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The Introduction of Chickens Into Norway and Their Early Use: New Evidence From the Borgund Kaupang

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ABSTRACT

Chickens reached areas of northern Europe by the 6th to 5th century BCE, but their dispersal into Scandinavia appears delayed. Here we present a thorough assessment of chicken remains recovered from Borgund, a deserted late Viking Age–Medieval urban site located near Ålesund on the west coast of Norway. Direct and indirect dating of 20 chicken bones gives an age range from the Viking Age to the boundary between the High and Late Medieval. The Borgund chickens thus include some of the earliest evidence for chicken-keeping in Norway. The absence of juveniles indicates that chickens were kept for secondary products, such as eggs and feathers, and societal reasons rather than just meat. This is in line with data on chickens from Medieval Norway. The low percentage of chickens in comparison to other domestic species indicates chickens were not a vital part of the day-to-day diet of the people of Borgund. The chickens here represent the earliest unambiguous record for the west coast and second earliest for Norway, indicating a Viking Age introduction. The existence of Viking Age trading networks with northwestern Norway and Denmark suggests that chickens may have been introduced to Borgund through this route. Alternatively, chickens may have been first introduced in southern Norway via a separate Viking Age network and then spread from there. The route through which chickens came to Borgund remains unclear.

1 | Introduction

The domestic chicken (*Gallus gallus domesticus*) is arguably the biggest success story in domestication. Due to their size and ease of transportation, and their ability to adapt to almost any environment, they have become established across the globe. Conservative approaches have suggested that chickens were domesticated by 1500 BCE in Southeast Asia from jungle fowl in their native range (Eda et al. 2016; Peters et al. 2016, 2022; Pitt et al. 2016). The earliest unambiguous domestic chickens have been found at a Neolithic (specifically, ~1650–1250 BCE) site Ban Non Wat, Thailand (Peters et al. 2022). They then spread rapidly east into Island Southeast Asia (Meijer et al. 2022) and Oceania (Storey et al. 2008, 2012), and west across South Asia and Mesopotamia (Perry-Gal et al. 2015; Peters et al. 2022). During the first millennium BCE, chickens dispersed into Africa and Mediterranean Europe (Best et al. 2022; Peters et al. 2022). The dispersal of chickens into Europe was facilitated through Greek, Etruscan, and Phoenician maritime trade routes (Serjeantson 2009; Becker 2013; Perry-Gal et al. 2015; Peters et al. 2022). Initially, the number of chickens in Europe remained low (Best et al. 2022), suggesting that they had a mostly ceremonial and/or symbolic relevance during this period. From the 1st century BCE onwards, chickens became more abundant and had started to form an established part of European livestock (Maltby 1997, 2010; Maltby et al. 2018).

However, the presence of chickens in northern and central Europe by the 6th to 5th century BCE (Best et al. 2022) did not lead to a natural diffusion of chickens into Scandinavia. Evidence suggests a later introduction into the region, with the earliest records from Sweden and Denmark contextually dated to around the 1st century BCE and the 1st century CE, respectively (Lepiksaar 1977; Tyrberg 2002; Ericson and Tyrberg 2004; Gotfredsen 2013, 2014). The earliest evidence for Finland currently dates to the 8th century CE (Ukkonen and Mannermaa 2017; Wessman et al. 2018). For Norway, the earliest *G. gallus domesticus* remains date to the 9th century CE (Barrett et al. 2007). However, it is not until 1100 CE that *G. gallus domesticus* starts to be more common on Norwegian sites, and not until 1300 CE that chickens become abundant within the bird remains (Walker et al. 2019; Walker and Meijer 2020). This delayed arrival of chickens into Scandinavia, especially Norway and Finland, contrasts with other elements of the agricultural package, such as cattle, sheep/goats, pigs, and dogs, that were already well established in Scandinavia since the Neolithic period (Rowley-Conwy 2011; Price 2015). This pattern, however, does correlate with some other northerly areas such as the Scottish Islands (Western and Northern Isles), where dating now indicates a Norse period introduction of chickens (Best et al. 2022).

Here, we present a thorough assessment of confirmed domestic chicken bones recovered from Borgund, a deserted late Viking Age–Medieval urban site located near Ålesund, in Møre Romsdal county on the west coast of Norway. This study is part of the Borgund Kaupang Project (BKP), which re-assesses the available legacy sources from the site (Borgund_URL). Previous work (Walker et al. 2019; Walker and Meijer 2020) suggests that the Late Viking Age–Early Medieval is a key period for the introduction of *G. gallus domesticus* into Norway. To ensure the most accurate assessment of the chicken remains from Borgund, we have, for the first time in Norway, undertaken a wide-scale re-dating of the *G. gallus domesticus* bones through both radiocarbon and contextual dating. The use of direct dating has been shown to be crucial in redefining the timing of the arrival of domestic fowl into Europe (Best et al. 2022). Through this reanalysis of dates and detailed osteological analysis, we aim to understand the importance of domestic chickens and their uses to the people of Borgund and local communities in Norway. Crucially, the Borgund chickens enhance our understanding of the arrival of domestic fowl in Norway.

