Title
Human-Animal Interaction at the Ancient Urban Site of Sisupalgarh, India

Author
Ammerman, Steven

Publication Date
2022

UNIVERSITY OF CALIFORNIA

Los Angeles

Human-Animal Interaction at the Ancient Urban Site of Sisupalgarh, India

A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Anthropology

by

Steven Michael Ammerman

2022

ABSTRACT OF THE DISSERTATION

Human-Animal Interaction at the
Ancient Urban Site of Sisupalgarh, India

by

Steven Michael Ammerman
Doctor of Philosophy in Anthropology
University of California, Los Angeles, 2022
Professor Monica L. Smith, Chair

Urbanism has been a continuous part of the landscape of the Indian subcontinent for thousands of years. During the Early Historic Period of South Asia, urban centers flourished and acted as the backdrop to many new innovations, including the development of widely used systems of writing and of novel religious movements such as Buddhism and Jainism which emphasized non-violence toward living things, or *ahimsa*, as a key part of their philosophies. Within the urban settings of the Early Historic period, people engaged in myriad relationships with non-human animals, continuing long-standing trajectories which date back to the origins of our species. In this dissertation, I explore how human relationships with animals in urban spaces changed in response to the adoption of the new approaches to humans' role in the environment encapsulated by Buddhism and Jainism. In order to do this, I identified and analyzed the corpus of faunal material recovered during excavations conducted from 2005 to 2009 at the urban site of Sisupalgarh located near the city of Bhubaneswar in modern-day Odisha, eastern India. Sisupalgarh was a major urban center of this region occupied from the mid-first millennium BCE

to the mid-first millennium CE. This period of occupation encompasses the time period before Buddhism and Jainism became widely adopted in eastern India to a time when they appear to have become well established. In order to contextualize data from my analysis of the faunal material, I compared the patterns suggested by that analysis to patterns implied by the rich textual record dating to this time period. My analyses showed that, during the early part of Sisupalgarh's occupation, the residents of the city had a broad-based economy based on the use of many different types of animals, including a wide variety of both wild and domestic taxa. This diversity of animal usage declined during the period of occupation, and in the later part of its occupation, Sisupalgarh's people appear to have been using a very limited set of animal products consistent with the adoption of *ahimsa* as a guiding principle for human-animal interactions.

The dissertation of Steven Michael Ammerman is approved.

Paul Jeffrey Brantingham

Nancy Levine

Levent Atici

Monica L. Smith, Committee Chair

University of California, Los Angeles

2022

List of Figures

List of Tables

Acknowledgements

In the process of conducting research for and writing this dissertation, I have had the extremely good fortune to benefit from the kind assistance of very many wonderful people and institutions to whom I feel exceedingly indebted. While listing them all would yield a document nearly as long as the dissertation itself, a few to whom I am particularly grateful bear special mention.

First and foremost, my committee chair and advisor Professor Monica L. Smith has been a constant guide, mentor, and friend to me throughout my career in graduate school. Since even before I officially enrolled at UCLA, Monica has made this program feel like a home to me. She has never stinted on sharing her time, her knowledge, her professional network, or her much-appreciated encouragement. I especially thank her for passing on her passion for urban archaeology to me. Of course, this project would also have been impossible without her excellent work at the site of Sisupalgarh, which has formed the basis of my intellectual life for the past several years.

Professor R.K. Mohanty has also played an irreplaceable role in my work. Aside from co-leading the fieldwork at Sisupalgarh and generating much of the information on which I have relied in this dissertation, he has also been an incredibly generous guide and host during my time working in India. His efforts on my behalf made me feel that he was truly invested in my success.

I would like to thank my committee members, Professor Jeffrey Brantingham, Professor Nancy Levine, and Professor Levent Atici. Professor Brantingham's advice was a crucial part of building my ideas about how to use and interpret my data, and his guidance was essential in developing my analysis of the taphonomic factors influencing the patterns I observed. I am very grateful for his constant support and encouragement. Professor Levine provided me with a non-archaeological perspective that challenged me to think my ideas through more fully and to critically examine possibilities that I may not have considered without her advice. Her enthusiasm for the study of human-animal interactions has also enlivened my own thinking on this topic. Professor Atici's zooarchaeological perspective improved the standard of my data reporting and the professional quality of this work, and his approaches to combining zooarchaeological evidence with other kinds of data have been an inspiration.

For their generous hospitality and for welcoming me into their community, I would like to thank the administration, faculty, students, and staff of Deccan College Post-Graduate and Research Institute in Pune. Professor Vasant Shinde, Professor Sushama Deo, and Mr. Anil Inamdar were especially instrumental in marshalling their institutional resources to assist me in my work at Deccan College, and they were all extraordinarily kind. I would also like to thank Dr. Elora Tribedy and Sanjay Krishna for their friendship and for helping me to get my bearings there.

My work at Deccan College was housed within the Archaeozoology Lab, and I could not have completed or even begun my analysis without the resources that the lab provided. I would like to extend my most effusive thanks to Professor P.P. Joglekar, Professor Arati Deshpande-Mukherjee, and Dr. Pankaj Goyal for sharing their extraordinary knowledge of South Asian fauna and its identification with me, and for being incredible resources as I went about my analysis. Furthermore, I would like to thank the lab for curating the faunal remains from Sisupalgarh, which form the subject matter of this dissertation.

During my time working in India, I was fortunate to interact with many people who went out of their way to provide me with their generous support and hospitality. Thank you to Dr. Sikhasree Ray, Dr. Tilok Thakuria, Dr. Sayan Bhattacharya, Dr. Kanika Kalra, and Dr. Karl La

Favre. Thanks also to Satya, Kalya, and the people of Talapada, who were unfailingly helpful to me.

At UCLA, I have been lucky to be surrounded by thoughtful and inspiring friends and mentors who have helped to stimulate my intellectual growth and who have provided me with support every step of the way. I would like to give my special thanks to Professor Tom Wake and Dr. Hannah Lau for showing me the ropes of faunal analysis. My peers have been essential in keeping me healthy and sane enough to write this work, and I am particularly grateful to Maddie Yakal, Dr. Stephanie Salwen, Baisakhi Sengupta, Eden Franz, and Queenie Lapeña for being such great friends, colleagues, and sounding boards.

This work was only made possible through the financial support of the UCLA Graduate Division through the Graduate Summer Research Mentorship, the Graduate Research Mentorship, and the Dissertation Year Fellowship; the Dr. Sambhi Memorial Doctoral Research Summer Fellowship program; and the Clement W. Meighan Research Archaeology Award. I have also greatly benefitted from the generosity of Mr. Navin and Mrs. Pratima Doshi, who have supported my work through their funding of the Navin and Pratima Doshi Chair in Indian Studies. I thank all these institutions for their support, which has allowed me the flexibility to conduct my research in exactly the way I would have hoped to.

Finally, thank you to my family, who have supported me all the way.

Vita

2014	B.A., Archaeology
	Dept. of Anthropology
	Washington University in St. Louis
	B.A., Anthropology
	Dept. of Anthropology
	Washington University in St. Louis
2016	Graduate Summer Research Mentorship
	Graduate Division
	University of California, Los Angeles
2016-2021	Teaching Assistant
	Dept. of Anthropology
	University of California, Los Angeles
2017	M.A., Anthropology
	"The Evolution of Animals through Domestication and other Human Relationships: An Animal-Centered Approach"
	Dept. of Anthropology
	University of California, Los Angeles
2017	Graduate Research Mentorship
	Graduate Division
	University of California, Los Angeles
2021	Teaching Assistant
	Academic Program in Global Studies
	University of California, Los Angeles
2022	Dissertation Year Fellow
	Graduate Division
	University of California, Los Angeles

CHAPTER 1. INTRODUCTION

The study of urban centers is of pressing importance, given the rapid growth of the proportion of the world's population living in cities. More than half the world's population currently lives in cities, and if the current rate of growth of the percentage of the population that lives in urban areas continues, that proportion will exceed two thirds by 2043 (World Bank 2022). India is one of the countries with the fastest growing urban population, as major urban centers like Delhi, Mumbai, Bengaluru, and Hyderabad increase in size. India's urban population is expected to increase from 482 million in 2020 to 766 million in 2050, resulting in a dramatic effect on the surrounding environment. Although the modern scale of this growth is unprecedented, urbanism has been a part of human life for thousands of years, with the earliest cities emerging approximately 6000 years ago in Mesopotamia (Smith 2019) and the earliest examples in South Asia being the cities of the Bronze Age Indus Valley civilization, beginning in the third millennium BCE (Singh 2009). Ancient cities had many of the features we expect to see in modern cities, such as larger population and population density than villages, specialization of labor, the ability to create and store surpluses, civic spaces, and some type of central authority (cf. Childe 1950). In addition, ancient cities, like modern ones, exerted an influence over a surrounding area that was much larger than the area of the city itself. Because of this an urban area and its human and non-human dwellers are part of a much larger ecosystem and have relationships with both the plants and animals within it.

Human populations rely on animals not merely as sources of meat but also as sources of fibers, dairy products, traction, transportation, and companionship. People also interact with animals in less direct ways that range from those that are beneficial to the humans or those that are detrimental, such as listening to songbirds, watching wildlife, or having resources (or health) reduced because of pests or parasites. The progression of human-animal relationships has had major repercussions on ancient and modern societies. Within an urban environment, the higher human and animal population density accelerates and intensifies these relationships. When humans build a city, that city becomes a portion of an urban environment that includes not only the buildings and roads, but also the unbuilt areas between and surrounding them. Both the built and unbuilt spaces offer locations where human-animal interactions occur, together creating new ecological formations that make cities, rather than just built environments, into living achievements which move through the interweaving of cultivated, feral, and wild ecological entanglements (Barua and Sinha 2022). The growth of cities introduces more and more people to a given area, but also relies on ever-growing resource catchment areas that are used to supply the city. Products from these areas (including animal products) are brought into the city, causing the presence of the city to have an influence on human-animal interactions over a region that is much larger than the city itself.

The interaction between humans and animals stems from much more ancient ecological relationships among all animals. The organisms within an ecosystem continuously interact with the other organisms that share their environment, either directly or indirectly. The degree of complexity that has arisen in our societies since the initial emergence of our species has done little to change this ecological embeddedness, even though the specific interactions may have changed. Even in urban environments, which are dramatically altered by human action, there are many types of relationships with other animals, some human-driven and others animal-driven. These relationships are contextualized by the long history of human-animal interactions, such as hunting, predation, and husbandry. Even in instances where people are not directly interacting with animals, human presence in the environment and modifications to the environment both create and destroy opportunities for other animals. In an urban environment there will be many individuals who have interactions with animal products rather than with the living animal from which they were sourced, but this type of relationship still constitutes a human-animal entanglement, and desire for the product causes somewhere a direct interaction, which may occur either within the urban environment or outside of it.

The Indian subcontinent presents an ideal location to pursue research on human-animal interactions. The large biodiversity of the area provides many opportunities for humans and animals to interact in a variety of ways. The first cities in South Asia, belonging to the Indus Valley civilization, emerged in the third millennium BCE and would have created new paradigms by which people accessed and imagined these diverse animal resources. People living in Indus cities used a large variety of domesticated animals, some domesticated in South Asia and others imported from places like the Near East. However, different cities seem to have adopted different patterns of use for different species or breeds depending on environmental and social conditions, suggesting relationships with animals and the environment that were highly specific on a city-to-city basis (cf. Patel and Meadow 2017). Evidence from Harappa also suggests continued entanglements with wild animal resources, for example in the exploitation of silk from wild silk moths (Good et al. 2008). While the religious and symbolic elements of human-animal interactions in the Indus civilization are not well-attested through a decipherable written record, the frequent depiction of animals on objects such as seals suggests that animals did play a major part in Indus people's imaginations as symbols and representations of the natural world (cf. Bhaskar 2022).

People's religious beliefs in South Asia have long included strictures about interaction with animals, strengthened by the implementation of the religious ideas contained in traditions such as Buddhism and Jainism during the first millennium BCE, which encouraged practices such as vegetarianism, adding another layer of complexity to the relationship. Both of these religious traditions emerged partially in response to the inherent violence of the centralizing leadership associated with increasing urbanism, and as a result both emphasized the principle of *ahimsa*, or non-violence toward living things, with Jainism placing an even greater importance on this tenet than Buddhism (Singh 2017:25-28). The birth and adoption of these beliefs occurred during the “second urbanization” of the Indian subcontinent (the “first urbanization” corresponds to the Bronze Age Harappan Culture of the Indus Valley, but these cities were no longer occupied by the middle of the 2nd millennium BCE, and there were no cities in the subcontinent for about 1000 years), and the flourishing of cities was inextricably tied to value systems of these religions (Sawant and Shete 2016).

The second urbanization began in the Gangetic Plain of northern India at urbanizing sites that became recognized as the centers of state-level political organizations, or Mahajanapadas, and by the second century BCE there were dozens of cities located throughout the subcontinent (Smith 2006, Sawant and Shete 2016). There have been archaeological investigations at many of these cities, and many of them are at least mentioned in Early Historic texts. One urban site that was occupied throughout the time of the popularization of Buddhist and Jain beliefs through India was Sisupalgarh, which is located near the head of the delta of the Mahanadi River on the east coast of the Indian peninsula and was occupied from approximately 500 BCE to 500 CE. Excavation of this site included work by B.B. Lal in the 1950s and by Mohanty and Smith between 2005 and 2009. Other archaeological investigations at the site include survey work led by Smith from 2000-2003 (Smith 2005) and geophysical survey and mapping led by Yule (Yule 2006).

Sisupalgarh's location on the Daya River in the alluvial plain of the Mahanadi River delta and near the lateritic highlands to its west meant that its residents would have had access to a wide variety of environmental resources, both aquatic and terrestrial (Lal et al. 2014). Massive stone architecture at the city is the most durable attestation to the extraction of raw materials from the surrounding landscape, but many more ephemeral resources such as timber, plant-based fibers and foodstuffs, and clay must have been important assets to Sisupalgarh's inhabitants. Importantly, the wide range of environmental engagements that would have been available also mean that the people living at Sisupalgarh would have had many opportunities to encounter many different kinds of animals, which would have been sources of a huge variety of potential interactions and resources.

Urban centers like Sisupalgarh, which likely acted as sites of ritual and religious activity, should have experienced a change in the use of animals if people elected to follow the strictures of religions being circulated at the time. For example, the faunal remains from a society transitioning to *ahimsa*, or the practice of non-violence espoused by Buddhist and Jain traditions, should show a corresponding change in animal usage, with a distinct drop in diversity of taxa represented because of a decrease in hunting and raising of animals for food. Instead, the faunal remains should focus on animals which would have provided secondary products, such as cattle and water buffalo which are useful as sources of traction and dairy.

Generally, in urban settings there is specialization of activities, and it is expected that not all members of a society would be performing all functions. This is also true regarding the methods used to feed the populace and to interact with animals in other ways. There might be members of society who specialize in raising animals, others who sell animal products, perhaps a specialized segment that prepares meals, and one that disposes of refuse. These specialized activities are also likely to not be uniformly distributed throughout the urban setting, with some activities even possibly taking place outside the boundaries of the urban area. It is possible that these specializations present archaeologically in ways that mimic the signature of changes in dietary customs. Improvements in disposal of animal remains, for example, could appear archaeologically the same as an overall reduction in the use of animals as a source of food. Determining which of these is the more likely explanation requires either a broader archaeological dataset or the additional use of non-archaeological evidence as a source of analogy.

To understand how people were interacting with animals in the past, a comprehensive and integrative zooarchaeological approach is required to develop a more complete and fine resolution picture, including an answer to why the remains were deposited in the locations from which they were discovered (and also if and why few or no remains were discovered in other locations). To answer this type of question, archaeologists frequently turn to ethnographic evidence. In the case of Sisupalgarh and other urban sites from around the time of the genesis and early adoption of Buddhism and Jainism, there are few modern analogues from which it would be possible to generate an accurate portrayal of daily life and the factors that influence it, but texts from the time of Sisupalgarh's occupation can provide ethnographic analogies which are relevant to the site. Relevant texts dating from around the time of Sisupalgarh's occupation that describe factors that may have determined why faunal remains were deposited in the way they were discovered and how people interacted with animals include inscriptions, political treatises, and religious texts.

Of the many possible ways for humans and animals to interact, the archaeological record at Sisupalgarh only provides insight into a few, and these are the ones that will form the main focus of this dissertation. Of these, the most obvious is the use (or active disuse) of animals as a source of meat. One of the major goals of this dissertation is to ascertain if there was a change in human-animal relationships during the period of occupation at Sisupalgarh, which would indicate a corresponding change in cultural attitudes toward humans' place in the environment. The prime evidence that such a change did occur would be a change in the types and amounts of animal remains recovered. Such a change may not be interpreted as conclusive evidence to argue that there was indeed a change in animal usage since excavated and analyzed faunal assemblages may be a mere reflection of biases such as recovery and pre- and post-depositional processes that might have modified or destroyed certain skeletal elements or taxa differentially. Sometimes this change may also be associated with poorer preservation of the older material and better preservation of the newer material, but that may not always be the case. Another possible cause for changes in recovered material would be changes in the manner in which material is initially deposited. For example, the location (either within the site or outside of the site) where material is deposited could change, and since it is impossible for archaeological excavations to cover all possible depositional locations, it is impossible to rule out that the location where material was deposited was not excavated and hence the material not recovered.

To probe the foregoing anthropological, archaeological, and zooarchaeological questions, I analyzed the faunal remains recovered during the 2005-2009 Mohanty and Smith excavations to determine animal taxon and skeletal element to the extent possible. This analysis enabled a correlation of remains to excavation location in order to differentiate animal usage both spatially and temporally. The faunal analysis provides evidence of how animal remains were being deposited by the inhabitants of the site, but it does not by itself answer the question of why the remains are deposited in that manner.

The change in how humans interact with animals will likely have a cascading effect on the culture of the city. These changes may be part of the reason that the site experienced a change in material culture. If changes in human/animal interactions, as evidenced from the faunal remains, occur in the same context as changes in material culture, it is likely that the change in material culture occurred at the same time as the change in religious ideology. If, however, the change in material culture is not in the same context as the change in the faunal assemblage, it is likely that the change in religious ideology did not produce the change in material culture. Changes in human-animal interactions may also be the result of changes in economy. Depletion of wild animal resources spurred by the growth of the city's population could lead to an economy that is more reliant on domestic animals as sources of meat. Another potential explanation for changes observed in the faunal remains from a site has to do with taphonomy, or the processes responsible for the preservation and distribution of animal remains after deposition.

My analysis of the faunal remains and supplementary evidence supports the idea that during the period of occupation at Sisupalgarh there was a shift in animal usage that occurred approximately from the time of the Ashokan edicts to the reign of King Kharavela. This time period corresponds with the popularization of Buddhist and Jain beliefs within the region, and analysis of textual evidence points to this as a likely catalyst for the change in animal usage.

Including this introduction (Chapter 1) this dissertation is divided into eight chapters and an appendix. Chapter 2 ground human-animal interactions theoretically and provides a more in-depth discussion of ecological and evolutionary processes that result in and result from the relationships between humans and other animals and how these relationships are intensified in urban settings. Human relationships with wild, commensal, tame, and domestic animals are the basis for the human use of all animal derived resources and the mechanisms by which faunal remains are ultimately deposited in the archaeological record of urban sites.

In Chapter 3, I give a more complete description of the Early Historic Period of South Asia and the urbanization that was beginning to take place during this period. The city of Sisupalgarh is one example of this urbanization, and this chapter also gives a general description of the city, its excavation history, detailed descriptions of the 2005-2009 excavations on which my analysis is based, and the social-political environment that surrounded and contextualized Sisupalgarh's occupation.

Chapter 4 focuses on the faunal analyses I performed on the material recovered from the 2005-2009 excavations. For each operational unit the relative abundance of the identified taxa is shown, and for operations that include material from the complete historical sequence of the site, comparisons are made as a function of excavation depth, an approximate proxy for age of deposit.

Chapter 5 provides a more complete discussion of the relationships between deposited material and recovered material that could have bearing on the results of the faunal analysis. The analyses in this chapter show that changes in preservation are not sufficient to explain the differences observed in the distribution of taxa and relative quantity of recovered material.

In Chapter 6, I discuss the inscriptional texts located near Sisupalgarh as well as Early Historic texts that provide insights into the lives of people at this time, including examples relevant to human-animal interactions. I provide specific examples of many types of human-animal interactions in cities which are attested in these texts or can be inferred from them. Applicable texts include early inscriptional evidence such as the Edicts of Ashoka and the Hathigumpha Inscription, religious texts such as the Pali Canon, and political treatises such as the *Arthashastra*. These texts provide an ethnographic background with which to contextualize the archaeological findings from Sisupalgarh.

In Chapter 7, I synthesize the evidence from Chapters 4, 5, and 6 to show that different areas of Sisupalgarh were being used differently and that there were changes in the relationships between humans and animals throughout the period of occupation. This chapter also provides correlations between excavation depth and historical events for the operations that encompassed the entire occupational history of the city. Other archaeological evidence from the excavations is used to contextualize the results of the faunal analyses.

Chapter 8 provides my conclusions based upon comparison of the faunal analyses and the textual evidence. I find that many aspects of human-animal relationships implied by the texts are reflected in some parts of the faunal assemblage from Sisupalgarh. Taken together, the evidence suggests that, over the site's period of occupation, people living at Sisupalgarh moved from a broad-based economy that relied heavily on exploitation of a wide variety of both wild and domestic animal resources to an economy more focused on resources that could be obtained from animals without killing them. This change aligns with a hypothesis that human-animal interactions at Sisupalgarh became more and more structured by the philosophical perspectives of Buddhism and Jainism, which disavow violence against living things.

In the appendix, a complete listing of the recovered faunal remains identified is presented along with comparisons of taxa identified within each operation.

CHAPTER 2. HUMAN-ANIMAL INTERACTION IN CITIES: RELATIONAL TRAJECTORIES IN HUMAN-MODIFIED ENVIRONMENTS

Humans, like all other living organisms, are deeply enmeshed in networks that include all the other species within their environment. Therefore, it should not be a surprise that hominids have been interacting with animals since even before the earliest beginnings of our species. Interaction with other species is one of the key environmental pressures that influence evolution. Unique to humans (and especially modern humans) is the depth and breadth of these interactions, and therefore the degree that they affect our biological and cultural evolution and those of the animals within our habitats.

Different categories of human settlement foster different types of interactions with animals. For example, people living in a modern hunter-gatherer camp are certain to have predator-prey type relationships with animals and may live in close association with commensal animals (that is, animals which are neither domesticated nor under direct human control, but which nonetheless share the human environment and are acclimated to human presence), tame animals, or some domesticates, but are very unlikely to have close relationships with animals used for meat or agricultural labor. People living in cities, on the other hand, are certain to encounter commensal animals in their daily lives and likely interact with domestic or tame animals kept as pets. They also rely on products derived from animals kept for meat, secondary products, and labor, although few people living in the city have interactions with these animals other than their products.

Human alterations of the environment can be either of short duration or long-lasting and can have an influence on other organisms that are co-inhabitants (Odling-Smee et al. 2003:28).

Humans have been so successful and extensive in creating these changes that the present geological epoch is often referred to as the Anthropocene (cf. Braje and Erlandson 2013, Zalasiewicz et al. 2021). Global anthropogenic changes to the environment influence the evolution of all living things as well as other physical processes within that environment, and these changes in turn influence the course of human development. The distribution of humans is so broad and the scope of human action so extensive that the effects of humans on the environment have been felt in all regions of the globe (Boivin et al. 2016). Nowhere is this more evident than in the biomass of mammalian life, 36% of which is human and 60% of which is domestic livestock (Bar-On et al. 2018), leaving only 4% for all wild mammals. The intense human pressure from environmental changes is felt in over half of the range of 85% of terrestrial vertebrates and in all of the range of 16% of them (O'Bryan et al. 2020).

2.1 Niche Construction

Anthropologists have used many models to conceptualize the relationships between humans, their environment, and the animals in that environment. In the 1970s theories developed for evolutionary ecology were applied to human foraging behavior in the beginnings of a theory of human behavioral ecology (Dyson-Hudson and E.A. Smith 1978, Winterhalder and E.A. Smith 2000). This theory, and its variants, has been widely used to explain subsistence strategies and human interaction with the environment. Subsequently, R.C. Lewontin (1983) proposed that organisms not only respond to their environment, but are active participants in constructing their own niches, an observation constituting the beginning of niche construction theory. Niche construction theory addresses many of the shortcomings of human behavioral ecology, such as its assumptions that adaptations always result from a "scramble" for resources, that sedentism is an expensive last-ditch strategy, that diversification of resource use always emerges from resource depression brought about by intensification, and that populations always engage in "optimized" behaviors (Zeder 2012a); it also allows for and foregrounds the impacts of agency on the part of the niche constructor (Ammerman in press). Niche construction provides an especially helpful framework because it allows us to consider a complex image of the multiple interactions that an organism has with its environment, rather than a simplistic view of organisms merely competing to extract resources from that environment or adapting to external pressures exerted unidirectionally by the environment (that is, the process of natural selection in isolation).

