crows and Jays)

A total of 105 specimens (1.8%) were recorded within this family, representing four different species. Corvidae have been found exclusively within the urban sites. Fifty-two specimens have been identified as *Corvus corone*. Based upon the current geographical range, it is likely that the *C. corone* specimens are of the subspecies *Corvus corone cornix* (Hooded Crow). It should be noted that it is very difficult to osteologically separate Crows from Rooks (*Corvus frugilegus*). In spite of this, breeding pairs of Rooks in Norway are not that numerous (Madge 2019). Therefore, we have assumed that the Medieval specimens are most likely to be *Corvus corone cornix*, but *Corvus frugilegus* cannot be ruled out. The Common Raven (*Corvus corax*) is also well represented, with 36 specimens. The Eurasian Jackdaw (*Corvus monedula*) was identified in the material with eight specimens and a further two cf. *Corvus monedula*. The Eurasian Magpie (*Pica pica*) was the least common species in the Corvidae family with seven specimens. A very small number of sub-adult and juvenile specimens have been recorded for the Corvidae, most of them *P. pica* specimens.

#### Turdidae (Thrushes)

Thirty-nine specimens (0.7%) were assigned to this family. The majority of specimens were recovered from Vesle Hjerkin, with some additional specimens from Oslo. Whilst attempts have been made to separate these species, six specimens were identified no further than *Turdus* sp., 11 specimens have been placed into the small *Turdus* sp. group, and a further 20 specimens fell into the large *Turdus* sp. group. It was only possible to identify two specimens confidently to species, both specimens were humeri and were identified with the aid of Jánossy (1983) to Fieldfare (*Turdus pilaris*). These specimens were recovered from Vesle Hjerkin.

#### Sturnidae (Starlings)

A single specimen, a distal tibiotarsus from Vesle Hjerkin, was assigned to the Common Starling (*Sturnus vulgaris*).

#### Motacillidae (Pipits and Wagtails)

A single humerus of the Meadow Pipit (*Anthus pratensis*) was recorded from Vesle Hjerkin.

### Passeridae (Sparrows)

Passeridae are represented by a single House Sparrow (*Passer domesticus*) carpometacarpus and a cf. *P. domesticus* humerus, both from Oslo.

### Site type distribution

The Medieval assemblages can be split into four main site types; urban, rural, monastic and hunting. The full NISP figures and percentages per site type are presented in **Figure 7**. For full information on site type see **Table 1**. There are 15 urban sites represented in the re-examined material. These towns and cities are predominantly in the southern part of Norway, as no Medieval urban sites are known north of Trondheim. A minimum of 48 different species from a diverse number of avian families are represented within the urban material. The assemblages are dominated by domestic species with *G. gallus* and *A. anser* collectively forming 74% of the NISP. The wild Galliformes formed just over 6% of the species represented on urban sites. Accipitriformes are present exclusively on urban and monastic sites, and contributed 5% to the urban bird bone assemblages.

Rural sites are defined as small rural communities and farms, and the majority of these are found in northern Norway. The avian assemblages from the four rural assemblages re-examined here show a different pattern than the urban sites; only 21 species were represented within these four sites, and domestic species form only 2% of the avian material identified. Wild Galliformes are well accounted for (89%). This high percentage is mainly due to the number of *Lagopus* specimens identified from Vesle Hjerkinn, although this number may be inflated by the fact that Vesle Hjerkinn had a hunting lodge attached.

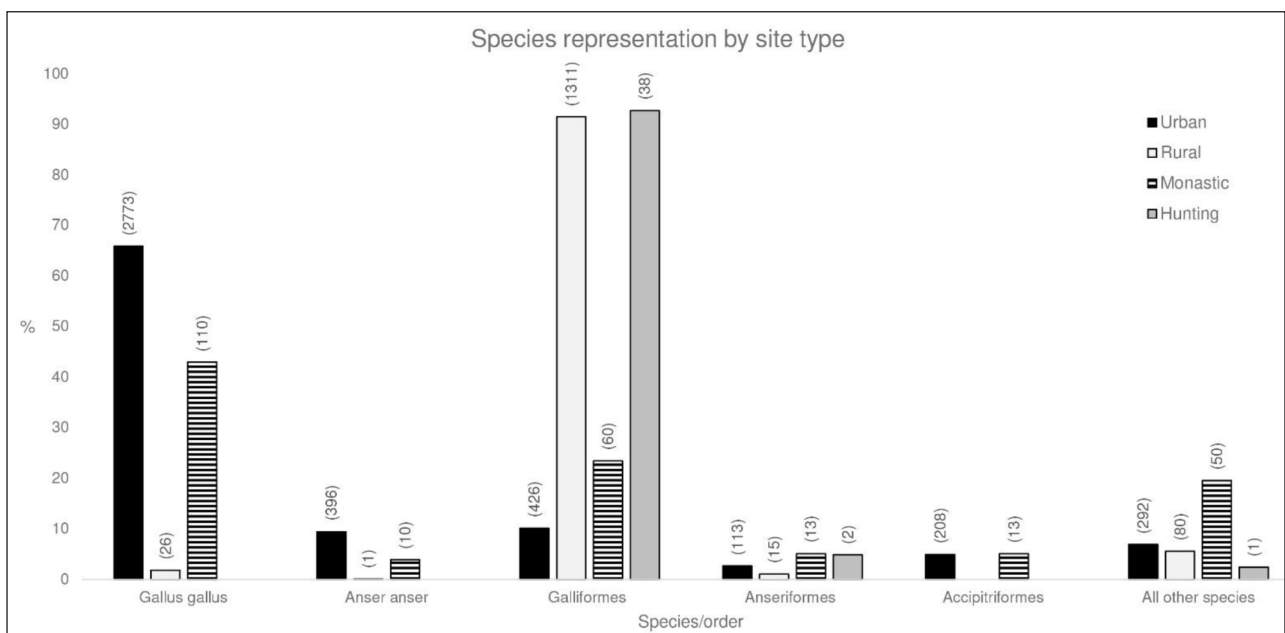
Only one monastic assemblage has been examined, the Erkebispegården site in Trondheim. The Erkebispegården