2 | Material and Methods

2.1 | Site Description and Excavation Methods

Borgund was one of 16 medieval towns in Norway. The place name is occasionally mentioned in written sources, but its location was not discovered until the mid-1950s. The site was excavated intensively between the mid-1950s and the mid-1970s, when the so-called Southern site and Northern site

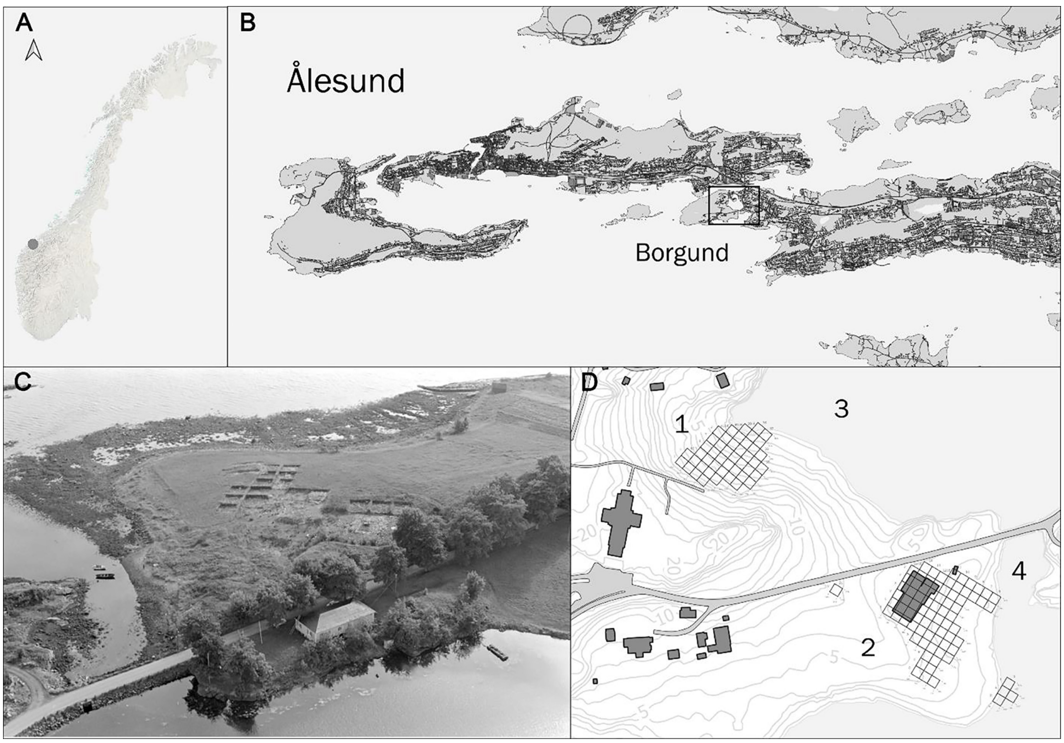

FIGURE 1 | (A) Map showing the location of Borgund in western Norway. (B) Borgund, located by Ålesund in western Norway. (C) Aerial photo of the Southern site 1966, view towards south. (D) Borgund site map, showing excavated areas, areas of the site: 1—Northern Site, 2—Southern site, 3—Katavågen, and 4—Klokkersundet. Maps produced by M. Blobel and G. Hansen, Photo: Topographical archive University Museum of Bergen.

were excavated (Figure 1). In addition, smaller archaeological campaigns have taken place, the first in 1912 and the most recent in 2020, and overall, the site has seen more than 30 archaeological field seasons. Around 5300 m^2 have been investigated, recovering 51,000 artifacts and 35,860 osteological specimens from dwelling quarters and harbor areas. The *G. gallus domesticus* remains studied here were found in the Southern site between 1955 and 1961 in connection with excavations carried out by the present University Museum of Bergen (see; Larsen 2008; Unpublished site reports and documentation in TopArk) and in the inlet Katavågen in connection with Bergens Sjøfartsmuseum's submarine investigation in 2014 (Søyland 2015). The Southern site was excavated in 7×7-m grid squares and in spits of varying thickness. The location of portable finds (artifacts and ecofacts, including bones) was most often described in relation to grid square and frequently in relation to spit. At the 2014 Katavågen investigation, trenches were excavated in spits, and finds were registered according to trench and spit number. While wet sieving was carried out in 2014, the 1955–1961 campaigns practiced handpicking with no explicit collection strategy. The unworked bone was thus not collected systematically throughout the many field seasons in Borgund, and this resulted in a bias towards larger elements and species in the material.

2.2 | Osteological and Metric Analysis

The unworked faunal material from Borgund is stored in the osteological collections at the University Museum's Department of Natural History in Bergen, Norway. The focus of this study is on the 20 domestic fowl bones recovered from Borgund. Osteological analysis of *G. gallus domesticus* bones was done as part of a wider assessment of bird bones recovered from Medieval sites in Norway (Walker et al. 2019). Identification to species was achieved through the use of the extensive comparative modern avian skeletal collections held at the University Museum of Bergen. There are six wild Galliformes native to Norway, all of which have a morphology similar to *G. gallus domesticus*: *Lyrurus tetrix* (black grouse), *Tetrao urogallus* (western capercaillie), *Tetrastes bonasia* (hazel grouse), *Lagopus muta* (rock ptarmigan), *Lagopus lagopus* (willow ptarmigan), and *Coturnix coturnix* (common quail). As such, care was taken to ascertain that any remains presumed to be domestic fowl are indeed *G. gallus domesticus* and not other Galliformes. In terms of size, only *L. tetrix*, female *T. urogallus* (males significantly larger), and potentially large *L. lagopus* could overlap with *G. gallus domesticus* (see Figures S1 and S2). We used the morphological criteria listed in Erbersdobler (1968) and Tomek and Bochenski (2009) to distinguish domestic fowl from these species (for specific identification criteria used for the Borgund chickens, see Figure S1). Where species remained uncertain due to taphonomy, remains were assigned to likeness (cf.). Measurements in this study were taken according to Von Den Driesch (1976), with the additional humerus KB measurement taken from Kraft (1972). Medullary bone (a mineral component deposited in the bone shafts of hens in lay) presence/absence was observed only in broken remains, where a cross-section of the shaft can be observed. See Table S1 for details of the osteological analyses and results.

