Wild and Domesticated Fauna in Desert Regions of the Near East

The Case of Saruq al-Hadid (UAE)

Eloísa Bernáldez-Sánchez, Esteban García-Viñas, Myriam Seco-Álvarez, José Luis Ramos-Soldado, Mansour Boraik, Ya'aqub Youssef, Javier Dantas-Cayuela, and Eduardo Ferrer-Albelda

A gazelle spotted in the Rub' al Khali Desert during the 2019 season at the site of Saruq al-Hadid (Dubai, U.A.E.); photograph by Esteban García-Viñas.

More than twenty years have passed since the discovery of the site of Saruq al-Hadid, United Arab Emirates (UAE), and two decades since the beginning of excavations at this site; hence we consider it is now appropriate to present some of the more significant results of the two archaeological field seasons carried out by the University of Seville and the Instituto Andaluz del Patrimonio Histórico (IAPH) in 2019 and 2020.

According to the official version, the site of Saruq al-Hadid was discovered in 2002 by Sheikh Mohammed Bin Rashid al Maktoum when he flew over the area in a helicopter and noted the dark slag accumulations that characterize the site. After an initial evaluation of the surface evidence by Hussein Qandil, Director of the Department of Archaeology of Dubai, several archaeological field seasons have been conducted by various international teams (Herrmann 2012: 50): the Jordanian Department of Antiquities in 2003–2008, the Australian University of New England from 2006–2009 (Weeks et al. 2017: 32), the University of Arkansas in the United States in 2009, the Municipality of Dubai from 2009 to present, the Archaeological Institute of Sanisera in Spain from 2014–2020, the University of Warsaw from 2015–2020, the German University of Tubingen in 2019, and the University of Seville in 2019–2020.

Although this archaeological site is large (approximately one and a half hectares), only a small part has been excavated (figs. 1 and 2). The peculiarity of the site lies in its location in the midst of the Rub al-Khali Desert, one of the largest (seven hundred square kilometers) and driest on the planet, characterized by large, moving quartzite sand dunes over thirty meters in height, known as mesodunes (Warren and Allison, 1998; Vincent 2008; Goudie et al. 2000). This ecosystem, as we know it today, was formed some six thousand years ago when the fluvial and humid climate of the Pleistocene eroded the Mesozoic escarpments and deposited large quantities of clastic sediments. The majority of these quartzite sands came from adjacent deserts, such as the ad-Dhana or Jafurah Deserts, after the draining of the Arabic Shield. There is evidence of sands coming from the Gulf of Oman, as suggested by the presence of coastal otoliths transported by the wind. After a period of glaciation about ten thousand years ago the sea level began to rise, inundating a large part of the coast of the peninsula until reaching the current level around six thousand years ago. The displaced sands were deposited upon a gypsum floor—called *sebkha*—along with stratified sands from mountains in Oman, which indicates that this level was submerged under water at some point. The region was already desiccated by the time the first settlers arrived, a date determined via Optical Stimulated Luminescence (OSL) at ca. 5821±282 BP (Brükner and Zander 2004; Hermann 2012; Potts 2012).

Archaeological Excavations at Saruq al-Hadid

According to the standard chronology (Magee 2014) the habitation of the site began in the Early Bronze Age and extended through the final stages of the Iron Age, with a further possible reoccupation in the Islamic era (Hermann 2012: 42–51). The earliest evidence of occupation could date to the end of the third millennium or the beginnings of the second millennium BCE, corresponding to the regional chronologies of the Umm an-Nar period (2700–2000 BCE) and Wadi-Suq (2000–1500 BCE), and thus dating to the Bronze Age. Nevertheless, some sites in the interior were well established, usually in relation to an oasis where it was possible to practice agriculture based on date palms and animal husbandry. Further processes of population concentration continue during the Wadi-Suq period (Weeks et al. 2019a: 159–63). According to Jason Hermann (2012), one of these stable settlements was Saruq al-Hadid, where settlements and postholes excavated in the *sebkha* provide evidence of ephemeral constructions similar to the current Omani *barasti* huts.

Five different layers have been identified at the site. Layer V dates to the Umm an-Nar period and the early phase of Wadi-Suq, when we have found faunal remains and pottery. Layer IV is contemporary with the beginning of the Late Bronze Age (1800–1400 BCE), to which belong the majority of the dwellings and a large volume of the faunal remains recorded, as well as remains of carvings, ceramic vessels, copper artifacts (arrowheads), and slag

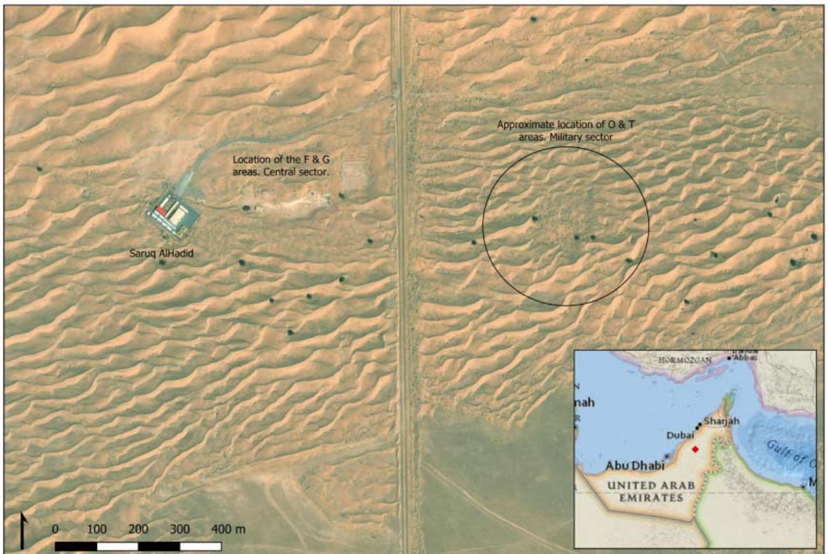

Figure 1. Location map of Saruq al-Hadid (UAE) and aerial view of the site.

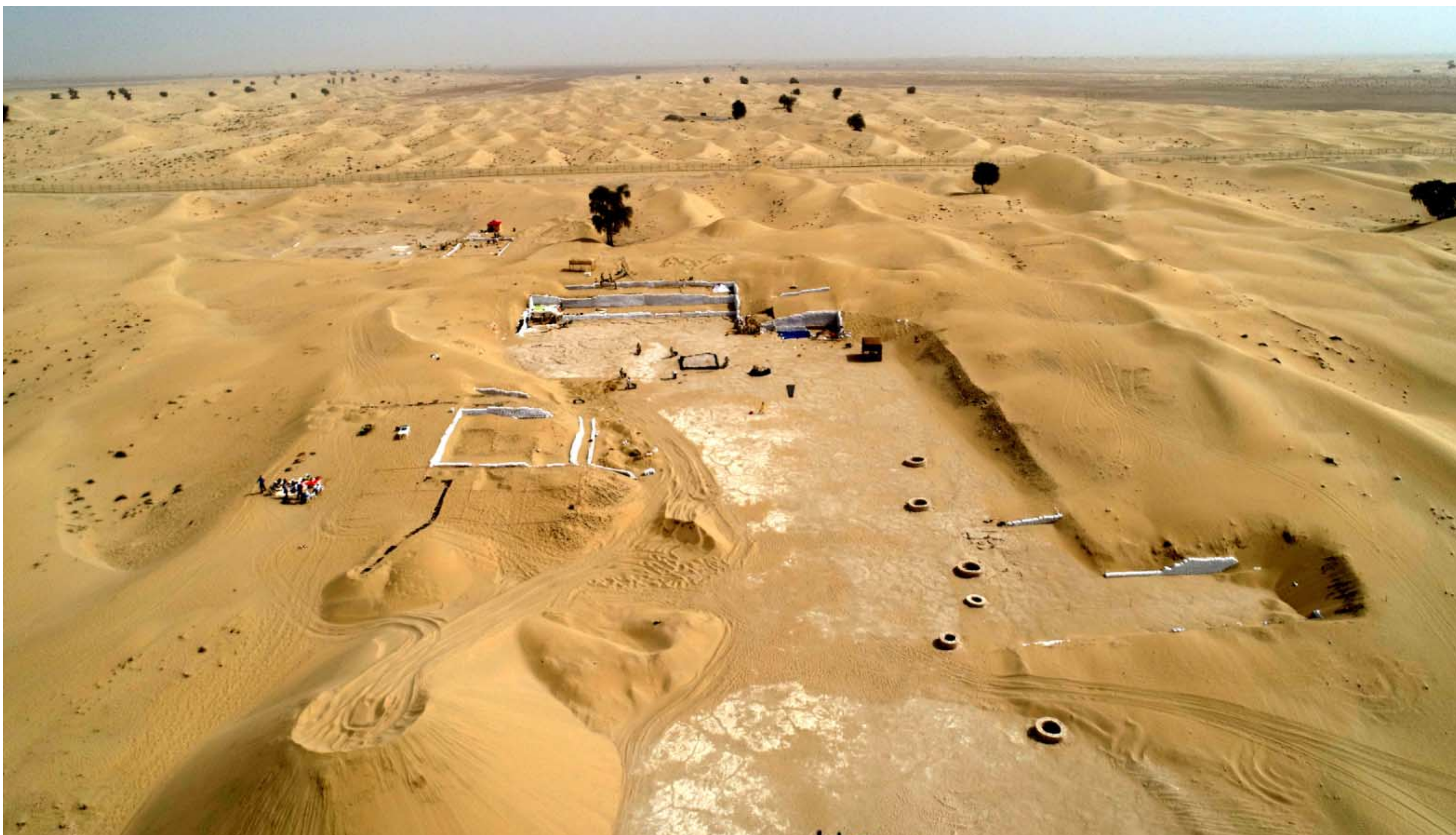

Figure 2. Detailed aerial view of the site, showing its different excavated areas.