Many organisms modify the attributes of their physical surroundings, and oftentimes these modifications affect other organisms that share their ecosystem. Niche construction theory recognizes the active role that organisms play in the process of the evolution of their population and how one organism's modification to the environment to benefit itself will also impact the relative evolutionary fitness of other organisms (of its own species and of other species) that share this modified environment. According to this way of conceptualizing evolution, the adaptive paths of species that share an environment are intertwined (Laland et al. 2000). This co-species influence occurs not only through direct interaction (e.g., the food-prey pathway), but also through abiotic intermediaries (Laland and O'Brien 2010). As an example, when some factor causes a large-scale disruption in a forest (e.g., a fire—an abiotic intermediary) certain species are more suited to the open environment created and provide pioneer growth. These pioneer species create a habitat that is more conducive to other species by providing shade, nutrients, and improved water retention, and eventually (perhaps not for many years or even centuries) the forest returns to a state akin to that before the disturbance. One of the most common and integral abiotic intermediaries is water, the availability of which might be altered by the niche constructing activities of any number of organisms. For example, beaver dam construction can create impoundments where none were before, serving as the basis for whole aquatic ecosystems. In the study of human-animal interactions, the foremost consideration is how the niche construction of humans affects the evolutionary trajectory of other animals (for example, the well-known example of the color changes in populations of peppered moths in Britain in response to environmental changes caused by industrial pollution; Majerus 2009) and how other animals construct niches to adapt to the human-perturbed environment (for example, use of human infrastructure as nesting sites for birds).

Although modern humans are extraordinarily adept niche constructors (Boggs 2016), our ancestors also practiced niche construction, although less intensively. The degree of niche construction of early hominins, such as *Australopithecus*, fell within the range of other mammals, whose niche construction may be either intentional or unintentional. The ability of *Homo erectus* to control fire beginning approximately one million years ago (Berna et al. 2012) was an early innovation which allowed large-scale hominin influence on the environment of other animals. The use of fire not only protected these hominins from predators, but also provided them with a method for hunting and for habitat modification. During the Pleistocene, niche construction (e.g., through construction of shelters and wearing of clothes) allowed hominins that had evolved in the warm climate of Africa to survive in the cold habitats of Europe and Asia.

As hominins became more proficient hunters, the hunter/prey relationship was an environmental factor that shaped the relative reproductive success, and thereby the evolutionary trajectory, of non-human animals. With the onset of the Holocene, approximately 12,000 BP, increased human population and changes associated with the nascent Neolithic such as new technology (e.g., more complex tools and construction techniques), domestication of plants and animals, and cultural knowledge on more efficient extraction of resources, created an even larger environmental pressure (cf. Laland and O'Brien 2010:315-318, Ruddiman 2010:95-96). Since the onset of the Holocene, human relationships with other species have changed both in terms of number of species involved, populations of animals, and closeness of the interactions. All of these relationships alter the long-term behavioral patterns (and often morphology) of the species involved, including humans, and have the potential to influence their evolution. These relationships between humans and animals are characterized by the animals using a survival strategy that relies upon human niche construction. There are other relationships between humans and animals, such as predation and parasitism, but in these cases the animals' survival strategy is not necessarily based on an interface with human niche construction.

To become better adapted, organisms either change to better survive in their environment, or change their environment to better fit their survival requirements. Evolution occurs when these changes are passed down through a sufficient number of generations that the change becomes a permanent part of the species. The first publication on natural selection, by the Linnean Society of London (On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection), included a paper by Alfred Russell Wallace (On the Tendency of Varieties to Depart Indefinitely from the Original Type) and excerpts from previously unpublished letters by Charles Darwin originally written in 1844 and 1857 (Darwin and Wallace 1858). Darwin, in his *On the Origin of Species*, initially published in 1859, proposes that changes in species come about due to the accumulation and preservation of small changes of natural variation that are advantageous and the rejection of those that are harmful via the process of natural selection (Darwin 1859). Given that organisms are in competition for limited resources available in their environment, the better-adapted individuals, no matter how small the advantage, are more likely to be in the group of survivors and to pass on their traits to their offspring. Natural selection can only cause divergence of species if natural variations occur, and if these variations are heritable to the offspring (Darwin 1859). Although Darwin understood that traits could be passed down from one generation to the next, *On the Origin of Species* was published several years before Gregor Mendel presented his work on heredity, and several decades before it became widely known. Therefore, it was up to others to join these two concepts to result in the birth of the modern understanding of the theory of evolution (Huxley 1942).

In general, niche construction involves the changing of the environment (either intentionally or unintentionally) by an organism to better meet its survival needs (Lewontin 1983). The niche construction theory fills a gap in the theory of natural selection, but still falls within the broader Darwinian sense of evolution and survival of the fittest. In niche construction theory, the organism that is most fit may be the one that is best able to alter its environment in a manner that enhances its survival (or impedes the survival of competing organisms). Niche construction is not always an activity that requires mobility, or even thought, on the part of the organism that is constructing (cf. Day et al. 2003).

Niche construction started to occur almost as soon as there was life on earth. An early example is the creation of free oxygen in the atmosphere through the process of photosynthesis carried out by cyanobacteria (Laland and O'Brien 2010), an event beginning about 2.5 billion years ago (Schopf 2014). In this event, the oxygen produced as a byproduct of innate cellular processes on the part of cyanobacteria was toxic to much of the surrounding anaerobic biota, triggering the conditions for a fundamental shift in evolutionary trajectories toward the eukaryotic life which dominates the planet today (Gross and Bhattacharya 2010, Schopf 2014).

Oftentimes, as in the case of cyanobacteria, changes are inherited by subsequent generations. In this manner, the parent organism passes to its offspring not only the genetic code that predisposes it to adjust its environment via niche construction, but also the ecological inheritance of the altered environment (Laland et al. 2000). For more cognitively developed organisms, there is another type of possible inheritance, the learned behaviors of the group. In this mode of inheritance, the parent (or other members of an older generation) passes knowledge to the younger generation through cultural learning. Applied to humans, B.D. Smith (2011) calls this cultural niche construction, but, as noted by Nicol (2006), this variety of niche construction can also be observed in many animals, such as tool use in chimpanzees (Watts 2008), birds learning songs (Aplin 2019), and ungulates learning migration paths (Jesmer et al. 2018).

Niche construction sometimes has only a very small effect on other species, such as that from a single small bird building a nest in a large tree. The nest provides a warm place for the bird to incubate its eggs, a platform to prevent the young chicks from falling, and perhaps camouflage to hide the parent, the eggs, and the chicks from predators, but it does little to perturb the host tree or the environment around the nest. In some cases, niche construction can have a direct influence on other species. When a colony of ants establishes a mound, it will frequently denude the surrounding area of all vegetation. In other cases, niche construction can have an indirect influence on other species through an abiotic intermediary. The cyanobacteria example above is one case of this, where the oxygen is the abiotic factor. A shorter-term example is the alteration of the riparian environment caused by a beaver dam. In this case, the water is the abiotic intermediary that floods and kills nearby standing trees, provides an environment for aquatic plant and animal growth, and creates a habitat for a host of terrestrial plants and animals to utilize. Other examples of niche construction include allelopathy, creating of shade, accumulation of detritus, making of cocoons, digging of tunnels/burrows, creation of wallows, herd grazing, creation and maintenance of pathways, use of tools, wearing of clothing, building of structures, and many other behaviors. As can be seen from the examples above, niche construction is carried out by many kinds of organisms and is far from uniquely human.

When animals, including humans, undertake niche construction, they are often attempting to moderate environmental fluctuations. Whether this is building a nest to conserve body heat, adjusting air flow to cool their habitation, or storing food, the purpose is to allow energy spent during times of plenty to be returned during times of shortage (Laland and O'Brien 2010). In other words, niche construction can be a type of intentional or unintentional resource management (or perhaps it is better to state that resource management is a type of niche construction). Human resource management initially focused on wild resources and preserving and storing of wild foods and is not so different from a squirrel storing nuts or a beaver storing branches on the bottom of its pond. In the case of humans, extension of wild resource management is a likely impetus for domestication, and therefore, domestication is an extension of human niche construction (B.D. Smith 2007).

Resource management in effect increases the carrying capacity of the environment, since the populations practicing it are accumulating surplus in times of plenty to use in times of shortage, thus allowing the environment to support a larger population by not being limited by the minimum availability of a given resource, but rather by a level approaching its average availability. In all instances, even the average level of resources is only enough to support a finite population, and as the population approaches the carrying capacity of the environment, competition for the available resources increases. For short periods of time, it is possible for a given population to exceed the carrying capacity of the environment, but this will result in subsequent die-off, unless additional resources are added (or previously unusable resources become usable—actually a change in the environment and its carrying capacity). Resource augmentation via the addition of new resources or development of new technology to extract previously unusable resources, is generally a type of cultural niche construction that is practiced mostly by humans, although animal tool use and learning to eat human-supplied food are non-human examples.

From the human point of view, domestication is an example of resource augmentation. Humans cannot directly extract energy from the sun or nutrients from the soil, so we rely on plants (or animals that eat plants) as a means of getting these necessities. Domestic plants allow us to extract more energy and nutrients from a given area than is possible with wild plants because the process of domestication has modified them to increase the expression of traits which are most compatible with human exploitation. Dedicating an area of soil to the exclusive growth of a preferred domestic plant increases the extractive potential of that area of soil because less of the soil nutrients are being utilized by non-preferred species. Domestic animals provide us with a readily available means of extracting energy and nutrients from plants that we are unable to extract directly. They also provide a way to store that extracted energy so that it can be used when it is more beneficial (a notion sometimes referred to as the "walking larder" [cf. Clutton-Brock 2014]).

When human niche construction alters the environment, the animals that were exploiting the unaltered environment can either migrate away from the area of alteration in order to continue their previous behaviors or utilize it as a means of resource augmentation. This latter approach is optimized through the use of cultural niche construction on the part of the animals to learn new behaviors or adapt existing behaviors to the new environment and pass down these changed behaviors to their offspring. Continuation of this cultural niche construction eventually differentiates the groups of animals that are exercising it from those that are not and one pathway to domestication (cf. Zeder 2012b) can ensue if exploitation of this new habitat also leads to an evolved reduced fear of humans. Reduced fear of humans may have an evolutionary advantage in this environment due to increased foraging efficiency.

Humans perform many different kinds of niche construction, often simultaneously. This leads to heavily human-modified environments surrounding areas of concentrated human settlement. Human niche construction has increased exponentially over the last 10,000 years due to the advent of agriculture, sedentary populations, population growth, and eventually urbanization. During this period, the more sedentary the people, the more their presence resulted in modifications to the environment, because a transitory population allows the environment to change back towards its previous state after the humans have moved away. The culmination of this process is the development of urban areas, where overlapping niche constructions create a landscape where nearly all areas have been modified. Even in this environment, human relationships with animals continue to flourish. These include relationships with wild animals that share the human environment (e.g. rats), wild animals that are brought into the environment (e.g. circus animals), domestic animals (e.g. pet dogs), and domesticates which have formed independently breeding populations outside of human control (that is, feral animals, e.g. free-ranging dogs in India).

2.2 Categories of Human-Animal Interaction

There are several paradigms under which humans and animals can interact, with varying degrees of closeness/control/benefit: relationships for various purposes with wild, commensal, tame, and domestic animals (Ammerman in press). The boundaries between different types of relationships are generally fuzzy and frequently overlap, but the sections below will discuss the more prevalent categories of these relationships.

2.2.1 Relationships with Wild Animals

2.2.1.1 Predator/Prey Relationship

The most obvious relationship between humans and wild animals is the predator/prey relationship. This is also a common relationship between animals of different species in the wild and frequently forms our species' baseline for interaction with other animals. For modern humans, this relationship almost exclusively has humans as the predator, but this was not necessarily the case for early humans. The general parameters for this type of relationship are obvious—individuals of one species are attempting to kill and consume individuals of the other. In the simplest interpretation for the evolutionary pressure of this scenario, the prey individuals that are most adept at escaping predation and the predator individuals that are most adept at catching prey are the ones most likely to pass their genes on to subsequent generations. If the reason for their individual success is a heritable trait, this leads to enduring changes in the distribution of traits within the population, the building blocks of evolution. For human-animal relationships of this type, the primary driver would be for the acquisition of food, but non-edible (or less-edible) parts of the animal may also be used for other purposes, such as hides for clothing or bones for tools.

2.2.1.2 Gathering of Wild Animal Products

Sometimes the acquisition of animal products does not involve killing of the animal that produced them. Examples of such products include wild honey, ambergris, guano, animal fibers, and shed antlers. The prevalence of this type of animal product could have been a factor in the choice of locations for human habitation or foraging, especially when these goods are socially or economically valuable.

2.2.1.3 Utilization of Wild Animal Niche Construction by Humans

Humans at times take advantage of the niche construction of wild animals. This was probably truer in the past than it is now, when humans have become such adept niche constructors that we no longer need to utilize the niches that other animals have created. Examples include utilization of animal trails for paths (Haynes 2006, Keil 2020), beaver dams as a means to cross streams (Brazier et al. 2021), wallows as a source of drinking water, nests as a source of tinder, and beehives for honey (Demps et al. 2012, Dunne et al. 2021).

2.2.1.4 Human Niche Construction Impact on Wild Animals

Normally, when we think of how human niche construction affects wild animals, we gravitate toward habitat destruction. There are also instances where human niche construction has provided an improved environment for a wild species. For example, structures built by humans which modify the environment for their own shelter or convenience (e.g. buildings and bridges) can provide ideal shelters and nesting sites for birds (such as barn swallows) and bats. The elimination of large predators (other than humans) creates an environment that is beneficial to large prey animals. Sometimes this benefit is so profound that there are population explosions with subsequent detrimental effects, as in the overpopulation of white-tail deer which has dramatically altered many eastern US forests (Pendergast et al. 2016).

2.2.2 Relationships with Commensal Animals

Commensal animals differ from wild animals in that they live in close proximity to humans, and as a result, have lost much of their fear of humans. In order to be truly commensal, they also must be taking advantage of the human niche construction. Many populations of commensal animals are so well adapted to the human environment that their population and range has dramatically increased, such as the nearly ubiquitous brown rat.

2.2.3 Relationships with Tame Animals

The use of tame animals is a clear indication that humans can benefit from an association with that species, therefore suggesting that it would be desirable as a domesticate. However, some tame species have had a long period of living under human control (e.g., elephants, cheetahs, falcons), but have not become domesticated in the sense that their reproduction is not under human control. Nevertheless, these animals have often become fixtures within human societies, and the specialized infrastructure needed for their keeping can constitute a major investment.

2.2.4 Relationships with Domestic Animals

Domestic animals are used for many purposes. The primary driver in the initial domestication of animals (except for the dog), was probably for use as a source of food, and this is still the way that many of our most common domesticates, such as chickens, cattle, and pigs, are frequently used. Domestic animals are also used for reasons other than as a source of primary bodily products (that is, meat, hide, and bone). The use of these secondary products (Sherratt 1981) encompasses the capacity to use animals as tools, providing traction (e.g., horses, oxen) or assisting in hunting (e.g., dogs). Other secondary products are products of an animal's natural biological processes, such as wool or milk, but do not typically require the killing of the animal for humans to access them. Many other domesticates are used primarily as pets for emotional support and companionship or just for novelty. Some species, or individuals within species, can supply multiple of these functions, and the function that they provide can change during their lifetime. Domestic animals usually live in close proximity to humans, and generally have a lower fear of humans than other categories of animals with which we interact. To better understand how the relationship between humans and domestic animals developed, it is necessary to look at the various processes and pathways by which the relationship of domestication unfolds.

2.3 Process of Domestication

To understand how the human/animal relationship of domestication has evolved, it is important to examine how it began. Other than dogs, current archaeological research suggests the domestication of animals began after humans had become at least partially sedentary and began domesticating plants in the early part of the Neolithic. Melinda Zeder (2012b) describes three pathways to domestication: commensal, prey, and directed. Commensal domesticates include the dog, cat, pig, Guinea pig, golden hamster, chicken, duck, and turkey. Prey domesticates include the Old World bovines, caprines, and ovines and New World camelids. Directed domesticates include the horse, donkey, Old World camelids, buffalo (American bison), ferret, mink, silver fox, chinchilla, emu, ostrich, and fish (Zeder 2012b). In all pathways to domestication, the process takes place over many generations and within the context of human niche construction.

Our increasingly close connection to animals through the process of domestication is one of the most significant developments of the past twelve thousand years of human history. The early domestication of herbivores (sheep, goats, cattle, and pigs) roughly corresponds with the beginning of plant agriculture. Our connection with animals has had major repercussions on ancient and modern societies, as well as being a principal factor in the transformation of the Earth’s climate we think of as the Anthropocene (cf. Ruddiman 2010:5, Shipman 2010).

2.3.1 Commensal Pathway

Commensal domesticates are animals that became domesticated via a process of habituation. These species, for one reason or another, originally became associated with humans not through human agency, but by their own intent (Price and Hongo 2020).

In the commensal pathway to domestication, animals maintained close physical proximity to humans with no coercion on the parts of the humans; no enclosures or capture devices were used. There were, however, at most a few locations where this kind of domestication took place, out of all the possible locations where the wild progenitors of commensal domesticates were in the vicinity of humans. Was there something unique about the particular group of animals that continued down the commensal pathway to domestication, or was there something unique about the group of people that took advantage of the animals' choice to stay nearby? Were there other initiations of domestication that failed and did not progress far enough along the pathway to be evident in the DNA of modern domesticates or the archaeological record? For a commensal animal to become a commensal domesticate there must be a desire on the part of the humans that are in contact with the animals to advance the relationship (Price and Hongo 2020). If the humans do not obtain a benefit from the emergent commensal relationship, the commensal pathway to domestication will not be followed to completion, but the relationship will remain commensal.

It is not too difficult to imagine how the commensal pathway to domestication could have unfolded because we have many animals today that are at least taking the initial steps along this pathway (in the sense that they maintain close proximity to humans without direct human input). Nowhere is this truer than in modern exurbs with relatively low housing density. In these regions, there is ample cover for animals but also a plentiful supply of food in the form of enhanced foliage, garbage, food placed out for already domestic animals, and purposeful feeding of desirable wildlife such as birds, the presence of which may be considered aesthetically appealing and therefore be actively encouraged. In the case of the white-tailed deer, this commensal animal takes advantage of both the ample cover and the plentiful food supply. In the case of the commensal coyote, the dynamic is slightly different: The benefit of the cover is direct, but the benefit of the enhanced food supply is two-fold, as some of it is directly consumed by the coyote, but it also attracts other animals that can be prey for the coyote. Both species have benefited from the human removal of large predators (wolves, mountain lions, and bears).

2.3.2 Prey Pathway

For prey domesticates, the domestication process followed from the niche construction activities of selective hunting and game management, which are methods of resource augmentation. It is possible that this domestication was a response to prey scarcity, caused by overhunting (Marom and Bar-Oz 2013) or possibly by non-anthropogenic changes to the environment such as natural climatic variations. Animals that archaeological evidence suggests were domesticated via this pathway include goats, sheep, cattle, New World camelids, and reindeer (Zeder 2012b), and in some respects, pigs and horses (Price and Hongo 2020, Olsen 2006) may also fit into this category. Of the many animals that were hunted from the early Neolithic until the present, only a few followed this pathway to domestication. Obviously, there was something distinctive about the species of prey domesticates that led to their being domesticated, and some aspect of the other prey animals that kept them from being domesticated. For instance, none of the many species of cervids or antelope were domesticated in antiquity, although many of them are herd animals in the size range of other prey domesticates, which could have made them targets for domestication. Their increased tendency toward panic when frightened may have been a substantial factor that kept them from becoming domesticated (Price 2002).

2.3.3 Directed Pathway

After initial domestication provided evidence on the economic and social benefit as well as the relative cost of keeping domestic animals, many other animals were domesticated via the directed pathway. This is the only method of domestication that starts with a deliberate act by the domesticators, with the end goal being envisioned. Animals were domesticated not only as sources of food, but for other benefits that they could supply, such as transportation or traction (horses, donkeys, dromedaries), furs (mink, chinchillas), and fibers (silkworm) (Larson and Fuller 2014). In this pathway, it is more difficult to see the role played by the animals, but considering all the wild animals that could provide benefit and the relatively small number of species that have been domesticated it is most certain that the choice of domesticates was not entirely up to the human domesticators (Ammerman in press). This differential is predicated on how well the animals are able to adapt within the context of environments that are heavily altered by human niche construction.

2.3.4 Natural Selection vs Artificial Selection

In the commensal pathway to domestication, initially natural selection is taking place and the individuals most adept to survival within the human-modified environment are the ones that most likely will pass on their genes. As the domestication process proceeds down this pathway, humans begin to have more control over the breeding and natural selection gives way to artificial selection. For the prey pathway, herd management processes at the beginning may or may not play a role in the selection of breeding partners. Natural selection with the fitness driver of being able to adapt to the human-controlled environments near human habitations is also likely at play.

Just as in the commensal pathway, as the domestication process proceeds, humans begin to exercise more control over selection of breeding stock. The directed domestication pathway usually has more artificial selection from the beginning, with selection being driven by traits that are most useful to humans, not necessarily based on fitness to survive in the natural environment.

Once domestication is established, humans generally exercise a great deal of control over the selection of which animals are allowed to pass on their genetic material (that is, artificial selection). One aspect of this is the establishment of breeds of domestic animals. In one location or among one segment of society certain characteristics may be more valued, and selection for those characteristics above others will lead to differentiation in the lineage. Within the relatively short span since the first domestications, we have seen that human selection has created breeds with vastly different characteristics (e.g., the Chihuahua and the Great Dane). If there were not intermediate forms, the small likelihood that these breeds would hybridize would prevent their genetic material from mixing and eventually they would likely be recognized as separate species (although true speciation requires many generations of separation).

2.4 Success of domestication

From examination on a species level, it is hard to argue that domestication has not been extremely successful for animals. There are currently approximately1400 million domestic cows (FAO 2017), while their wild progenitor, the aurochs (*Bos primigenius*), is extinct (Felius et al. 2014). There are currently approximately 1200 million domestic sheep, while their wild progenitor, the Asiatic mouflon (*Ovis orientalis*), is listed as vulnerable by the International Union for Conservation of Nature (IUCN 2016). There are currently approximately 1000 million domestic goats, while their wild progenitor, the Asiatic bezoar (*Capra aegagrus*), is listed as vulnerable by the IUCN. There are currently approximately 1000 million pigs, and their wild progenitor (*Sus scrofa*) is also doing well in much of its traditional range, but has been driven to extinction in other parts (e.g., the British Isles) (Oliver and Leus 2008). In addition, there are approximately 21 billion domestic chickens worldwide (FAO 2017)—a tremendous success story. Overall, the biomass of domesticated animals far outweighs that of all wild vertebrates (Boivin et al. 2016, Bar-On et al. 2018).

In terms of resource augmentation, the domestication of animals has resulted in an approximately four-fold increase in the total biomass of mammals (Bar-On et al. 2018:6508). Since much of this biomass is directly managed by and accessible to humans, it is readily available for consumption and use, a dramatic success of human niche construction. Having readily available accumulated resources is essential for the formation and continued existence of cities, where the large number of inhabitants depend on access to food even if they are not directly engaged in the creation of food resources.

2.5 Human-Animal Relations in Urban Areas

Cities constitute a created environment that has been so dramatically transformed by human niche construction. This transformation may be so complete that it is difficult to assess the character of the underlying "natural" environment. As humans gather together in larger and larger populations and change the landscape through infrastructure like buildings, walls, and roads or environmental alterations such as the conversion of large areas to agricultural fields to support growing cities, the parameters of the habitat that the animals that were living in that area had become adapted no longer exist. If those animals continue to be present, they must adjust to living in this human-altered landscape. Archaeologically, it is expected that any faunal remains recovered from cities are from animals that were living in some association with humans, whether they were hunted prey, domesticated sources of subsistence, animals used as tools or sources of secondary products, or commensal animals. Evidence of a society that is supplementing its economy via hunting would be expected to include faunal remains from a variety of wild taxa, although the mere presence of wild animal remains in archaeological sites is not necessarily in itself evidence of hunting, as wild animal remains may enter the assemblage as novelties with limited economic value or as intrusive taphonomic agents. Because the areas surrounding cities are so heavily altered by human niche construction, these hunted taxa will likely be living within the greater sphere of human modification. On the other hand, a society with a meat economy based solely upon eating domestic animals will leave behind faunal remains from meat-producing domestic species, such as pigs, goats, sheep, cattle, and fowl and very little from wild animals. Many of these species could also be present due to secondary products in a society that was not using these domesticates for meat (pigs being a likely exception). In a society where people avoid the consumption of meat, the likely faunal remains are from animals that are useful for secondary products (e.g., traction, milk production, fibers). Since many domesticated animals can be used for both meat and secondary products, distinguishing between these last two economies requires more than simple identification of species. Faunal remains from animals used for meat are likely to include butchery marks, have a lower average age at death, and be more plentiful than animals used solely for secondary products (a person might collect the eggs from a laying hen for many years, but might also kill and consume many chickens during that period of time).

