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Meat Supplies at the Ribadeo I Shipwreck (*San Giacomo di Galizia* galleon): Preliminary Results from Three Small Faunal Samples

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Abstract: The 78 faunal remains recovered from the Ribadeo I shipwreck, identified as the *San Giacomo di Galizia* galleon found at the Ribadeo estuary of north-west Spain, represent a very small part of the meaty provisions that this 16th-century warship would have originally carried on board. Cattle, sheep, pig, goose and hake are the species identified in the three samples analysed. The number of cattle bulk-meat cuts from the axial skeleton and fore/hind leg quarters suggest beef was an important source of protein for the crew, with mutton and pork occupying a secondary position. Aging data demonstrate the consumption of meat from sub-adult and young individuals while the frequency and location of butchery marks indicate extensive processing of the carcasses into small manageable portions, particularly in the case of cattle. Recovery of a goose tarsometatarsus (low-yield meat bone) may point to live poultry on board, while a hake vertebra evidences the likely provision of stockfish. In sum, the archaeozoological analysis provides interesting information to gain some knowledge on foodways and the types of meat available on board this Spanish galleon.

Keywords: archaeozoology; meat consumption; butchery marks; galleon; 16th-century; Spain

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1. Introduction

Food provisions on board were of crucial importance for the success of past maritime enterprises (trade, war, exploration). Ideally, supplies of appropriate quality, nutritional value and quantity were necessary to warrant the physical and mental well-being of crew and officers. Likewise, few things were more regulated than the distribution of food rations and water. All the ships had on board stewards in charge of distributing the daily food so that no one would go without rations. Another very important figure was the water bailiff, whose duties were supplying the precious liquid and looking for it when the shore was reached. Documentation of accounts for the provisioning of the ships and of loading lists and log-books provide a great deal of information on the victuals supply. They record different legumes, fresh vegetables and fruits that were consumed during the first weeks together with meat preserved in brine or in salt and live animals which were usually reserved for the sick and crew officers [1–3]. Live animals were also needed to provide a "living grocery" in an age before refrigeration or any form of food preservation except salting or smoking [4]. Historical documents reveal that much of the provisions originated from the hinterland of the port cities, although some foodstuffs may have been imported from elsewhere [3].

With the development of maritime underwater archaeology faunal and botanical remains recovered from shipwrecks have enabled to gain detailed insights into the food products carried for shipboard consumption [5–14]. However, this is an under-studied area of research in Spanish underwater archaeology that deserves attention as most of the information available derives from documentary sources [3,15–18]. From this perspective, the work here presented on the animal bones recovered from the Ribadeo I underwater

archaeological site in the Ribadeo estuary (north-west Spain), identified as the 16th-century warship *San Giacomo di Galizia*, attempts to throw some light on the eating habits of mariners serving on board the Ragusan squadron that King Philip II sent to the planned invasion of England at Falmouth, Cornwall, in 1597 [19,20]. Although the small number of faunal remains analysed limits our interpretations, the data collected on species and anatomical parts representation as well as on butchery traces constitute, to our knowledge, the first study of its kind in a 16th-century galleon sunk in the Atlantic coast of Spain. Our findings testify to foodways and the meaty victuals available on this ship before she hit the sandbanks at Ribadeo in November 1597.

2. Materials and Methods

The archaeological survey carried out in 2019 included the preserved part of the starboard side of the wreck from the keel. The faunal assemblage submitted for analysis in 2021 comprises three samples found in two very specific parts of the vessel. On the one hand, samples HU/006 and HU/010 come from the area where the ship's ballast is located, that is, in the middle of its length. The occurrence of faunal remains near the ballast can be tentatively explained by the disappearance of the upper decks, where the barrels containing food provisions would presumably be stowed. When the ship sank, the upper decks fell apart, the barrels decayed over time, and their contents deposited on the bottom of the wreck on top of the ballast. On the other hand, sample HU/001 was found immediately aft of the aforementioned zone. The finding of a large bronze cauldron with legs near the bones suggests this might have been a cooking area. In total 76 mammal remains plus 1 bird and 1 fish bones were collected (Table 1). The limited number of remains and the few differences noted between them call for their analysis as a unit.