Figure 3. Different states of preservation of bone assemblages in the Central Sector.

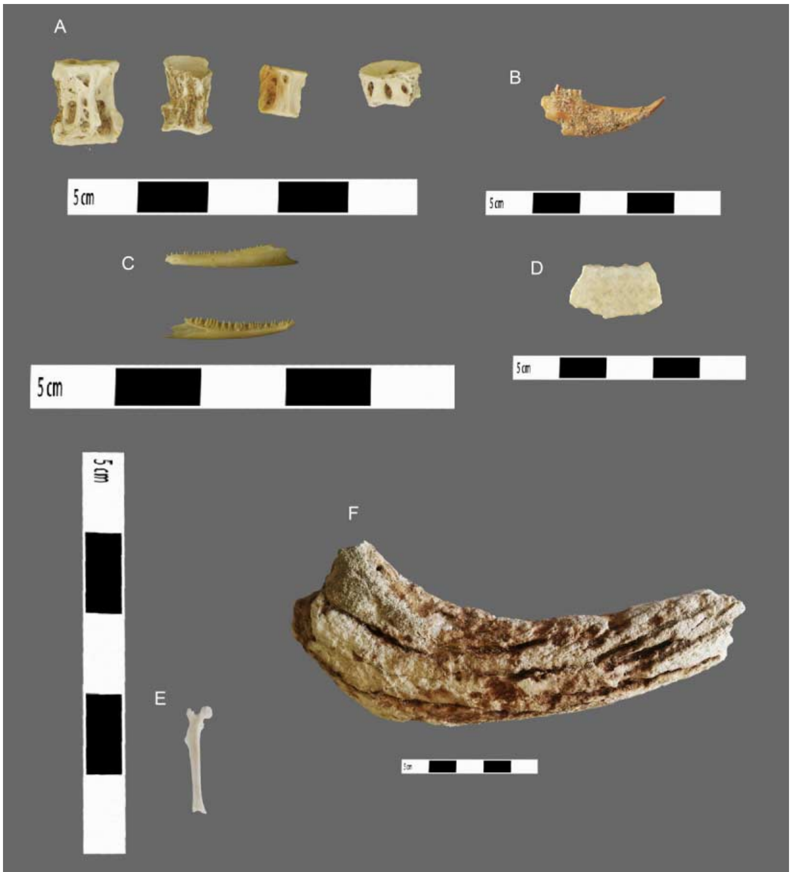

Figure 4. A. Vertebrae of teleost fish and elasmobranchs found in Central Sector (Area F/surface); B. Lagomorph jaw found in Central Sector (Area G/Trench F5/Context 1); C. Lizard jaw located in Central Sector (Area G/Trench H4/Context 3031); D. Ostrich egg shell (Area F/Trench Z5/Context 3); E. Rodent femur (Area G/Trench V3/Context 1); F. Dugong rib found in the Military Sector.

(Weeks et al. 2019b: 1043–46). Layer III dates to the Iron Age, a period during which Saruq al-Hadid seems to have emerged as a relevant center of metallurgical exploitation and trade. A large quantity of the copper-based metal artifacts belongs to this phase (such as arrowheads, ingots, containers, snake votive offerings), as well as slag, soft stone containers, and decorated ceramic vases (Weeks et al. 2019a:163; 2019b: 1046). Layer II (1000–800 BCE) contains large quantities of slag and copper-based metal objects—bowls, axes, and arrowheads—as well as gold jewelry, including gold wire and threads, which may suggest the presence of a goldsmith's workshop (Weeks et al. 2019a: 166). The final layer (I) is characterized by copious slag (thirty-five kilograms for one thousand liters of sand), although there are difficulties in dating this layer as the wind has altered the stratigraphy. In addition to slag, we have also found artifacts of iron, copper, and gold, ceramics, and other objects in this layer (Weeks et al. 2019a: 167; 2019b: 1046–47). The research carried out so far has allowed the identification of areas of metalworking, woodburning, charcoal production, wells, and a sector of possible ritual nature (Contreras et al. 2017: 60).

The excavations carried out by the University of Seville took place in two archaeological field seasons. In the first, from January to March of 2019, we excavated twelve grid squares assigned by the Municipality of Dubai in Sector G, in which a small number of finds such as ceramics and metal objects appeared. Additionally, this sector revealed a large assemblage of faunal remains. In the second season, from November 2019 until March 2020, eighteen squares in Sector F were excavated, this one far richer in crafted materials and with abundant slag deposited in the upper layer of the dunes. Although the team excavated the grids mentioned, the faunal study was augmented with materials recorded by other research teams.

Regarding the faunal record, Saruq al-Hadid presents accumulations of bone remains in various contexts and layers of the two sectors analyzed. Our objective has been to study the preserved mammal fauna and the taphonomic conditions of this site, located in the heart of the Arabian Desert, considering the biological characteristics of the species that make up the faunal association and the state of conservation of the bones—both of the individuals and of the whole corpus in the two sectors under investigation: the Central Sector and the Military Sector. Both loci have been compared in order to find factors that explain the differences found.

Material and Methods

The paleobiological and taphonomic study of the osteological record from Saruq al-Hadid took place on two records from

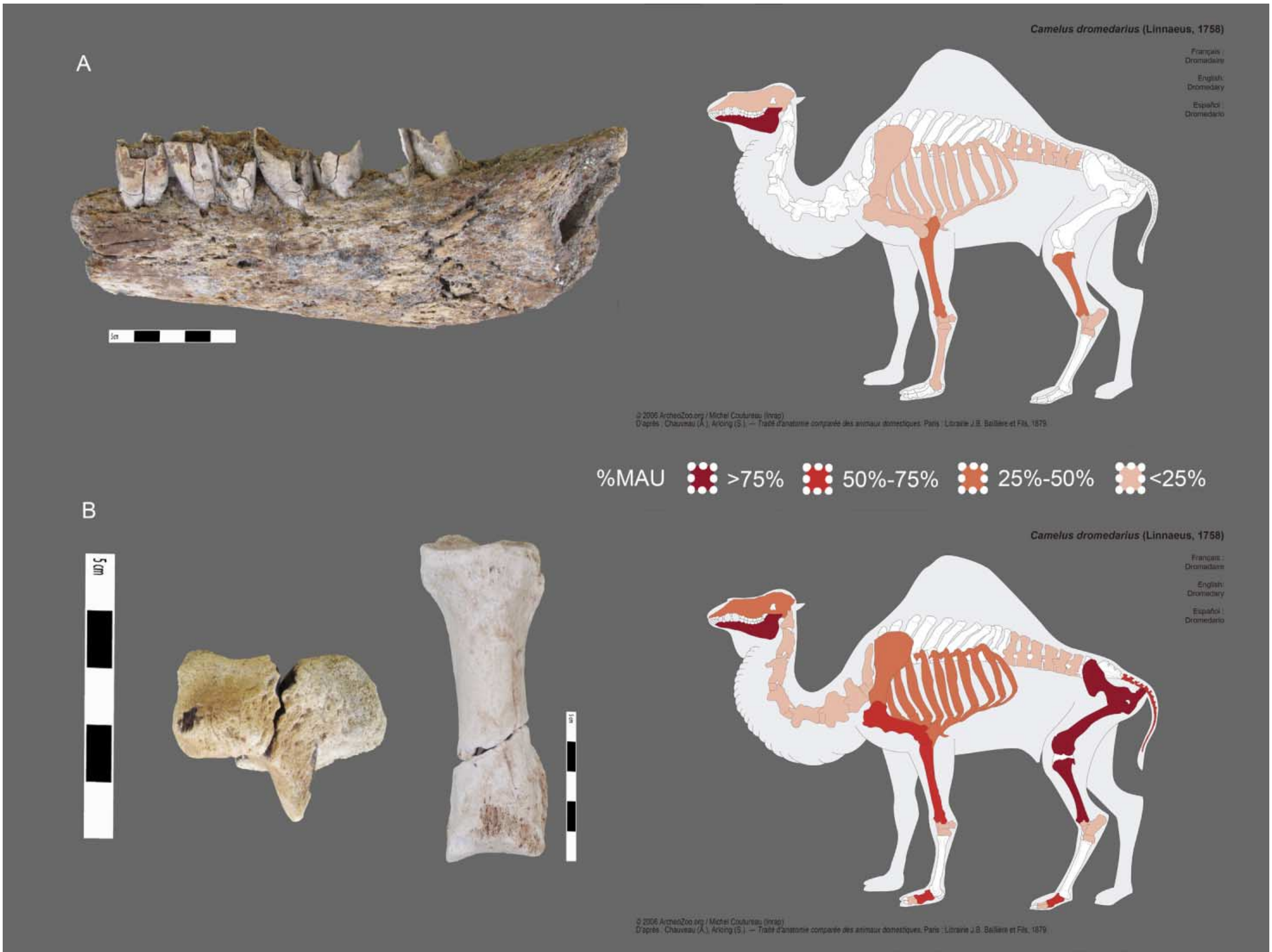

Figure 5. Percent MAU and bones of dromedaries; A. Mandible from the Military Sector (Area O/Trench Z5/Context 5); B. Malleolus (Area G/Trench W1/Context 3) and phalanx I (Area G/Trench R3/Context 2) from the Central Sector.

ninety-two trenches from the Central Sector (Areas F and G) dated from Middle Bronze Age to Iron Age I, and fifteen trenches from the Military Sector (Areas O and T) dated to Iron Age II, excavated by other teams. In this study we have considered variables that quantify the accumulation of remains of each species and their frequency as indicators of the preservation of bones and individuals in order to develop an accurate study. The application of the archaeozoological methodology can reveal the species, age, size, and sex of the animals, for which specialized guides and support tools are used (Boessneck 1980; Schmid 1972; Barone 1999; Zeder and Lapham 2010; Zeder and Pilaar 2010), as well as consulting reference collections such as those of the Arid Zone Experimental Station (Estación Experimental de Zonas Áridas—EEZA) and the Doñana Biological Station (Estación Biológica de Doñana—EBD). The biometric study was implemented on bones of adult and subadult animals according to Angel von den Driesch's methodology (1976).