Even within an urban environment, there will be animals, such as many different kinds of lagomorphs, rodents, reptiles, birds etc., that have adapted to live within the anthropogenic environment. These animals are to a greater or lesser extent commensal. Manicured lawns provide excellent feed for rabbits and hares while shrubbery provides an excellent hiding location. These lawns and shrubs also provide excellent locations for insects which attract lizards and birds. Grains and garbage provide food for rats, which are much more abundant within human modified spaces than in natural settings. Fruit, seed, and nut trees provide an excellent habitat for squirrels (and monkeys). Human dwellings provide both food and shelter for mice. The dwellings can also provide nesting sites for birds. No matter what the economy of the humans living in the city, one would expect faunal remains from these animals to be represented within the archaeological assemblage. Although these animals are not always directly managed by human actions, they form a meaningful part of the ecosystem of an urban environment. Some commensal animals, such as jackals, rats, and carrion eating birds, are also often taphonomic agents, altering the distribution of faunal remains after they have been deposited by humans.

2.6 Summary of Human-Animal Interaction

The dynamic environment has both structured and been structured by the relationships among organisms, particularly in the case of human-animal interaction. Up until approximately 200,000 BP the non-human animal environment exerted a larger influence on the development of humans than the human environment did on the development of other animals (so much so that the human and non-human environment could even be considered indistinguishable). There is little evidence that even human control of fire initially had any outsized influence on the overall environment (although the presence of fire within a human setting may have provided some degree of protection for the humans) or the evolutionary trajectory of other species. In the period from 200,000 to approximately 40,000 BP or maybe even until around 12,000 BP there was a nearly equal dialogue. In more recent times, human niche construction has had a greater influence on animal evolution than the other way around (but there is still some animal influence on human evolution, e.g., through the increased prevalence of lactase persistence—the ability to digest milk products beyond childhood—in some populations; Gerbault et al. 2011).

There are many ways for humans and animals to co-exist other than merely a one-way trajectory in which humans purposely induce changes on the animals to fit their own needs or designs. As past interactions between humans and animals cannot be directly observed, we must rely on archaeological proxies to assess the past trajectories of domestication. Among them are such diverse indicators as changes in kill-off patterns, changes in diet, changes in faunal assemblages, changes in range, changes in morphology, and changes in genotype. An understanding of the factors that can lead to this archaeological evidence helps archaeologists better define the process of domestication.

The Darwinian theory of natural selection states that in a changing environment, species will either evolve to better fit within these new sets of constraints or else become marginalized (Darwin 1859). In this sense, evolution does not necessarily imply the aggregate mutations of DNA resulting in completely novel traits, but could also be the result of certain groups of extant genes becoming more common. The world's environment has been undergoing constant change since the formation of our planet, but the rate of change within the late Holocene or Anthropocene has been higher than in most previous epochs (Braje and Erlandson 2013). Niche construction theorists would argue that these changes in environments which are caused by living organisms are just as important to evolution as natural selection. "There are in fact two logically distinct routes to the evolving match between organisms and their environments: either the organism changes to suit the environment, or the environment is changed to suit the organism" (Odling-Smee et al. 2003:18). Indeed, niche construction and natural selection can be seen as forces which are constantly influencing each other to mediate the relationship between an organism and both the biotic and abiotic factors in its environment.

Cities are particularly good places to study the dynamics between environments, humans, and non-human animals because of the extensive niche construction that characterizes them and the wide variety of ecological entanglements that occur there. Because cities are a relatively new phenomenon in evolutionary terms, most of the changes which have taken place in animal communities to adapt to them are through niche construction and genetic drift rather than through accumulated mutation. Cities are environments that are continuously in flux, with their form and population subject to change from social and environmental factors. This constant change means that the inhabitants of cities might have many different kinds of relationships with animals over the period that an urban area is occupied. These shifting symbioses ensure that both humans and animals are likely to use a variety of strategies in order to mutually benefit.

The Early Historic Period in South Asia provides particularly good examples of cities where many different kinds of human-animal interactions take place. South Asia is home to a rich diversity of animal species, including both wild animals native to the subcontinent and, by the time of the Early Historic Period, a wide variety of domestic animals. As people came together into urban configurations, each of these species had to adjust to the emergent landscape of the city. These negotiated relationships were further complicated by social changes occurring in South Asia at this time which altered people's perceptions of ideal human-animal relationships. As humans and non-human animals interacted in these urban spaces, they were iterating on and continuing the trajectories of the ecological relationships which had been previously established. Taking these relationships into account when conducting any analysis of the human-animal interactions in ancient cities provides a rich background and contextualizes the ecological and evolutionary importance of these interactions.

CHAPTER 3. INTRODUCTION TO THE EARLY HISTORIC PERIOD IN SOUTH ASIA AND SISUPALGARH

The Early Historic Period in South Asia saw a fluorescence of urban forms (Ghosh 1989:131, Dhavalikar 1999:72-74, Smith 2006, Behera and Chattopadhyay 2013:124, M. Lal 2014:458-498, Sawant and Shete 2016:319). Although each of the many cities emerging in this time period had features unique to its particular cultural and environmental context, there are some features which appear repeatedly in Early Historic cities which allowed them to serve as centers of a complex web of social and environmental realities. The social, ideological, economic, and ecological changes from a pre-urban society to one with cities result in a corresponding change in how people perceive and utilize animals.

The accepted chronology for what is called the Early Historic Period of South Asia varies in relation to the perceptions of its onset. I apply this term to a period between 600 BCE (Dhavalikar 1999:1) and the third or fourth century CE that corresponds to the increased urbanization of this period in the Gangetic Plain in northern South Asia often mentioned in the earliest written sources (exemplified by, but not limited to, the sixteen emergent city-states or nations known as the Mahajanapadas; Ghosh 1989:130-131, Dhavalikar 1999:1). The Early Historic Period, by this definition, contains the development of Shramanic religious movements such as Buddhism and Jainism, sometimes described as "heterodox" relative to Vedic "orthodoxy," and the great expansion of Buddhism throughout South Asia during the Mauryan period. The Mauryan period, corresponding to the reigns of the Maurya rulers Chandragupta, Bindusara, Ashoka, and their descendants (322-184 BCE), also provides us with the earliest legible inscriptional evidence from South Asia. This evidence occurs in the form of rock-carved edicts widely distributed throughout much of the subcontinent (Gillespie et al. 2016). The wide distribution of these edicts has been modeled as representing a system of loose influence and asymmetrical control of territory by the Mauryan polity (Sugandhi 2013). The Ashokan edicts are the oldest extant complete documents from this region (Agrawal 2014), so some scholars (e.g., Chakrabarti 1999:263, Smith and Mohanty 2016) may define the date of their creation as the beginning of the Early Historic Period. However, defining the beginning of this period at the earlier date allows the inclusion of the urbanization and ideological innovation that contextualize the developments that followed (Ghosh 1989:130, Dhavalikar 1999:1, Singh 2009:257). Many of the earliest texts, while not known to have been written down as early 600 BCE, discuss the events of this time period (e.g., the life of the Buddha) and may have been transmitted orally from that time.

3.1 Beginnings of Urbanism

During the Early Historic Period of South Asia, people formed urban centers when they moved from dispersed agricultural village sites to concentrated locations usually surrounded by impressive fortifications of ramparts and moats (Ghosh 1989:131, Chakrabarti 1999:279-290, Dhavalikar 1999:72-94, Coningham and Young 2015:354) by around the eighth to sixth centuries BCE (M. Lal 2014:472). By modern standards these locations were not large cities, but they had all the hallmarks of developed urban centers. V. Gordon Childe describes ten characteristics which can be used to identify cities in the archaeological record (1950). These are:

1. They have large populations and high population densities.
2. They employ full-time specialists (e.g., craftspeople, priests, administrators).
3. There exists a centralized system for collecting surplus production.
4. They include monumental public structures.

5. They exhibit a social elite.
6. They use a system of record keeping.
7. There is an understanding of and investment in math and science.
8. There is sophisticated art.
9. They establish a wide trade network.
10. Membership is based on place rather than family ties.

Yoffee and Terrenato (2015), while acknowledging the difficulty and arbitrariness of compiling such a list of traits, compile a similar list of ten features shared by cities based on qualities identified by scholars in a variety of disciplines:

1. Cities are permanent settlements that are large in area.
2. They have quite a few people who live closely together.
3. They have bureaucracies who keep track of people and things leaving and entering.
4. They have a center with impressive architecture that affords and/or restricts political, social, and/or ideological activity.
5. They feed people with foodstuffs produced in the related countryside or with imported produce.
6. They acquire, through long-distance trade, luxury and utilitarian goods.
7. They provide a sense of civic identity.
8. They provide arenas in which the rulers demonstrate their special connections to the high gods and the cosmos.
9. They are containers of potential social drama and discontent among various competing/cooperating social groups and their leaders.

10. They create and incubate significant environmental and health problems.

While not all of these traits may be present in every city globally or at all phases of urban development, the urban centers of the Early Historic Period do seem to have exhibited many or all of these characteristics. They were much larger than the surrounding villages; there were specialists in religious practice and craft production; the presence of monumental public structures indicates that there was a centralized means of collecting surplus; there was a ruler and a system of writing (evidenced by stone inscriptions) that could be used for record keeping; the regularity of the construction indicates an understanding of math and science; examples of sophisticated art; the widespread prevalence of certain forms of material culture suggest established trade networks, or at least long-distance links; and the ramparts present at most of these urban sites are an indication of an “insider vs. outsider” mentality, suggesting a sense of community. Early Historic urban centers were also characterized by mud and fired bricks for construction, the appearance of punch-marked silver coins, private and public water management works, standard weights and measures, and textual accounts and sacred texts (Basak 2016). Cities formed the main nodes of networks which also comprised town- and village-sized sites (Dhavalikar 1999, Coningham and Young 2015:354), with the largest cities such as Kausambi, Taxila, and Rajgir acting as capitals of early regional states or Mahajanapadas (M. Lal 2014:472). The political and economic stability generated by these growing urban networks likely had an overarching effect on all aspects of urban life, including availability of and attitudes toward different foods.

3.2 Urban Form

During the Early Historic Period the capitals of the Mahajanapadas became urban and developed an urban form. Many of these cities included fortifications in the form of ramparts and moats. The local geography of the sites often dictated the form of the city, but certain features appeared to be desired or standard.

The *Arthashastra*, a political treatise dating to the Early Historic Period which comments on ideal forms of governance (see Chapter 6) offers clear guidelines for the construction of an ideal settlement, suggesting a square shape for the settlement, ramparts oriented with the cardinal points, a moat fed by a stream, an earthen wall built up with bricks, and roads arranged in a grid pattern (Olivelle 2013:103-107, Lal 1991).

Not all cities follow this general plan. For example, Kaushambi in Uttar Pradesh, due to its location adjacent to a river, is encircled by ramparts and a moat on only three sides (Pal 2014). The site of the Old City of Rajgir in Bihar also seems to eschew the rectilinear plan proposed by the *Arthashastra* in favor of conforming more closely to the topography of the hills among which it is built, while the somewhat later New City of Rajgir more closely follows an orthogonal layout (personal observation).

The monumental ramparts associated with urbanism in the northern part of the subcontinent represent the marshalling of a huge labor force toward a communal task. For example, the rampart of Kausambi encloses an area of 200 ha in a 6.44 km perimeter fortification (Davis et al. 2016). This pattern of monumental construction, repair, and aggrandizement was probably a competitive action to attract people to the city (cf. Coningham and Young 2015, Smith 2003).

Archaeological work has demonstrated that many of the sites developed from an already-existing smaller population, who appear to have coordinated the construction of an initial earthen barrier surrounding the site. Excavations at the site of Tilaurakot, for example, have yielded evidence of two early phases of palisade construction that suggest that the division between inner and outer space was a concern at the pre-urban stage, perhaps as a precaution against flooding of the nearby river. In later periods the initial earthen rampart was covered with bricks to create a more monumental wall, indicating the city was attempting to improve either its appearance or defensive capability (Davis et al. 2016).

A similar succession of construction of the defensive structures occurred at Kaushambi (Sharma 1960), the original wall of which was made of rammed clay that was later supplemented with stone. During the long history of occupation at Kaushambi, the rampart was augmented at least four times. In addition to the rampart, a moat was constructed around the city. These constructions took place over a long period of time (over 1000 years), indicating a continued effort to define the boundary of the city and continued investment in building and maintaining the urban space.

Although the intended function(s) of the ramparts and moats may have differed between sites, some proposed explanations are a defensive function, a symbolic boundary delineating the extent of the city, protection against natural forces such as erosion and flooding or incursions by wild animals, or symbolic rendering of the mountain range surrounding the universe (Paranavitana 1950, Davis et al. 2016). At any rate, walls crystalize the social moment of their creation by giving material form to the social, symbolic, and mental boundaries which motivated people to construct them (cf. Harmanşah 2013, Smith 2003).

3.3 Introduction to Sisupalgarh

Another political entity contemporaneous with the Mahajanapadas, but located south and east of the Gangetic plain in modern Odisha, was Kalinga. In some references, this polity is actually included as one of the Mahajanapadas (Sarao 2014). The seat of government for this region was the city of Kalinganagari (Sahu 1984). While the location of Kalinganagari is not known with certainty, the most likely site is the Early Historic Period urban center of Sisupalgarh.

Sisupalgarh is located about 2.4 km from present-day Bhubaneswar, in the state of Odisha (ancient Kalinga), India (see Figure 3-1). It existed as part of the emerging system of urbanism in the Indian subcontinent in the mid-first millennium BCE onward, and parallels can be drawn between this site and other locations in South Asia. Like the other urban centers of the Mahajanapadas, investigations at Sisupalgarh indicated that it had a central government (e.g. the kings and high officials mentioned by nearby inscriptions), examples of sophisticated art (such as the elaborate stone carvings at the nearby Udayagiri caves), an established exchange network (presence of coinage, non-local pottery), a rectilinear urban form similar to that suggested by the *Arthashastra*, and several phases of monumental rampart construction. The site appears to have been occupied in some form from the mid-first millennium BCE to the mid-first millennium CE (Smith and Mohanty 2016).

Sisupalgarh is located on an alluvial plain bordered on the east by the Daya River (a distributary of the Mahanadi River delta) and on the west by the Gangua streamlet and then a gently rising slope of laterite. The site is estimated to have at times reached a population of 25,000 individuals (Lal et al. 2014) within an area of approximately 130 ha within the rampart walls (Smith 2005) and extended "suburbs" (Smith and Mohanty 2016). Sisupalgarh's monumental architecture, which includes a circumscribing rampart with gateways and a moat, centrally located monolithic free-standing pillars, and stone-lined reservoirs are evidence for a significant labor investment and central organization. Geophysical survey revealed that a regular network of roads connecting the gateways divided the site into nine sectors of approximately equal size within the rampart (Mohanty and Smith 2007:7-9).

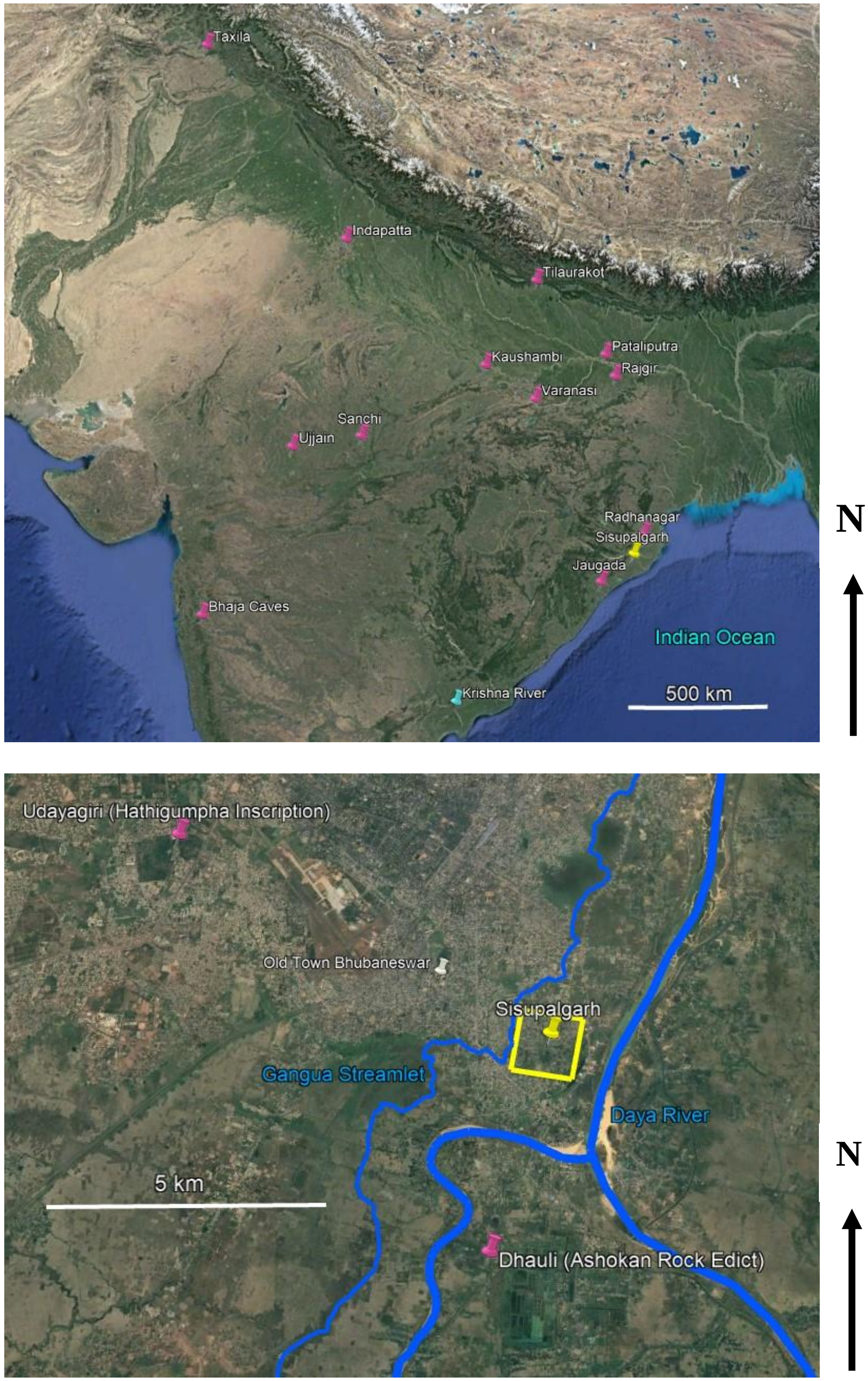


Figure 3-1 Locations of Sisupalgarh and other mentioned sites (Google Earth 2022)

The urban center is situated in relatively close proximity to two Early Historic inscriptions that associate it with local and distant rulers. The hills of Khandagiri and Udayagiri, eight kilometers northwest of the site, are home to the Hathigumpha inscription referring to the king Kharavela of the first century BCE. Four kilometers to the southwest of Sisupalgarh is Dhauli, a Buddhist site containing an inscription from Ashoka, the Mauryan ruler, dated to the third century BCE (Lal et al. 2014). The city offers strong correspondence to the ideal parameters for fortified cities described in the *Arthashastra* (Lal 1991).

Over the long period of Sisupalgarh's occupation, the large areal extent of the site and its extensive population ensure that the provisioning and expansion of the city would have had a substantial impact on the surrounding area, both in social terms (i.e. the impact that it had on the lives of people living outside the city in the broader region) and in ecological terms (i.e. the impact it had on the surrounding environment, plants, and animals).

3.4 Monumental and Public Architecture

Sisupalgarh's rampart measures about 1.1 km on a side and contains eight formal gateways (two per side), located at an equal distance apart (see Figure 3-2). The initial construction of this rampart was accomplished by piling the earth dug in the process of creating a moat surrounding the city (fed by the Gangua streamlet flowing along its western edge). The rampart was 33 m wide at its base and 9 m tall (Lal et al. 2014:620, Lal 1949:73). Within the ramparts, the entire area shows evidence of human manipulation of the landscape, with long roadways connecting opposite gateways in a grid-like pattern (Lal et al. 2014:625).

In the center of the site, there are fourteen monolithic laterite stone pillars that are still standing, indicating monumental construction of a large building. Excavations in the area revealed eighteen additional columns, possibly the supports of a monumental structure (Mohanty and Smith 2008). These excavations indicated a structure different in form and scale from the domestic structures of the site.

Other public structures within the site of Sisupalgarh are several stone-lined reservoirs, each about 25 meters square. In the center of the site, there is a circular reservoir 75 m in diameter (not stoned-lined) (Lal et al. 2014), providing access to water for the city's residents.

3.5 Residential Architecture

Within the cells of the grid formed by the roadways connecting the monumental gateways, the densely packed residential neighborhoods excavated at Sisupalgarh do not seem to follow a centralized or orthogonal plan, as houses varied in shape and size (Lal et al. 2014:623, Lal 1949:70). They sometimes have foundations of large laterite blocks which were likely supports for mud walls and roofs probably made of organic materials and perhaps tile (recycled tile has been found as paving material) (Lal et al. 2014:624). Open spaces around the domestic structures could have been used for many daily activities of production or leisure (624). Within the domestic neighborhoods, there were local square and ring wells that would have provided household water (623).

3.6 Allocation of Power and Labor

Decisions being made at Sisupalgarh on an everyday basis would have played out at various levels of organization ranging from the personal or household level to the neighborhood level to the very centralized level (Smith 2005, 2016). Each of these levels of decision-making manifests in different types of archaeological evidence. For example, there is strong archaeological and epigraphical evidence for the existence of a central authority at Sisupalgarh. Archaeological evidence of a central authority includes the regularity of the architecture and engineering of Sisupalgarh, the monumentality of the rampart and the central features, the structured streets, the uniformity of the pottery within each period, the successful provisioning strategies that point toward self-sufficiency, and the longevity of the city. The epigraphical evidence also lends support. The nearby Hathigumpha inscription (see Sahu 1984), dated to the 1st century BC, tells of Kharavela, overlord of Kalinga and of his capital, Kalinganagari. Details describing Kalinganagari in this inscription seem to match with archaeological evidence from Sisupalgarh.

Several questions come to mind concerning the distribution of labor, which is in turn representative of the organization and implementation of power. Centuries before the political control attested by the Hathigumpha inscription, what compelled the initial population to abandon its way of life to congregate in a city with a central authority? Were there intermediate levels of authority, and what roles did households command? Did the economic and political sphere of the city go beyond its immediate surroundings? Did the central authority enact rules governing the interaction with animals, as suggested in the Ashokan edicts and the *Arthashastra*, and if so, how did these rules affect the actual interactions that people had with the natural world?

Leaders are able to install themselves in situations that necessitate significant levels of cooperation and coordination of large groups of individuals (Hooper et al. 2010). Powers and Lehmann (2014) propose a model that considers both the agency of the leader and the agency of the subordinate group, the latter evincing a bottom-up demand for leadership. They contend that if subordinates could not reap any benefits, especially the generation of surplus resources, they would not submit to the leader. Singh (2017) highlights a further dynamic in emergent leadership in South Asia, in which political leaders, who emerged from more decentralized systems of decision-making in the Vedic period, had to balance the violence inherent to the exercise of power and authority with expectations of ethical rulership deriving from both underlying Brahmanical ideas about leadership and emergent emphases on non-violence coming from Shramanic traditions like Buddhism and Jainism (23-32). A look at Sisupalgarh reveals the need for the high levels of cooperation and the possible benefits to both a leader and the population that could have motivated the top-down and bottom-up mechanisms of agency that resulted in a centrally governed urban center.

Not all activities would necessarily have originated at the central levels of authority. Building enterprises related to the needs of the neighborhood would likely have been handled at that intermediate level. For example, the labor-intensive square and ring wells that provided potable water seem to have been shared between several households—they were located within neighborhood clusters, and there were significantly fewer wells than houses, suggesting communal effort, but not central planning. The large laterite blocks that serve as the foundations for the residential houses would have been too heavy to be installed by a single person or family, indicating neighborhood cooperation in the construction of houses. The variation in house configuration is indicative of yet another layer of decision-making and labor allocation: the family unit. This evidence for multiple levels of decision-making at the site underscores the reality that attitudes toward animals in any urban center may have been as diverse as the city's inhabitants, and the adoption of ideologies by elites may not have translated into wholesale adoption of these ways of thinking by everyone in the city.