site is best described as a high status site, characterised by ecclesiastical practices. We compared the Erkebispegården with other monastic sites within Norway, but many of the non-native introductions which were found in the Post-Medieval period are more likely linked with the high status of the site rather than the religious practices. The vast majority of the bird bone material from the Erkebispegården is associated to Post-Medieval contexts, and not considered here. The Medieval assemblage from this site is relatively small. In terms of species representation, this monastic site falls between urban and rural sites. The assemblage contained only 15 different species, which is relatively high considering the small assemblage size. Domesticates form 47% of the assemblage. The number of corvids (18%) identified on this site is higher than on all other site types.

The only hunting site represented in the re-identified material is Tøftom, in the Dovre region. The main focus on this site was reindeer hunting (Lie & Fredriksen 2007). The assemblage size here is very small, making it difficult to discern any patterns. Wild Galliformes form 93% of the assemblage and likely were the target species. Domesticates are not represented at all, and in this respect it is similar to rural sites.

### Discussion

Our re-examination of bird remains in Norwegian Medieval faunal assemblages identified a minimum of 55 different species from 16 different orders. This is the first time data on avian remains from Norwegian Medieval faunal assemblages has been amalgamated, and it forms the first holistic representation of avian species in Medieval Norway. Furthermore, our work identifies patterns of avian exploitation and highlights the importance of birds in Medieval Norwegian societies.



**Figure 7:** Species representation by site type. The four main site types for Medieval Norway are represented here (Urban, rural, hunting and monastic). Percentages are based on the NISP figures for each site type, in order to compare and identify site specific patterns. The NISP figures are placed in brackets within the figure.

### Patterns in wild bird species

We adopted a cautious approach in identifying specimens. As a result, less species may be represented, but these likely paint a more accurate representation of the Medieval avifauna for Norway. In addition to the re-identification of material from archaeological sites, a large amount of new data has been recorded for the material, highlighting the need to closely re-examine existing collections, particularly when they include species prone to misidentification. When considering the distribution of birds in Medieval assemblages, we have to work under the assumption that the species representation within the bird bone assemblages is the result of anthropogenic bias. In addition to humans selecting for or against certain species, trade and fishing bycatch can cause displacement of species outside of their natural habitat. Furthermore, recovery bias also causes distortions in species representation, particularly when methods like sieving have not been implemented methodically. Consequently, the absence of certain species from the archaeological record does not mean they were not present, or possibly even abundant, within the Norwegian avifauna, and we should treat any absences with caution.

Despite these caveats, we found no evidence to suggest that the Medieval Norwegian avifauna differed from the current one, as all wild species identified in the Medieval assemblages are still extant within Norway today. In most cases, their occurrences in Medieval locations overlap with their modern ranges. This was somewhat unexpected, given that the Medieval period experienced significant climatic oscillations (Ahmed et al. 2013; Zawiska et al. 2017), and saw the rise of urban centres. Climatic changes were expected to be reflected by the presence of species well outside their current ranges or by species currently absent from Norway. The rise of urban centres may have resulted in habitat destruction and increased hunting pressure, and potential extinction of species. Nevertheless, our data do not show any evidence for these scenarios. That is not to say that Medieval climatic oscillations and an increasing human population did not impact the Norwegian bird fauna. The lack of precise dating for a number of sites and the concomitant binning of species in broad time periods obscures any links between the temporal occurrence of a species and the timing of climatic oscillations. In addition, the anthropogenic bias on most of our sites means that the presence, absence or abundance of species in an assemblage does not necessarily translate to population status in the wild.

Although the current Norwegian avifauna can be traced back to at least the Medieval period, we recorded a few species that were either unexpected or observed in higher or lower quantities than predicted based upon their current range and abundance. The Black Stork (*Ciconia nigra*) breeds in the Western Palearctic but not as far north as Scandinavia. However, *C. nigra* does occur as a vagrant in Norway (Elliott et al. 2019). Generally, this species avoids dense woodlands and forests, as well as areas of human activity. Although slightly higher summer temperatures of around 1–2°C warmer than the mean millennial temperature during the Medieval warm period (Zawiska et al.