Figure 6. A. Gazelle phalanx I (Area G/Trench V3/Context 4); B. Oryx talus (Area G/Trench R3/Context 2).

The accumulation of paleobiological material is estimated by quantifying the number of identified specimens by taxa (NISP), the number of remains/fragments (NR), the minimum number of individuals (MNI), and the weight (W). For the estimation of NISP we did not include recently broken fragments, nonfused epiphyses belonging to the same bone, or isolated teeth that might belong to an identified maxilla or mandible. Two categories of unidentifiable bones were considered: those that we

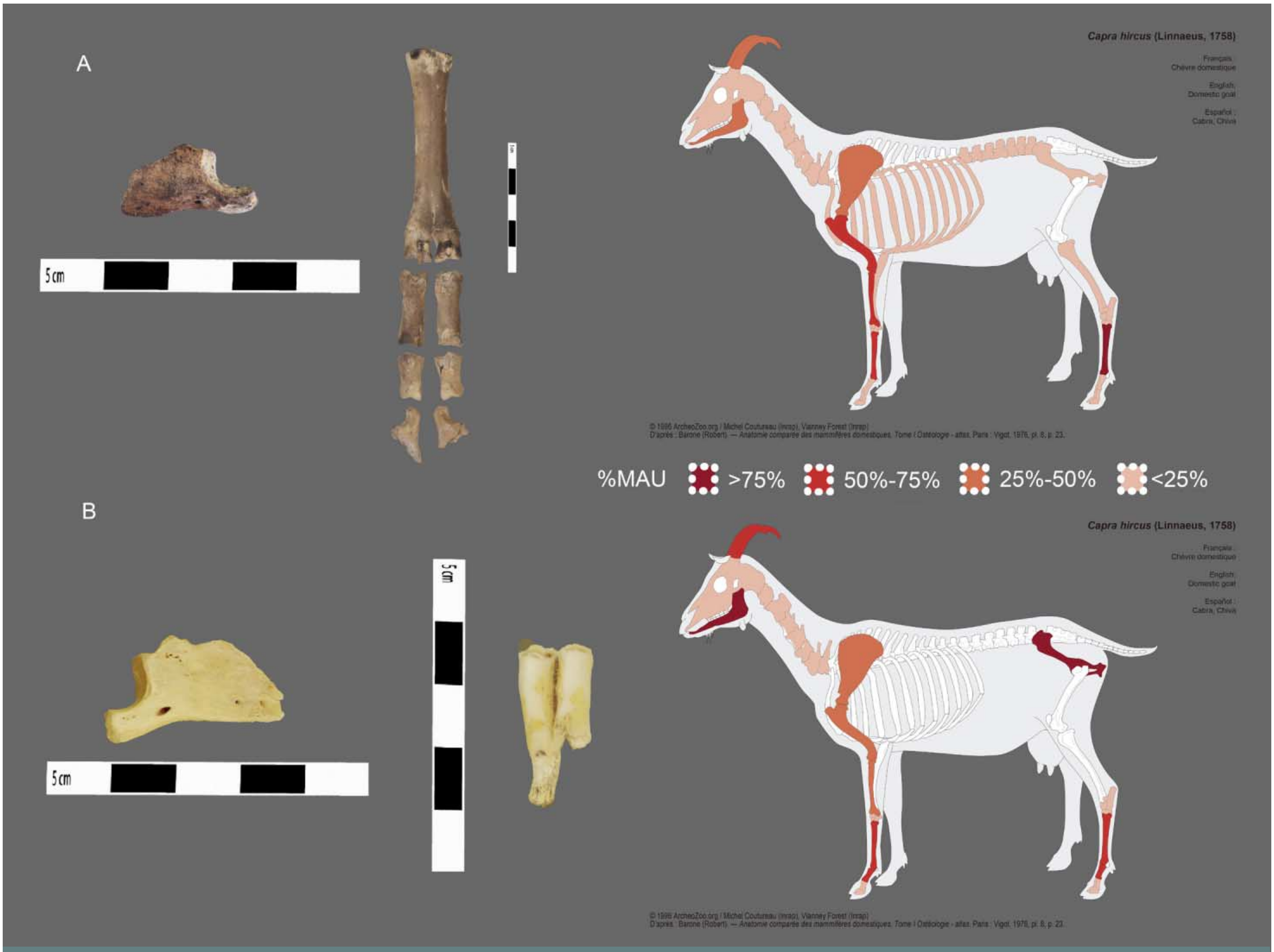

Figure 7. Percent MAU and bones of sheep/goat. A. Phalanx III (Area O/Trench Z6/Context 4) and bones from the metacarpus to the phalanx III of goat found in the Military Sector (Area O/Trench Z6/Cleaning); B. Phalanx III of goat and mandible molar from the Central Sector (Area F/Trench Z6/Context 3).

could not identify anatomically, and thus could not identify the species; and those that were anatomically identifiable but did not present any characteristics that allowed their taxonomic classification. These latter were included in four zoological classes depending on their size, following the methodology of Eloísa Bernáldez-Sánchez (2009, 2011). According to Bernáldez-Sánchez et al. (2017), it is possible to identify four classes of animals in this regard: Class I includes those skeletal remains of mammals with a body weight of more than two hundred kilograms (usually cattle and equines); Class II consists of those with a body weight between eighteen to two hundred kilograms (usually sheep, goats, pigs, and deer); Class III are those with a body weight between one and eighteen kilograms (small mammals such as rabbits or small carnivores); and Class IV includes those with a body weight less than one kilogram (rodents, bats, and other zoological groups).

The state of preservation of the skeletons of slaughtered mammals with a body weight higher than one kilogram has been assessed according to the skeleton conservation index (SCI) (Bernáldez-Sánchez 2011), [SCI = (NB × NISP) / (NS × MNI) x 100] which measures the average percentage of preserved and/or recovered skeletal bones (NS) of all the individuals of each of the identified species (MNI); NB is the number of bones identified and MNI is the minimum number of individuals estimated. In order to study the conservation of anatomical remains in relation to the bones we have used both minimum animal units (MAU) and percent MAU (Lyman 1994a). The first variable is calculated by dividing the minimum number of determined fragments of a bone by the number of times that bone is repeated in a complete skeleton, and the second one by dividing MAU x 100 by the maximum MAU value observed in a bone set.

In addition to the taphonomic analysis of traces of erosion and use (Lyman 1994b; Fernández-Jalvo and Andrews 2016), we have evaluated the state of preservation of the bones through the index of fragmentation (IF), a method described by Eloísa Bernáldez-Sánchez and Maria Bernáldez (2000), whereby [IF=log (TNR/NISP)], where TNR refers to the total number of remains. Considering that animals with a body weight over eighteen kilograms are generally better preserved and more prevalent in the archaeological record (Bernáldez-Sánchez 2009, 2011), this

Figure 8. A. Awl with a bone handle. It was made with the distal epiphysis of the left tibia of a gazelle/sheep/goat found in the Military Sector (Area T/Trench Y6/Cleaning); B. Different degrees of thermoalterations (Area G/Trench R3/fallen); C. Fragments of worked bones (Area F/Trench J5/Context 1); D. Set of splinters next to a worked bone with green coloring (Area F/Trench K6/Context 3); E. Fleshing marks found in an oryx pelvis (Area F/Trench U5/Context 3681/Layer 3673); F. Distal fragment of a tibia and a talus from an oryx (Area G/Trench R3/Context 2).

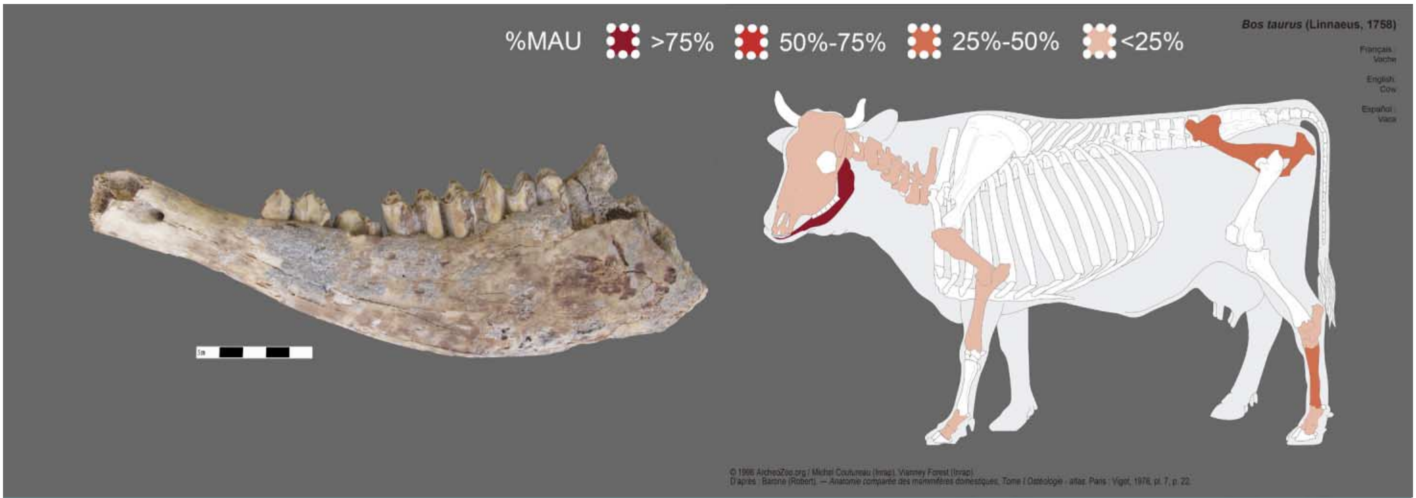

Figure 9. Percent MAU of cattle from the Military Sector and one cattle mandible (Area O/Trench Z6/Context 6).

calculation relates exclusively to specimens of this category. The average weight (AW) of the bones and the percentage of indeterminate bones were also calculated. Finally, we have estimated the ages of the individuals following the work of Elisabeth Schmid (1972) and Robert Barone (1999), thus grouping them as infants, juveniles, subadults, adults, or seniors.