Pottery findings at the site indicate differential allocation of labor among the households and possibly class differences (Smith 2005). For example, the distribution of thick wares varied among households. Since the manufacturing of these comparatively larger vessels required higher investment in clay and labor, the dissimilarities could be explained by differential wealth.

On the other hand, they could also be an indication of storage or market activities. Similarly, the distribution of decorated wares, also with more labor invested in their manufacture, varied around the site, possibly marking economic differences as well.

No evidence of concentrated manufacturing locations within the site have been discovered through either excavation or survey. Even at the household level, there is little evidence of production of durable goods such as metals or ceramics (e.g., metal slag or ceramic wastes). The uniformity and quantity of the ceramics excavated at the site suggest some degree of standardization of the manufacturing process, and the local source of the clay (Smith 2002), suggest that the majority of the pottery was manufactured locally. The site of this manufacture could have been within a heretofore unexcavated part of the city or outside the city walls, but the bulk of pottery used at the site was most likely not sourced through long-distance trade.

The survival of the city and of its authority hinged on coordination and cooperation that both legitimized said authority and guaranteed the successful provisioning and functioning of the city. While the evidence points to a significant central authority, it is also clear that there were aspects of daily life that were controlled at the local or individual level (Smith 2016).

3.7 History of Archaeological Studies at Sisupalgarh

There have been several archaeological investigations at Sisupalgarh, including excavations by B.B. Lal in 1948 (Lal 1949), by B.K. Thapar in 1950 (Ota 2007), survey by M.L. Smith in 2001-2003 (Smith 2005), P. Yule's ground penetrating radar work in 2005 (Yule 2006), and excavations, site surveys, and geophysical survey by R.K. Mohanty and M.L. Smith in 2005-2009 (Mohanty and Smith 2005, 2006, 2007, 2008, 2009, Mohanty et al. 2007, Smith and Mohanty 2016). The state archaeological department also conducted excavations in the second half of the 20th century (Lal et al. 2014). Lal's excavations included an 18 x 18 m area inside the ramparts near the northern gateway of the western rampart. This excavation was subdivided into nine 6 x 6 m squares. Only part of one of these squares was excavated down to the point of natural soil (opening an area of approximately 2 x 4 m to this depth). The water table at that time was approximately 4.5 m below the surface, and natural soil was reached at about 7.5 m below the surface. The deep excavation was stratified in 25 layers. Other excavations included a 6 m wide by 72 m long trench through the rampart approximately midway on the western side and excavation of the northern gateway on the western side (Lal 1949).

The work on the fauna in this dissertation will focus on the material excavated from 2005-2009 by R.K. Mohanty and M.L. Smith. These excavations included two deep soundings (Core Sequence 1 and Core Sequence 3), an excavation (Operation 1) adjacent to the area excavated by Lal in 1948 near the northern gate of the western rampart, one on the top of the northern portion of the eastern rampart (Operation 2), one just inside the center of the northern rampart (Operation 3) that also included an excavation through the rampart (Operation 3 Rampart Strip), one to verify the presence of one of the roads identified by geophysical survey (Operation 4), one near the center of the site where the standing pillars remain (Operation 5), one outside the northern rampart (Operation 6) and one of the western gateway of the northern rampart (Operation 7). Each of these operations were subdivided into trenches which were further subdivided into loci in order to more accurately document the three-dimensional location of findings.

The sections below provide a more detailed description of each operation of the 2005-2009 excavations. Table 3-1 gives a summary of this information.

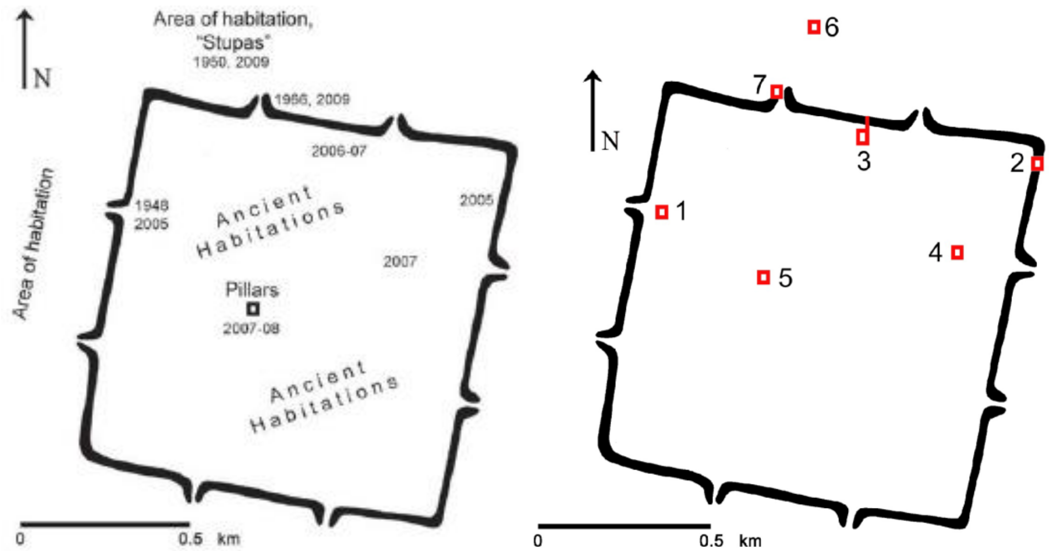


Figure 3-2 Outline of the Rampart, years in the left figure refer to excavations (Lal et al. 2014:619), numbers in the right figure refer to Operations (Smith and Mohanty 2016:692)

Table 3-1 Summary of operations in the 2005-2009 excavations at Sisupalgarh

Operation	Years Excavated	Description	Units
1	2005	Excavation in residential area in northwest quadrant of site	A, B, D, E
Core Sequence 1	2005	Deep sounding near Operation 1	CS1
2	2005	Excavation on top of eastern rampart near northeast corner of site	A, C
3	2006, 2007	Excavation in residential area inside the rampart near the center of the northern rampart	F, G, H, J, K, L, N, P, Q, R, T, V, W, X, Y
3, Rampart Strip	2007, 2008	Excavation from northern edge of Operation 3 through the northern rampart	AA, BB, CC, DD, EE, FF, GG
Core Sequence 3	2006	Deep sounding near Operation 3	CS3
4	2007	Verifying presence of road detected by geophysical survey in northeastern quadrant of site	GA
5	2007, 2008	Excavation in monumental pillar area near center of site	GB, PF11, PG11, PH11, PK11, PL11, PM11, PM17, PN11, PN12, PP12, PP13, PQ11, PQ12, PQ13, PQ14, PR11, PR12, PS9, PS10, PS11, PS12, PT10
6	2009	Excavation outside the northern rampart	HC6, HC7
7	2009	Excavation of the western gateway of the northern rampart	D7, E7, F7, G7, H7, J7, K7, L7, M6, M8, M10, N12, P8

3.7.1 <u>Operation 1</u>

Operation 1 was excavated in 2005. It is adjacent to B.B. Lal's excavations from 1948 just inside the northern of the two gateways on the western rampart of the site (see Figure 3-2). This represents a residential area with several structures. Operation 1 was excavated in four trenches: A, B, D, and E. Trenches A and B each measured 5 x 5 m, while D and E each measured 5 x 3 m. Figure 3-3 shows the layout of Operation 1. Trench A consisted of 29 loci, trench B of 31, trench D of 18, and trench E of 40. Loci were assigned on the basis of changes in soil type or cultural context. The structures present in Operation 1 represent two phases of brick and laterite construction. Large amounts of ceramics were recovered from Operation 1, primarily of the expedient oxidized ware type characteristic of the site's later phases, as well as a number of small finds, including coins, beads, and metal artifacts (Mohanty and Smith 2005:4-15).

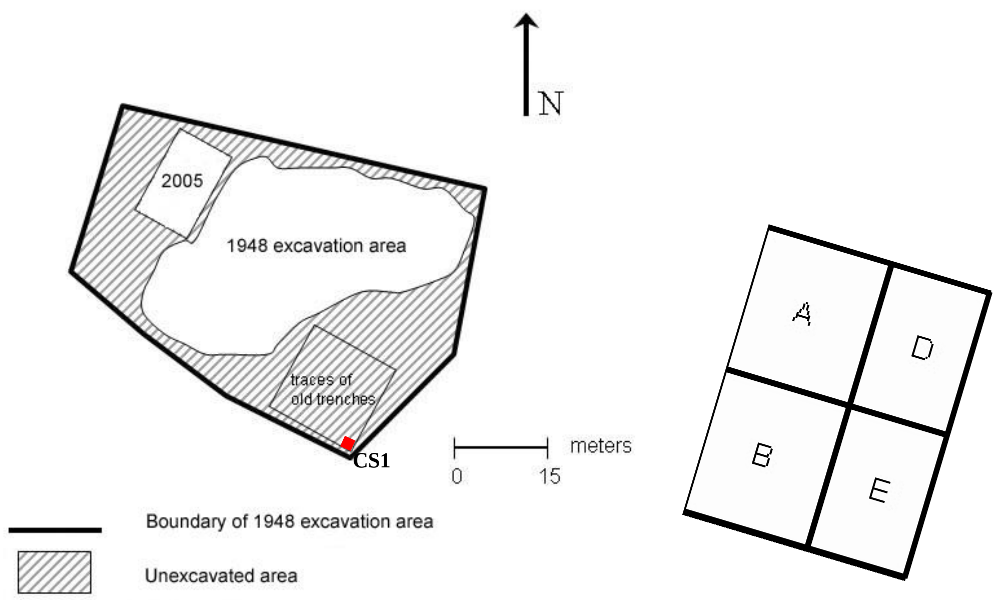


Figure 3-3 Location of Operation 1 (labeled 2005) and CS1 (represented by a red square) relative to B.B. Lal's 1949 excavations and orientation of the various trenches in Operation 1 (Mohanty and Smith 2005:4)

3.7.2 Core Sequence 1

Core Sequence 1 was excavated in 2005. Core Sequence 1 is located just southeast of B.B. Lal's 1948 excavations (see Figure 3-3). It consists of a 1.5 x 1.5 m square deep sounding excavated in nineteen uniform 30 cm levels designated Split 1 through Split 19. Below 2.1 m, groundwater had to be pumped out of the trench in order for excavation to continue. Remains of laterite and brick architecture similar to those found in Operation 1 were recovered. Large amounts of ceramics were recovered from Core Sequence 1. Levels closer to the surface primarily contained expedient oxidized wares, while deeper levels featured higher amounts of burnished and slipped oxidized and reduced wares (Mohanty and Smith 2005:15-17).

3.7.3 Operation 2

Operation 2 was excavated in 2005. Operation 2 was a shallow excavation on the top of the rampart south of the northeast corner (see Figure 3-2). Two trenches were excavated, titled A and C. Operation 2 was placed to investigate the architecture at the top of the rampart and revealed a linear arrangement of stone and bricks (Mohanty and Smith 2005:17-20).

3.7.4 Operation 3

Operation 3 is located in the north-central portion of the site, approximately 50 m south of the mid-point between the two gates of the northern rampart (see Figure 3-2). Excavations in this area began in 2006, initially intended as a deep sounding and labeled as Deep Sounding 2. When two distinct phases of architecture were uncovered within the first 1.24 m of the deep sounding, the excavators decided to expand the area into a horizontal excavation labeled Operation 3. In 2006, Operation 3 consisted of a trench measuring 13 x 18 m and reaching a maximum depth of 1.24 m below the modern surface (Mohanty and Smith 2006, 11). In 2007, the trench was further excavated and expanded north to eventually measure 13 x 25 m and reached a maximum depth of 3.42 m. The operation was divided into 15 trenches. Figure 3-4 shows the layout of the trenches of Operation 3.

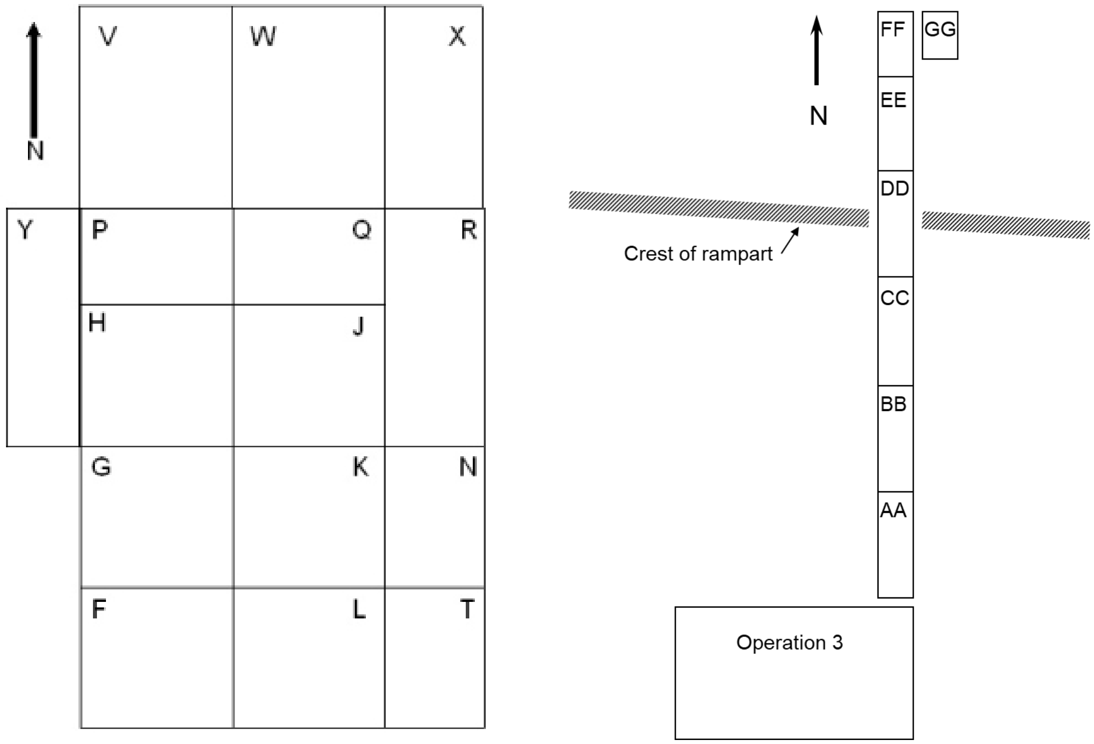


Figure 3-4 Location of the various trenches in Operation 3 (Mohanty and Smith 2007:13) and Operation 3 Rampart Strip (modified from Mohanty and Smith 2008:5)

Table 3-2 gives the number of loci associated with each trench. Loci were assigned on the basis of changes in soil type or cultural context. Architectural remains recovered from Operation 3 consisted of several individual structures. Within this area of the site there were at least three phases of successive construction. Ceramics from Operation 3 are almost exclusively of the expedient oxidized ware type corresponding to the second half of the site's occupation. Artifacts recovered from Operation 3 include hundreds of terracotta ornaments including bangles, earspools and pendants. One particularly striking find (see Figure 3-5) was a complete shed antler of a deer, apparently intentionally deposited along with upright ceramic bowls and cups and a few small artifacts (Mohanty and Smith 2006:11-23; Mohanty and Smith 2007:12-23).

Figure 3-5 Antler and pottery cache from Operation 3, Trench G (Mohanty and Smith 2007:21)

Table 3-2 Number of loci in each trench for Operation 3

Trench	Number of Loci
3-F	75
3-G	57
3-H	31
3-J	48
3-K	23
3-L	39
3-N	20
3-P	28
3-Q	38
3-R	19
3-T	32
3-V	51
3-W	41
3-X	36
3-Y	17

3.7.5 Operation 3 Rampart Strip

In 2007, the excavators took advantage of Operation 3's proximity to the exterior rampart to investigate the construction of the rampart, an extremely salient feature of the site. To this end, a 2 x 55 m trench was excavated northward from Operation 3, all the way to the exterior of the rampart uncovering portions of the rampart itself as well as the intervening habitation areas (see Figure 3-4). The rampart strip was divided into seven units, designated AA to GG. AA through EE measured 2 x 10 meters each, and FF measured 2 x 5 meters. These six units were arranged linearly, with AA being nearest to operation 3, and FF being outside the crest of the rampart. In 2008, a small trench measuring 2 x 4 meters, designated GG, extending from the northernmost extent of the 2007 rampart strip was excavated in an attempt to understand the full sequence of rampart construction over time, revealing multiple successive layers of rampart augmentation (Mohanty and Smith 2008) (see Figure 3-4). Trench AA consisted of 29 loci, BB of 45 loci, CC of 14 loci, DD of 41 loci, EE of 33 loci, FF of 17 loci, and GG of 24 loci. Loci were assigned on the basis of changes in soil type or cultural context. These excavations uncovered three distinct phases of construction of the rampart. The earliest of these phases included burnished oxidized and reduced wares, indicating that the lowest levels excavated of the rampart strip contain material dating to early occupation levels of the site (Mohanty and Smith 2007:23-29; Mohanty and Smith 2008:4-8).

3.7.6 Core Sequence 3

Core Sequence 3 was excavated in 2006 and was located about 40 m south of Operation 3 (see Figure 3-4). The deep sounding was excavated as a 2 m diameter round trench in 22 uniform 30 cm units designated Split 1 through Split 22. As in Core Sequence 1, ground water had to be pumped out of the excavation after the water table was reached, in this case at 2.6 m below the ground surface. Five phases of architecture were recovered from Core Sequence 3. The lower levels of Core Sequence 3 were rich in ceramics corresponding to the first portion of the site's habitation, but also featured relatively less preserved architecture (Mohanty and Smith 2006:23-28).

3.7.7 Operation 4

Operation 4 was excavated during 2007. This operation was placed to ground-truth the results of geophysical survey of the site (see Donkin et al. 2007). The operation consisted of a single trench located on one of the linear anomalies detected via magnetometry. The linear anomaly selected was one of what appeared to be roads between opposite gates in the rampart. Operation 4 consisted of a single trench measuring 2 x 10 meters located in the northeastern quadrant of the site (see Figure 3-2). The trench, designated GA (for "Geophysics A"), consisted of 11 loci. Loci were assigned on the basis of changes in soil type or cultural context. Sparse findings of artifacts and the absence of any architecture supported the interpretation that this was a road (Mohanty and Smith 2007:29-31).

3.7.8 Operation 5

In 2007 a 3 x 3 m test trench, designated GB (for "Geophysics B"), was excavated on the upper portion of the central pillar mound, revealing two additional pillar fragments in addition to the fourteen standing pillars already readily visible on the mound. Prompted by these findings, four additional open excavations were initiated in 2008. The first, on the east side of the pillar mound consisted of units PN11, PN12, PP12, PP13, PQ11, PQ12, PQ13, PQ14, PR11, PR12, PS9, PS10, PS11, PS12, and PT10. These excavations revealed the remains of monumental architecture in the form of eighteen additional pillars. The second, in the center-north of the pillar mound consisted of units PK11, PL11, and PM11. This excavation revealed a large rectilinear structure with robust rooms of large laterite blocks. The third, in the center-west of the pillar mound, consisted of units PF11, PG11, and PH11. This excavation uncovered architecture similar to the residential architecture found in Operations 1 and 3. The final open excavation, in the flat fields south of the pillar mound, designated PM17, uncovered the remains of a platform made up of laterite blocks. Figure 3-6 shows the layout of the trenches from Operation 5.

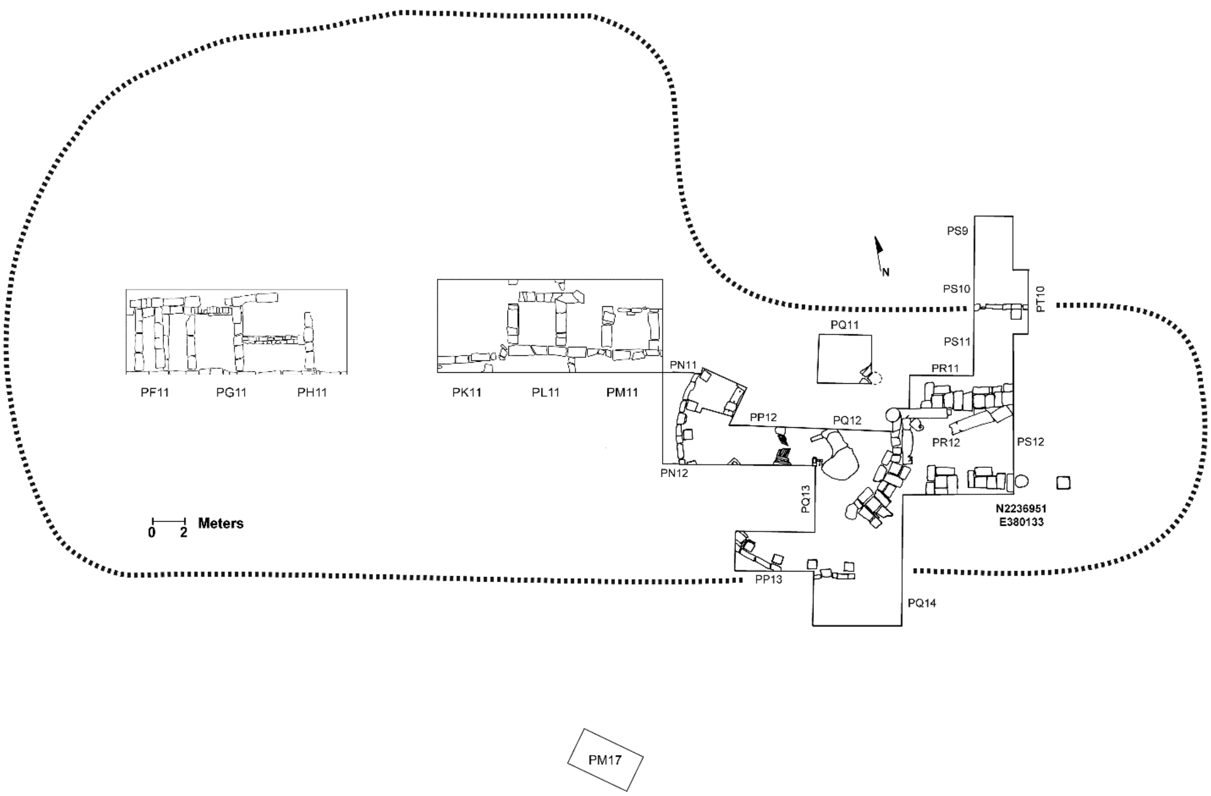


Figure 3-6 Location of the various trenches in Operation 5 (modified from Mohanty and Smith 2008:10). Edge of pillar mound is represented by a dashed line.

Table 3-3 shows the loci associated with each unit. Loci were assigned on the basis of changes in soil type or cultural context. Oxidized wares associated with most of the remains suggest a date contemporaneous with the residential structures uncovered by operations 1 and 3, but deeper excavations in a few extremely limited areas of operation 5 suggest earlier habitation in this area of the site (Mohanty and Smith 2007:33-35; Mohanty and Smith 2008:8-39).

Table 3-3 Number of loci per unit for Operation 5

2007 Excavation		Eastern Area		Mid-North Area		Western Area		Southern Area	
Unit	No. of Loci	Unit	No. of Loci	Unit	No. of Loci	Unit	No. of Loci	Unit	No. of Loci
GB	8	PN11	16	PK11	11	PF11	11	PM17	10
		PN12	10	PL11	52	PG11	26		
		PP12	16	PM11	21	PH11	36		
		PP13	11						
		PQ11	7						
		PQ12	10						
		PQ13	10						
		PQ14	15						
		PR11	9						
		PR12	17						
		PS9	11						
		PS10	4						
		PS11	13						
		PS12	11						
		PT10	12						

3.7.9 Operation 6

Operation 6 was excavated in 2009. This operation is located about 200 m north of the western gate of the northern rampart (see Figure 3-2). Operation 6 consisted of a single trench measuring 5 x 10 m with the long axis oriented east-west. The western half was designated HC6 and consisted of 82 loci, and the eastern half was designated HC7 and consisted of 69 loci. Figure 3-7 shows the layout of the trenches for Operation 6. Loci were assigned on the basis of changes in soil type or cultural context. Operation 6 contained many jumbled stone blocks and, in the deeper parts of the excavation, portions of four stone circles. Findings included abundant ceramics and very worn terracotta ornaments as well as some glass and metal objects (Mohanty and Smith 2009:4-19).

Operation 6 was excavated to bedrock (Mohanty and Smith 2009:12), the only excavation in the 2005-2009 project where this geological level was reached, although the two core sequences also excavated to natural soil, capturing the entire cultural sequence. Because of this, the excavations in Operation 6 captured evidence from time periods before and after the construction of the rampart, an important distinction given that the construction of the rampart likely created distinctions between "insiders" and "outsiders" that would not have existed prior to its emplacement. The exact roles of these outsiders relative to the insiders is not readily apparent in the context of the archaeological evidence from Sisupalgarh.