2017) could have encouraged northwards dispersal of *C. nigra*. There is evidence of *C. nigra* breeding in Sweden from at least c. 1450 CE up to the middle of the twentieth century, with only the occasional breeding pair being recorded in recent times (Ericson & Tyrberg 2004). Magnus (1555) mentions *C. nigra* as linked to the Norse god Odin, which suggest that this bird may have had a special status. This makes the Dreggsalmenningen (Bergen) specimen even more intriguing, but currently this is the only record of *C. nigra* in the archaeological record for all periods in Norway.

Wild Galliformes are in decline across Scandinavia (Alsaker 2017; Gregersen & Gregersen 2009), although the reasons behind this are not fully understood. Both *Tetrao urogallus* and *Lyrurus tetrix* occur throughout most of modern Norway, although their densities are higher east of the Norwegian watershed in eastern Norway and Sweden (Gjershaug et al. 1994; Haftorn 1971). Increased precipitation and a lack of old forests is thought to drive this pattern (Alsaker 2017; Gregersen & Gregersen 2009). Occurrences of these two species in Medieval sites overlap with their modern ranges, but both *T. urogallus* and *L. tetrix* are more abundant in eastern sites (Oslo and Trondheim) than in western Norway (Bergen). This suggests that current patterns in the distribution and abundance of these two wild galliforms may be older than previously thought. Another example of a species that appears to have maintained a similar range since Medieval times is *Corvus monedula*. Although only a few specimens have been retrieved from the Medieval period, all were recovered from Oslo or Trondheim sites. This overlaps with its current distribution, which is restricted to south eastern Norway and a small area around Trondheim (Madge & de Juana 2019).

Although several Norwegian seabird populations are currently in decline (Fauchald et al. 2015), it has been suggested that certain species of seabirds were more abundant in Medieval times. For instance, the Black-legged Kittiwake (*R. tridactyla*) was more abundant in Sweden during the Medieval period, and this was attributed to a good “Herring period” in the southwest Baltic (Ericson & Tyrberg 2004). Although we identified a number of species of seabirds in Norwegian Medieval assemblages, gaviiforms, procellariiforms, suliforms, pelecaniiforms and charadriiforms are only present in low abundances. For the Northern Gannet, *Morus bassanus*, prehistoric data indicate that it was rather abundant in Norway from 6000–5000 BP (Montevicchi & Hufthammer 1990), but similar to other marine species, *M. bassanus* has only been found in small numbers in the Medieval period. The species continued to decline during the Post-Medieval period and went extinct in Norway, only to reappear in the 1940s (Barrett & Folkestad 1996). Our data therefore do not support the notion of high seabird abundances in Medieval times. Whether this reflects actual low population abundances, possibly related to a decline in fish stocks in southern Norway since 1000 CE onwards due to increased fishing activities in the North Atlantic (Barrett et al. 2004), or reflects a preference for other wild and domestic species remains unclear. It is worth noting here that during



the Norse periods on the Western Isles of Scotland, there was a marked decrease in the exploitation of seabirds, and an increase in domesticates and land fowl exploitation (Best & Mulville 2014). This suggests a preference away from seabirds, and a similar shift might have occurred in Norway as well. The Great Auk (*Pinguinus impennis*) is notably absent from Medieval contexts. The latest archaeological specimen from Norway dates to 1500 BP (not calibrated) (Hufthammer, unpublished data). The absence of any *P. impennis* specimens from Medieval contexts implies it was already in heavy decline during this time, and it is likely that the Great Auk had abandoned former breeding sites in Norway prior to the Medieval period (Hufthammer 1982). This pattern is echoed in the Scottish Isles, where the dominance of Great Auk remains in Bronze Age and Iron Age assemblages is heavily diminished or absent by the Norse periods (Best & Mulville 2014).

Interestingly, several groups of birds which are ubiquitous today, particularly near urban centres, such as passerines, Laridae and Corvidae, are poorly represented within the Medieval archaeological record. In the case of the passerines, this is likely due to a recovery bias, as the lack of sieving means that smaller bones have not been sampled. In addition, smaller bones are less likely to survive compared to the larger bones. That being said, a number of small fish bones have been recovered from almost all of the sites, which suggests that passerines may not have been in demand. The practice of trapping thrush species has been mentioned by historical sources (Magnus 1555; Nilsson 1858; Lloyd 1867), but this is likely to have happened mostly on the rural and hunting sites (for which we have limited data) rather than in the urban centres. The dispersal of gulls and corvids into urban areas may have lagged behind the emergence and expansion of large urban centres and these species may not have been established within towns at this point. Swedish data suggests that certain gull species, particularly *L. argentatus*, were almost exclusively marine species prior to c.1900, but are now frequently breeding inland (Ericson & Tyrberg 2004). Alternatively, the absence of corvids and gulls could indicate a taboo against eating these birds. Gulls were not considered particularly inedible, as evidenced by a quote from Bjørnstad (1972) "The meat of the year-old birds being particularly delicious, as indeed it is for all year-old gulls". Interestingly, Christian laws forbade the consumption of 'unclean' species and although it is not known if this included birds as well, it could explain the lack of Laridae within the archaeological material. The complete absence of *Larus* species from the high status/monastic site of Erkebispegården would support this.