2.3 | Dating, 14C, and Stratigraphical by Association With Mechanical Layer (ML)

The chicken remains described here were dated either by direct radiocarbon dating or indirectly through contextual information. Five chicken bones were selected for radiocarbon dating at the National Laboratory for Age Determination, Norwegian University of Science and Technology, Trondheim (Table 1). Calibration of the dates was done using OxCal version 4.4.4 software (Bronk Ramsey 2021; Atmospheric data from Reimer et al. 2020). Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) signals were obtained during the 14C dating process (see Table 1). All specimens had a $\delta^{13}C$ value that indicated a terrestrial signal and were therefore calibrated using the IntCal20 calibration curve for the Northern Hemisphere (Reimer et al. 2020). The calibrated age ranges reported are at the 95.4% probability standard.

The remaining 15 chicken bones were dated contextually based on original site documentation as part of a revised dating framework for the site by the BKP (Hansen et al. Forthcoming). Based on original site documentation, MLs have been defined for each grid square with squares and original spit-numbers as the point of departure in the Southern site. The Katavågen finds have been assigned to ML through a similar approach. Each ML and associated finds are dated through a combination of object typology (~11,500 finds) including radiocarbon dates ($n = 129$). The date range of the directly dated chicken specimens in a given ML is further constrained/narrowed down by dates of ML below or above the ML in consideration. The dating frame/stratigraphical date for an ML and associated finds is expressed as broad *terminus post quem* (PQ "after which") and *terminus ante quem* (AQ "before which") dates. The dates of ML are homogenized by rounding up to the nearest quarter century. When the homogenized ML-date/stratigraphical date can enhance the accuracy of the radiocarbon date of directly 14C dated specimens, the ML-date is given preference as proposed date for the specimen (see Table 1).

2.4 | Isotope Analysis

The Borgund $^{12}C/^{13}C$ ($\delta^{13}C$) and $^{14}N/^{15}N$ ($\delta^{15}N$) isotope values included in this paper were attained from the isotope ratio mass spectrometer (IRMS) analyses conducted alongside the direct dating by the National Laboratory for Age Determination, Norwegian University of Science and Technology, Trondheim, following their collagen extraction protocols. Carbon and nitrogen isotope values ($\delta^{13}C$ and $\delta^{15}N$) are reported per mil (‰) relative to VPDB and AIR, respectively. The Borgund chicken samples had C:N ratios between 3.4 and 3.6, indicative of acceptably well-preserved collagen and are therefore considered sufficient for yielding reliable $\delta^{13}C$ and $\delta^{15}N$ values (the range is generally accepted to be between 2.9 and 3.6; DeNiro 1985). While some specialists (e.g., Vaiglova et al. 2023) have noted the need for caution in the use of carbon and nitrogen isotope data generated via radiocarbon dating for dietary reconstructions, this is primarily where the values are produced by accelerator mass spectrometer (AMS). It is the IRMS values that are used as dietary indicators in this paper. Given the scarcity of the remains considered here, the small number of published comparable sources for chickens, and that the research is not exploring small differences between samples, the decision was made to use the data.

TABLE 1 | Radiocarbon and stratigraphically dated *Gallus gallus domesticus* (referred to as *G. gallus* in the table) bones from Borgund. Radiocarbon dates have been calibrated (see Section 2.3 for details). The proposed date considers stratigraphical and radiocarbon dates to provide a refined chronology where possible. Specimens 8929–8931 and 8960–8961 are from the same mechanical layer (ML) and have therefore been grouped within this table. The proposed date is the one we accept and discuss.

Specimen ID (lab ID)	Context ID (sample code)	Species	New proposed date (CE)	Radiocarbon age (BP)	Calibrated date at 95.4% probability (CE)	$\delta^{13}C$	$\delta^{15}N$	C:N	Comments, date and context
8941 (TRa-15256)	0001/60/001853/002 (BKP/C14/068)	*Gallus gallus*	887–986 (VA)	1125 ± 15	887–986	−20.9	11.8	3.5	Square Ø8. Specimen 8941 is assigned to ML Ø08/23B dated to: 0900PQ-1050AQ mix, the ML was mixed. Thus, the proposed date is now the 14C date from 8941.
8900 (TRa-15255)	0001/59/001037/002 (BKP/C14/067)	*G. gallus*	993–1024 (VA)	1040 ± 13	993–1024	−21.3	12.3	3.5	Square Ø8. Specimen 8900 is assigned to ML Ø08/20A/sek2 dated to: 1050PQ-1125AQ. The 14C date of 8900 is an outlier from the date of the ML, and the bone is interpreted as residual. Thus, the 14C date of 8900 is accepted as proposed date, and other remains from the context treated as complex.
8876 (TRa-15253)	0001/56/000458/002 (BKP/C14/065)	*G. gallus*	992–1117 (VA/EM)	1000 ± 13	992–1117	−21.6	13.0	3.4	Square Z14. Specimen 8876 is assigned to ML Z14/05/K27 dated to: 1000PQ-1300AQ. It stems from fill in a well, the stratigraphical relationship between the well and associated culture layers cannot be discerned in detail. Thus, the 14C date of 8876 is accepted as proposed date and other remains from the context treated as complex.

(Continues)

TABLE 1 | (Continued)