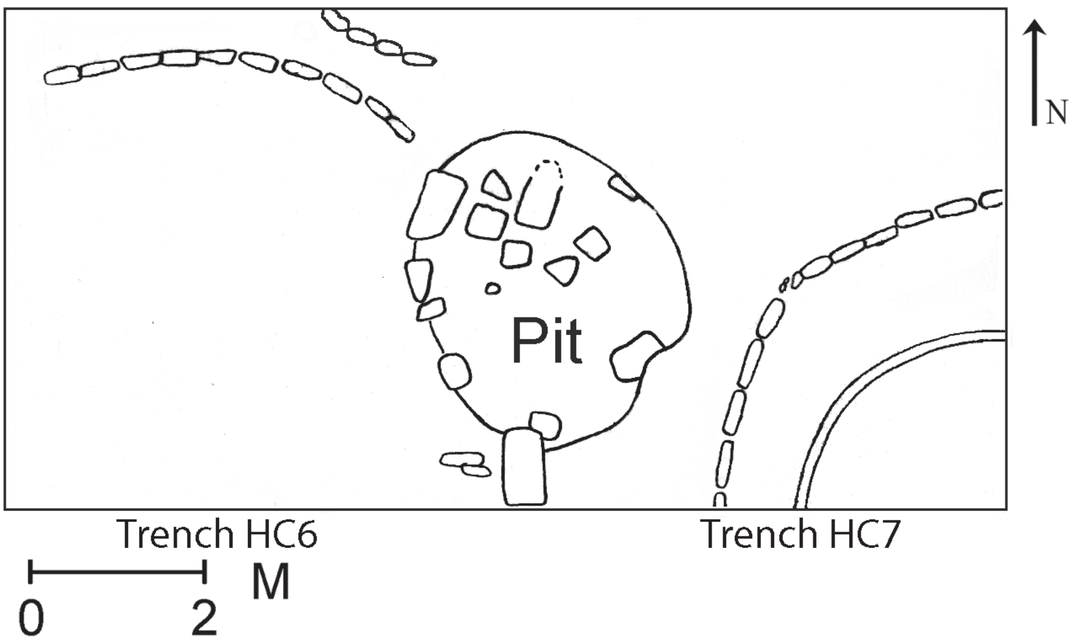


Figure 3-7 Operation 6 trench designations with features at approximately 1.75 m below modern ground surface (modified from Mohanty and Smith 2009 with additional information from M.L. Smith pers. comm.)

3.7.10 Operation 7

Operation 7 was excavated in 2009. Operation 7 was an excavation of the westernmost gateway of the northern rampart (see Figure 3-2). Operation 7 consisted of four trenches. A north-south trench measuring 5 x 40 m was divided into units D7, E7, F7, G7, H7, J7, K7, and L7 (from north to south), and an intersecting east-west trench measuring 2.5 x 25 m was divided into units M6, M8, and M10 (from west to east). These were intended to investigate both the interior passageway and the longitudinal extent of the gateway. Two detached excavations, a vertical scraping 4.22 m wide against the eastern wall of the gateway (unit N12) and a 2 x 2 m trench (unit P8), were placed to investigate specific features of the gateway's architecture (Mohanty and Smith 2009:18-30). Figure 3-8 shows the layout of the trenches for Operation 7. Table 3-4 gives the number of loci in each of these units. Loci were assigned on the basis of changes in soil type or cultural context.

Figure 3-8 Operation 7 layout of trenches (in red) and gateway configuration. Map by J.W. Lehner (M.L. Smith pers. comm. 2022)

Table 3-4 Number of loci in each unit of Operation 7

Unit	Number of Loci
D7	7
E7	9
F7	6
G7	11
H7	15
J7	11
K7	3
L7	4
M6	13
M8	57
M10	6
N12	1
P8	5

3.8 Chronology of Sisupalgarh and Its Regional Context Over Time

Smith and Mohanty (2016) have presented a chronology for Sisupalgarh based on radiocarbon dating.

Table 3-5 (from Smith and Mohanty 2016) provides the radiocarbon dates from the 16 samples that were recovered for dating from the operations of the 2005-2009 excavations, along with the location of recovery of the material that was dated. One sample from Operation 5 was split into two parts and analyzed by two different laboratories.

Table 3-5 Radiocarbon dates from 2005-2009 excavations at Sisupalgarh (information taken from Smith and Mohanty 2016:693)

Operation	Trench	Locus	Depth below modern ground surface (cm)	Calibrated 1-sigma	Calibrated 2-sigma
Core Sequence 1		Split 17	500-530	706-409 BCE	751-402 BCE
Core Sequence 1		Split 18	530-560	746-414 BCE	755-408 BCE
Core Sequence 1		Split 14	336-366	347-109 BCE	356-51 BCE
Core Sequence 3		Split 9	252-282	168-53 BCE	344 BCE-2 CE
Core Sequence 3		Split 12	368-399	354-180 BCE	372-117 BCE
Core Sequence 3		Split 15	472-502	406-364 BCE	485-210 BCE
Core Sequence 3		Split 18	575-605	406-368 BCE	486-211 BCE
Core Sequence 3		Split 19	605-635	395-235 BCE	400-209 BCE
Core Sequence 3		Split 19	605-635	400-240 BCE	504-210 BCE
Core Sequence 3		Split 19	605-635	804-669 BCE	811-551 BCE
Operation 5	Trench PL11	Locus 33	135-143	161-51 BCE (University of Arizona date)	197-1 BCE (University of Arizona date)
				100-40 BCE (Beta Analytic date)	170 BCE-10 CE (Beta Analytic date)
Operation 6	Trench HC6	Locus 31	83-93	359-54 BCE	480 BCE-126 CE
Operation 6	Trench HC6	Locus 54	243-250	503-386 BCE	703-372 BCE
Operation 6	Trench HC6	Locus 54	243-250	401-260 BCE	407-210 BCE
Operation 6	Trench HC6	Locus 78	370-378	793-555 BCE	802-520 BCE
Operation 7	Trench M8	Locus 57	632-658	510-400 BCE	731-392 BCE

Evidence of occupation at Sisupalgarh dates from the 6th-7th century BCE (based on radiocarbon dates) to the middle of the first millennium CE (based on ceramic evidence). The earliest settlement predates the rampart walls, which were probably first constructed in the 4th or 5th century BCE (Smith and Mohanty 2016:684). These findings from the 2005-2009 excavations expand on the dating initially proposed by B.B. Lal, who dated the site's habitation from 300 BCE to 350 CE based on ceramic and numismatic evidence (Lal 1949:70-72).

Contemporaneous with or even before the initial construction of the rampart, the presence of knobbed ware ceramics is evidence for a broad regional sphere of interaction at the site. This distinctive ceramic type is found at many sites in coastal East India, including sites in West Bengal, Odisha, and Andhra Pradesh (Tripati et al. 2019). Roughly 150 pieces of knobbed ware were recovered from the 2005-2009 excavations at Sisupalgarh. The earliest examples of this type of ceramic were recovered from excavation contexts dating to approximately the same time as the initial rampart construction (Smith pers. comm.). Other evidence of interaction from this period is somewhat unclear, but findings such as the circular stone features from Operation 6, which bear some resemblance to Buddhist architectural forms such as the stupa (cf. Ota 2007, Smith and Mohanty 2016) and which appear to date to roughly the time of the rampart's construction, may also suggest that the residents of Sisupalgarh were at least absorbing social information from beyond the local area.

Radiocarbon dates indicate that a shift in the material repertoire of the site occurred between the 4^{th} and 3^{rd} centuries BCE, which would include the time of the Mauryan expansion into the region. That the Mauryas had influence in the area of Sisupalgarh is demonstrated by the Ashokan rock edicts at Dhauli. This time saw the beginning of the use of brick and tile as building materials, as well as a shift in ceramic style and new forms of personal adornment in the form of terracotta ornaments (Smith and Mohanty 2016:686). Whether or not the Mauryan presence was directly responsible for these changes, it is clear that the inhabitants of Sisupalgarh were by this time participating in a cultural sphere that went far beyond the local area. In excavation periods dating to this time, small amounts (approx. 80 pieces from the entire 2005-

2009 excavation: Smith pers comm.) of ceramic in the style known as rouletted ware were recovered. Although the exact origins of rouletted ware ceramics are disputed (see Magee 2010), sherds of vessels in this style have been recovered from many sites in coastal South and East India as well as sites as far afield as Egypt and Indonesia (Schenk 2006, Magee 2010). The presence of pottery decorated in this style indicates that the inhabitants of Sisupalgarh had some level of access to networks that went much beyond the regional level. This style of pottery has not been frequently reported from sites in the Gangetic plain (cf. Schenk 2006), suggesting that the cultural influences at Sisupalgarh during this period were not restricted to simply an importation of the Mauryan repertoire from Magadha.

The excavations clearly indicate that the structures of the ramparts and gateways were augmented in both width and height several times, becoming more massive and imposing (Lal et al. 2014, Smith and Mohanty 2016), but the exact timing of these expansions cannot be determined from the radiocarbon dates from the sites. What can be determined is that the site underwent a period of grand construction in the first century BCE, based upon radiocarbon dating from the pillar mound region. This time period roughly corresponds to the reign of the king Kharavela, who documented a stage of stability and prosperity in his Hathigumpha inscription at the nearby Udayagiri caves. The pillared structure was built in the center of the city, and according to Kharavela improvements to the ramparts were made, accompanied by another shift in pottery styles (Smith and Mohanty 2016). During this period of peak occupation, the population may have reached 25,000 (Lal et al. 2014). The first archaeological evidence of coinage from the 2005-2009 excavations also dates to roughly this time period (Smith pers. comm), perhaps suggesting the adoption or use of novel economic forms which may already have been established in other parts of the subcontinent. Although relatively few coins were found in excavations, the Hathigumpha inscription estimates the cost of renovations conducted by Kharavela in terms of coins, suggesting that they were at least imagined as a metric for value.

Following the peak occupation, there appears to have been a gradual depopulation of the city until approximately the late 6th century CE, with people moving to the area of Old Town Bhubaneswar, which was becoming the center of regional religious activity (Smith and Mohanty 2016:687). The evidence from the excavations does not provide a detailed chronology of the site abandonment, and it is difficult to say with certainty how long after the reign of Kharavela the city remained heavily occupied, but there is evidence for at least some occupation until approximately the late 6th century CE (Lal et al. 2014:627). Since Old Town Bhubaneswar is less than 2 kilometers from Sisupalgarh, it is likely that even after the site was abandoned, there were still people visiting, perhaps to obtain building materials or as small agricultural encampments.

3.9 Chapter Summary

Sisupalgarh has all the hallmarks of a developed urban center and is therefore a good location to examine the relationship between humans and animals within an urban setting. The site is the largest and earliest known of its kind in Odisha, but it exists within a broader context of urbanization occurring in the Indian sub-continent. The extensive excavation history and survey has helped to clarify how Sisupalgarh functioned as a city. This archaeological context also provides the foundation for the interpretation of the faunal remains recovered from the site, the analysis of which will be detailed in Chapter 4.

CHAPTER 4. FAUNAL REMAINS RECOVERED FROM THE EXCAVATIONS AT SISUPALGARH

4.1 Methods

The study of faunal remains must start with the identification of those remains. Spending a total of six months over three separate trips to Deccan College in Pune, India, from 2017-2018, I examined all the faunal remains recovered from the 2005-2009 excavations at Sisupalgarh (a detailed record of the faunal remains from 1948 excavations does not exist, and any remains recovered and stored from these excavations were not available for this analysis, although there is a possibility that they are still under curation at the Zooarchaeological Survey of India, Kolkata).

4.1.1 Recovery Methods

During the 2005-2009 excavations at Sisupalgarh, most of the excavated material was hand-sorted under the supervision of a trench supervisor and the project directors. Wet sieving was only performed in contexts below the water table in Core Sequence 1 (below a depth of 2.1 m) and Core Sequence 3 (below a depth of 2.6 m), presumably resulting in more complete recovery of smaller remains from these loci. Recovered material was sorted according to artifact class, with faunal material comprising one of those categories. The total faunal material recovered from each locus was weighed after excavation of the locus was completed. Most of the material was then placed in plastic zip bags, while material recovered from loci with large amounts of faunal remains were often placed in larger, sturdier non-zip bags. A Tyvek® tag recording provenance information was placed within each of these bags. Bags of faunal material from each locus were then stored together in "meta-bags" which collected material from an entire trench (for some trenches, only one meta-bag was necessary, but for trenches with greater recovery of faunal remains, multiple meta-bags were used). These bags were all stored in metal trunks which were transported to the Archaeozoology Laboratory at Deccan College, Pune, for curation. For a more complete discussion of recovery methods, see Mohanty and Smith 2005, 2006, 2007, 2008, and 2009.

4.1.2 Curation Concerns

When beginning my analysis of the faunal material from the 2005-2009 excavations in 2017, my first order of business was to assess the curatorial integrity of the assemblage. In the years between initial storage of the remains and my analysis, some of the bags containing material had deteriorated. I examined each bag to assess whether it still provided an accurate assessment of the provenance of the remains it contained. In cases where multiple bags within a given meta-bag had deteriorated to the point that their contents had become mixed, accurate provenance of the material could no longer be determined to the level of locus (for example, material from bags from Splits 3, 10, and 10A of Core Sequence 1 became so mixed with each other that it was impossible to discern which material came from which context). In these cases, this material was identified and recorded, but was discounted from the analysis unless otherwise stated. In spite of significant deterioration, especially in the older zip bags, the multi-tiered storage strategy was generally able to maintain the distinction between material from different bags. In order to facilitate future use of this material in other projects, I placed deteriorated bags within new, sturdier zip bags, when possible keeping the old bag and the original tags, which were almost always still intact. The entire resulting package was then placed within another zip bag and returned to the corresponding meta-bag (note that all of the meta-bags had remained intact from the time of the initial packaging at the field site).

Because weights of recovered faunal material had been recorded upon excavation, a record existed of the original excavated material. This record was used as a point of comparison to ensure that all the material was accounted for. During this process, it was noted that the recovered material from Split 9 of Core Sequence 1 was not stored with the rest of the faunal material and was not found. Because of this, Core Sequence 1, Split 9 represents a lacuna in this analysis. No other absences were noted, but it is possible that other material was also unavailable for analysis (for example, material that was originally miscategorized as belonging to a different class of artifact or worked bone that was separately classified as a "small find," neither of which would necessarily have been stored in the trunks with the rest of the faunal material).

4.1.3 Sampling Methods

All of the faunal material recovered in the 2005-2009 excavations and stored in the Deccan College Archaeozoology Laboratory was assessed for identification. Once a bag had been processed, a paper tag was inserted in the bag recording that I had examined it and the date of examination, preventing possible double counting of any of the material as well as providing a record for future use of this assemblage. Specimens that could not be identified with taxon or element (mainly bone fragments) were sorted into three size classes, <30 mm, 30-50 mm, and >50 mm, according to their greatest dimension.

4.1.4 Identification Methods

I catalogued the remains with respect to location of recovery, taxon, and skeletal element. Each specimen recovered from excavation was examined, and when possible, element and taxon were determined. As aids for this determination, I compared the remains with the reference collection in the Archaeozoology Laboratory at Deccan College, which comprises a collection of skeletal remains of approximately 300 animal species. In the rare event that complete elements were present, measurements were taken following criteria established by von den Driesch (1976). Although the faunal remains were identified to the highest possible degree of specificity, state of preservation and degree of bone surface modification sometimes made this difficult. In such cases, remains were identified to broader taxonomic and methodological categories, such as "Mammalia, medium" for taxon or "long bone diaphysis" for skeletal element. Categories based on size are sometimes uncertain, so groupings that include multiple size classes, such as "Mammalia, medium to large" were sometimes used, which should be taken to include all taxa which might fall into the grouping of "Mammalia, medium" or into "Mammalia, large."

Due to the poor state of preservation, it is difficult to distinguish between *Bos indicus* and *Bubalus bubalis* remains, so for this assessment the remains from these two genera have been grouped. The different environmental demands from these two types of bovine would lead one to believe that their remains might be found in different contexts, but when a positive identification could be made, both *Bos indicus* and *Bubalus bubalis* remains were often present.

4.1.5 Recording Methods

Complete tables and selected photographs of the faunal remains analyzed are included in the Appendices of this dissertation. Each table contains information on recovery location, the original state of the bag in which the material was stored, the skeletal element, the number of elements, the taxon, and when possible, information about the age of the animal, relevant measurements of the specimen, comments on the appearance of the specimen or any unusual features, and a record of the number of photographs taken of the specimen.

For analytical simplicity within the body of this dissertation, some taxa have been grouped into broader, less ambiguous categories. For example, while some remains were identifiable as *Bos indicus* or *Bubalus bubalis*, many remains were identified only as belonging to one of these two taxa. In order to be able to group these remains together, the artificial category of "*Bos indicus* or *Bubalus bubalis*" has been used. In a similar way, the remains of *Ovis aries* and *Capra hircus* can be difficult to distinguish, so they too have been grouped into the category of "*Ovis areis* or *Capra hircus*." In some taxa, such as Cervinae or Antilopinae, specific identifications were sometimes possible, but for practicality, these species have been grouped together to more general taxonomic levels (in the case of Cervinae and Antilopinae, to the subfamily level). Remains of Aves were identified belonging to several different taxa, but a specific identification was often not possible, so these have been grouped together as well. Finds of remains from Serpentes and *Varanus* were uncommon in the assemblage, so they have been grouped together in Squamata. Remains of Osteichthyes were sometimes identified as belonging to fresh-water or salt-water species, but since these are not necessarily taxonomically valid categories, for analytical purposes they have been grouped under the label "Osteichthyes."

Elements that showed potential signs of human modification, either in the form of cut marks on the specimen or discoloration from exposure to fire, were noted and recorded. Neither of these categories definitively reflect a particular use, as animal remains may be exposed to fire or physically modified for a variety of reasons related or unrelated to consumption. Furthermore, chemical processes may mimic the physical coloration changes caused by exposure to fire, and various turbation and excavation processes may result in marks on remains. None of these confounding factors were extensively controlled for in the present analysis.

For ease of legibility, values marked as "0" in the tables presented in this chapter are shaded in grey. Pie charts were generated from recorded data for most excavation areas. In order to clearly delineate findings, these pie charts render remains from taxa which are probably domestic in shades of green, remains from taxa which could be either wild or domestic in shades of blue, and remains from taxa which are probably wild (including probably tame animals) in shades of yellow and red.

A glossary of commonly used scientific names (Table 4-1) is included to improve the legibility of this data, organized in alphabetical order by scientific name.

4.1.6 Quantitative Methods

Relatively little faunal material was recovered from the site as a whole (especially when compared to the abundance of other classes of artifact such as ceramics). With a few rare exceptions, multiple elements from the same animal were not found together in the same locus. Because of this, the remains were quantified using NISP (number of identified specimens), which accurately represents the number of specimens examined without attempting to calculate the number of individuals or the biomass that the remains represent.

Table 4-1 Glossary of commonly used scientific names

Scientific name	Taxonomic level	Associated common name(s)	Included in grouping:	Examples of included identifications (see Appendix A)
Antilopinae	Subfamily	Antelope	Mammalia, medium; Mammalia, small	*Antilope cervicapra* (blackbuck), *Gazella benetti* (gazelle)
Aves	Class	Birds	N/A	*Anser indicus* (bar-headed goose), *Pavo christatus* (peafowl), *Gallus gallus* (chicken)
Bos indicus	Species	Zebu cattle, cattle	Mammalia, large	N/A
Boselaphus tragocamelus	Species	Nilgai	Mammalia, large	N/A
Bubalus bubalis	Species	Water buffalo, buffalo	Mammalia, large	N/A
Canis	Genus	Dogs and wolves	Mammalia, medium	N/A
Capra hircus	Species	Goats	Mammalia, medium	N/A
Cervinae	Subfamily	Deer	Mammalia, large; Mammalia, medium	*Cervus unicolor* (sambar), *Axis axis* (spotted deer, chital)
Chondrichthyes	Class	Cartilaginous fish	N/A	Selachimorpha (sharks)
Decapoda	Order	Crabs, lobsters, and crayfish	N/A	N/A
Elephas maximus	Species	Asian elephant	N/A	N/A
Equus	Genus	Horses and donkeys	Mammalia, large	N/A
Lepus	Genus	Hares	Mammalia, small	N/A
Mammalia	Class	Mammals	N/A	N/A
Mollusca	Phylum	Bivalves and snails	N/A	*Lamellidens* (freshwater mussel), *Pila* (freshwater snail), *Bellamya* (freshwater snail), *Melania* (freshwater snail)
Osteichthyes	Superclass	Bony fish	N/A	N/A
Ovis aries	Species	Sheep	Mammalia, medium	N/A
Rodentia	Order	Rodents	Mammalia, small	*Rattus rattus* (black rat), *Mus* (mouse spp.)
Soricidae	Family	Shrews	Mammalia, small	N/A
Squamata	Order	Lizards and snakes	N/A	*Varanus* spp. (monitors), Serpentes (snakes)
Sus scrofa	Species	Pigs	Mammalia, medium	N/A
Testudines	Order	Turtles	N/A	*Kachuga tecta* (Indian roofed turtle), *Lissemys punctata* (Indian flapshell turtle), *Chitra indica* (Indian narrow-headed softshell turtle)

4.2 *Core Sequence 1*

Core Sequence 1 was excavated in 2005. It consists of a rectilinear 1.5 x 1.5 m deep sounding south and east of Operation 1 (see Figure 3-3) excavated in nineteen arbitrary 30 cm levels, starting with Split 1 at the surface and continuing to Split 19, which was to approximately 5.7 m below the surface. Below 2.1 m groundwater had to be pumped out of the excavation in order for work to continue. The deeper portions of Core Sequence 1 yielded some of the highest densities of bone in the entire excavation. The original inventory created at the time of excavation suggests that large quantities of bone were recovered from Split 9, but this material was not found in any of the archival trunks, so there is no data from Split 9.

There was no faunal material recovered from Splits 1, 3, 4, 5, and 19. Table 4-2 provides the Number of Identified Specimens (NISP) in each split for the 16 taxa that were identified (some of these taxa are groupings of similar species, and others are broader groupings, e.g., large mammals). Figure 4-1 shows the percentages of each of these taxonomical groups from all of Core Sequence 1. Figure 4-2 shows graphically the split and NISP of all the identified specimens from Core Sequence 1.

Overall, Core Sequence 1 consisted of approximately 13 m^3 of total excavated soil. Within all of this material, there were only 469 identifiable specimens and no cases in which more than one element could be identified as coming from the same skeleton. The material from this excavation below the groundwater level was sieved, so small bones and bone fragments are more prevalent here than in other locations of the site (except the lower portions of Core Sequence 3, in which material was also sieved upon removal from the excavation after the water table was reached). The low density of remains and the lack of multiple elements from a single animal all in one location suggests that for the most part these findings were not from primary deposit sites (that is to say, the faunal remains were not recovered from the locations where humans initially made use of the animal product which those remains represent or where humans initially discarded the remains).

Even with these limitations, it is possible to learn something from the assessment of the faunal remains from Core Sequence 1. There is a distinctive shift in the faunal assemblage at approximately Split 10 (i.e., 3 m below modern ground surface). In the deeper deposits (Splits 11-18) there are more faunal remains, a wider distribution of taxa represented and relatively few *Bos indicus* or *Bubalus bubalis* remains. In the lower part of the sequence, there is a large presence of bones from Osteichthyes (bony fish), many remains from *Sus scrofa* and medium sized mammals in general, and a diverse collection of wild animal remains from taxa such as *Boselaphus tragocamelus,* Aves, Rodentia, and Testudines. In the upper deposits (Splits 2 through 8), many fewer remains were recovered, and the remains are dominated by *Bos indicus* or *Bubalus bubalis*; there is a complete absence of *Sus scrofa*, *Boselaphus tragocamelus,* Osteichthyes, Aves, and Rodentia. There are only 2 specimens from Testudines in Split 8 and none from higher in the sequence.