### Domesticates

Domesticates are the largest group of birds represented in the Norwegian Medieval bird bone assemblages. Although the definition of a domestic species varies, we here follow the species mentioned within Serjeantson (2009). The timing and nature of introduction of domestic fowl into Scandinavia is not fully understood. Current evidence suggests that introduction appears to be slightly later than Central Europe. In Sweden the earliest evidence

dates to the 1<sup>st</sup> century BCE (Lepiksaar 1977). Domestic fowl are not abundant in Sweden and Denmark until the Late Iron Age into the Viking Age (Tyrberg 2002; Ericson & Tyrberg 2004; Gotfredsen 2013; Gotfredsen 2014). Prior to this, domestic fowl are not dominant within assemblages; rather, they are seen as high status commodities. Current evidence places the introduction of *G. gallus* in Finland to the 8<sup>th</sup> century CE (Ukkonen & Mannermaa 2017; Wessman et al. 2018). For northern Scotland and the Scottish Isles the introduction of domestic fowl is later than the rest of Britain (Serjeantson 1988). Zooarchaeological work conducted on the Orkney Islands and the Hebrides dates the introduction of *G. gallus* to possibly the Iron Age, but more likely the Norse period (c. 1100–1300 CE) (Serjeantson 2014). Best and Mulville (2014) have identified a similar date for the Western Isles.

Barrett et al. (2007) claim that the presence of early domestic fowl in Viking Age Kaupang dating to the early 9<sup>th</sup> century CE constitutes evidence for early domestic fowl in Norway. It is possible that the single *G. gallus* specimens from Iron Age sites at Viklem, Sør-Trøndelag and Sør-Dalaheller, Kristiansund (Unpublished data from the Natural History archive, University Museum of Bergen) are earlier but they have not been re-examined or radiocarbon dated. However, a lack of avian assemblages dating to the Iron Age and early Viking Age makes it difficult to assess the presence and abundance of domestic fowl before the Medieval period. Regardless, current evidence seems to suggest a slightly delayed introduction in both Norway and Finland, with domestic fowl not being abundant until the Medieval period.

Sites with more refined dating give an indication of how quickly *Gallus gallus* became established in Norway. The site of Bibliotekstomten in Trondheim has *G. gallus* present in its early phases dated to 900–ca.1125 CE (Lie 1989, Unpublished report, see SMF1). Another Trondheim site, Televerkstomten, records a single *G. gallus* specimen from early 1100 CE contexts, with the abundance of *G. gallus* not increasing until the later part of 1100 CE (Marthinussen 1992, Unpublished thesis, see SMF1). In addition, early Medieval evidence of *G. gallus* is recorded in Oslo at Mindets Tomt (contexts dating to 1025–1125/1150 CE (Lie 1988)) and Oslogate 4 (contexts dating to 1000–ca.1150 CE (Lie 1991)). The Borgund sites may represent another early introduction of *G. gallus*, as there are a number of Viking Age contexts with domestic fowl. Further analysis of the stratigraphy on this site is necessary, along with radiocarbon dates for the *G. gallus* specimens, in order to be certain. From Dreggsalmenningen, Bergen, *G. gallus* is present in the earliest phases dated to ca.1170–1300 CE and becomes more abundant in the second phase dated to 1300–1332 CE (Undheim 1985, Unpublished report, see SMF1). All of these dates point towards a presence of domestic fowl on most urban sites during the early Medieval period.

*Gallus gallus* is the most dominant species within the Medieval assemblages. On urban sites domestic fowl overall account for 66% of the avian representation. This is in stark contrast to rural sites, where domestic fowl represent only 2% of the assemblages. However, an increased

abundance of *G. gallus* specimens is found on the supplementary rural sites, where they account for 38% of the assemblage. It is possible that a proportion of these are misidentified, given the high number of *L. tetrix* specimens that were previously recorded as *Gallus gallus*. The dominance of domestic species on urban sites and a focus on wild resources on rural sites is a common trend across Norway. This likely reflects a focus on imports and domesticates within the towns and a reliance upon local resources on rural sites. It is most likely that the larger populations within towns would have needed a steady supply of food, leading to a reliance on domesticates, a pattern mirrored in the mammalian fauna identified in towns. In addition, the hunting possibilities around towns would not have been as easily accessible as on the rural sites.