The use of special technical analyses for the study of distribution of biological materials at archaeological sites has become more common in recent years, demonstrating that GPS is proving to be a useful tool in zooarchaeology. In our study, we used QGIS 3.28 software to set out the site's excavation grids and to assign NISP values and the weight studied in each grid. As such, we used special analysis techniques and data interpolation to design a model to facilitate the interpretation of spatial variables in the distribution of the faunal bone remains at the site. For this we applied the inverse distance weighting (IDW) method, in which the sampled area is weighted during interpolation so that the influence of one point relative to another decreases with the distance to the unknown point calculated for the model. This method allows us to generate a map that shows the finds and the characterization of the faunal remains, revealing the density and estimation for the entire area studied based on the remains found.

Results

The faunal analysis presented below describes two archaeological records from two sectors of the site of Saruq al-Hadid that differ regarding their chronological frameworks, faunal assemblages, and state of preservation: the Central Sector, whose layers date from the Bronze Age to the Iron Age I (2200–800 BCE), and the Military Sector, whose finds date to the Iron Age II (800–600 BCE).

Fauna from the Bronze Age through Iron Age I

In the Central Sector we studied faunal remains from ninety-two trenches in Areas F and G, each with a surface of 25 m^2 and a maximum of five layers ranging from 0.04 to 1.35 m. The faunal assemblage analyzed contained 227,925 bone fragments, of which 4,527 could be identified anatomically and by zoological group or species (NISP); as such, 98 percent of the faunal remains were unidentifiable fragments (fig. 3). The reason for this high percentage of unidentifiable bones is their poor state of preservation: The index of fragmentation (IF) calculated for this record was 2.06 (log of the quotient between 225,209 bone fragments and 1,950 remains of specifically identified mammals with more than 18 kg of body weight), which constitutes an elevated value of bone fragmentation. The average weight of the fragments was 0.38 g, indicating a large number of small splinters, as suggested by the fact that 97.5 percent of these fragments belong to animals over 18 kg (Classes I and II). In addition, we registered bones from rodents, reptiles, fish, and birds, all belonging to Class IV (fig. 4) following Bernáldez-Sánchez et al. 2017. The specimens from these zoological groups are still under study, but the 2,073 NISP associated with the ichthyo-fauna (table 1), and the finding of three fragments of ostrich shell do stand out among them (fig. 4D). We have identified 102 individuals and 501 NISP of six species from Classes I and II (table 1): 35 dromedaries (*Camelus dromedarius*), 33 oryxes (*Oryx sp.*), 15 gazelles (*Gazella sp.*), and 19 sheep/goats (*Ovis aries/Capra hircus*). We also identified 11 bones of a lagomorph (probably a hare of the genus *Lepus*), and 2 canid bones. The study of marine vertebrates is not yet complete (fig. 4A), but we have the data from James Roberts et al. (2019) for the Central Sector. In this analysis 8,395 fish bones have been identified, revealing *Rhabdosargus sp.* as the most common species. The authors of this study describe at least nine families in total, including two species of Elasmobranchs (sharks). All these species usually live in places along the coast around forty kilometers from Saruq al-Hadid.

The poor state of preservation of the sample has made it difficult to study accurately the ages of slaughter, although no bones of neonate or juvenile individuals have been found. Concerning specific body parts, the preservation of the skeletons as measured by the skeletal conservation index (SCI) is in all cases less than 5 percent, which means we have not found 95 percent of the bones that constitute the entire skeleton. However, we have

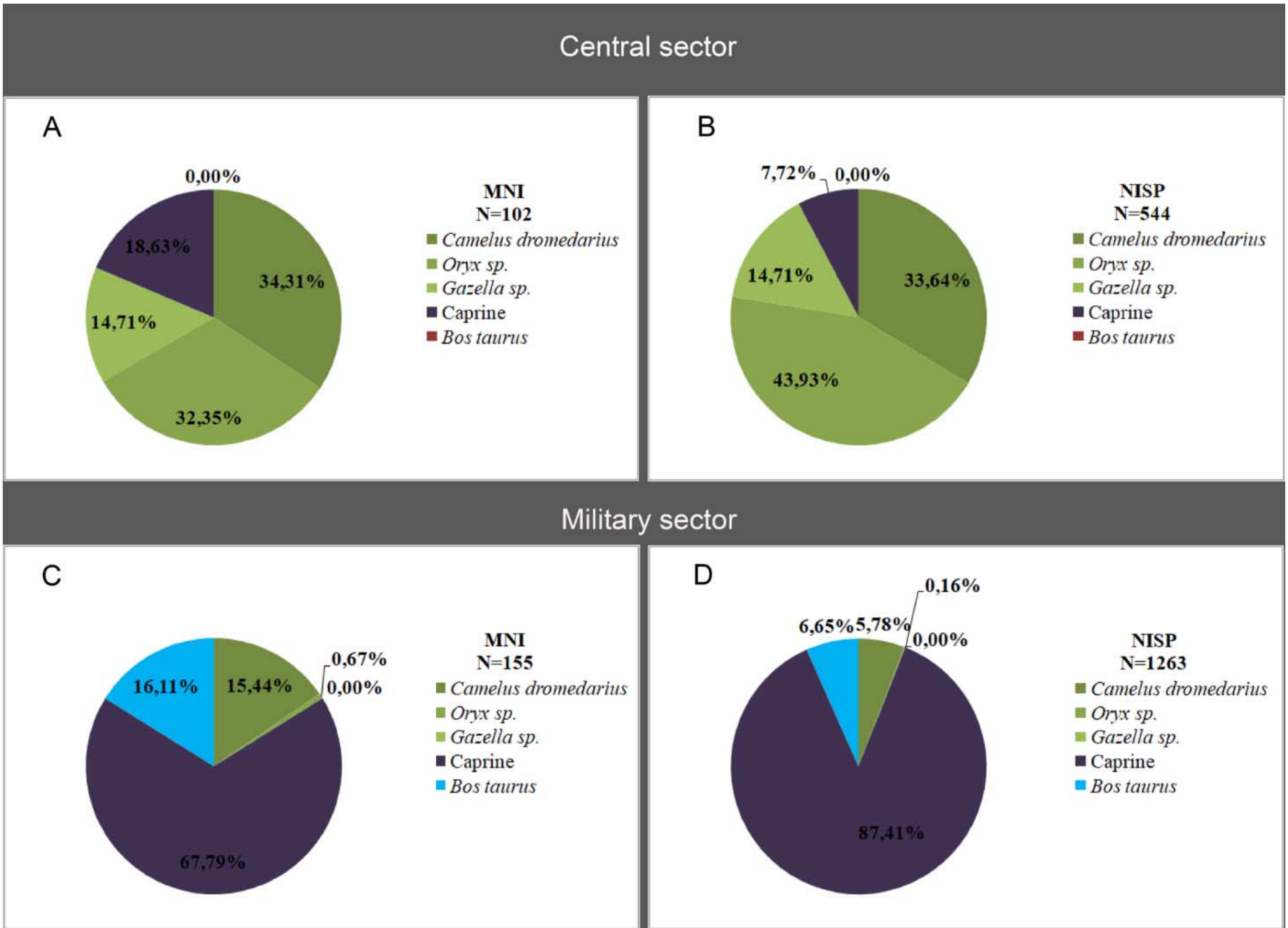

Figure 10. MNI and NISP of Classes I and II species in the Central Sector and the Military Sector. The majority of the species identified in the Central Sector (A–B) were wild mammals (green), while the record from the Military Sector (C–D) is mostly composed of domestic species (blue).

found preserved fragments of all the anatomical parts of the skeleton (table 2; figs. 5, 6, and 7). Almost all the bone fragments present butchering cuts, and some fragments display thermoalterations at different temperatures (fig. 8B). Furthermore, we have found what seem to be carved bones in this area, somewhat resembling dagger handles (fig. 8C), which in some cases were dyed green (fig. 8D). Preliminary chemical analyses of these colorations indicate a high concentration of copper (Bernáldez-Sánchez et al., forthcoming).

Fauna of the Iron Age II

The Military Sector dates to the Iron Age II, of which fifteen trenches in Areas O and T were excavated. The faunal record of this sector comprises 1,839 NISP from 4,223 bone fragments, of which 56 percent could not be anatomically identified, 42 percent less than in the Central Sector. This difference in preservation may be associated with the characteristics of the matrix and/or the origin of the bone deposit. We measured the bone fragmentation of this sector via the IF with a resulting measurement of 0.36, while the average weight of the fragments is 3.5 g (table 1). We have estimated a total of 1,255 NISP of 157 individual vertebrates from Classes I and II (table 1): 24 dromedaries (*Camelus dromedarius*), 2 dugongs (*Dugong dugon),* 1 oryx (*Oryx sp.*), 26 cattle (*Bos taurus*), 104 sheep/goats (*Ovis aries/Capra hircus*), and bones of 3 birds. The majority of the caprines were identified as goats according to Melinda Zeder and Suzanne Pilaar (2010) and Zeder and Heather Lapham (2010). Furthermore, we found 14 NISP from 5 individuals of Classes III and IV (birds and fish). The small number of fish remains stands in contrast to the record found in the Central Sector (table 1).