Table 4-2 Number of Identified Specimens from each Split in Core Sequence 1

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Bos indicus* or *Bubalus bubalis	0	2	0	0	0	2	2	16	?	6	2	0	0	0	6	6	0	0	0	42
Mammalia, large	0	0	0	0	0	0	2	3	?	8	8	4	6	0	2	4	0	0	0	37
Sus scrofa	0	0	0	0	0	0	0	0	?	3	1	1	6	3	12	8	2	2	0	38
Mammalia, medium to large	0	0	0	0	0	0	7	0	?	5	11	0	1	0	9	2	0	0	0	37
Mammalia, medium	0	0	0	0	0	0	0	0	?	3	6	2	1	6	6	25	0	2	0	51
Mammalia, small to medium	0	0	0	0	0	0	0	0	?	0	1	0	1	0	1	15	1	0	0	19
Boselaphus tragocamelus	0	0	0	0	0	0	0	0	?	0	7	0	1	2	0	0	0	0	0	10
Cervinae	0	0	0	0	0	0	0	0	?	2	4	0	1	2	1	0	0	0	0	10
***Lepus* sp.**	0	0	0	0	0	0	0	0	?	0	1	1	0	0	0	0	0	0	0	2
Rodentia	0	0	0	0	0	0	0	0	?	0	7	0	1	4	4	4	0	3	0	23
Mammalia, small	0	0	0	0	0	0	0	0	?	0	0	0	0	2	1	10	0	18	0	31
Aves	0	0	0	0	0	0	0	0	?	2	1	1	2	0	2	7	0	2	0	17
Testudines	0	0	0	0	0	0	0	0	?	6	1	1	6	0	4	5	1	0	0	26
Squamata	0	0	0	0	0	0	0	0	?	0	1	1	0	0	0	0	0	0	0	2
Osteichthyes	0	0	0	0	0	0	0	0	?	1	22	8	15	10	27	35	0	10	0	128
Total	0	2	0	0	0	2	11	17	?	36	73	19	41	29	75	121	4	39	0	473

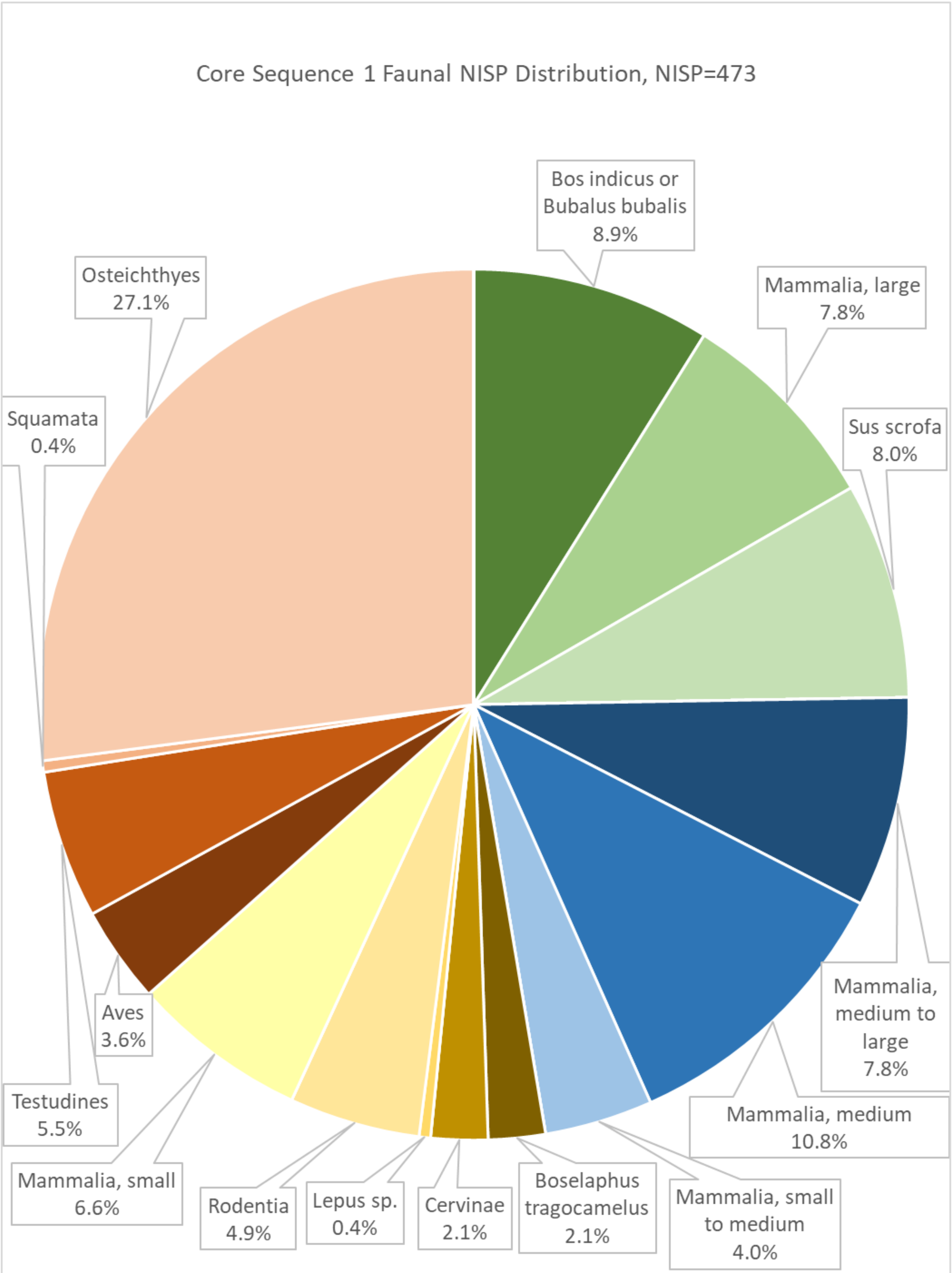


Figure 4-1 Ratio distribution of all faunal remains from Core Sequence 1.

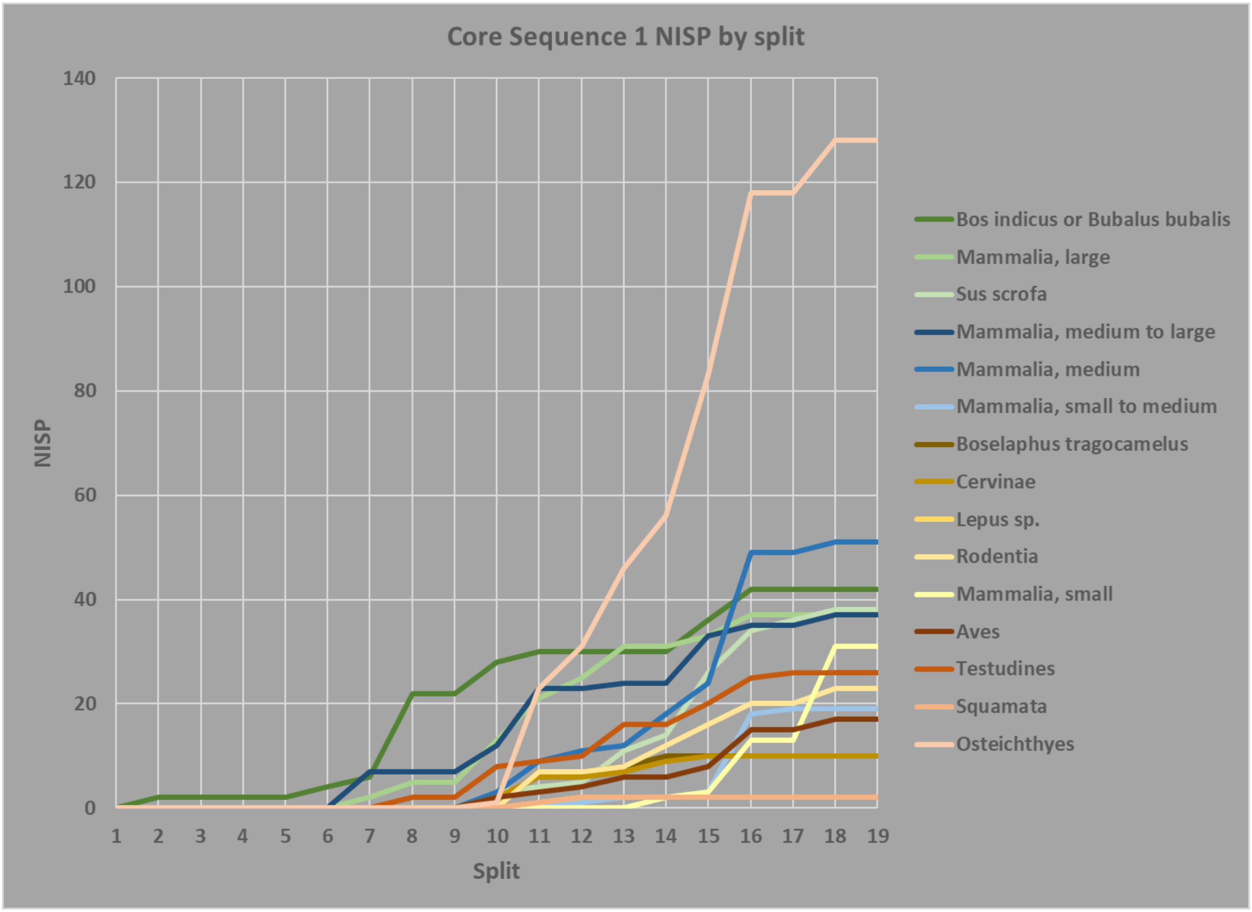


Figure 4-2 Number of identified specimens and location of finds from Core Sequence 1

There was evidence of human modification to some of the faunal remains recovered from CS1, either cut marks or evidence of exposure to fire. 27 of the identified remains had cut marks, comprising 5.7% of the NISP from CS1. One additional unidentified specimen also exhibited a cut mark. 26 identified specimens showed signs of burning or charring, representing 5.5% of the NISP from CS1, as did 39 further unidentified specimens.

Table 4-3 lists the elements that show cut marks. Table 4-4 shows the elements that show signs of fire.

Table 4-3 Elements with cut marks from CS1

Split	Element	No. of elements	Taxon identification	Comment
7	Long bone diaphysis	1	Mammalia, medium to large	Cut marks
8	Fragment with cut mark	1	*Bos indicus* or *Bubalus bubalis*, probable	Cut mark
8	Large fragment, possibly worked	1	*Bos indicus* or *Bubalus bubalis*, probable	Cut marks, large, end appears rounded
8	Cranial fragment	1	Mammalia, large	Cut mark
8	Fragment with cut mark	1	N/A	Cut mark
10	Ulna, proximal epiphysis	1	Aves, medium sized	Cut marks
11	Long bone fragment	1	Mammalia, medium	Cut marks
11	Tibia, left, distal	1	*Boselaphus tragocamelus*	Cut marks, gnaw marks?
12	Large long bone fragment	1	Mammalia, large	Cut marks, one large gouge, several smaller cuts
13	Bone fragment	1	Mammalia	Cut mark
13	Long bone fragment	1	Mammalia, large	Cut marks
13	Scapula fragment	1	Mammalia, small to medium	Cut mark, burnt black
13	Calcaneus, right, unfused	1	*Boselaphus tragocamelus*	Cut marks; nearly complete
15	Scapula fragment, right	2	*Bos indicus* or *Bubalus bubalis*	Cut marks
15	Shed antler	1	*Cervus unicolor*, probable	Modified with tines cut cleanly, polish on one side of smaller tine
15	Rib fragment	1	Mammalia, large	Cut marks
15	Cranial fragment	1	Mammalia, medium to large	Cut mark
15	Long bone fragment	1	Mammalia, medium to large	Cut mark(s)
15	Long bone fragment	1	Mammalia, medium to large	Cut mark, possible
16	Jugal fragment	1	Mammalia, medium	Cut mark
16	Metacarpal diaphysis	1	Mammalia, medium to large	Cut marks
3,10, or 10a	Long bone, partial diaphysis (possibly ulna)	1	Aves, medium	Cut marks
3,10, or 10a	Vertebral spine	1	Mammalia, large	Cut mark
3,10, or 10a	Pelvic fragment	1	Mammalia, medium	Cut marks

Split	Element	No. of elements	Taxon identification	Comment
3,10, or 10a	Pelvic fragment, ischium	1	Mammalia, medium	Cut marks, long
3,10, or 10a	Rib fragment	2	Mammalia, medium to large	Cut marks

Table 4-4 Elements with evidence of burning from CS1

Split	Element	No. of elements	Taxon identification	Comment
2	Tibia, distal epiphysis fragment	1	*Bos indicus* or *Bubalus bubalis*	Interior burnt white, exterior appears unburnt
2	Unidentified fragments	4	N/A	All burnt white
3	Unidentified fragments	8	N/A	All burnt white
10	1st phalanx, anterior	1	*Bos indicus*	Complete, articulates with metacarpal, distal end charred
10	Metapodial, proximal, unfused	1	Mammalia, large	Lightly charred
11	Patella	1	Cervid, large	Slightly charred, no match with *Axis axis* or *Cervus unicolor*
11	Cheek tooth	1	*Lepus* sp.	Burnt black, very worn
11	Tooth fragment	1	Mammalia, medium (possible *Sus scrofa*)	Burnt
12	Cheek tooth	1	*Lepus* sp.	Burnt black, very worn
12	Unidentified fragments	5	N/A	Burnt black
13	Femur, proximal epiphysis	1	Mammalia, large	Charred
13	Scapula fragment	1	Mammalia, small to medium	Cut mark, burnt black
13	Unidentified fragments	1	N/A	Burnt black
13	Unidentified fragments	1	N/A	Burnt white
13	Unidentified fragments	8	N/A	Charred
14	Rib epiphysis	1	Mammalia, medium	Charred
14	Caudal vertebra	1	Mammalia, small	Charred
15	Humerus, distal epiphysis	1	*Anser* sp.	Charred
16	Caudal vertebrae	3	Mammalia, small	Charred
16	Long bone fragment	1	Mammalia, small/medium	Completely charred
16	Unidentified fragments	1	Mammalia, large	Long bone fragment, burnt black

Split	Element	No. of elements	Taxon identification	Comment
17	Unidentified fragments	3	N/A	Burnt black
17	Unidentified fragments	9	N/A	Burnt black
18	Caudal vertebra	1	Mammalia, medium	Burnt black
18	Vertebral centrum	1	Mammalia, medium to large	Burnt black
18	Dental fragments	4	Mammalia, small, possible juvenile *Sus scrofa*	Charred
18	Deciduous molar	1	*Sus scrofa*	Completely burnt (black)
3,10, or 10a	Neurocranial fragment	1	Osteichthyes, medium to large	Burnt black
3,10, or 10a	Carapace fragment	1	*Kachuga tecta*	Slightly charred

4.3 Core Sequence 3

Core Sequence 3 was excavated in 2006 and was located about 40 m south of Operation 3 (see Figure 3-4). The deep sounding was excavated as a 2 m diameter round trench in 22 arbitrary 30 cm units referred to as “splits.” Five phases of architecture were recovered from Core Sequence 3. The lower levels of Core Sequence 3 were rich in ceramics corresponding to the first portion of the site’s habitation, but also featured relatively less architecture (Mohanty and Smith 2006). Relatively large amounts of faunal material were also recovered from the lower levels of Core Sequence 3.

There was no faunal material recovered from Splits 1, 2, 3, 4, and 22. Table 4-5 provides the Number of Identified Specimens (NISP) in each split for the taxa that were identified (some of these taxa are groupings of related species, such as clustering multiple species of turtle under the ordinal level heading of Testudines, and others are broader groupings, e.g., Mammalia, large). Figure 4-3 shows the percentages of each of these taxonomical groups from all of Core Sequence 3. Figure 4-4 shows graphically the split and NISP of all the identified specimens from Core Sequence 3.

Overall, Core Sequence 3 consisted of approximately 21 m^3 of total excavated soil. Within all of this material, there were only 1099 identifiable items and no cases in which more than a single specimen could be identified as coming from the same skeleton. The overall faunal remains density was slightly higher for Core Sequence 3 than it was for Core Sequence 1. Similar to Core Sequence 1, the material from this excavation below the groundwater level (2.6 m below ground surface at Core Sequence 3) was sieved, so small bones and bone fragments are more prevalent here than in other locations of the site. The low density of remains and the lack of multiple elements from a single animal all in one location (with the possible exception of some of the rodent remains) suggests that, like Core Sequence 1, for the most part these findings were not from primary deposit sites.

Even with these limitations, it is possible to learn something from the assessment of the faunal remains from Core Sequence 3. There is a dramatic increase in the number of faunal remains in Splits 10 to 13 and another less dramatic increase in Splits 19 and 20. Unlike in Core Sequence 1, there is a substantial amount of *Bos* or *Bubalus* and unidentified large mammal (which could be *Bos* or *Bubalus)* remains in the lower portions of the sequence. There is a large presence of bones from Rodentia (primarily *Rattus* sp.), and bones from Osteichthyes, from both freshwater species and marine species, as well as three bones from Chondrichthyes. In this core sequence there were also three bones from *Equus* spp. and a portion of an *Elephas maximus* tooth.

Table 4-5 Number of Identified Specimens from each Split in Core Sequence 3

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
***Equus* spp.**	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	3
Bos indicus* or *Bubalus bubalis	0	0	0	0	0	0	0	0	4	1	1	6	38	11	8	3	2	14	13	4	3	0	108
Mammalia, large	0	0	0	0	0	0	0	9	5	14	17	24	82	14	14	9	8	4	10	14	11	0	235
Sus scrofa	0	0	0	0	0	0	0	0	5	1	0	0	1	1	0	1	2	6	4	4	1	0	26
Ovis aries* or *Capra hircus	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	1	0	0	7
***Canis* spp.**	0	0	0	0	0	0	0	0	2	9	3	0	3	0	0	0	0	1	2	2	0	0	22
Mammalia, medium to large	0	0	0	0	0	0	0	2	1	2	4	5	12	2	0	0	6	7	9	5	5	0	60
Mammalia, medium	0	0	0	0	7	0	0	4	3	3	4	12	22	3	2	1	3	5	8	6	0	0	83
Mammalia, small to medium	0	0	0	0	0	0	0	1	3	0	1	0	3	0	0	0	0	0	1	0	0	0	9
Elephas maximus	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cervinae	0	0	0	0	0	0	0	1	0	3	0	0	2	1	0	0	0	0	0	0	0	0	7
Antilopinae	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
***Lepus* sp.**	0	0	0	0	0	0	0	0	3	5	7	5	8	1	0	0	0	0	0	0	0	0	29
Rodentia	0	0	0	0	0	0	2	3	21	30	12	37	31	3	1	0	2	0	1	1	0	0	144
Soricidae	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Mammalia, small	0	0	0	0	0	0	0	3	6	3	6	10	11	1	0	2	0	0	0	4	1	0	47
Aves	0	0	0	0	0	0	0	1	2	9	5	9	9	0	0	0	0	0	2	5	0	0	42
Testudines	0	0	0	0	0	0	0	0	1	3	4	4	12	0	0	0	0	0	2	6	0	0	32
Squamata	0	0	0	0	0	0	0	0	0	1	1	1	3	0	0	0	3	0	0	0	0	0	9
Osteichthyes	0	0	0	0	0	0	0	2	4	3	1	41	111	6	2	0	0	4	13	14	3	0	204
Chondrichthyes	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	3
Mollusca	0	0	0	0	0	0	0	0	2	0	0	5	0	0	0	0	0	0	10	2	5	0	24
Total	0	0	0	0	7	0	2	26	66	89	67	162	353	43	27	17	26	41	76	68	29	0	1099

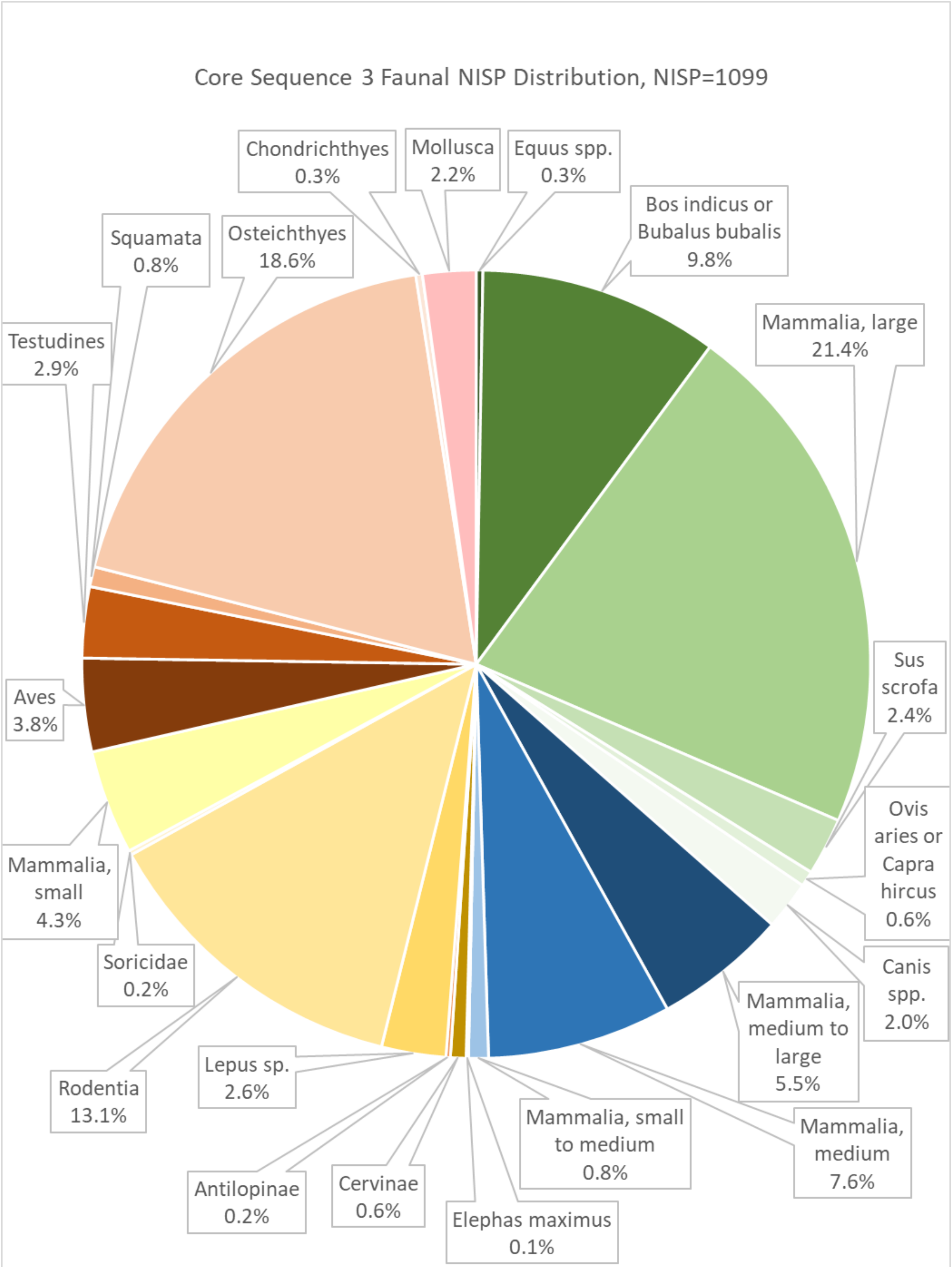


Figure 4-3 Ratio distribution of all faunal remains from Core Sequence 3

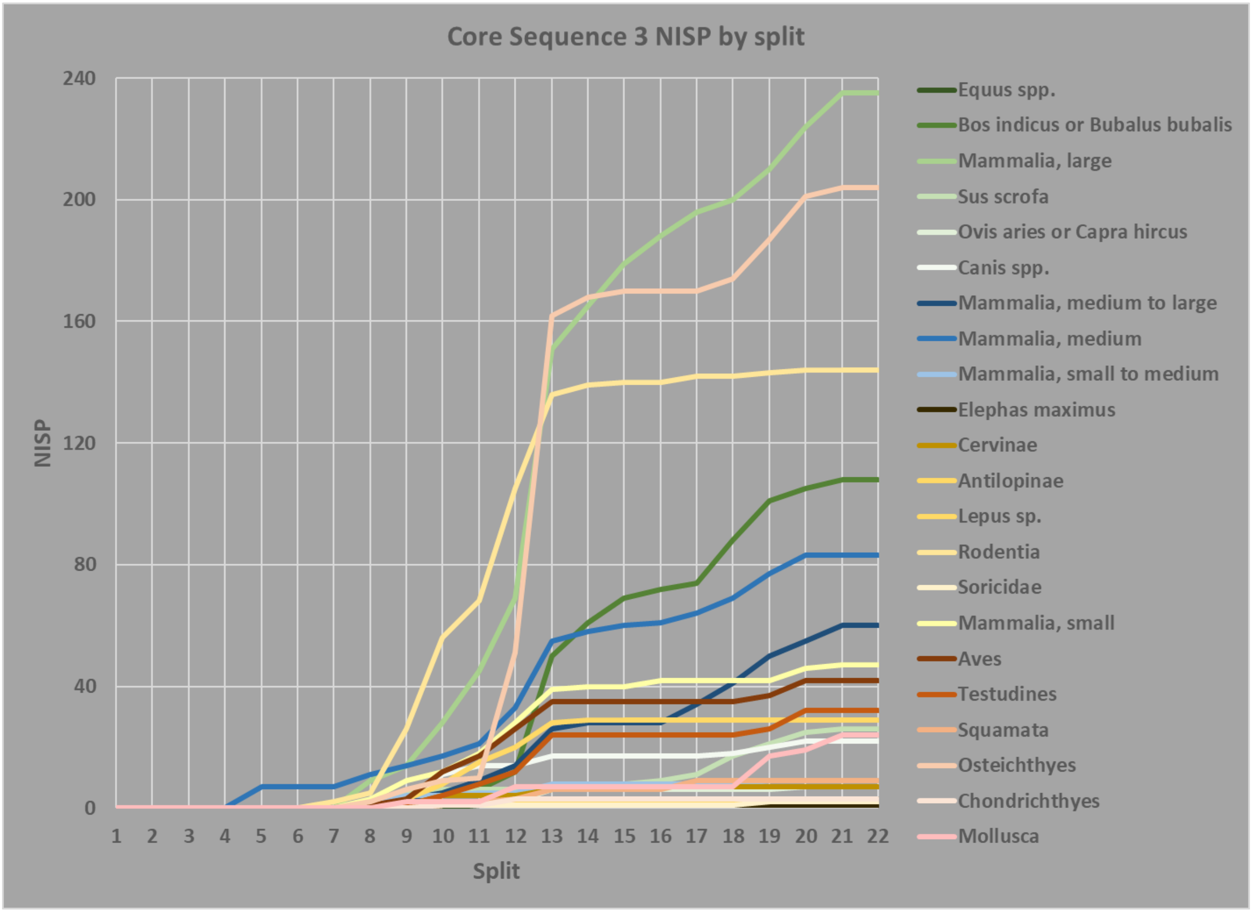


Figure 4-4 Number of identified specimens and location of finds from Core Sequence 3

There was evidence of human modification to some of the faunal remains, either cut marks or evidence of exposure to fire. Eleven of the identified remains had cut marks or other signs of working by humans, representing 1.0% of the NISP from Core Sequence 3. There was evidence of burning on 41 identified specimens, representing 3.7% of the NISP from Core Sequence 3. There were also 42 unidentified bone fragments that showed evidence of discoloration from fire.