The Norwegian material suggests the primary focus on domestic fowl was the production of eggs, as indicated by the low percentages of immature birds. This suggests that domestic fowl were not intensely exploited, and birds were allowed to reach full maturity. Alternatively, the lack of evidence for immature *G. gallus* may be due to taphonomic processes, whereby the more porous juvenile bones are simply not surviving. In England, a rise in the number of immature specimens in the Medieval periods has been associated with meat exploitation (Maltby & Wilkinson 1979; Serjeantson 2009). As domestic fowl became established in Britain during the Roman period, it is likely they were viewed as a precious commodity and exploited mostly for eggs. Chickens may have been only consumed when they were older or by higher status households. We propose that the later introduction, and presumed lack of juvenile *G. gallus* into Norway reflects a similar role of domestic fowl in Norwegian Medieval society as that seen in Roman Britain.

The identification and distinction of domestic geese from their wild counterparts is almost impossible osteologically, with very few morphological characters separating the two. In the case of the Norwegian Medieval material we are assuming that the majority of the geese identified are domesticated. This is based on the higher abundance of *A. anser* found within assemblages in comparison to previous periods. Prior to the Medieval period sites rarely have more than one *A. anser* specimen recorded, and these sites are often located along the coast where the current distribution of wild *A. anser* can be found. In contrast, the Medieval specimens are almost exclusively found within urban contexts, which is outside of their natural habitat. In addition, the specimens appear slightly larger and more robust in size than their wild counterparts. The presence of pathologies on a small percentage of the *A. anser* specimens also adds support to the idea that these represent domesticated individuals. A similar percentage and types of pathologies were only observed in the other domesticated species, *Gallus gallus*. Evidence suggests that the introduction of domesticated geese into much of Scandinavia is dated to the Iron Age. This introduction has been identified in Sweden through a massive increase in subfossil *A. anser* remains from the Iron Age onwards (Ericson & Tyrberg 2004). Interestingly there are a number of Swedish sites in the

Skåne region, where *A. anser* begins to replace *G. gallus* as the most dominant bird species, this begins to occur in the Medieval into the Post-Medieval period (Magnell & Nilsson 2019; Magnell, Unpublished report, see SMF1). In Denmark, domestic geese were present during the Roman Iron Age, specifically around 200–250 CE, and have been identified within high status graves (Gotfredsen 2013). Despite this, it is unlikely that domestic geese were common during this period. It is not until the Viking Age and the Early Medieval period that domestic geese occur on numerous sites and are generally the second most dominant species after *G. gallus* (Gotfredsen 2014). Evidence from the Scottish Isles indicates a pattern similar to that of *Gallus gallus*, in that geese were introduced during the Norse period (Best & Mulville 2014).

Our data for Norway show a distribution of *A. anser* focused on the larger urban sites of Oslo, Bergen, Tønsberg and Trondheim. Very few specimens have been identified outside of these large towns. The urban location of these specimens indicates that these specimens represent domesticated *Anser anser*. Based on current evidence we propose that a Medieval introduction of *A. anser* to Norway seems most likely. *Anser anser* has been identified from late 1100 CE contexts at Televerkstomten, Trondheim, but is not abundant on this site until 1300 CE (Marthinussen 1992, Unpublished thesis, see SMF1). Similarly, *A. anser* is recorded in phase 2 at Bibliotekstomten, Trondheim (only a broad date is given for phases 1–3 of 900–ca.1125 CE, (Lie 1989, Unpublished report, see SMF1)). The site of Oslogate 4, Oslo, shows an introduction of *A. anser* on the site between the first half to the middle 1200s, whilst *G. gallus* is present from 1000 CE onwards (Lie 1991). There is currently no definitive osteological method for separating the domestic from the wild and we realise that the specimens we have identified as domestic geese may include wild specimens. Nonetheless, we believe the evidence is strong enough to suggest the presence of domestic *A. anser* in Medieval Norway.

On a number of sites *A. anser* and *G. gallus* are both present in the earliest phases, but with *A. anser* not becoming abundant until later, it is possible that these earlier specimens are wild *A. anser* and not the domesticated form. The site of Mindets Tomt in Oslo shows the presence of both *G. gallus* and *A. anser* in phase 1 dating to 1025–1125/1150 CE (Lie 1988). The same is the case for Dreggsalmenningen, Bergen, where both domesticates are present in the earliest phases dating to ca.1170–1300 CE (Undheim 1985, unpublished report, see SMF1). The identification of only two sub-adult *A. anser* specimens would suggest a pattern of exploitation similar to that of domestic fowl, whereby secondary products are being exploited. Historical evidence does not mention egg production for geese. Instead, they were prized for their fat, often used in cooking and also as a remedy to many ailments (Magnus 1555). With the evidence at hand, we suggest a slightly later introduction of *A. anser* than *G. gallus*. More precise dating of these specimens will show if this is indeed the case. However, it is not until the mid-late Medieval period in Norway that both domestic fowl and geese become abundant.