Concerning the age of slaughter, the analyzed cattle individuals were slaughtered as juveniles (age ratio from five or nine months to twenty-four months) and subadults (twenty-four–sixty months), that is, around two years of age. In the case of the caprines, the majority of individuals were neonate (<5/9 months) and juvenile (5/9–twenty-four months): individuals under two years of age.

Although bones of all parts of the skeleton were found (table 2, figs. 5, 7, and 9), the best preserved were mandibles, horns, and distal fragments of hind limbs (fig. 7), parts that are generally discarded and accumulated in the slaughterhouses. The state of preservation of the samples oscillates between 5 and 14 percent of the skeleton in the case of mammals of more than eighteen kilograms body weight, higher than the SCI estimated in the Central Sector. Likewise, these bones present butchering cuts and evidence of temperature changes related to consumption. However, the number of carved bones is lower and of a different typology than those found in the Central Sector. In this instance, the handle of an awl made with the epiphysis of an ungulate stands out among the finds (fig. 8A).

Several samples of dromedary, oryx, goat, and cattle were sent to the Laboratory of Ancient Genetics of The Doñana Biologic Station (EBD-CSIC) in order to undertake analysis for aDNA. However, owing to the poor state of preservation of the remains, this analysis provided no result. In addition, around one hundred samples were further selected for archaeometric and biomolecular analysis during the 2020 season, but they have not been delivered yet to the Laboratory of Palaeobiology of the IAPH.

Discussion: Two Garbage Dumps, Two Anthropic Activities, Two Cultures

Based on the biological results obtained, the following discussion is presented addressing two subjects: On the one hand, the difference in the management of mammal species; and on the other hand, the possible relationship between the state of conservation of the bones from both sectors and certain human activities. The main aim of this article is to identify the differences regarding the management and exploitation of the ungulate species found in the record, which constitute the largest assemblages from both analyzed deposits: the Central Sector and the Military Sector. In this regard the faunal diversity has been described according to the estimation of the number of bone fragments and individuals of each identified species in both records.

The first noteworthy issue in this study lies in the difference between the accumulation of faunal remains in both deposits, which could be a result of the excavated mass in each sector. While ninety-two trenches were excavated in the Central Sector, only fifteen were excavated in the Military Sector. However, 98 percent of the fragments gathered from the former were unclassifiable, in contrast to the 56 percent unidentified remains from the latter (fig. 3). Such differences related to the state of preservation of the bones could result in a skewing of the analysis of the records at issue.

Indeed, the analysis of the state of preservation of the faunal remains showed that while the average number of bone fragments per trench is considerably higher in the Central Sector—2,500 fragments approximately in comparison with the 280 remains recorded at the Military Sector—their degree of fragmentation is also higher. The average weight per fragment and the index of fragmentation (IF) of the record of the Military Sector are 3.5 g and 0.36 respectively, whereas remains from the Central Sector display an average weight per fragment of 0.38 g and an index of fragmentation of 2.06.

Hence, the estimation of the number of slaughtered individuals in the record from the Central Sector is probably biased to a certain extent owing to the high fragmentation of the bones. In the Central Sector 501 fragments belonging to a minimal number of 102 ungulate individuals have been identified in such records, from a total of 227,925 elements (NISP; table 1). Conversely, the record of the Military Sector is composed of 4,223 fragments, of which 1,253 fragments from at least 155 ungulate individuals were estimated. Furthermore, bones from every anatomical region are present in both assemblages (figs. 5, 6, 7, and 9). Thus, it would be inaccurate to assess if the record of the Central Sector is constituted by a higher or lower number of individuals. Since more than 220,000 fragments could not be classified, it is not possible to specify more precisely which animal species were originally part of this assemblage and in what frequency.

The formation of both faunal records seems mainly related to the slaughter and consumption of ungulate species (fig. 10), which is supported by several finds: butchering cuts in numerous fragments; worked and carved bones, some of which present a green coloring, probably related to copper contamination according to archaeometric analysis (Bernáldez et al., forthcoming); thermo-alterations; and artifacts, postholes, and hearths (fig. 8). However, the species that comprise both records differ, which could suggest these deposits probably did not share the same functionality.

The faunal species described in the record of the Central Sector of Saruq al-Hadid, except for the fragment of ostrich egg (fig. 4D), were also identified in previous studies (Weeks et al. 2019a; Roberts et al. 2018) at sites such as al-Sufouh 2 (Dubai; von den Driesch and Obermaier 2007) and the Tomb of Sharm (Fujairah; Andrews 2003). Owing to the fragmentary state of the remains of the 102 ungulate individuals from this deposit, which belong to four different species—cattle, sheep/goat, oryx, and gazelle—their available biometric data are scarce. As a result, it is only possible to confirm the hunting nature of this record, based on the frequency of oryx and gazelle exemplars—19 and 15 respectively—which constitute 33 percent of the estimated individuals. In addition, the 35 dromedary individuals also found in this deposit could be equally considered in this light. According to other scholars, it is difficult to determine the characteristics and processes related to dromedary domestication, although it probably began in the early first millennium BCE based on the archaeological evidence (Uerpmann and Uerpmann 2002, 2017; Magee 2014: 187; Almathen et al. 2016). Therefore, it seems reasonable to consider that the exemplars found in the Iron Age II contexts of the Military Sector were probably domesticated, similar to the record from the sites of Tell Abraq (Uerpmann 2001) and Muweilah (Uerpmann and Uerpmann 2017), and thus integrated within the husbandry and hunting practices of the ancient population at Saruq al-Hadid.

On the other hand, several relatively well-preserved fragments of mandibles, horns, and distal limbs have been recorded in the Military Sector. This allowed the estimation of at least 26 cows, 24 dromedaries, and 104 caprine individuals—most of them goats—which constitute 66.24 percent of the ungulates identified (table 1). However, there is not enough evidence to assess the domestic or wild nature of cattle and caprine individuals at this site, other than previously existing research on the region. Sheep and goats were the most numerous domesticated

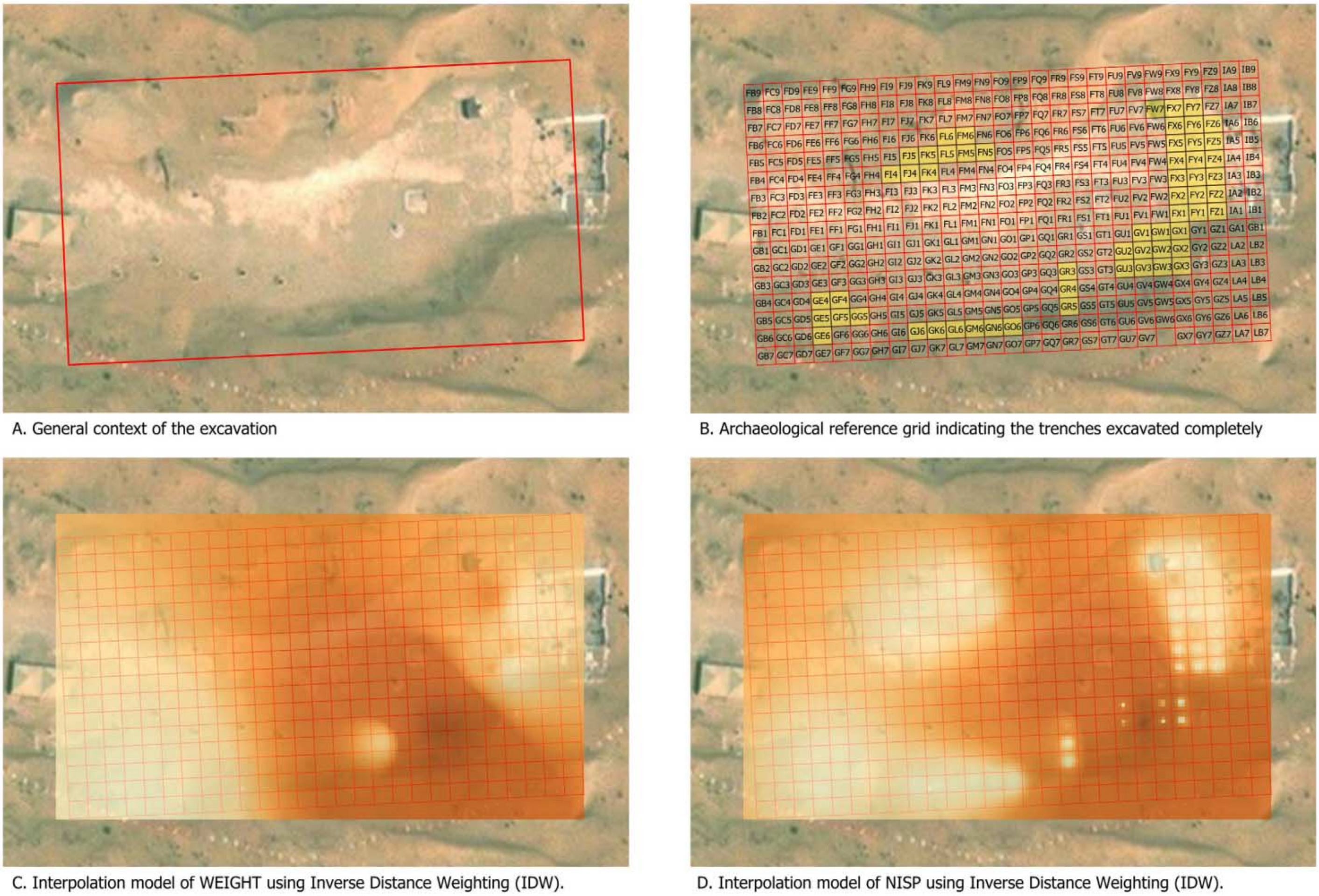

Figure 11. A. General context of the excavation. B. Central sector: archaeological reference grids indicating the trenches excavated completely. C. Interpolation model of weight using inverse distance weighting (IDW). D. Interpolation model of NISP using inverse distance weighting (IDW).