Table 1. Number of animal remains recovered from the Ribadeo I shipwreck in 2019.

Sample	BOS	OVA	O/C	SUS	MSM	AVE	PISCIS	UNI	Total
HU/001	5	1	-	-	-	-	-	-	6
HU/006	37	4	6	2	7	1	1	4	62
HU/010	9	-	1	-	-	-	-	-	10
TOTAL	51	5	7	2	7	1	1	4	78

BOS: cattle; OVA: sheep; O/C: sheep/goat; SUS: pig; MSM: medium-sized mammal; AVE: bird; PISCIS: fish; UNI: unidentified.

Analytical techniques followed standard zooarchaeological procedures. Taxa and anatomical identifications were carried out with the aid of the Archaeobiology lab modern comparative osteological collections housed at the Institute of History (CSIC) in Madrid. Rib fragments unidentifiable to species level are included according to their size in the artificial category of medium-sized mammal (MSM). They most likely belong to sheep or pig. Bone splinters appear as unidentified. Distinction of sheep and goat elements follow the criteria described by Boessneck, Müller and Teichert [21]. Since no goat remains were recognized it may be assumed that bones recorded under the mixed category sheep/goat most likely are from sheep. In the absence of mandibular teeth, epiphyseal fusion sequences of post-cranial bones were used to estimate the culling age of the mammal taxa [22,23]. Cut and gnaw marks as well as burns were recorded in order to characterize the preservation of the samples. Bone surfaces were observed under a light microscope (×10–×40 magnification). Measurements (in mm) were taken on mature and well-preserved specimens using Mitutoyo digital calipers (graduated 0.02 mm) after von den Driesch [24]. Determination of the wild or domestic status of the only goose bone recovered is attempted through metrical analysis [25,26]. Skeletal elements were recorded individually for each sample and data were fed into a database using IBM SPSS Statics 27.

3. Results

3.1. Preservation

In general, the animal bones recovered from the Ribadeo I shipwreck were assessed as moderately well preserved. Some of the specimens in samples HU/006 and HU/010 exhibit rounded edges, moderate abrasion and polishing of the cortical layer caused by post-depositional damage from seabed sedimentary disturbance [27]. Color alterations range from light yellow, orange, and red to dark brown. Taphonomic conditions that favor the production of iron oxides may be responsible for the more red-orange shades of bone [28] (Figure 1a). Most remarkable is the uniform surface black color displayed by the six bones conforming sample HU/001 (Figure 1b).

(**a**) (**b**)

Figure 1. (**a**) Cattle and sheep/goat bones from sample HU/010 showing different color staining; (**b**) Black burnt cattle and sheep bones from sample HU/001.

Taphonomical investigations on skeletal material from archaeological caves and lake-side settlements suggest that the black color is not always caused by fire but may relate to mineral staining, decomposition of the organic components of bone, or a combination of any of these processes [28–30]. In order to clarify this issue, the cattle rib in sample HU/001 (RIB26 in Figure 1b) was examined through Optical and Scanning Electron Microscopy (SEM). The black coloration of the inner trabecular bone ascertained thermal staining, supporting the hypothesis that the faunal remains from this sample were discarded into a fire after fleshing or consumption to be used as fuel. Moreover, this result confirms the idea that a cooking area might have been placed in that part of the ship as indicated by the abovementioned recovery of a large bronze cauldron. On the contrary, the other two samples (HU/006 and HU/010) are consistent with the supplies of foodstuffs carried as preserved cuts of meat in barrels or as live animals on board.

Most of the bones have clear butchery marks on them both from filleting and dismembering, but also from producing preserved meat portions, revealing the extent to which carcasses were cut up in preparation for cooking meals on board. Those on the cattle remains were particularly distinctive and are discussed further below.

Rodent tooth gnawing marks on three bones from sample HU/006: a cattle rib (Figure 2), the proximal end of a sheep radius and the distal part of the goose tarsometatarsus (Figure 3a), indicate that they had been scavenged by shipboard rats, attesting to the presence of these rodents on the galleon.