In contrast to geese, ducks are distinctly lacking in the assemblages. Tyrberg (2002) also notes a lack of domesticated duck from Swedish Medieval periods. Yet there are some sites along the eastern coast of Sweden (from Mälardalen to Kalmar) where ducks are more abundant (Vretemark 1997), but these likely represent wild ducks. This high number of ducks is also seen at Novgorod, Russia, where a dominance of Mallard/domestic duck has been observed (Hamilton-Dyer 2002). This pattern differs from Norway, where *G. gallus* and *A. anser* were the dominant domesticates, assuming the *A. anser* specimens are indeed domesticated. The lack of ducks is reflected in historical sources, in particular Olaus Magnus (1555), who refers to ducks as “cold and coarse in taste” and preferring woodland birds to water birds, a statement which is supported by our findings.

The practice of falconry in Medieval Norway is well documented (Lie 2018). Currently, the earliest zooarchaeological evidence for falconry practice in Norway dates to 900 CE, from the Gokstad burials (Hufthammer 2019). Iconographic evidence from Norway may point to an earlier use of falcons (Lie 2018). Our data identify the favoured species used in Norwegian Medieval falconry: the Northern Goshawk, the Eurasian Sparrowhawk, the Gyrfalcon and the Peregrine Falcon. There is little evidence for the use of Golden Eagle and White-tailed Sea-eagle as falconry birds (Prummel 1997; Cherryson 2001). However, historical sources do not mention their use in Norway (Lie 2018), and the dominance of wing elements suggests a different use for these larger species. The dominance of wing elements is an interesting and common pattern. It likely results from the extraction of feathers, which have many uses such as arrow fletching's and decorations amongst others (Bovy 2002).

The most striking pattern observed within the avian assemblages is the dominance of the Northern Goshawk (*Accipiter gentilis*) above all other birds of prey. This species accounts for 95% of the falconry species represented (not including *H. albicilla* and *A. chrysaetos*). Due to the persecution of this species in the last century (Heggøy & Øien 2014), it is possible that it was more abundant during the Medieval period than today. The dominance of females shows a clear selection of large individuals for use as hunting birds. Further analysis also identified seven ABGs within this species, more than any other for the Norwegian Medieval material. The deposition of these species as a whole or partial bird possibly indicates greater respect shown to falconry birds.

In contrast to the abundance of Northern Goshawk, the lack of Gyrfalcon and Peregrine Falcon remains was unexpected, given that they were highly prized (Serjeantson 2009; Lie 2018). However, current population figures show a higher abundance of *Accipiter* species than *Falco*, this suggests that *Falco* species may have been less abundant, harder to access and/or trap. Whilst the *Falco* species were highly sort after, *A. gentilis* and *A. nisus* could be owned by a range of people from low nobility to wealthy commoners (Wood & Fyfe 1955). It has been suggested the practice of falconry within Norway was not reserved for the upper classes of society as it was in many other countries, such

as England (Thorsen 2007; Iversen 2013), but was rather seen as a means by which to supply subsistence. Despite this the practice of trapping birds would've been more efficient, and we presume this was the main hunting technique employed. Recent work has investigated the heavy exportation of falconry birds from Norway (Lie 2018), which could have lowered the abundance of *Falco* species found within the Norwegian archaeological record.

Falconry species are limited to sites in Oslo, Bergen and Trondheim. The presence of these species within Oslo and Bergen could represent birds which were to be traded with Europe. Some of the individuals identified were from high status and monastic sites, whilst others, such as those found in Bryggen, could have been used by lower classes. At the site of Mindets Tomt, Oslo, a higher abundance of *A. gentilis* in the earlier phases (1025–1225 CE) was observed, with a decrease in numbers in later phases (Lie 1988). Whether this represents an increase in exportation of falconry birds after 1225 CE or simply a decrease in its popularity is unclear.

Indirect evidence of possible falconry practices can be found at Vesle Hjerkin. Although no falconry species were identified from this assemblage, this site is dominated by *Lagopus* remains, and a number of *Turdus* specimens (a typical prey of falconry species). These species may have been snared and trapped, a practice well documented within Norway (Magnus 1555; Nilsson 1858; Lloyd 1867; Collett et al. 1921). However, the small number of specimens which display puncture marks indicative of an avian predator may be evidence for the use of falconry. Whilst discussing the presence of falconry prey, it is worth mention that the remains of Grey Heron and Common Crane have been documented as highly prized falconry prey (Sykes 2014). This is something to consider, especially for the Grey Heron, which has only been found on sites in Oslo, Bergen and Trondheim, all locations with strong falconry evidence. Our re-examination of birds of prey from the Medieval contexts has strengthened the evidence for falconry within Norway, by adding sex and metric data, as well as ABG information to the observations following the key zooarchaeological indicators for falconry as outlined by Prummel (1997). Our current work on falconry species adds zooarchaeological evidence for falconry in Norway to the recently conducted work by Lie (2018) on the historical records of falcon catching in Norway.