Table 4-6 lists the elements that show cut marks. Table 4-7 shows the elements that show signs of fire.

Table 4-6 Elements with Cut Marks from CS3

Split	Element	No. of elements	Taxon identification	Comment
8	Humerus, distal epiphysis fragment	1	Cervinae (*Axis axis* size)	Cut mark
9	Humerus, diaphysis fragment	1	Aves, medium (*Anser indicus* size)	Cut marks
9	Tibia, diaphysis fragment	1	*Bos indicus* or *Bubalus bubalis*	Cut mark
10B	Probable rib fragment	1	Mammalia, large	Worked
11A	Pelvic fragment	1	Mammalia, large (*Bos indicus* or *Bubalus bubalis* size)	Cut marks
12	Tibia, distal epiphysis	1	*Bos indicus*	Cut marks
13	Ulna, proximal epiphysis fragment	1	*Bos indicus*	Cut marks on body and articular surface
13	Cranial fragment	1	Mammalia, medium to large	Cut mark
13A	Long bone fragment	1	Mammalia, large	Worked, cut marks (probably for tool-making purpose), polished edge
20	Worked bone, prob. Pelvis	1	Mammalia, large	Polished on both faces and on edge, broken, many cut marks on one face
20	Pelvic fragment, ischium	1	*Ovis aries* or *Capra hircus*	Cut marks

Table 4-7 Elements with Evidence of Fire from CS3

Split	Element	No. of elements	Taxon identification	Comment
8	Long bone fragment	1	Mammalia, medium to large	Slightly charred
9	Rib fragment	1	Mammalia, large (*Bos indicus/Bubalus bubalis* size)	Charred exterior
9	Dental fragment	1	Mammalia, medium	Burnt black and white
10C	Vertebral fragment	1	Osteichthyes, medium	Burnt black
10C	Unidentified fragment	6	N/A	Burnt white
12	Plastron fragment	1	*Trionyx* sp.	Burnt white
13	Scapula fragment, glenoid fosa	1	*Bos indicus* or *Bubalus bubalis*	Burnt black
13	Spine	1	Osteichthyes, medium	Burnt black
13	Spine	1	Osteichthyes, small	Burnt black
13	Rib fragment	1	Mammalia, medium	Lightly charred
13A	Bone fragment	1	Osteichthyes, medium	Burnt white
13A	Long bone fragment	2	Mammalia, large	Burnt black
17	Vertebra	1	Serpentes	Burnt black
17	Incisor fragment	1	*Sus scrofa*	Burnt white, broken post-fire
17	Unidentified fragment	1	N/A	Burnt white
18	Spine	1	Osteichthyes, small	Burnt black
18	Vertebral fragment	1	Mammalia, large	Burnt white
18	Molar fragment	2	*Sus scrofa*	Partly burnt
18	Unidentified fragment	5	N/A	Burnt black
19	M_3, right	1	*Bos indicus* or *Bubalus bubalis*	Burnt black
19	I_2, right	1	*Bos indicus* or *Bubalus bubalis*	Burnt black, worn
19	Cheek tooth fragment	1	*Canis* sp.	Broken into 2 pieces, burnt black
19	M^1, right	1	*Canis familiaris*	Broken, burnt black
19	Cranial fragment	5	Osteichthyes	Burnt black
19	Spine	1	Osteichthyes, small	Burnt black
19	Spine	1	Osteichthyes, small	Burnt black, serrations on one side
19	Spine	1	Osteichthyes, small to medium	Burnt black, serrations on one side
19	M^3, deciduous	1	*Sus scrofa*	Recently erupted, large individual, burnt black

Split	Element	No. of elements	Taxon identification	Comment
19	Unidentified fragment	12	N/A	Burnt black
19	Unidentified fragment	1	N/A	Burnt black
19	Unidentified fragment	1	N/A	Burnt white
20	M^1 or M^2	2	*Bos indicus* or *Bubalus bubalis*	From 2 different individuals, both burnt (one more than the other)
20	M^2	1	*Canis familiaris*	Burnt partly black
20	Spine	1	Osteichthyes, small	Burnt black
20	Spine	1	Osteichthyes, small	Burnt black, serrations on one side
20	Vertebra	1	Osteichthyes, very small	Burnt black
20	Long bone fragment	1	Mammalia, large	Burnt black
20	Vertebral fragment	1	Mammalia, small	Burnt black
20	Lower incisor	1	*Sus scrofa*	Burnt black
20	Molar fragment	1	*Sus scrofa*	Partly burnt black
20	Unidentified fragment	16	N/A	Burnt black

4.4 Operation 1

Operation 1 was excavated in 2005. It is adjacent to B.B. Lal's excavations from 1948 and just inside the northern of the two gateways on the western rampart of the site (see Figure 3-2), in a portion of the site that has been surrounded by a low wall constructed prior to 2000 by the Archaeological Survey of India indicating a zone of special protection within the archaeological site. The area excavated by Lal represents a residential area with several structures. Operation 1 was excavated in 2005 in four trenches: A, B, D, and E. Trenches A and B each measured 5 x 5 m, while D and E each measured 5 x 3 m. The structures present in Operation 1 represent two phases of brick and laterite construction. Large amounts of ceramics were recovered from Operation 1, primarily of the expedient oxidized ware type characteristic of the site's later phases, as well as a number of small finds, including coins, beads, and metal artifacts (Mohanty and Smith 2005).

Table 4-8 provides a listing of all of the faunal remains from Operation 1 and the trench from which they were excavated. Figure 4-5 shows the percentages of identified specimens over the entire operation. In this operation, each of the trenches was only excavated to a depth of 1 meter, so judging by the low amount of faunal remains found in the upper splits of the core sequences, the small amount of faunal material recovered is expected. The total volume of material excavated in Operation 1 was 80 m^3, so the faunal remains density is much lower than in the core sequences. There were no bones with cut marks discovered in Operation 1, but 10 of the identified specimens showed evidence of exposure to fire, representing 14.1% of the NISP from Operation 1. Some unidentified remains also showed evidence of exposure to fire. Remains with evidence of fire exposure are listed in Table 4-9.

Table 4-8 Number of Identified Specimens from each Trench in Operation 1

Taxa	Trench A	Trench B	Trench D	Trench E	Total
Bos indicus* or *Bubalus bubalis	8	1	2	0	11
Mammalia, large	13	9	3	1	26
Sus scrofa	0	2	0	0	2
***Canis* spp.**	0	1	0	0	1
Mammalia, medium to large	3	2	2	7	14
Mammalia, medium	2	4	0	3	9
Mammalia, small to medium	0	1	0	0	1
Mammalia	0	1	0	0	1
Boselaphus tragocamelus	0	0	2	1	3
Testudines	1	2	0	0	3
Total	27	23	9	12	71

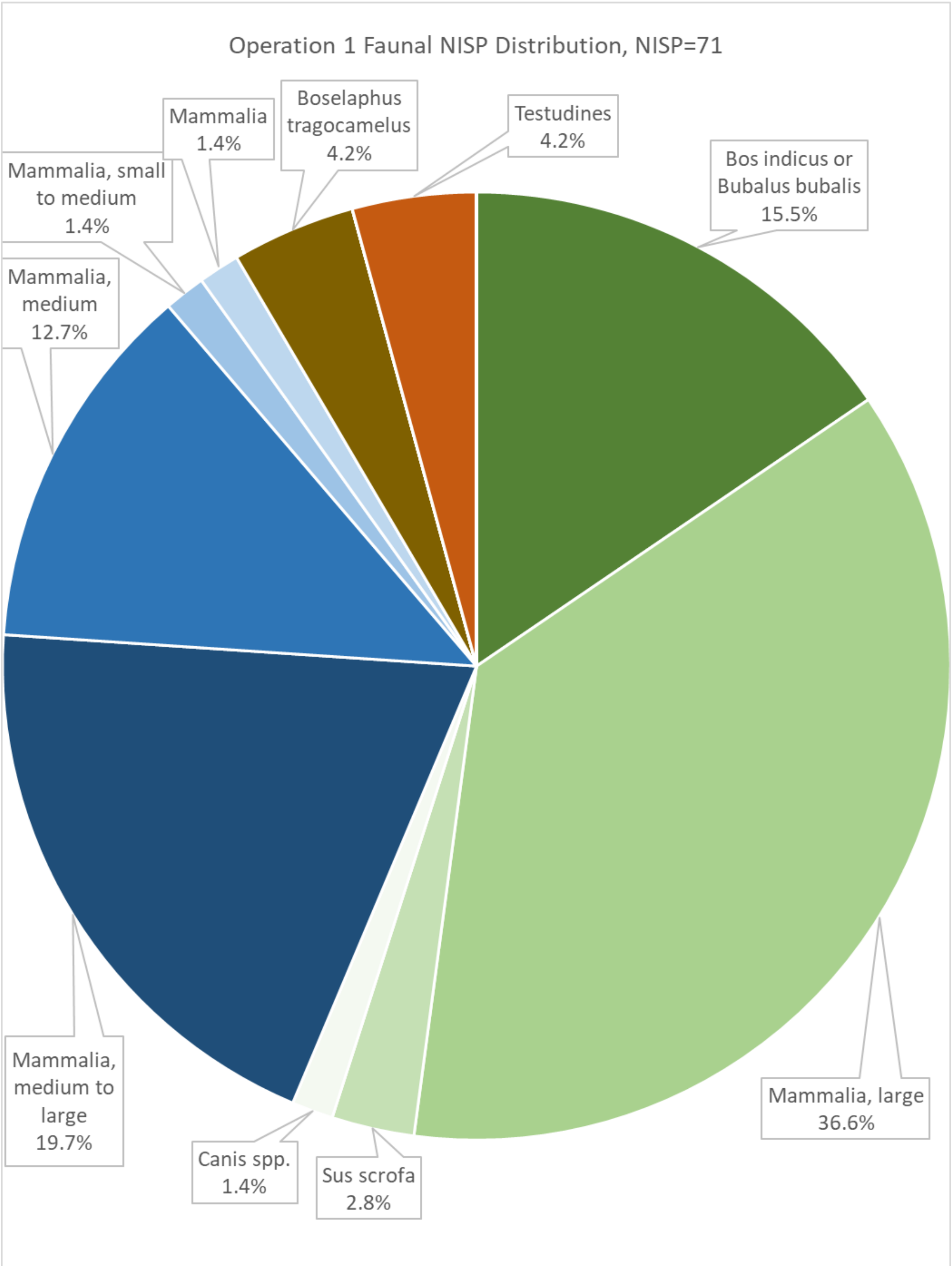


Figure 4-5 Ratio distribution of all faunal remains from Operation 1

Table 4-9 Elements with Evidence of Fire from Operation 1

Trench	Locus	Element	No. of elements	Taxon identification	Comment
A	2	Long bone fragment	1	Mammalia, large	Burnt
A	6	Unidentified fragments	6	N/A	Burnt
B	14	Unidentified fragment	1	N/A	Burnt
B	29	Unidentified fragments	~15	N/A	Burnt, could all be of 1 bone
E	15	Carpal	1	Mammalia, medium	Burnt black and white
B	13	Carapace fragment	1	*Chitra indica*	Burnt exterior, gnaw marks
B	8	Unidentified fragments	2	N/A	Burnt white
B	17	Long bone fragment	1	Mammalia, large	Burnt white
B	29	Long bone fragment	1	Mammalia, medium to large	Burnt white
D	3	Long bone fragment	1	Mammalia, large	Burnt white
E	22	Long bone fragment	1	Mammalia, medium to large	Burnt white
B	8	Long bone fragment	1	Mammalia, medium	Charred
B	23	Plastron fragment	1	*Lissemys punctata*	Charred
E	38	Unidentified fragment	1	N/A	Charred
D	9	Long bone fragments	1	Mammalia, large	Burnt white

4.5 Operation 2

Operation 2 was located at the top of the rampart in the northern part of the eastern rampart. The purpose of this operation was to examine the brickwork at the top of the rampart. Only a single severely fractured unidentified bone fragment was recovered from Operation 2.

4.6 Operation 3

Operation 3 was located in the north-central portion of the site, inside of the northern rampart and approximately 50 m south of the mid-point between the two gates (see Figure 3-2). Excavations in this area began in 2006, initially intended as a deep sounding and labeled as Core Sequence 2. When two distinct phases of architecture were uncovered by the course of the initial digging in this area, it was decided to expand CS-2 into a horizontal excavation that was re-labeled Operation 3. In 2006, Operation 3 consisted of a trench measuring 13 x 18 m and reaching a maximum depth of 1.24 m below the modern surface. In 2007, the trench was expanded south to eventually measure 13 x 25 m and reach a maximum depth of 3.42 m. Operation 3 also included an excavation through the rampart (the faunal analysis for this Rampart Strip will be discussed in the next section). Architectural remains recovered from Operation 3 consisted of individual structures. In the upper architectural phase, the structural foundations are made up of irregularly sized pieces of laterite and bricks and have a somewhat irregular layout. In the lower architectural phase, the foundations are more regularly laid out and also have more consistently sized bricks and laterite blocks. A third, earlier architectural phase underneath the other two phases was just barely uncovered at the end of the excavation season in a few areas of Trenches G and T (below approximately the level of 2.75 m). Ceramics from Operation 3 are almost exclusively of the expedient oxidized ware type corresponding to the upper half of the site's occupation. Artifacts recovered from Operation 3 include large numbers of terracotta ornaments and items of personal adornment. One particularly striking find was a complete shed antler of a deer, intentionally deposited along with upright ceramic bowls and cups and a few small artifacts (Mohanty and Smith 2006:11-23, Mohanty and Smith 2007:12-23).

Table 4-10 provides a listing of all of the faunal remains from each of the trenches of Operation 3 where faunal remains were found. Figure 4-6 shows the percentages of all the identified faunal remains for all of Operation 3 excluding the Rampart Strip (a narrow trench extending from the northern part of Operation 3 across the rampart). Operation 3 involved the largest volume of material excavated in the 2005-09 excavations, at approximately 600 m^3. In this large volume of material, the total NISP was only 127, so the average density of faunal remains is much lower here than in either of the two Core Sequences or even in Operation 1.

Table 4-10 Number of Identified Specimens from each Trench in Operation 3

Taxa	F	G	J	K	L	N	P	Q	T	V	W	Y	Total
Equus **spp.**	0	1	0	0	0	0	0	0	0	0	0	0	1
Bos indicus **or** ***Bubalus bubalis***	2	15	2	0	0	2	0	0	0	5	3	1	30
Mammalia, large	2	12	3	4	0	0	1	0	0	2	0	0	24
Sus scrofa	2	5	0	0	0	0	0	1	0	0	0	0	8
Ovis aries **or** ***Capra hircus***	0	2	0	0	0	0	0	0	0	0	0	0	2
Canis **spp.**	0	1	0	0	0	0	0	0	0	1	0	0	2
Mammalia, medium to large	2	4	1	0	1	0	0	5	3	3	8	0	27
Mammalia, medium	0	3	1	0	0	0	0	0	0	1	0	0	5
Mammalia, small to medium	0	1	0	0	0	0	0	0	0	0	0	0	1
Cervinae	0	2	0	0	0	0	0	0	0	0	0	0	2
Rodentia	1	0	0	0	0	0	0	0	0	0	0	0	1
Mammalia, small	0	2	0	0	0	0	0	0	0	0	0	0	2
Aves	0	8	0	0	0	0	1	0	0	0	0	0	9
Testudines	3	7	0	0	0	0	0	0	0	2	0	0	12
Osteichthyes	0	0	0	0	0	0	0	0	1	0	0	0	1
Total	12	63	7	4	1	2	2	6	4	14	11	1	127

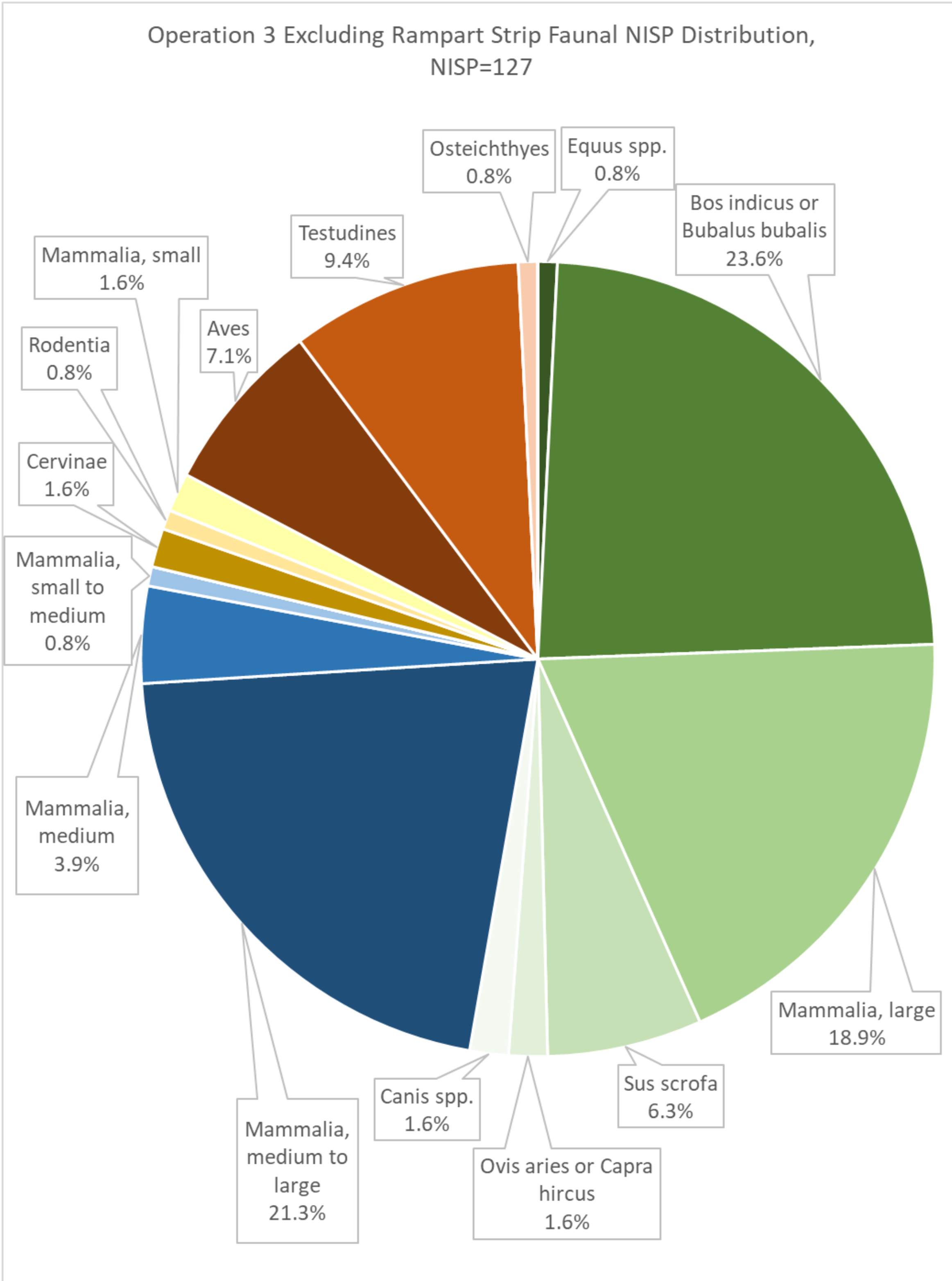


Figure 4-6 Ratio distribution of all faunal remains from Operation 3 excluding the Rampart Strip.

Excavations in Operation 3 did not reach the earliest levels of habitation, even in the deepest portions of Trench G (which was the trench excavated to the greatest depth in the operation). The findings generally correspond with the kinds of material found in the upper levels of Operation 6 and Core Sequence 1. The majority of the remains recovered from Operation 3 are *Bos indicus, Bubalus bubalis,* or Mammalia, large and Mammalia, medium to large. The remainder of the sample is distributed over a diverse range of taxa, none appearing in very large numbers. Approximately half of the identifiable remains from Operation 3 came from Trench G, possibly suggesting a concentration of animal-related activities in this location (although this could also be accounted for by the relatively greater depth of the excavations). The bulk of identified specimens from Trench G came from loci 37-46 (see Figure 4-7), constituting a depth of 1.75 m to 2.55 m (roughly equivalent in depth to Splits 6, 7, and 8 of Core Sequence 3). Other regions of this trench had similar frequencies of faunal material to other trenches in Operation 3. This range of loci also includes the striking feature with a shed deer antler and complete ceramic vessels.

There was evidence of human modification to some of the faunal remains in Operation 3, either cut marks or evidence of exposure to fire. Five of the identified remains, 3.9% of the NISP from Operation 3, had cut marks or other physical modifications, as did one unidentified bone which had been modified into a point. Five identified specimens, 3.9% of the NISP from Operation 3, showed evidence of exposure to fire. There were also six unidentified bone fragments that showed evidence of fire. Table 4-11 lists the elements that show human mechanical alterations. Table 4-12 shows the elements that show signs of fire.