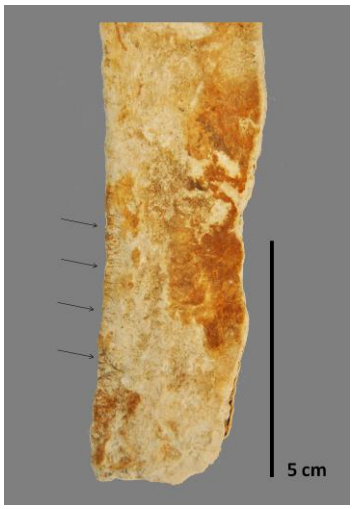

Figure 2. Cattle rib gnawed by rodents. The arrows point to the distinctive parallel incision marks produced by their incisors.

(**a**) (**b**)

Figure 3. (**a**) Greylag goose (*Anser anser*) left tarsometatarsus; (**b**) European hake (*Merluccius merluccius*) caudal vertebrae.

3.2. Faunal Spectrum, Body Parts and Aging Data

The standard domestic species—cattle, sheep and pig- make up 97% of the identified assemblage which also yields one goose tarsometatarsus (Figure 3a) and a caudal vertebra of hake (Figure 3b). These two species serve to illustrate the variety of meats consumed on board the *San Giacomo di Galizia* galleon.

The identification of the wild (*Anser anser*) and/or domestic (*Anser* dom.) nature of the goose tarsometatarsus was made metrically. Its greatest length (GL) and mid-shaft width (SC) were compared to goose tarsometatarsi from British, Irish and German medieval deposits as well as to published modern reference specimens. Both measurements revealed to be comparable to Greylag goose rather than to the domestic form, particularly to female individuals (Table 2).

Table 2. Size of the goose tarsometatarsus from the Ribadeo I shipwreck in comparison with archaeological and modern specimens. Measurements (in mm): GL greatest length; SC mid-shaft width.

	GL				SC			
	Mean	Min	Max	*n*	Mean	Min	Max	*n*
Ribadeo I shipwreck	77.2			1	7.1			1
Norwich, Barbican well, UK [31]	84.6	78.0	92.0	20	8.1	7.7	8.9	30
King's Lynn, UK [32]	81.1	75.0	86.0	10	7.6	7.3	8.3	10
York, UK [33]	83.6	78.5	89.2	12				
Wood Quay, Ireland [34]	83.9	77.1	90.8	69				
Haithabu, Germany [35]	86.1	78.0	96.8	37				
Modern domestic goose [36]	92.2	81.8	103.0	17	8.4	7.4	9.7	17
Modern wild goose [36]								
Male	85.1	79.5	91.3	10	7.5	7.0	8.9	10
Female	79.3	74.4	83.7	11	6.9	6.6	7.3	11

Notwithstanding, this is always a problematic issue with archaeological samples. Early forms of domestic specimens are very similar to the wild ancestor since the larger size of domestic geese has only occurred in recent times [25,35,36]. In addition, it cannot be excluded that geese purchased at late medieval urban contexts (as it has probably been the case with the individual present on board the *San Giacomo di Galizia* galleon) derived of wild geese who were kept captive.

Cattle bones clearly dominate due to the abundant number of rib fragments. They together with vertebrae and skull fragments comprise over 62% of the mammal remains. Also, it is noteworthy that with the exception of the lower hind limb all anatomical regions of cattle are represented. Body part distribution of sheep/goats evidences to the consumption of whole carcasses, too, including low-yield meats (foot) and skull fragments (headmeats), while in the case of pigs only two elements (rib and pelvis) were recovered (Table 3).

Table 3. Mammal skeletal elements in the Ribadeo I shipwreck.