Previous work has identified a number of species that are non-native, such as *Pavo cristatus* and *Perdix perdix*, but we have found these to be erroneous. Our re-examination of a previously identified *Pavo cristatus* specimen from Mindets Tomt was, in fact, Western Capercaillie, and we have found no Indian Peafowl in Medieval Norway. Historical sources support, the absence of *P. cristatus*, noting how rare and highly prized Indian Peafowl were (Magnus 1555). We have subfossil *P. cristatus* from the Gokstad burials (Hufthammer 2019) dating to the Viking period. After these specimens, *P. cristatus* does not re-appear in the archaeological record until the Post-Medieval period. The Post-Medieval specimens are from Revierstredet, Oslo and Erkebispegården, Trondheim (dating to 1640–1672 CE). There is also a possible *P. cristatus* specimen from Post-Medieval contexts at

Kontraskjæret, Oslo but DNA analysis is needed to rule out other larger Galliformes.

There were a number of species that we presumed were introduced into Norway during the Medieval period. Despite this, our work found that the earliest evidence for these non-native species dates to the Post-Medieval period, and were identified from the Erkebispegården site. Currently these specimens are the best evidence we have for their introduction into Norway. Common Pheasant (*Phasianus colchicus*), has been identified in period 11, which dates to 1708–1783 CE (Hufthammer 1999). The timing of the introduction of *P. colchicus* into Norway is uncertain. In Sweden, the Common Pheasant was introduced in the 16<sup>th</sup> century (Ericson & Tyrberg 2004). The identification of Turkey (*Meleagris gallopavo*) from period 11, dating to 1708–1783 CE (Hufthammer 1999) also forms our earliest evidence for the introduction of this species to Norway. The Grey Partridge (*Perdix perdix*) was identified from period 9 (1537–1660 CE) (Hufthammer 1999). *Perdix perdix* was only introduced to southern Norway for hunting purposes (Collett et al. 1921). All of the previously identified *P. perdix* specimens dating to the Medieval period were re-identified as Hazel Grouse (*Bonasa bonasia*), a similar-sized species native to Norway. Given *P. perdix* is easy to misidentify the Post-Medieval specimens must be viewed with caution. DNA analysis is needed to confirm these identifications, especially given that *P. perdix* was not established in Sweden until the 18<sup>th</sup> century (Ericson & Tyrberg 2004).

The establishment of feral pigeons within Norway and Scandinavia is poorly understood, and consequently little attention has been given to these species, and where the first populations came from. In Sweden, there are three Medieval sites which may indicate the keeping of *C. livia* (Ericson & Tyrberg 2004) but, these are not conclusive. By the 17<sup>th</sup>–18<sup>th</sup> century Tyrberg (2002) claims that domestic pigeons were introduced to Sweden, supported by finds of *C. livia* from Gothenburg. Olaus Magnus (1555) mentions doves within Scandinavia, but they were not common. In Norway, our research has shown that there is no Medieval evidence for *C. livia*. Rock Doves appear in the Post-Medieval Period 11 contexts (1708–1783 CE) from the Erkebispegården (Hufthammer 1999), with nine specimens, and we interpret these as kept pigeons. These specimens currently represent the strongest evidence for pigeon keeping within Norway. Michaelsen and Refvik (2003) mention the Utstein monastery as a possible source for the Rennesøy colony, with kept *C. livia* released after the reformation in 1537 CE. However, there is no specific evidence of pigeons being kept at the Utstein monastery. Despite the absence of *C. livia* from Medieval contexts, it is possible that with more avian assemblages from monastic sites we may identify Medieval kept pigeons. If this is the case, the release of kept pigeons from monastic sites after the reformation, may have been the source for feral populations.

It is clear that the Erkebispegården was a site of great importance and may have been the site of many non-native bird species introductions. The high status of this site and its excellent trade links make it very possible.

The addition of more high status sites to the Norwegian archaeological record would assist in understanding more about these species' introduction to Norway.

#### Supplementary Norwegian data

In addition to the material from the 21 sites that were re-examined in this study, a further 33 Medieval sites were included, but not re-examined (Supplementary Table 3). These additional sites are mostly small assemblages and contain 2226 specimens, of which 1229 could be identified beyond Aves (Table 4; Supplementary Table 3). Broadly speaking, the species present and their abundance follow the same patterns observed in the re-examined assemblages. An additional eight species have been previously identified within these supplementary sites that have not been recorded in our re-analysis of the 21 main sites, but all remain extant within Norway.

A specimen from Bibliotekstomten, Trondheim was previously identified as Pink-footed Goose (*Anser brachyrhynchus*), which breeds on Svalbard, and only occurs for short periods of the year on mainland Norway, during migration (Carboneras & Kirwan 2019a). There are important staging areas for *A. brachyrhynchus* near Trondheim, and it is possible that this was also the case during the Medieval period. However, we would need more specimens from the area to confirm this. It is also worth bearing in mind that given the difficulty in osteologically separating the Anserini species, this specimen may have been misidentified. There is evidence that *A. brachyrhynchus* is spending more time on the Norwegian stop-over sites due to climate change (Bauer et al. 2008), and it is possible that with climate fluctuations during the Medieval period, extended or shortened periods spent at staging sites would have occurred.

A femur of a Common Scoter (*Melanitta nigra*) was identified from the Alstahaug 1992 site. *Melanitta nigra* occurs all year round in Norway, breeding inland and wintering on the coast (Carboneras & Kirwan 2019b). The identification of Anseriformes is notoriously difficult and as such the identification of the two species mentioned above also need to be confirmed by re-examination.