Specimen ID (lab ID)	Context ID (sample code)	Species	New proposed date (CE)	Radiocarbon age (BP)	Calibrated date at 95.4% probability (CE)	$\delta^{13}C$	$\delta^{15}N$	C:N	Comments, date and context
8877 (TRa-15254)	0001/56/000446/002 (BKP/C14/066)	*G. gallus*	1025–1125 (VA/EM)	980 ± 13	1022–1150	−21.8	12.3	3.5	Square Z15. Specimen 8877 is assigned to ML Z15/09 dated to: 1025PQ-1125AQ. The correlation between the direct and indirect dates indicates that the proposed date for 8877 can be refined to 1025–1125 CE.
8854 (TRa-15252)	0001/55/000138/002 (BKP/C14/064)	*G. gallus*	1100–1125 (EM)	940 ± 12	1039–1158	−22.8	9.3	3.6	Square V12. Specimen 8854 is assigned to ML V12/04 dated to: 1100PQ-1125AQ. Thus, the 14C date is refined to 1100–1125 CE, which is the proposed date for specimen 8854.
8963	0001/61/002019/002	*G. gallus*	900–1125 (VA/EM)	—	—	—	—	—	Square Ø8. Specimen 8963 is assigned to ML Ø08/22B,23B dated to: 900PQ-1125AQ.
8861	0001/55/000130/002	cf. *G. gallus*	1000–1125 (VA/EM)	—	—	—	—	—	Square V15. Specimen 8861 is assigned to ML V15/04 dated to: 1000PQ-1125AQ.
8878	0001/56/000446/002	*G. gallus*	1025–1125 (VA/EM)	—	—	—	—	—	Square Z15. Specimen 8878 is assigned to ML Z15/09 dated to: 1025PQ-1125AQ. (This specimen is from the same individual as 14C-dated ID 8877 and is found in the same ML as this specimen 8877).
8943	0001/60/001894/006	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	Square Ø7. Specimen 8943 is assigned to ML Ø07/10 dated to: 1050PQ-1125AQ.
8920	0001/59/001265/003	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	Square Ø8. Specimen 8920 is assigned to ML Ø08/21A/sek2 dated to: 1050PQ-1125AQ.

(Continues)

TABLE 1 | (Continued)

Specimen ID (lab ID)	Context ID (sample code)	Species	New proposed date (CE)	Radiocarbon age (BP)	Calibrated date at 95.4% probability (CE)	$\delta^{13}C$	$\delta^{15}N$	C:N	Comments, date and context
8929	0001/60/001925/004	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	Square Ø8. The specimens 8929, 8930, and 8931 are assigned to ML Ø08/21B dated to: 1050PQ-1125AQ.
8930	0001/60/001925/004	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	
8931	0001/60/001925/004	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	
8936	0001/60/001876/003	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	Square Ø08. Specimen 8936 is assigned to ML Ø08/20B dated to: 1050PQ-1125AQ.
8955	0001/60/001837/008	*G. gallus*	1050–1125 (EM)	—	—	—	—	—	Square Ø8. Specimen 8955 is assigned to ML Ø08/19B dated to: 1050PQ-1125AQ.
8960	0001/60/001845/003	*G. gallus*	1100–1125 (EM)	—	—	—	—	—	Square Ø7. Specimens 8960 and 8961 are assigned to ML Ø07/09 dated to: 1100PQ-1125AQ.
8961	0001/60/001845/003	*G. gallus*	1100–1125 (EM)	—	—	—	—	—	
8964	BRM1191/000022/001	*G. gallus*	1275–1400 (HM/LM)	—	—	—	—	—	Katavågen. Specimen 8964 is assigned to ML 1191/sjakt 3/3 dated to: 1275PQ-1400AQ.
8910	0001/59/001391/A/002	cf. *G. gallus*	Unstrat (ND)	—	—	—	—	—	Square Ø7. Specimen 8910 is assigned to ML Ø07/00AB, which is unstratified. No date.
8874	0001/yy/007309/001	*G. gallus*	Unstrat (ND)	—	—	—	—	—	Squares X12-X13-Y12-Y14-Y15-Z14 or Z15. Specimen 8874 is assigned to an unstratified context. No date.

Abbreviations: EM = Early Medieval, HM = High Medieval, LM = Late Medieval, ND = Not dated, VA = Viking Age.

3 | Results

In total, 108 bird bones were identified from the excavations in Borgund. Further detail regarding these species can be found in Walker et al. (2019). A total of 35,860 animal bones were recovered from Borgund; birds made up only 0.3% of the faunal assemblage. The results from the dating of the bones can be found below in Table 1.

3.1 | Chicken Remains From Borgund

Eighteen specimens were confidently identified as chicken using a combined metrical and morphological approach, with a further two specimens assigned as cf. *G. gallus domesticus*. The latter were very likely chicken, but taphonomic damage obscured some features. From here on in, they will all be referred to as chicken (see Supporting Information for details). Of the 20 bones, all but one were found in the Southern site; six specimens were recovered in dwelling areas, while 13 bones were found among domestic waste deposits in the tidal zone of the waterfront towards Klokkersundet (Figure 2). The last bone was found in Katavågen, by the shore in the vicinity of the Northern site (Figure 2). This context may reflect the disposal of domestic waste into the Katavågen inlet, possibly from the Northern site.

All 20 specimens represent fully ossified adults. Aging from spur length (Doherty et al. 2021) on two of the tarsometatarsi (ID 8963 and 8964) gave ages of 18 and 12 months, respectively, but due to the loss of the spur tips, these are minimum ages. As no medullary bone was identified, only the presence or absence of a spur could be used to sex individuals at Borgund, all three tarsometatarsi had a spur and were therefore categorized as male individuals. Due to the small size of the *G. gallus domesticus* assemblage, any meaningful analysis of element representation is difficult; however, there does not seem to be any bias towards a single element, as both axial (sternum, pelvis, and synsacrum) and limb elements (e.g., humerus and tibiotarsus) are represented. Pathology relating to osteophytic new bone growth around joints was identified on three specimens: two femora, a left, and right likely from one individual based on metrics (ID 8877 and 8878) and an ulna (ID 8874). Butchery was observed on two specimens, a humerus (ID 8941) and a tibiotarsus (ID 8931), in the form of small superficial cut marks around the articular ends. Other taphonomic markers identified included two specimens with some form of erosion (ID 8861 and 8910) and one specimen showing signs of rodent gnawing (ID 8854); no evidence of burning was identified. In general, the osteological bird material from Borgund was well preserved, displaying relatively complete bones with minimal signs of surface weathering.