animals identified in the faunal records from the third millennium BCE through the Iron Age layers at Tell Abraq (Sharjah-Umm Al Quwain; Stephan 1995). The relevance these species had in Prehistoric Arabia can also be perceived at Saruq al-Hadid, since goats/sheep are present in Bronze Age contexts at this site (fig. 10). Cattle remains have only been identified in Iron II contexts, although Roberts et al. (2018) describe the discovery of three individuals in Layer IV of the Central Sector, dated to the Bronze Age. In summary, ungulates identified in the Central Sector relate mainly to hunting activities, while ungulates recorded at the Military Sector are mostly domesticated, aside from the presence of a single oryx individual and the discovery of two dugong ribs.

The age of slaughter of certain species also presents certain differences in each deposit. Cattle and goat exemplars from the Military Sector follow a slaughter pattern usually displayed in domesticated animals since they were mostly killed before the age of two. However, most of the animals from the Central Sector were identified as subadults or adults, which rather relates to hunting practices (e.g., according to Soriguer et al. 1994, subadult deer individuals reach 97 percent of their adult size in the Iberian Peninsula).

These differences between the ungulate species and their age of slaughter further suggest the hunting nature of the older records from the Central Sector in comparison with the assemblages of the Military Sector, which are mainly composed of food waste from domestic animals. In this context, the presence of cattle stands out owing to their low adaptability to arid environments, as stated by Jesse Casana, Jason Hermann, and Hussein Suleiman Quandil (2009), Michael Petraglia et al. (2020), Fernando Contreras et al. (2017) and Tatlana Valente et al. (2020). In this regard, it is possible that bovines were transported to this site from other regions.

Besides the difference in the species present in two distinct records according to their culture and climatic framework, their dissimilar state of preservation is also significant. While the assemblages from the Iron II relate to a consumption midden, the Iron I deposit is mainly distinguished by small fragments from large bones of heavy animals. It should be considered that, for example, a single metapodial of a cow of an approximate weight of 500 kg has a mass of around 350 g. Despite this, only some remains from dromedary mandibles exceeded 100 g of mass among the more than 200,000 fragments collected from this context.

The results of the analysis described in this article suggest that ungulate remains from the Central Sector could constitute a deposit originated by an activity carried out after the consumption of the animals, maybe of a metallurgic nature. However, it has also been considered that the arrangement of the bone layers identified in this context could relate to the containment of the dunes.

Concerning the spatial distribution of the faunal record analyzed in the Central Sector—there are no data from the Military Sector in this regard—we have studied the accumulation of bone remains along with their frequency and weight, observing a higher concentration in trenches V1, V2, and V3 of Area G, where 36,716, 68,971 and 95,486 bone fragments with a weight of 8.2, 19.5, and 23.3 kg respectively were gathered. The faunal record of these three trenches constitutes 97 percent of the total bone fragments analyzed, and 89 percent of the total weight of the record of the Central Sector. Large quantities of bones in trenches R3, U2, W1, and X1 were also found in Area G, located close to the previously mentioned trenches (table 3 and fig. 11). This shows that the distribution of bone samples is not, in fact, homogeneous throughout the sector, and according to our final results and those of Project SHARP (Weeks et al. 2019b) this might suggest a higher concentration of bones on the eastern/southeastern side of the excavated area of the Central Sector. This is a relevant issue to be considered in future excavations, which should also address the environmental and economic reconstruction of the ancient occupation at Saruq al-Hadid among its objectives.

Furthermore, there are also differences concerning the consumption of other zoological groups. A large number of well-preserved remains of marine fish were recorded in the oldest sector, a state of preservation present even in unidentified species. Moreover, the consumption of these animals in this context contrasts to the scarcity of fish remains in Iron Age II layers. This constitutes another feature that further differentiates the trophic behavior of the two cultures identified at this site despite sharing the same space. The dynamics of the climate changes perceivable in the transition from the Iron I Age to the Iron II Age in this region could also partially explain such differences.

Although faunal remains of wild species were found in considerably larger quantities in the contexts dated from the Bronze Age to the Iron I Age in comparison with those of the Iron II, this cannot be explained solely according to climate change or particular trophic customs. After all, both causes are plausible and not mutually exclusive. In this regard, Casana, Herrmann, and Quandil (2009) suggest that there was a higher abundance of water and vegetation during the Bronze Age at Saruq al-Hadid than in current times. This situation deteriorated at the end of the 4.2 ka event, which resulted in the reduction of the humidity of the area, causing the desiccation of lakes and the rise of dunes (Petraglia et al. 2020). This desiccation was probably gradual in the region, although according to Contreras et al. (2017) and Valente et al. (2020) not all of the local area would have been covered by dunes during the Iron II. This would have allowed the establishment of an important metallurgical center at the site in addition to a suitable place for the enactment of activities of both commercial and ritual nature. Additionally, the adoption of a *falaj* irrigation system—a means of obtaining water through a system of wells—and the domestication of the camel would have enabled the further expansion of settlements into the hinterland throughout the Arabian Peninsula since the beginning of the Iron II (Casana, Hermann, and Quandil 2009).

It is possible that, owing to the adverse climate changes that occurred during the Iron II in the region, hunting would have become limited and impractical until its ultimate disappearance. In this context domesticated animals would have therefore constituted the main source for meat, allowing the continuation of the settlement. However, it is not possible to define to what extent these animals were exploited within a husbandry economy or if they were obtained through trade, since cattle were not suitable for the arid environment of the region during the Iron II.

Conclusions

The two strategies identified regarding the consumption of meat from ungulates by the ancient inhabitants of Saruq al-Hadid present considerable differences concerning the management of the species at issue. During the Middle Bronze Age to the Iron Age I ungulate hunting seemed to have constituted the main meat resource, while domestic ungulates were the most consumed animals during the Iron Age II—goats in particular according to the number of individuals (MNI). However, the large number of remains from small cows preserved in the most recent sector in such an arid ecosystem is definitely remarkable, since their breeding would not have been suitable or even possible. Thus, the presence of this species is particularly appealing as a framework for archaeozoological research.

Another noteworthy future line of research would center on the study of the taphonomy of the layers of the Central Sector—the oldest at the site. The state of fragmentation of dromedary bones here recorded does not seem to be the result of consumption, but rather mostly of a second activity that required such a high fragmentation. Since the main activity of this settlement was of a metallurgic nature, it would be interesting to conduct physical-chemical and biological analyses that could provide further insights for the understanding of the relationship of the bones with this anthropic activity. Woefully, despite more than one hundred samples being collected during the 2020 season, they have not yet been delivered to our laboratory.

Acknowledgments

We would like to thank the Instituto Andaluz del Patrimonio Historico and the Research Project P18-FR-2100 “Avances e innovaciones en métodos, técnicas y análisis experimentales aplicados al patrimonio arqueológico orgánico: Paleobiología, genética y arqueometría en medios terrestre y marino” for supporting part of this research. We would also like to thank the Dubai Municipality and all the responsible staff of the aforementioned two seasons who counted on our collaboration: Ahmed Mahmood Ahmed Mohamed, Director of the Department of Archeology and Architectural Heritage, Yaaqoub Yousif Ali Ramadhan Al-Ali, Manager of the Antiquities Section of the Department of Archeology and Architectural Heritage, Mahra Saif Ebrahim Bin Touq Almansoori, Director of the Excavation Unit of the Department of Archeology and Architectural Heritage, and Dr. Mansour Boraik, archaeological specialist of the Department of Archeology and Architectural Heritage.

This article was translated from the Spanish by Stephanie L. Budin.

References

Almathen, Faisal, Pauline Charruau, Elmira Mohandesan, et al. 2016. Ancient and Modern DNA Reveals Dynamics of Domestication and Cross-continental Dispersal of the Dromedary. *PNAS* 113:6707–12. https://doi.org/10.1073/pnas.1519508113.

Andrews, Edwina. 2003. Faunal Remains from the Tomb at Sharm. *Arabian Archaeology and Epigraphy* 14:54–57. https://doi.org/10.1034/j.1600-0471.2003.140104.x.

Barone, Robert. 1999. *Anatomie comparée des mammifères domestiques*, vol. 1: *Ostéologie*. Paris: Vigot.

Bernáldez-Sánchez, Eloísa. 2009. *Bioestratinomía de macromamíferos terrestres de Doñana: Inferencias ecológicas en los yacimientos arqueológicos del S.O. de Andalucía*. BAR International Series 1978. Oxford: Archaeopress.

———. 2011. Biostratinomy Applied to the Interpretation of Scavenger Activity in Paleoecosystems. *Quaternary International* 243:161–70. https://doi.org/10.1016/j.quaint.2011.06.023.

Bernáldez-Sánchez, Eloísa, and María Bernáldez. 2000. La basura orgánica de Lebrija en otros tiempos: Estudios paleobiológico y tafonómico del yacimiento arqueológico de la calle Alcazaba de Lebrija. *PH. Boletín del Instituto Andaluz del Patrimonio Histórico* 32:134–50. https://doi.org/10.33349/2000.32.1052.