	BOS	OVA	O/C	SUS	MSM	TOTAL
Skull						
Skull	8	-	1	-	-	9
Upper teeth	1	-	3	-	-	4
Axial						
Atlas	2	-	-	-	-	2
Axis	1	-	-	-	-	1
Vertebrae	7	-	-	-	-	7
Ribs	13	-	1	1	7	22
Upper fore limb						
Scapula	-	1	-	-	-	1
Humerus (d)	1	-	1	-	-	2
Lower fore limb						
Radius (p)	3	1	-	-	-	4
Radius (d)	1	-	-	-	-	1
Ulna	3	-	-	-	-	3
Metacarpal (d)	1	-	-	-	-	1
Upper hind limb						
Pelvis	-	-	-	1	-	1
Femur (d)	3	-	-	-	-	3
Lower hind limb						
Tibia (d)	-	2	-	-	-	2
Calcaneus	-	-	1	-	-	1
Feet						
Phalanx 2	2	-	-	-	-	2
Phalanx 3	-	1	-	-	-	1
Long bone fragments	5	-	-	-	-	5
TOTAL	51	5	7	2	7	72

(d): distal; (p): proximal.

Based on the epiphyseal fusion evidence (unfused and fusing) from two cattle distal femora and one distal radius (fusing) it can be inferred that these specimens were younger than 3 $\frac{1}{2}$ years of age when butchered, while an unfused and a fused distal tibiae indicate the sacrifice of a juvenile lamb of less than 1 $\frac{1}{2}$ years old and of an older sheep. These results point to the consumption of tender beef and mutton from young animals and animals in their prime. No aging data was recorded for pig.

3.3. Butchery Patterns

Cattle remains exhibit abundant and multiple butchery traces made with heavy choppers or cleavers and sharp knives. The splitting of vertebrae in the sagittal plane, i.e., dorso-ventrally down the length of the body, including atlas and axis, shows that carcasses were originally cut lengthways to produce two sides of beef. The shafts, proximal and distal ends of all limb bones as well as several skull fragments demonstrated longitudinal and transverse chop marks. Distal ends of femora were reduced to square fragments of approximately 8 cm whereas the radii were split along the diaphysis (RIB34 & RIB35 in Figure 1a). Such an intensive processing gave access to the spongy interior, which would have been used to make bone soup. The cooking would free up the marrow which could then be used to make broth [5] (p. 287).

The length of most of the cattle ribs shafts ranges between 5 and 11 cm. Some of them bore evidence of cutting below the proximal articular head representing large portions of rib meat removed with sections of backbone (i.e., the ribs in the cuts of meat would still have been articulated with their respective thoracic vertebrae) (Figure 4). Knife cuts may also relate to filleting of the salted meat.

Figure 4. Cattle ribs exhibiting chop and knife cuts.

Although the few caprine and pig limb bones recovered were not so extensively cleaved through as those of cattle, their ribs were processed in a similar way. Such standardization is indicative of the practice of professional butchers.

4. Discussion

The faunal remains recovered from the archaeological site Ribadeo I shipwreck (identified as the *San Giacomo di Galizia*) are consistent with the type of bone assemblage one might expect to find on board a late medieval galleon [5], but their limited number calls for caution as we cannot know for certain how much representative they are of all the meat supplies that would have actually been consumed by its crew. The galleon *San Giacomo di Galizia* was part of the Ragusan squadron that made up the fleet of Captain General Martín de Padilla in 1597 [19].

According to the historical data, this warship and two urcas from the royal navy arrived in the harbor of Ribadeo, severely damaged and loaded with infantry and horses

[RMA, Libros de Actas, 6 (1595–1611), fs. 49], in November 1597. People on board came badly and ill as a result of the hard work they have had after fighting a naval battle against the Flemish and English and sailing through a huge storm. They went to the village begging for food, so the municipal council resolved to provide the infantry with bread. While the ship was beached, the Crown sought to organize a wreck salvage to recover the coins she was appointed to carry and some of the supplies and maybe the artillery that were on board, so that few victuals would have been left behind by the time the galleon sank [19].

Underwater excavations usually recover food-stocks not yet consumed rather than leftovers, which would have regularly been thrown away overboard. However, in the case of the *San Giacomo di Galizia*, the events just mentioned suggest that the faunal samples here studied are likely to represent mostly kitchen refuse or table waste rather than uneaten preserved meat rations. The occurrence of rodent gnawing marks, the use of some bones as fuel and the low representation of pig support this working hypothesis.