3.2 | Age of the Chickens

Radiocarbon dates were obtained from five chicken specimens (Table 1; Figure 3). Thirteen chicken bones were dated through contextual data (Table 1). In line with Norwegian conventions, we here define the Viking Age as c. 800–1030 CE, the Early Medieval as 1030–1150 CE, the High Medieval from 1150 to 1350 CE, and the Late Medieval as 1350–1537 CE. Working from these periods, two specimens (ID 8941* and 8900*, asterisk indicating radiocarbon-dated specimen ID numbers) date to the Viking Age, five (ID 8861, 8863, 8876*, 8877*, and 8878) date to the boundary between the late Viking Age and the Early Medieval, 10 specimens (ID 8854*, 8920, 8929, 8930, 8931, 8936, 8943, 8955, 8960, and 8961) date to the Early Medieval, and one specimen (ID 8964) dates to the boundary between the High and Late Medieval. Two bones (ID 8910 and 8874) were found in unstratified contexts and have not been dated; we include them in the study due to the rarity of chickens from early sites and presume they are of Medieval date; nonetheless, we draw no conclusions from these two specimens.

3.3 | Isotope Data

Table 1 gives the $\delta^{13}C$ and $\delta^{15}N$ values for the five directly dated specimens, and Figure 4 shows these in comparison with other chicken isotope data (from Best et al. 2022). The Borgund $\delta^{13}C$ values ranged from −22.8 to −20.9, with $\delta^{15}N$ values between 9.3 and 13. While four of the Borgund samples have fairly enriched nitrogen values, these are within the ranges seen from areas such as Britain (e.g., CKN 11 from Howe, Orkney dated to 1302–1405 cal CE; see Figure 4). This probably results from a varied omnivorous diet that may have included household scraps and wild protein sources (e.g., insects and small rodents).

4 | Discussion

4.1 | The Age of the Borgund Chickens

Direct and indirect dating results show that the Borgund chickens range in age from the Viking Age to the boundary between the High and Late Medieval, and include some of the earliest chickens in Norway, notably specimen 8941, which dates to 887–986 cal CE. The direct dates of the chicken bones correlate well with other radiocarbon-dated finds and the contextually proposed date ranges indicating a largely secure stratigraphic chronology of the other indirectly dated finds of organic materials from the Borgund site (Hansen et al. Forthcoming). The specimens from the Late Viking Age/Early Medieval are considered early chickens for Norway in comparison to contemporary sites (Walker et al. 2019). Very few archaeological chicken bones in Norway have been directly dated. The only other reported Viking Age chickens come from Skiringssal Kaupang in southeast Norway (early 9th century CE; Barrett et al. 2007), one of which was C14 dated (James Barrett pers. comm.). Further reports of chickens from Viking Age contexts have come from Trondheim, ~230 km northeast of Borgund, from the Bibliotekstomten site (Phases 1–3) dated to the last half of the 900s–1050 CE (Lie 1989; dates according to Christophersen and Nordeide 1994). Given the morphological similarity between galliform taxa in Norway and the potential of individual fowl bones to migrate down through the sequence (Best et al. 2022), the age and taxonomic affinity of these specimens need to be confirmed. Our results, along with Barrett et al. (2007), suggest a late Viking Age introduction of domestic fowl into Norway.