Bernáldez-Sánchez, Eloísa, Estaban García-Viñas, Ines Sánchez-Donoso, and Jennifer A. Leonard. 2017. Bone Loss from Carcasses in Mediterranean Ecosystems. *Palaios* 32:288–94. https://doi.org/10.2110/palo.2016.047.

Bernáldez-Sánchez, Eloísa, et al. Forthcoming. Animals and Plants of the Past: The Other Treasure of Saruq al-Hadid (Dubai, U.A.E.). In *De las arenas de Babilonia a las aguas del Tarteso. Estudios españoles sobre Orientalística y Egiptología I*, ed. Eduardo Ferrer Albelda. Sevilla: Universidad de Sevilla.

Boessneck, J. 1980. Diferencias osteológicas entre la oveja (*Ovis aries* linné) y la cabra (*Capra hircus* linné). Pp. 338–66 in *Ciencia en arqueología*, ed. Don R. Brothwell and Eric S. Higgs. Madrid: Fondo de Cultura Económica.

Brükner, H., and A. Zander. 2004. Results from the Saruq 7 Site: Luminescence Dating of Former Dunes in the Desert. Unpublished report submitted to the Dubai Department of Archaeology.

Casana, Jesse, Jason T. Herrmann, and Hussein Suleiman Quandil. 2009. Settlement History in the Eastern Rub al-Khali: Preliminary Report of the Dubai Desert Survey (2006–2007). *Arabian Archaeology and Epigraphy* 20:30–45. https://doi.org/10.1111/j.1600-0471.2008.00306.x.

Contreras, Fernando, Bernardo Vila, Pedro Albarracín, et al. 2017. Excavations in Area 2A at Saruq al-Hadid: Iron Age II Evidence of Copper Production and Ceremonial Activities. *Proceedings of the Seminar for Arabian Studies* 47:57–66.

von den Driesch, Angela. 1976. *A Guide to the Measurement of Animal Bones from Archaeological Sites*. Peabody Museum Bulletin 1. Cambridge: Harvard University Press.

von den Driesch, Angela, and V. Obermaier. 2007. The Hunt for Wild Dromedaries during the 3rd and 2nd Millennia BC on the United Arab Emirates Coast: The Camel Bones from the Excavations at al-Sufouh 2, Dubai/UAE. *Documenta Archaeobiologiae* 6:133–67.

Fernández-Jalvo, Yolanda, and Peter Andrews. 2016. *Atlas of the Taphonomic Identifications: 1001+ Images of Fossil and Recent Mammal Bone Modification*. Dordrecht: Springer.

Goudie, Andrew S., Alison Colls, Stephen Stokes, Adrian G. Parker, K. H. White, and Asma Al- Farraj. 2000. Latest Pleistocene and Holocene Dune Construction at the North-eastern Edge of the Rub Al Khali, United Arab Emirates. *Sedimentology* 47:1011–21. http://dx.doi.org/10.1046/j.1365-3091.2000.00336.x.

Herrmann, Jason T. 2012. Prehistoric Human Ecodynamics in the Rub Al- Khali Desert: Results of Remote Sensing and Excavations in Dubai, United Arab Emirates. PhD diss., University of Arkansas.

Lyman, R. Lee. 1994a. Quantitative Units and Terminology in Zooarchaeology. *American Antiquity* 59:36–71. https://doi.org/10.2307/3085500.

———. 1994b. *Vertebrate Taphonomy*. Cambridge Manuals in Archaeology. Cambridge: Cambridge University Press.

Magee, Peter. 2014. *The Archaeology of Prehistoric Arabia: Adaptation and Social Formation from the Neolithic to the Iron Age*. Cambridge World Archaeology. Cambridge: Cambridge University Press.

Petraglia, Michael D., Huw S. Groucutt, Maria Guagnin, Paul S. Breeze, and Nicole Boivin. 2020. Human Responses to Climate and Ecosystem Change in Ancient Arabia. *PNAS* 117.15:8263–70. https://doi.org/10.1073/pnas.1920211117.

Potts, Daniel T. 2012. *In the Land of the Emirates: The Archaeology and History of the UAE*. London: Trident, Abu Dhabi: Sultan bin Zayed's Culture and Media Centre.

Roberts, James, Lloyd Weeks, Charlotte Cable, et al. 2018. The Role of Wild Terrestrial Animals in Late Prehistoric Societies of Southeastern Arabia: New Insights from Saruq al-Hadid. *Arabian Archaeology and Epigraphy*. https://doi.org/10.1111/aae.12112.

Roberts, James, Lloyd Weeks, Melanie Fillios, et al. 2019. Preliminary Insights into Late Prehistoric Fish Procurement Strategies in the Desert Interior of Southeastern Arabia: The Results of LA-ICP-MS Analysis of a Fish Otolith Assemblage from Saruq al-Hadid. *Journal of Archaeological Science: Reports* 26:101856. https://doi.org/10.1016/j.jasrep.2019.05.021.

Schmid, Elisabeth. 1972. *Atlas of Animal Bones for Prehistorians, Archaeologists and Quaternary Geologists*. Amsterdam: Elsevier.

Soriguer, Ramón C., P. Fandos, E. Bernáldez and J. R. Delibes-Senna. 1994. *El ciervo en Andalucía*. Seville: Junta de Andalucía.
Stephan, Elisabeth. 1995. Preliminary Report on the Faunal Remains of the First Two Seasons of Tell Abraq/Umm al-Quwain/United Arab Emirates. Pp. 52–63 in *Archaeozoology of the Near East II: Proceedings of the Second International Symposium on the Archaeozoology of Southwestern Asia and Adjacent Areas*, ed. H. Buitenhuis and Hans-Peter Uerpmann. Leiden: Backhuys.
Uerpmann, Margarethe. 2001. Remarks on the Animal Economy of Tell Abraq (Emirates of Sharjah and Umm an-Qaywayn). *Proceedings of the Seminar for Arabian Studies* 31:227–33.
Uerpmann, Margarethe, and Hans-Peter Uerpmann. 2017. The Iron Age Site of Muweilah (Sharjah, UAE) and the Problems of Dromedary Domestication. Pp. 312–19 in vol. 2 of *Archaeozoology of the Near East 9*, ed. Marjan Mashkour and Mark Beech. 2 vols. Oxford: Oxbow.
Uerpmann, Hans-Peter, and Margarethe Uerpmann. 2002. The Appearance of the Domestic Camel in South-east Arabia. *Journal of Oman Studies* 12:235–60.
Valente, Tatiana, Fernando Contreras , Ahmed Mahmud , Mansour Boraik Radwan Karim, Mahra Saif Al Mansoori, and Hassan Zein. 2020. Five Seasons of Excavations in Areas 2A and G of Saruq al Hadid (Dubai, UAE): Iron Age II Evidence of Copper Production, Workshop Area and Ceremonial Activities. *Isimu* 23:169–95. http://dx.doi.org/10.15366/isimu2020.23.010.
Vincent, Peter J. 2008. *Saudi Arabia: An Environmental Overview*. London: Taylor & Francis.
Warren, Andrew, and David Allison. 1998. The Palaeoenvironmental Significance of Dune Size Hierarchies. *Palaeogeography, Palaeoclimatology, Palaeoecology* 137:289–303. https://doi.org/10.1016/S0031-0182(97)00110-7.
Weeks, Lloyd, Charlotte Cable, Kristina Franke, et al. 2017. Recent Archaeological Research at Saruq al-Hadid, Dubai, UAE. *Arabian Archaeology and Epigraphy* 28:31–60. https://doi.org/10.1111/aae.12082.
———. 2019a. Saruq al-Hadid: A Persistent Temporary Place in Prehistoric Arabia. *World Archaeology* 51:157–82. https://doi.org/10.1080/00438243.2018.1491324.
———. 2019b. Dating Persistent Short-term Human Activity in a Complex Depositional Environment: Late Prehistoric Occupation at Saruq al-Hadid, Dubai. *Radiocarbon* 61:1041–75. https://doi.org/10.1017/RDC.2019.39.
Zeder, Melinda A., and Heather A. Lapham. 2010. Assessing the Reliability of Criteria Used to Identify Postcranial Bones in Sheep, *Ovis*, and Goats, *Capra*. *Journal of Archaeological Science* 37:2887–2905. https://doi.org/10.1016/j.jas.2010.06.032.
Zeder, Melinda A., and Suzanne E. Pilaar. 2010. Assessing the Reliability of Criteria Used to Identify Mandibles and Mandibular Teeth in Sheep, *Ovis*, and Goats, *Capra*. *Journal of Archaeological Science* 37: 225–42. https://doi.org/10.1016/j.jas.2009.10.002.

Table 1. Fauna identified in the Central Sector and the Military Sector. NR: number of remains; NISP: number of specimens of each species; MNI: minimal number of individuals; Weight in g; IF: index of fragmentation.