The archaeozoological analysis demonstrates that cattle bones were the most abundant, followed by sheep/goat, pig and two isolated elements of goose and hake. Such result reflects the significant contribution beef would have made to the diet of sailors and officers serving on this warship. In fact, it aligns very well with the records on naval food regimes in sixteenth-century Europe which highlight the importance of a rich-meat diet to support the heavy manual work that had to be performed on board, with beef being a major source of animal protein in England, Denmark, France and Spain [37]. However, the finding of a large number of sheep/goat bones compared to pig is somehow remarkable.

Pork is by far the best suited meat for preserving in salt and was always included in the provisions purchased to supply Spanish late medieval ships [2,9,10], where shifts were usually made between pork and beef [3]. Thus, the under-representation of pig in the assemblage must tentatively be a consequence of the particular incidents pointed above. On the contrary, sheep/goat bones are scarcely found in wrecks because salted mutton was difficult to preserve or did not last long enough [5]. For this reason, the occurrence of caprine remains in shipwrecks has been interpreted as evidence that either joints of fresh mutton were brought onto the ship at the start of the voyage or that they were transported alive [12] (p. 56). Accordingly, mutton was not intended for the feeding of the general crew but to supplement the diet of important officers and passengers [8] (p. 55) as well as to provide special food for sick sailors [38] (p. 178). The discovery of a left maxilla with the three upper molars in place and low meat yield elements from the lower limbs (i.e., a complete calcaneum and a third phalanx) in sample HU/006 may well derive from animals carried live which were butchered on board. Likewise, the finding of a caprine humerus from an individual of less than 6 months of age in sample HU/010 implies that lamb rather than mutton would have been served to the higher-ranking crew of the *San Giacomo di Galizia*.

In the same vein it can be interpreted the goose tarsometatarsus which not only attests to the consumption of this avian species on board but also proves the variety of meat supplies that formed part of the store of provisions of the galleon. Although geese' remains are found in Iberian medieval urban and rural faunal assemblages, they are always less frequent than chicken [39–41]. Goose is more common on sites of high status, reflecting they were not staple elements of the diet of the general population. Iberian medieval chronicles also mentioned they were part of the banquets enjoyed by the royals or the nobility [42]. Nor do geese' remains appear to be usually found on wrecks. They are recorded only once among the 33 published shipwrecks faunal studies reviewed by Migaud [5] (p. 284).

Finally, the hake vertebra suggests the likely consumption of stock fish on board. Dry and salted fish was together with beef and pork an essential victual. Ordinarily soldiers and sailors ate fish from two to four days a week, on which cod appears to have been the most frequently consumed species [3,5]. The record of hake in Iberian coastal and inland archaeological deposits reveals that hake progressively became a more important item not only of the Spanish fisheries but also for the Spanish fish trade. It also appears to be more frequently mentioned in Early Modern Age (16th to 18th century) texts, which report hake

being shipped as a dried, though not necessarily salted, product named "pescado cecial" or simply "cecial". Based on the fact that drying is a deficient preparation compared to salting because it generates a low-quality, shortlasting product, Morales et al. argue this was an Iberian commodity that would have been restricted to small regional circuits [43] (p. 25).

5. Conclusions

Despite the limited number of remains and the fact that the wreck has not been totally excavated, the study of the faunal material from the Ribadeo I shipwreck underwater site, named *San Giacomo di Galizia* 16th century galleon, has enabled to gain a preliminary knowledge on the eating habits on board this galleon. The main domesticates (cattle, sheep/goats and pigs) were the principal sources of meat, which were supplemented by lesser contributions from goose and hake. It was not possible to establish with any confidence whether the cattle and caprine skull fragments and phalanges found in the samples originated from animals carried live that had been slaughtered on board or derive from joints, but the high number of cattle ribs and hacked limb bones attests to beef transported in preserved form. The regularity of butchery traces points to the purchased of these meat portions from professional butchers while the relatively small size of the remains suggests boiled and stewed meat were the most common methods of consumption. The aging data denote also the likely consumption of tender beef and lamb on board, pointing to differential foodways between the high-ranking officers and the rest of the crew. It is hoped that further work on additional samples will help to confirm the interpretations tentatively put forward here.

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