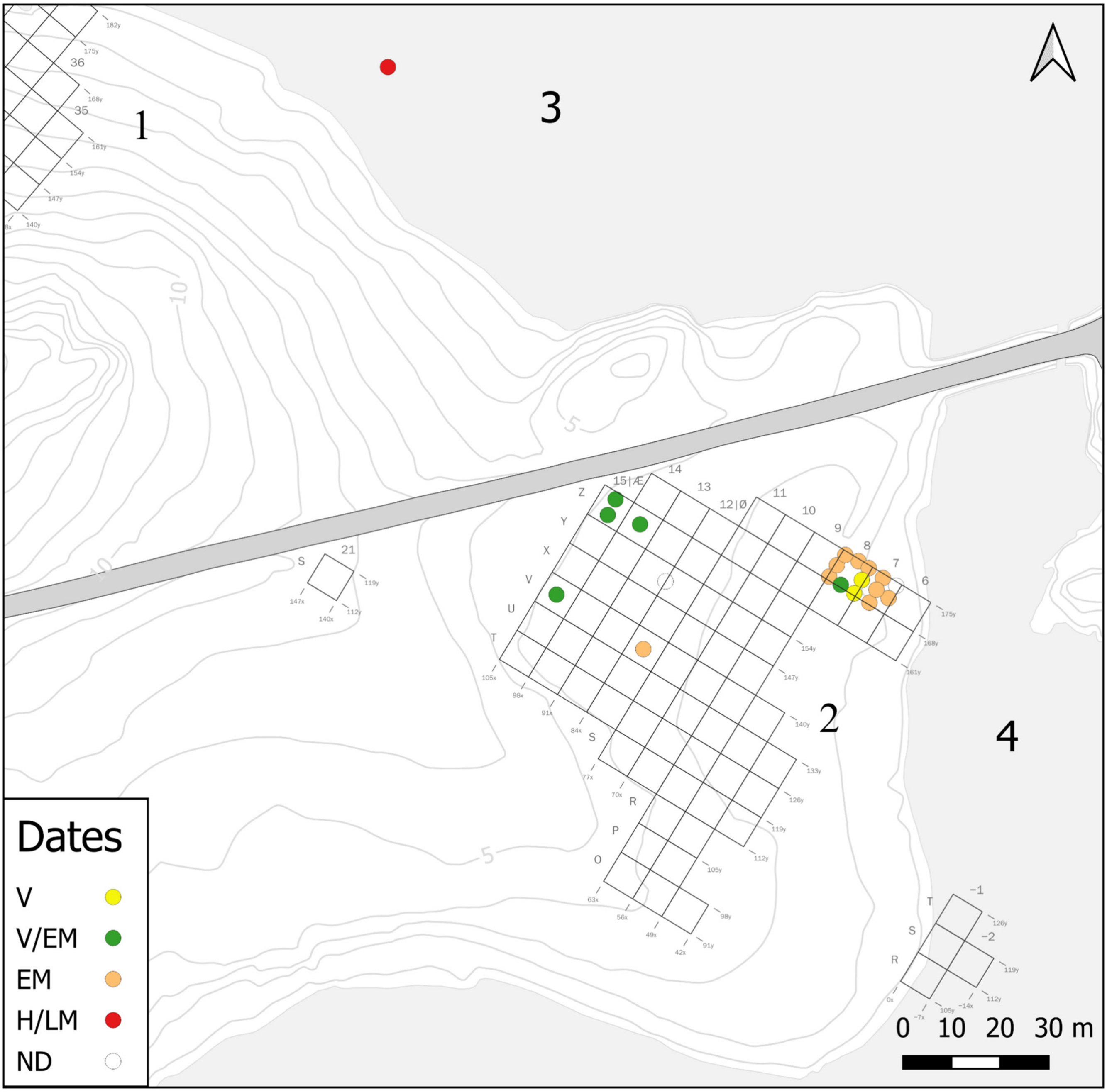

FIGURE 2 | Spatial and temporal distribution of *Gallus gallus domesticus* bones recovered from Borgund. The distribution within grid squares is placed at random. Areas of the site: (1) Northern Site, (2) Southern site, (3) Katavågen, (4) Klokkersundet. Dates: EM = Early Medieval, HM = High Medieval, LM = Late Medieval, ND = Not dated, V = Viking Age. Basemap BKP, data G. Hansen. [Colour figure can be viewed at wileyonlinelibrary.com]

The absence of earlier chickens in Norway could be explained by the lack of Viking Age sites with preserved bone remains, and potentially that early excavations did not consistently recover animal bone remains. In comparison, animal bone remains from the Medieval period are well represented, due to the many urban sites characterized by waterlogged cultural layers and good preservation conditions for osseous materials. Interestingly, preservation of organic materials in Borgund favors the lowermost strata and features with humid conditions (e.g., wells), with fewer organics preserved from the upper well-drained strata, resulting in older material being better preserved. The presence of the ID 8994 dated to the High/Late Medieval shows that *G. gallus domesticus* in Borgund was not confined to the late Viking Age/Early Medieval. The fact that the main part of the retrieved and dated bones is centered on the late Viking Age/Early Medieval may be a consequence of preservation conditions rather than a real picture of presence throughout the Middle Ages.

4.2 | Possible Introduction Routes

The Borgund chickens currently represent our earliest unambiguous record of chickens on the Norwegian west coast. The

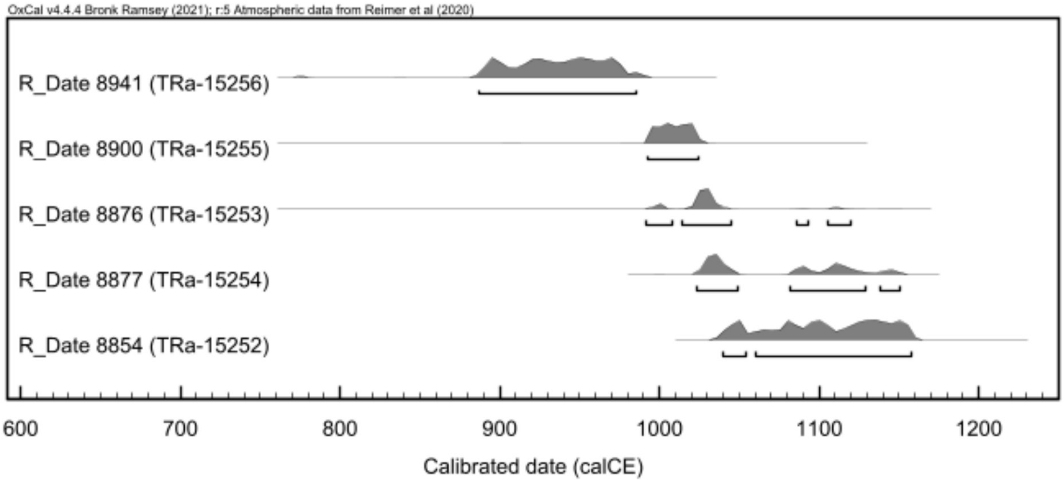

FIGURE 3 | Calibrated plot of radiocarbon dates from the Borgund chickens, calibrated dates given at 95.4% probability. Information on each sample, including the uncalibrated and calibrated date range, is given in Table 1. Modeled using OxCal v.4.4.4 (Bronk Ramsey 2021; Atmospheric data from Reimer et al. 2020). Specimen ID is shown, with the laboratory code given in brackets.