Species	Variable	Central Sector	Military Sector
Camelus Dromedarius	NISP	170	73
	MNI	35	24
	Weight	2,287.8	6,322.6
Oryx sp.	NISP	209	2
	MNI	33	1
	Weight	1,105	4
Bos taurus	NISP		83
	MNI		26
	Weight		2,052.7
Dugong dugon	NISP		2
	MNI		2
	Weight		73
Gazella sp.	NISP	77	
	MNI	15	
	Weight	132.3	
Ovis aries/Capra hircus	NISP	45	1,095
	MNI	19	104
	Weight	62.9	2,361.2
Canid	NISP	2	
	MNI	2	
	Weight	5	
Lagomorph	NISP	11	
	MNI	9	
	Weight	8.3	
Rodent	NISP	11	
	MNI	5	
	Weight	3.4	
Bird	NISP	23	3
	Weight	12.2	1.1
Reptile	NISP	9	
	MNI	5	
	Weight	1.71	
Fish	NISP	2,073	4
	Weight	208.15	2.1
Class I	NISP	740	275
	Weight	2,491.2	1,760.7
Class II	NISP	709	295
	Weight	891.4	422.25
Classes III–IV	NISP	448	7
	Weight	99.2	2.6
Indeterminate	NISP	223,259	2,380
	Weight	69,437.3	1,746.75
Worked	NISP	139	4
	Weight	120.3	19.3
Total	NR	227,925	4,223
	NISP	4,527	1,839
	MNI	123	157
	Weight	76,886.16	12,715.63
	IF	2.06	0.36

Table 2. Anatomical parts of the species of Classes I and II preserved in the Central and the Military Sectors at the archaeological site of Saruq al-Hadid (Dubai, UAE).

	Military Sector												Central Sector											
	Ovis aries/Capra hircus			*Bos taurus*			*Camelus dromedarius*			*Oryx* sp.			*Ovis aries/Capra hircus*			*Camelus dromedarius*			*Oryx* sp.			*Gazella* sp.		
Bone	NISP	MAU	%MAU	NISP	MAU	%MAU	NISP	MAU	%MAU	NISP	MAU	%MAU	NISP	MAU	%MAU	NISP	MAU	%MAU	NISP	MAU	%MAU	NISP	MAU	%MAU
Horn core	36	18.18	30.51										2	1.01	50.01				6	3.03	46.12	11	5.56	100.00
Skull	7	0.39	0.66	1	0.06	0.79	6	0.34	4.44				2	0.11	5.56	9	0.51	25.00	4	0.22	3.42	3	0.17	3.03
Mandible	44	22.22	37.29	14	7.07	100.00	15	7.58	100.00				4	2.02	100.01	3	1.52	75.01	13	6.57	100.00	5	2.53	45.42
Tooth	220			48			16			1			2			53			22			9		
Vertebrae																35			7					
V. cervical	5	0.72	1.21	1	0.14	2.04							1	0.14	7.14	2	0.29	14.36	2	0.29	4.39			
V. thoracic																			3	0.23	3.55			
V. lumbar	2	0.34	0.56				2	0.34	4.44															
Sacrum																								
V. caudal																			8	0.73	11.18			
Ribs	68	2.64	4.43				1	0.04	0.51							13	0.51	25.00	13	0.51	7.69	1	0.04	0.70
Sternum																								
Scapula	33	16.67	27.96										1	0.51	25.00	1	0.51	25.00	6	3.03	46.12	1	0.51	9.08
Humerus	60	30.30	50.84	2	1.01	14.29	3	1.52	19.99				1	0.51	25.00	2	1.01	50.01	6	3.03	46.12			
Radius	85	42.93	72.03	2	1.01	14.29	4	2.02	26.65				1	0.51	25.00	2	1.01	50.01	8	4.04	61.50	1	0.51	9.08
Ulna	9	4.55	7.63	1	0.51	7.14	5	2.53	33.31							1	0.51	25.00	9	4.55	69.19	1	0.51	9.08
Carpals	3	0.25	0.42				5	0.42	5.55				3	0.25	12.50	3	0.25	12.50	4	0.34	5.12			
Metacarpus	87	43.94	73.72				2	1.01	13.33				2	1.01	50.01				5	2.53	38.44			
Phalanx	4	0.17	0.28																					
Pelvis	10	10.10	16.95	2	2.02	28.57							2	2.02	100.01	2	2.02	100.00	4	4.04	61.50			
Femur																4	2.02	100.01	3	1.52	23.06	4	2.02	36.33
Malleolus																3			1					
Tibia	25	12.63	21.19				6	3.03	39.98							4	2.02	100.01	9	4.55	69.19			
Patella																								
Tarsals	22	2.22	3.73	1	0.10	1.43	1	0.10	1.33				2	0.20	10.00	2	0.20	10.00	34	3.43	52.27	13	1.31	23.62
Metatarsus	118	59.60	100.00	4	2.02	28.57							2	1.01	50.01				5	2.53	38.44	2	1.01	18.17
Phalanx I	106	13.38	22.46	3	0.38	5.36				1	0.13	100.00	8	1.01	50.01	8	1.01	50.01	12	1.52	23.06	13	1.64	29.52
Phalanx II	28	3.54	5.93	2	0.25	3.57							2	0.25	12.50	3	0.38	18.75				2	0.25	4.54
Phalanx III	18	2.27	3.81										3	0.38	18.75							4	0.51	9.08
Sesamoidea	6	0.25	0.42																			1	0.04	0.76
Metapodium	99	25.00	41.95	2	0.51	7.14	3	0.76	9.99				6	1.52	75.01	2	0.51	25.00	25	6.31	96.09	6	1.52	27.25
Long bone																16								
Total	**1095**			**83**			**73**			**2**			**45**			**170**			**209**			**77**	**0.37**	

Table 3. Table displaying the fifty-six trenches studied and excavated completely (fig. 11) of the ninety-two analyzed of the Central Sector (Areas F and G), including NISP, weight (g) and average weight of the bone fragment (AW; g).

Area	Trench	NISP	Weight	AW
F	I4	320	80.8	0.26
F	J4	189	89.1	0.47
F	J5	160	44.3	0.28
F	K4	472	131.2	0.28
F	K5	111	53.9	0.49
F	L5	372	90.7	0.24
F	L6	61	23.5	0.39
F	M5	208	84.1	0.40
F	M6	143	26.9	0.19
F	N5	454	158.7	0.35
F	W7	12	17.2	1.43
F	X1	373	416	1.12
F	X2	241	360	1.49
F	X3	659	572.7	0.89
F	X4	181	154.3	0.85
F	X5	460	467	1.02
F	X6	1367	1,093.5	0.80
F	X7	122	126.5	1.04
F	Y1	198	181	0.96
F	Y2	461	381	0.83
F	Y3	1205	1,114.7	0.93
F	Y4	113	106.9	0.95
F	Y5	437	741.9	1.29
F	Y6	576	730.7	1.27
F	Y7	44	68.8	1.56
F	Z1	220	139.3	0.63
F	Z2	570	434.7	0.76
F	Z3	532	334.5	0.63
F	Z4	246	196	0.80
F	Z5	722	471.7	0.65
F	Z6	904	594.8	0.66
G	E4	41	12.5	0.30
G	E5	26	8.5	0.33
G	E6	2	1	0.50
G	F4	2	1.5	0.75
G	F5	49	55.4	1.13
G	G5	36	11.5	0.32
G	J6	23	21.1	0.92
G	K6	6	1.3	0.22
G	L6	130	74.1	0.57
G	M6	120	64.6	0.54
G	N6	188	155.3	0.83
G	O6	306	167.75	0.55
G	R3	1896	4,001.5	2.11
G	R4	423	349	0.83
G	R5	518	613.5	1.18
G	U2	228	141.75	0.62
G	U3	755	1.517	2.00
G	V1	36.716	8,187.9	0.22
G	V2	68.971	19,524.71	0.28
G	V3	95.486	23,342.4	0.24
G	W1	2.873	2,733.1	0.95
G	W2	86	18.9	0.22
G	W3	103	15.5	0.15
G	X1	2.733	1,872.4	0.79
G	X2	33	6.1	0.18
G	X3	2	21.5	10.75

Eloísa Bernáldez-Sánchez holds a PhD in biology and a masters in geography and history at University of Seville. She is manager of the laboratory of paleobiology in the Andalusian Cultural Heritage Institute (IAPH, Spain). She is a member of the University of Seville at the Saruq al-Hadid Site in Dubai (UAE) and Thutmosis III Temple Project in Luxor (Egypt).

Esteban García-Viñas holds a PhD (2016) from the Pablo de Olavide University (Seville, Spain). He works in the laboratory of paleobiology of the Andalusian Cultural Heritage Institute (IAPH, Spain). He has participated in two seasons of Saruq al-Hadid archaeological site studying faunal remains.

Myriam Seco-Álvarez is a professor of the Department of Prehistory and Archaeology, University of Seville. She is responsible for excavations in the Middle East and Egypt, director of the University of Seville Mission at Saruq al-Hadid Site in Dubai (U.A.E.), and director of Thutmosis III Temple Project in Luxor (Egypt).

Eduardo Ferrer Albelda is professor of archaeology at the University of Seville. Codirector of the excavation at Saruq al-Hadid (2019–2020), his research work has focused on Phoenician-Punic culture, archaeological historiography, and Tartessus. He is the director of the collection Spal Monografías Arqueología of the University of Seville Press.

José Luis Ramos-Soldado is an archaeologist currently associated with the laboratory of paleobiology at the Andalusian Institute of Historical Heritage (IAPH, Spain). He has a PhD in archaeology (University of Seville, Spain), master postgraduate in archaeology (ancient Near East, University of Durham, United Kingdom), and a bachelor's degree in history (University of Seville, Spain).

Javier Dantas Cayuela holds a BA and MA in archaeology from the University of Seville. He has participated in the archaeological activities at Saruq al-Hadid as an archaeologist and is currently working on his doctoral thesis on the site.

Mansour Boraik is the principal archeologist in the municipality of Dubai, Antiquities Department. He is the former Undersecretary of State for Cairo and Giza Antiquities in the Ministry of Antiquities. He is also the exdirector general of Upper Egypt Antiquities in Luxor.

Yaqub Youssef is the head of the antiquities section in the municipality of Dubai. He has directed many archaeological projects in Dubai.