Additional species recorded in the supplementary sites are the Eurasian Buzzard (*Buteo buteo*), the Rough-legged Buzzard (*Buteo lagopus*), the Osprey (*Pandion haliaetus*), the Eurasian Oystercatcher (*Haematopus ostralegus*) and the Common Swift (*Apus apus*). It was possible to locate and confirm both *P. haliaetus* identifications. Given the sizeable population of Eurasian Oystercatchers in Norway (Hockey et al. 2019), their presence in the Medieval material is sparse.

It is also worth mentioning here that, although no *Lagopus muta* were positively identified in the re-examined material, 27 specimens were identified in the supplementary material. Based on our data from the re-examined assemblages, the more abundant *Lagopus* species within Medieval contexts for Norway has been *Lagopus lagopus*. It is therefore likely that the abundance of *L. muta* in the supplementary material results from overly confident identifications. As a result, the abundance of *L. muta* within the supplementary sites should be regarded with caution.

When the supplementary material is compared with the re-examined material based upon site type, the general patterns remain the same. The supplementary sites are made up of 18 urban (NISP = 790), 10 rural (NISP = 363), four monastic (NISP = 67) and a single hunting site (NISP = 9). The addition of more rural sites within the supplementary material results in an increased importance in domesticates on rural sites, within the supplementary sites *G. gallus* forms 38% of the assemblages, compared to the 2% in the re-examined assemblages. It is possible that some of the *G. gallus* identifications on rural sites are misidentified, given the discrepancy between re-identified rural sites and the supplementary sites. In addition, our re-examination found that wild Galliformes were often misidentified as domestic fowl. Domestic goose is also increased from 0.1% to 13%. As the NISP figures on these additional sites are not substantial these figures do not change the patterns overall inferred from the re-examined material. However, we believe that the slight increase in domesticates at rural sites is likely to give a more accurate representation of species abundance. Whilst wild species remain the most important on rural sites, domesticates are still fairly well represented on the majority of rural sites.

### Conclusion

Our re-examination and compilation of bird bone assemblages from Medieval Norway found no evidence to suggest that the Medieval bird fauna differed from the modern one. Although certain groups of birds have been found in low numbers from Medieval sites, this may not reflect actual low population abundance in Medieval times. The most common birds in Medieval assemblages are Galliformes. In urban sites these are mostly domestic fowl, whereas at rural sites wild species dominate. Our data indicates an introduction of domestic fowl in the early Medieval period and a slightly delayed introduction of domestic geese, with both species becoming more abundant during the mid to late Medieval period. This appears to be later than other Scandinavian countries. Interestingly, species that are now ubiquitous in urban areas, such as pigeons, corvids, and gulls are mostly absent from Medieval urban centres. In addition, we found a bias towards the use of female *Accipiter gentilis* in falconry, while *Falco* species may have been exported. For the majority of non-native species found in Norway today, our data suggests that these were introduced during Post-Medieval times.

Our work has identified a number of exciting research avenues that warrant future research. The timing of the arrival of domestic bird species, mostly *G. gallus* and *A. anser* in Norway and their role(s) in Scandinavian society are still poorly understood. Further analyses of their earliest occurrences and their subsequent spread will shed light on when, how and why domesticates reached Norway. Furthermore, the clear size difference between medieval *A. gentilis* and modern ones suggests the effects of human selection for large individuals for falconry in Medieval Norway. Analyses of older *A. gentilis* material, as well as material from a wider geographic range, is needed

to better interpret these trends in body size. Lastly, the absence of several groups of birds that were expected to be present during Medieval times merits further investigation to see if this is indeed an effect of the rise of urban centres in the last few centuries, or if this represents an ecological shift in species habitats.

### Data Accessibility Statement

The supplementary files for this publication are available on the Open Quaternary Dataverse: Walker et al. 2019 (See DOI: 10.7910/DVN/SONARR). The files found within the Open Quaternary Dataverse are listed below.

### Additional Files

The additional files for this article can be found as follows:

- **Supplementary Material File 1 (SMF1).** Unpublished sources reference list. This is predominantly grey literature archaeological and zooarchaeological reports. DOI: <https://doi.org/10.5334/oq.58.s1>
- **Supplementary Table 1 (ST1).** Table of Number of Identified SPecimens (NISP) for birds in comparison to all other identified fauna for Medieval Norway. DOI: <https://doi.org/10.5334/oq.58.s2>
- **Supplementary Table 2 (ST2).** Table of bird species identified by NISP, broken down under each of the 21 re-examined sites. DOI: <https://doi.org/10.5334/oq.58.s3>
- **Supplementary Table 3 (ST3).** Table of bird species identified by NISP, broken down under each of the 33 additional sites. DOI: <https://doi.org/10.5334/oq.58.s4>

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### Competing Interests

Hanneke J.M. Meijer is a co-Editor-in-Chief of Open Quaternary and was removed from all editorial processing for this submission. The remaining authors have no competing interests to declare.

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