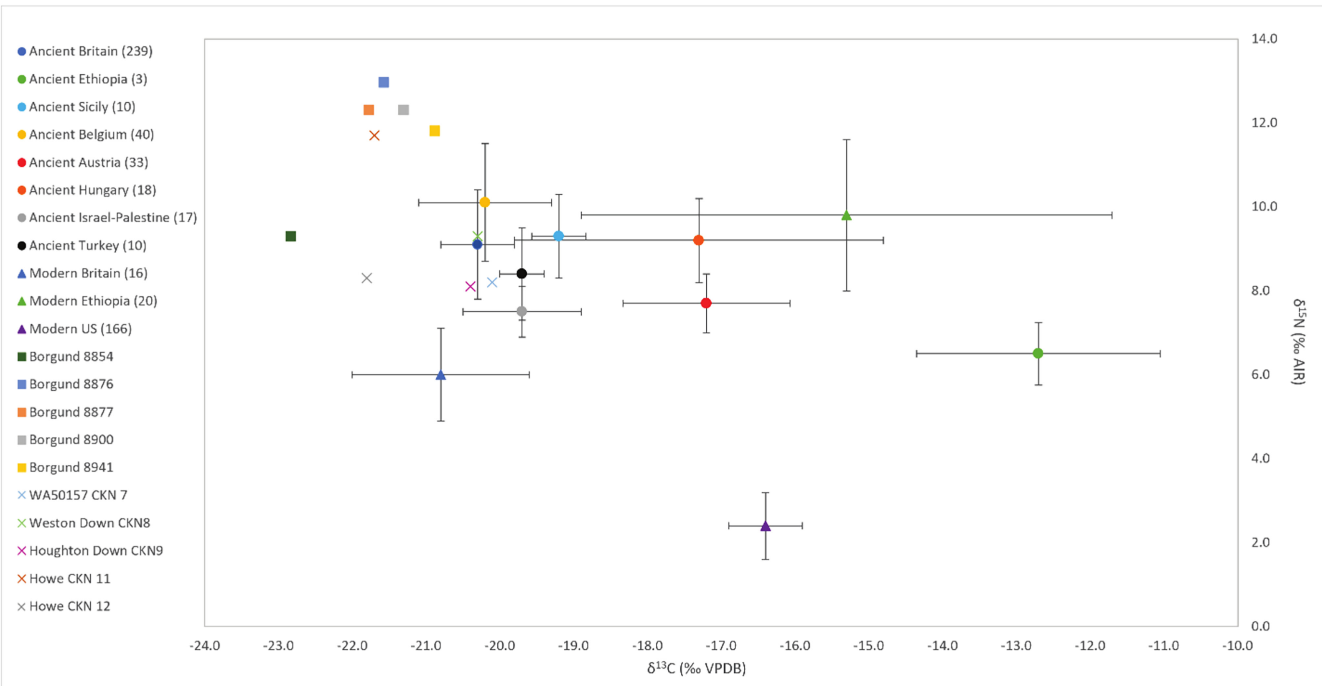

FIGURE 4 | Carbon and nitrogen isotope values for the dated Borgund chickens compared to a broader isotope dataset for ancient and modern chickens, and other dated specimens from England (Iron Age) and Scotland (Medieval and post-Medieval). All comparative data are taken from Best et al. (2022). [Colour figure can be viewed at wileyonlinelibrary.com]

current data suggest that chickens might have been introduced to Norway during the Viking Age, although a lack of faunal remains from earlier periods means that earlier introductions cannot be conclusively discounted. This suggests that a scenario in which chickens diffused into southern Norway and Sweden via trade networks between the Romans and northern Germanic tribes during the Iron Age is unlikely.

The routes through which chickens were introduced to Norway remain unclear. Borgund is located geographically on a whetstone trading route between Trøndelag in Northwestern Norway and Ribe (Denmark). Chicken remains are reported from Ribe from the 8th century (Kveiborg 2022). Whetstones from Mostamarka in Trøndelag were traded to Ribe from the early 8th century, throughout the Viking Age and well into the Medieval period (Baug et al. 2018, 2020). Chickens may have been introduced from Denmark or Trøndelag (chicken remains were reported from the Bibliotekstomten site but have not been confirmed by the authors) to Borgund through this network. Research suggests that the Viking Age trading networks in western Norway may have been separate from those in southern and eastern Norway. The Skiringssal Kaupang in southeast Norway was part of the early Viking Age trade network with links to Hedeby and Ribe (Denmark), Hamburg (northern Germany), Åhus and Birka (southern Sweden), and Truso (northern Poland) (Sindbæk 2005, 2007). The Skiringssal Kaupang chickens were likely to have been traded along this trade network with Denmark or eastern Sweden (Barrett et al. 2007). It is possible that chickens were first introduced to Southeast Norway via this Viking Age network and potentially spread across Norway from here.

Medieval occurrences of chickens are almost exclusively in urban settlements, which would have been the key trading sites in Norway (Walker et al. 2019). Once established in the towns, chickens are then assumed to have spread out to the rural sites, although few rural sites have been preserved. The spread and establishment of chickens in rural communities did not occur until the late Medieval to Post-Medieval (Walker et al. 2019). From the few Medieval rural sites with available bone materials, i.e., Alstahaug and Nesseby, it appears domestic fowl had little to no importance to these communities, as wild species were still favored (Walker et al. 2019). While becoming more prominent on urban sites, chickens remained a small fraction of the overall faunal assemblages across Medieval sites. Birds generally formed less than 5% of the faunal assemblages, and chickens accounted for, on average, 50% of the bird bones identified (approx. 2.5% of the overall faunal assemblages). As a result, chickens represented a relatively small part of the Medieval diet (Walker and Meijer 2020).

The timing of the earliest Borgund chickens might be linked to the rising influence of Christianity in Norway at the time. An increase in chickens in Europe during the Medieval period has been linked to the increasing influence of Christianity from ca. 1000 AD. Christian fasting practices forbade the consumption of meat from four-legged animals during fasting, but the consumption of birds and eggs was allowed (Loog et al. 2017; Sykes 2007). An increase in chicken consumption has also been observed in other Viking Age sites in Sweden (Boessneck et al. 1979) and Germany (Hüster Plogmann 2006). This is presumed to have coincided with the increasing influence of Christianity in the region during the 9th–10th century CE (Sanmark 2004).

4.3 | Why Were Chickens Introduced to Borgund

The Borgund chickens were not slaughtered at a young age and were allowed to reach full maturity. In some cases, these individuals may have reached considerable ages, as indicated by the presence of osteophytes around the articular surface, which is interpreted as osteoarthritis, a degenerative age condition (Gál 2013; Waldron 2020). The absence of juveniles could also indicate that chickens were not being bred in Borgund, or alternatively that the porous juvenile bones suffered from poor preservation/recovery. Often, the presence of juvenile bones is taken to indicate local breeding (Serjeantson 2009); the possibility that chickens were not initially bred in Norway is supported by the Medieval occurrences of chickens being almost exclusively from urban trading sites. Borgund is not unique in its absence of juveniles, as several Medieval sites across Norway showed a lack of or few juvenile remains (Walker et al. 2019). This could indicate that few sites in Norway bred chickens, especially during the early periods of introduction in the late Viking Age and into the Early Medieval period. In this case, it would explain why chickens are so scarce on sites from these periods.

The lack of juveniles and the fact that all the sexually distinct elements (tarsometatarsi) were male suggest a higher ratio of males to females (although females can grow spurs). Together, this suggests that chickens were kept with a focus on more than just meat. It is possible secondary products such as eggs and feathers were a focus; however, hens during these periods may not have laid the quantity of eggs that modern chickens do, and although the sample is small, the lack of observed medullary bone may indicate that the laying season was restricted due to the colder northerly climate. Yet, interestingly, evidence for apparently substantial chicken egg-laying soon after introduction is found at Norse Bornais in the Outer Hebrides, where a pilot study using microscopy and proteomics has identified a large appearance of chicken eggs from the Early Norse period (Best 2020; Best 2021). It is possible that the less northern location and the warm Gulf Stream made the Hebridean conditions more favorable. Alternatively, given the likely high portion of males at Borgund, other purposes like guards, bloodsport, or expression of social connections may have been important (Walker and Meijer 2020). The high ratio of males to females is in line with data on chicken remains from across Medieval Norway (Walker et al. 2019).

The isotope values from the five specimens are in line with those of Roman to Late Medieval chickens from the UK and Europe (Bennett et al. 2018; Best et al. 2022; Figure 4), which are distinct from modern broilers bred for meat purposes (Bennett et al. 2018). Broilers generally have low $\delta^{15}N$ through limited protein, and US broilers in particular have a diet heavily focused on C4 plants such as maize resulting in elevated $\delta^{13}C$ intake (Bennett et al. 2018; Best et al. 2022). In contrast, the Borgund chickens would have had an omnivorous diet that was probably fairly varied. Furthermore, the low percentage of chickens in comparison to other domestic species on the site indicates they were not a vital part of the day-to-day diet of the people of Borgund. At Medieval sites in Norway, bird bones rarely form more than 5% of the overall faunal assemblage (Walker et al. 2019); despite this, the representation of birds at Borgund is especially low at just 0.3% of the faunal assemblage. It is important to emphasize that while meat appears not to have been the primary focus of domestic fowl management, it is almost certain that chickens were consumed after they fulfilled other purposes, as indicated by the butchery marks seen and distribution among other domestic waste.

5 | Conclusion

Our osteoarchaeological and radiocarbon analysis confirms the presence of chickens during the Viking Age on the west coast of Norway. These chickens initially appear to be kept primarily for nonmeat purposes and played only a minor role in the Viking Age diet. Although the exact routes of their dispersal into Western Norway are unclear, Viking Age trade networks likely played an important role in the dispersal of chickens into and possibly across Norway. In the absence of any earlier chicken remains, our results suggest that the introduction of chickens into Norway occurred during the Viking Age. However, an even earlier dispersal of chickens into Norway cannot be ruled out. Given the morphological similarities between Galliformes and the potential of chicken bones to migrate down through the stratigraphic column, there is a need for more analysis and direct dating of chicken remains from other sites, Viking Age and older, in Scandinavia.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data will be stored in the University Museum of Bergen's public repositories.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Figure S1.** Humerus greatest length (mm) comparison between Borgund ($n=1$), Medieval archaeological *Gallus gallus domesticus* and wild Norwegian Galliformes within a similar size range. Comparative data include modern specimens held within the University Museum of Bergen collections of *Lagopus lagopus* ($n=22$), *Tetrao urogallus* male ($n=1$), *T. urogallus* female ($n=2$), *Lyrurus tetrix* ($n=8$) measured by SJW and HJMM. Archaeological *G. gallus domesticus* specimens from Medieval Norwegian sites are measured by SJW and include specimens from Bryggen ($n=50$; mixed Medieval dates), Mindets Tomt ($n=35$; Early/High Medieval), and Norde Felt II ($n=18$; mixed Medieval dates). Greatest length measurement taken according to Von den Driesch (1976). **Figure S2.** Tarsometatarsus greatest length (mm) comparison between Borgund ($n=2$), Medieval archaeological *G. gallus domesticus* and wild Norwegian Galliformes within a similar size range. Comparative data include modern specimens held within the University Museum of Bergen collections of *L. lagopus* ($n=22$), *T. urogallus* male ($n=1$), *T. urogallus* female ($n=2$), *L. tetrix* ($n=8$) measured by SJW and HJMM. Archaeological *G. gallus domesticus* specimens from Medieval Norwegian sites are measured by SJW and include specimens from Bryggen ($n=48$; mixed Medieval dates), Mindets Tomt ($n=26$; Early/High Medieval), Oslogate 7 ($n=3$; High/Late Medieval), and Norde Felt II ($n=20$; mixed Medieval dates). Greatest length measurement taken according to Von den Driesch (1976). **Table S1.** Overview of the Borgund chicken (*G. gallus domesticus* referred to in the table as *G. gallus*) bones with associated osteological data and chronological dates. Assignment of sex was carried out based on the presence of a spur; this is only relevant for the tarsometatarsus. The site codes refer to accession numbers of the Borgund faunal material held in the Osteological collections at the University Museum of Bergen; JS 344, JS 357, JS 374, JS 410, JS 411, JS 430, JS 431, JS 432, JS 1699, the archaeological site codes are BRM 1 and BRM 1191. VA = Viking Age, EM = Early Medieval, HM = High Medieval, LM = Late Medieval, ND = Not dated. Measurements were taken according to Von den Driesch (1976).