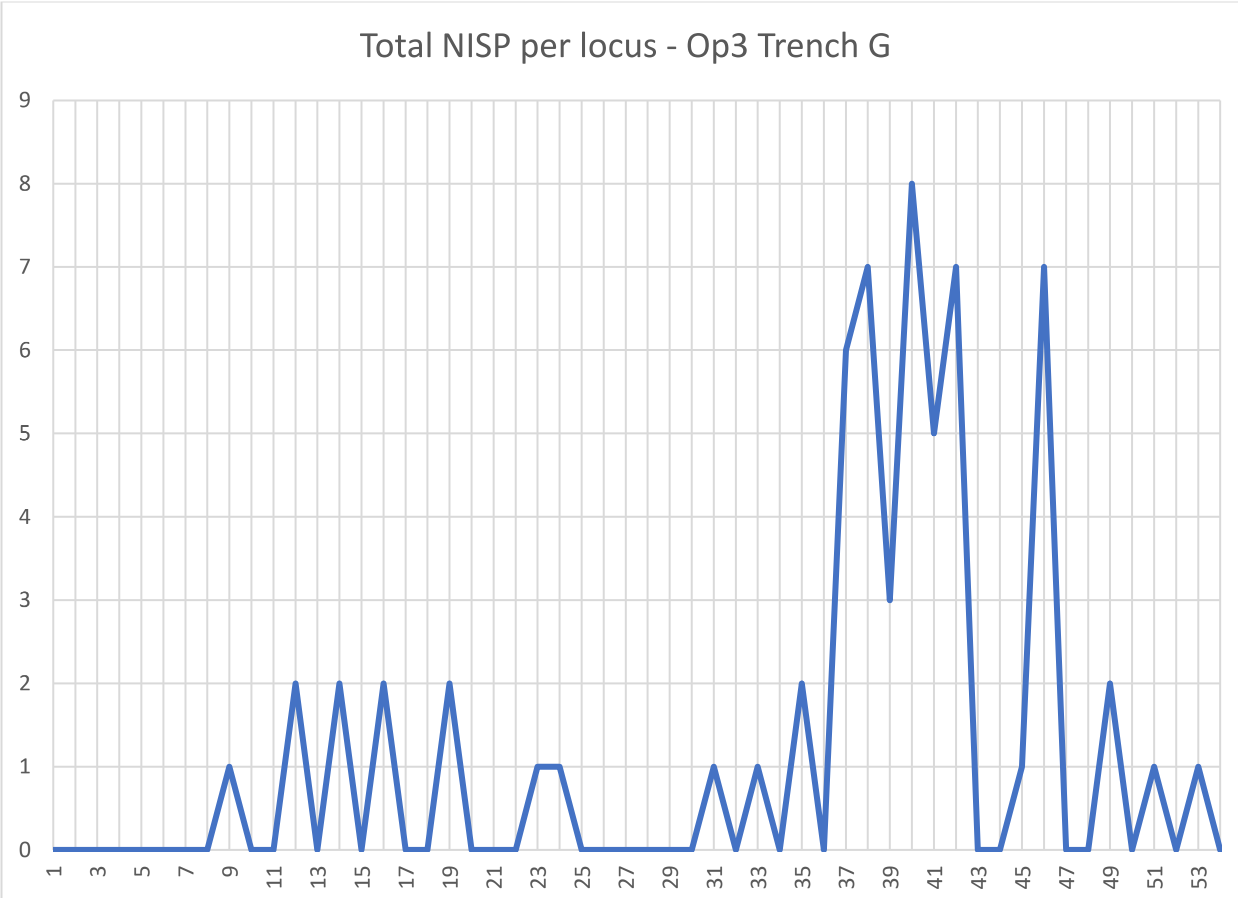


Figure 4-7 NISP from each locus of Operation 3 Trench G

Table 4-11 Elements with Cut Marks from Operation 3

Trench	Locus	Element	No. of elements	Taxon identification	Comment
F	6	M_2	1	*Bos indicus* or *Bubalus bubalis*	Deep gouge on labial surface perpendicular to axis of tooth
G	31	Long bone fragment	1	Mammalia, medium to large	Cut marks
G	41	Rib fragment	1	Mammalia, large	Cut marks on both sides, charred on interior (not exterior)
G	42	Scaphoid	1	*Bos indicus* or *Bubalus bubalis*	Chop mark
G	46	Carapace fragment	1	Testudines (possible *Kachuga tecta*)	Three pieces. Two of these are worked in some way with a shelf cut into the bone and polished
G	54	Worked bone point	1	N/A	Worked

Table 4-12 Elements with Evidence of Fire from Operation 3

Trench	Locus	Element	No. of elements	Taxon identification	Comment
F	16	Long bone fragment	1	Mammalia, medium to large	Burnt white
F	45	Unidentified fragment	1	N/A	Partially burnt black (carbonized)
G	41	Rib fragment	1	Mammalia, large	Cut marks on both sides, charred on interior (not exterior)
G	42	Hypsodont tooth fragment	1	Mammalia, medium to large	Charred, unusual texture
Q	33	Unidentified fragment	1	N/A	Burnt white with cut mark
T	28	Spine	1	Osteichthyes, medium	Rear-facing serrations on posterior, forward facing on anterior. Burnt white
V	23	Long bone fragment	1	Mammalia, large	Three pieces, probably from single bone. Burnt white on one side and inside bone, exterior appears unburnt
V	36	Unidentified fragment	1	N/A	Burnt white
W	33	Unidentified fragment	2	N/A	Burnt white
W	39	Unidentified fragment	1	N/A	Burnt white

4.7 Operation 3 Rampart Strip

In 2007, Operation 3 was expanded to the exterior rampart to investigate the particulars of this monumental feature of the site. To this end, a 2 x 55 m trench was excavated northward from Operation 3, all the way to the exterior of the rampart uncovering portions of the rampart itself as well as the intervening habitation areas. These excavations uncovered three distinct phases of construction of the rampart. The earliest of these phases included burnished oxidized and reduced wares, indicating that it dates to the earlier part of the site's habitation (Mohanty and Smith 2007:26). Faunal remains were relatively common in portions of the trench close to the main trench of Operation 3 but became less so in the subsequent fill of the rampart. In 2008, a small 2 x 4 m trench (Operation 3 Rampart Strip GG) immediately east of the northernmost extent of the 2007 rampart strip was excavated in an attempt to understand the full sequence of rampart construction over time where the rampart met the exterior surrounding moat. The excavations of the whole rampart strip revealed many successive layers of rampart augmentation (Mohanty and Smith 2008). Table 4-13 provides a listing of all of the faunal remains from each of the trenches of Operation 3's Rampart Strip where faunal remains were found. Figure 4-8 shows the percentages of identified specimens for all of the Operation 3 Rampart Strip. Within the rampart strip, there was great variability in the amount of faunal material recovered from each trench.

Table 4-13 Number of Identified Specimens from each Trench in Operation 3, Rampart Strip

Taxa	AA	BB	CC	DD	EE	FF	GG	Total
Bos indicus or *Bubalus bubalis*	2	6	0	0	0	0	1	9
Mammalia, large	6	51	0	1	6	0	2	66
Sus scrofa	0	1	0	0	0	0	0	1
Ovis aries or *Capra hircus*	0	1	0	0	0	0	0	1
Canis spp.	0	0	0	0	3	0	0	3
Mammalia, medium to large	7	7	0	0	0	0	0	14
Mammalia, medium	7	4	0	0	6	0	1	18
Mammalia, small to medium	2	0	0	0	0	0	0	2
Mammalia	0	0	0	0	0	1	0	1
Mammalia, small	2	0	0	0	0	0	0	2
Aves	3	0	0	0	2	0	0	5
Testudines	3	6	0	0	0	0	0	9
Mollusca	1	0	0	7	64	0	3	75
Total	33	76	0	8	81	1	7	206

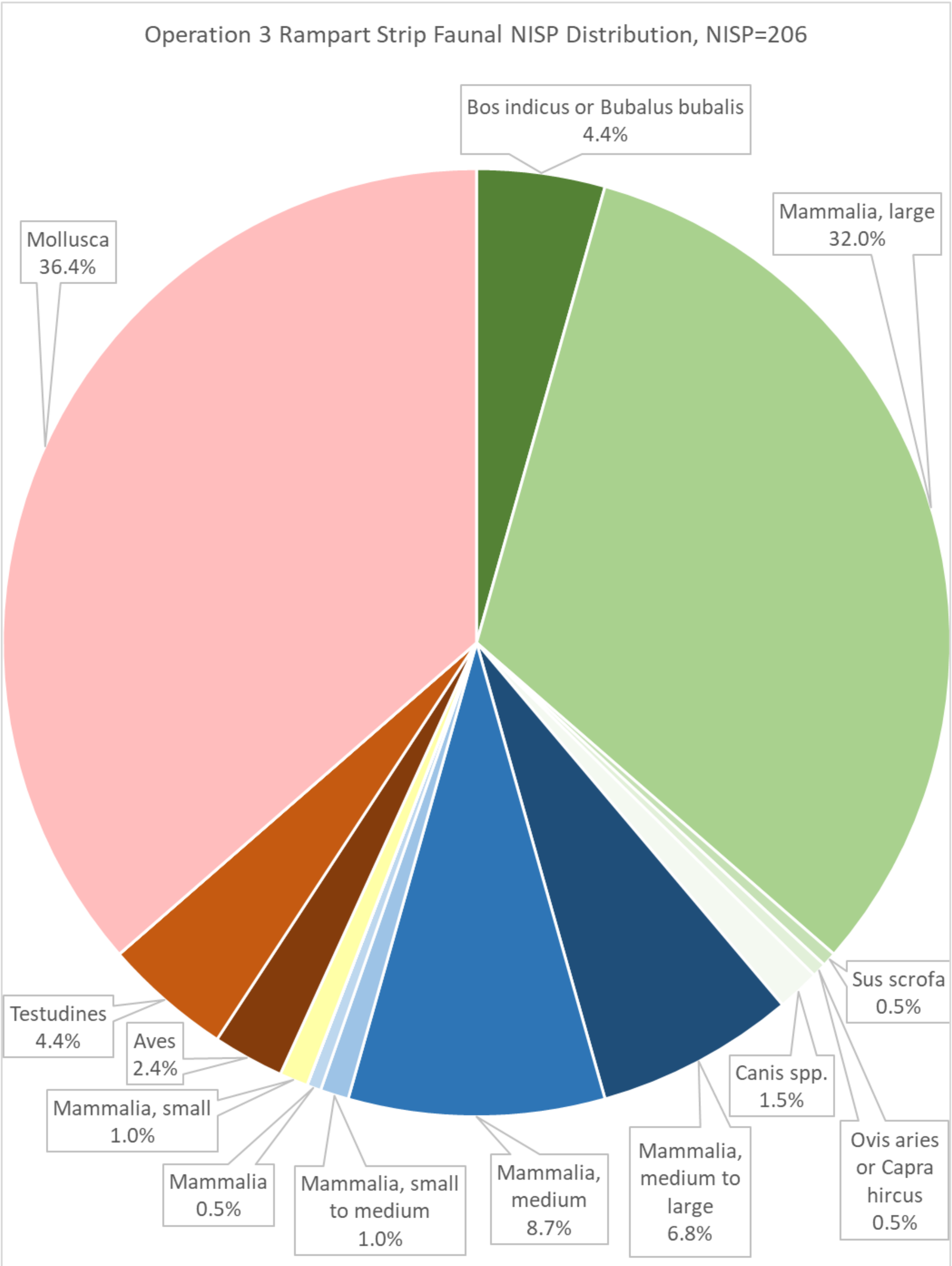


Figure 4-8 Ratio distribution of all faunal remains from Operation 3, Rampart Strip

The Operation 3 Rampart Strip cut through a diverse section of use areas in the site. It began near Operation 3 in a habitation area at the base of the rampart, continued over the crest of the rampart and terminated just outside the base of the rampart. Because of this, the findings from the rampart strip are diverse. Strips AA and BB represent habitation types of deposit, and most recovered remains from these strips came from Mammalia, medium, Mammalia, medium to large, and Mammalia, large. No faunal remains were recovered from Strip CC, and Strip DD, which includes the crest of the rampart, is nearly as sparse. Remains reappear in Strip EE, but in a very different form: the majority of the remains from this strip are from three different types of snails appearing in relatively large numbers. Strip FF and Strip GG are again relatively devoid of faunal remains. The distribution of these remains is certainly affected by the slope of the rampart; as the rampart probably eroded somewhat over the past millennium or so, remains from the top probably slipped downward and were deposited elsewhere. This slope is probably also the reason for the small amount of material in Strips CC, DD, FF, and GG. The most idiosyncratic aspect of the Operation 3 Rampart Strip assemblage is the high concentration of snail remains in trench EE, which have not been found in such concentrations anywhere else in the site. The presence of three distinct types of aquatic snail on the rampart itself suggests that their remains were deposited there by human action. This may have been intentional or may have been an unintended side effect of use of water-logged sediments, perhaps from the moat that is on the exterior of the rampart, in the augmentation of the rampart.

There was evidence of human modification to some of the faunal remains, either cut marks or evidence of exposure to fire. Three of the identified remains had cut marks or other physical modifications, representing 1.5% of the NISP from the Operation 3 Rampart Strip. Thirteen of the identified specimens showed evidence of exposure to fire, representing 6.3% of the total NISP from the Operation 3 Rampart Strip. There were also unidentified bone fragments that showed evidence of fire. Table 4-14 lists the elements that show cut marks. Table 4-15 shows the elements that show signs of fire.

Table 4-14 Elements with Cut Marks from Operation 3, Rampart Strip

Trench	Locus	Element	No. of elements	Taxon identification	Comment
BB	34	Tibia, proximal epiphysis, unfused	1	*Bos indicus* or *Bubalus bubalis*	Proximal end unusually flattened—chopping?
BB	37	Humerus	1	Mammalia, medium (*Canis familiaris* size)	Modified at end. Broken into 2 pieces during analysis
EE	25	Shell	1	*Lamellidens* sp.	Small hole, intentional i.e. bead

Table 4-15 Elements with Evidence of Fire from Operation 3, Rampart Strip

Trench	Locus	Element	No. of elements	Taxon identification	Comment
AA	19	Unidentified fragment	1	N/A	Burnt white
AA	19	Unidentified fragment	4	N/A	Burnt white
AA	23	Tibia fragment	1	Mammalia, medium to large	Burnt white
AA	23	Long bone fragment	1	Mammalia, medium to large	Interior burnt white, exterior appears unburnt
AA	24	Rib fragment	1	Mammalia, small (*Rattus rattus* size)	Burnt white
AA	26	Long bone fragment	1	Mammalia, large	Charred on exterior surface
AA	29	Rib fragment	1	Mammalia, medium (*Canis familiaris* size)	Burnt black
AA	29	Unidentified fragment	1	N/A	Burnt black and white
AA	29	Unidentified fragment	10	N/A	Burnt black and white, probably from single piece
BB	21	Unidentified fragment	2	N/A	Burnt black and white
BB	30	Dental fragment	1	Mammalia, medium	Burnt black, broken into 4 pieces
BB	30	Unidentified fragment	1	N/A	Burnt white
BB	30	Unidentified fragment	13	N/A	1 fragment burnt black
EE	1	Tibiotarsus fragment	1	*Gallus gallus*	Burnt white
EE	1	Long bone fragment	1	Aves, medium	Burnt white
EE	13	Unidentified fragment	8	N/A	Burnt black
EE	17	Long bone fragment	1	Mammalia, medium	Burnt black
EE	27	Shell fragment	1	*Bellamya* sp.	Partial, burnt white
EE	27	Vertebral fragment	1	Mammalia, medium	Charred
EE	30	Long bone fragment	1	Mammalia, large	Interior charred, exterior appears normal. Very accreted
FF	14	Long bone fragment	1	Mammalia	Burnt white
GG	11	Unidentified fragment	1	N/A	Burnt white
GG	11	Unidentified fragment	~20	N/A	Burnt white

4.8 Operation 4

Operation 4 was placed to ground-truth the results of geophysical survey of the site. The operation consisted of a single trench located on one of the linear anomalies detected via magnetometry. The linear anomaly selected was one of what appeared to be roads between opposite gates in the rampart. Operation 4 is located in the northeastern quadrant of the site. Very little bone was recovered from this trench, mostly from the uppermost loci. The recovered material consisted of a *Canis familiaris* vertebra, a fragment of Testudine plastron, and several long-bone fragments from unidentified mammals.

4.9 Operation 5

Operation 5 was excavated in the pillar area at the center of the site. Relatively little faunal material was recovered from Operation 5. Most or all faunal remains recovered from Operation 5 are clearly not in primary context. The bones are more fragmented and abraded than in almost any other area of excavation at Sisupalgarh. This is consistent with the idea that the fill for the elevated mound associated with the pillar area was redeposited from elsewhere in the site. However, the small sample of bones recovered from Operation 5 is surprisingly diverse, more reminiscent of the deeper deposits from Core Sequence 1 and Operation 6, suggesting that the material for the mound may have been at least partially sourced from areas with an animal exploitation strategy more associated with earlier practices. Figure 4-9 shows the percentages of all the identified faunal remains recovered from Operation 5.

There was evidence of human modification to some of the faunal remains, either cut marks or evidence of exposure to fire. Only one of the identified remains exhibited physical modifications, representing 2.1% of the NISP from Operation 5. Twelve of the identified specimens showed evidence of exposure to fire, representing 25.0% of the total NISP from

Operation 5. There were also unidentified bone fragments that showed evidence of fire. A burnt worked point made from an unidentified animal bone was also recovered. Table 4-16 lists the elements that show working or cut marks from Operation 5. Table 4-17 shows the elements that show signs of exposure to fire.

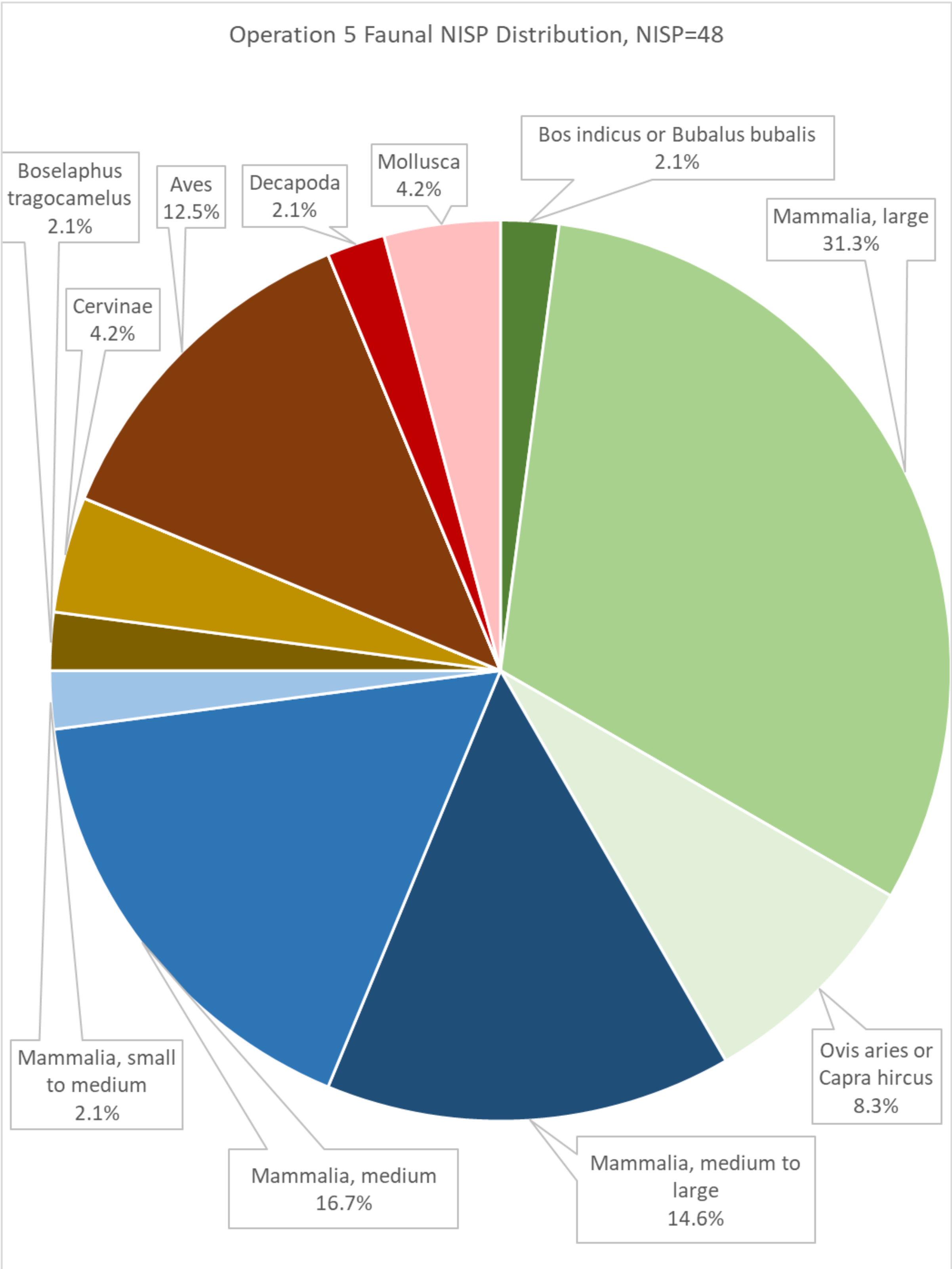


Figure 4-9 Ratio distribution of all faunal remains from Operation 5.

Table 4-16 Elements with Cut Marks from Operation 5

Trench	Locus	Element	No. of elements	Taxon identification	Comment
PM17	7	Bone point	1	N/A	Tip broken, worked and burnt
PM17	9	Long bone shaft	1	Mammalia, large	Worked, flakes removed?

Table 4-17 Elements with Evidence of Fire from Operation 5

Trench	Locus	Element	No. of elements	Taxon identification	Comment
PG11	10	Unidentified fragment	1	N/A	Burnt white
PG11	25	Long bone fragment	2	Mammalia, medium	Burnt white
PH11	20	Rib head	1	Mammalia, medium (*Ovis aries* or *Capra hircus* size)	Partially charred
PH11	20	Long bone outer diaphysis fragment	2	N/A	Charred
PH11	20	Long bone outer diaphysis fragment	~15	N/A	Charred
PH11	24	Radius diaphysis fragment	1	Mammalia, medium	Burnt white
PH11	24	Unidentified fragment	5	N/A	Burnt white
PH11	26	Long bone fragment	3	Mammalia, medium to large	Charred
PH11	26	Patella fragment	1	*Boselaphus tragocamelus*	Charred
PH11	28	Long bone fragment	1	Mammalia, medium to large	Burnt black on exterior, burnt white on interior
PH11	28	Vertebral fragment	1	Mammalia, medium to large	Slightly charred
PL11	31	Shell	1	*Lamellidens* sp.	Broken, burnt white
PM17	7	Bone point	1	N/A	Tip broken, worked and burnt
PS11	5	Femur diaphysis fragment	1	Mammalia, medium (*Ovis aries* or *Capra hircus* size)	Burnt white

4.10 Operation 6

Operation 6 was excavated in 2009. This operation is located about 200 m north of the western gate of the northern rampart. Operation 6 consisted of a single trench measuring 5 x 10 m. Operation 6 contained several layers of stone architecture, including portions of four stone circles made of thin laterite blocks standing on their edge. Findings included abundant ceramics and terracotta ornaments as well as some glass and metal objects. Operation 6 was the only excavation to reach bedrock, representing a complete cultural sequence (Mohanty and Smith 2009). Relatively large quantities of bones were also recovered. Operation 6 was divided into two trenches, HC6 and HC7, consisting of 82 and 69 loci, respectively. HC6 was the western half of the trench and HC7 was the eastern half. Table 4-18 provides the total NISP for 28 taxa (or groups of taxa) for each trench of Operation 6. Figure 4-10 shows the percentages of each of these taxonomical groups from all of trench HC6 and Figure 4-11 presents a similar figure for trench HC7.

Operation 6 had a lower density of faunal remains than Core Sequences 1 and 3, especially in Trench HC7. Each trench represented 25 m^2 of area, and at least portions of HC6 were excavated to a depth of 4.28 m and portions of HC7 were excavated to a depth of 2.34 m. Within all of this excavated material, there were only 138 identifiable specimens in HC6 and 24 in HC7. Due to the dense clayey nature of the soil, the material from Operation 6 was not sieved, so it is expected that there would be a lower prevalence of small bones and bone fragments than there was in the sieved material from the lower depths of Core Sequence 1 or Core Sequence 3. The reduced amount of faunal material from HC7 could be due to the lower excavation depth, since the upper portions of HC6 (Loci 1 through 45) had much less faunal material than the deeper portions (Loci 46 through 82). In fact, the pattern of the remains in HC6 closely resembles that from Core Sequence 1, with a much higher diversity of taxa in the deeper loci with a domination of *Sus scrofa* remains, while this species was absent from Loci 1 through 41. Osteichthyes remains also only appear in the sections of the trench lower than Locus 55 of Trench HC6.

In HC6, of the 138 identified remains 6 had cut marks (representing 4.3% of the NISP from HC6), and 14 of them showed evidence of exposure to fire (representing 10.1% of the NISP from HC6). In HC7, of the 24 identified remains 2 had cut marks (representing 8.3% of the NISP from HC7), and 8 of them showed evidence of exposure to fire (representing 33.3% of the NISP from HC7). There were also unidentified bone fragments from both trenches that showed evidence of fire. In one particularly striking example from HC7 locus 69, crushed long bone fragments from a large mammal had clearly been crushed after being burned and were still stuck together by dirt. This suggests that the materials were buried soon after, as they had not been scattered. Table 4-19 lists the elements from Trench HC6 that show cut marks. Table 4-20 lists the elements from Trench HC6 that show evidence of burning.

Table 4-21 lists the elements from Trench HC7 that show cut marks. Table 4-22 lists the elements from Trench HC7 that show evidence of burning.

Table 4-18 Number of Identified Specimens from each Trench in Operation 6

Taxon	HC6	HC7
Bos indicus or *Bubalus bubalis*	22	5
Mammalia, large	24	4
Sus scrofa	31	1
Ovis aries or *Capra hircus*	2	0
Canis spp.	1	0
Mammalia, medium to large	12	5
Mammalia, medium	12	0
Mammalia, small to medium	8	1
Mammalia	3	1
Boselaphus tragocamelus	6	0
Cervinae	0	3
Mammalia, small	4	0
Aves	2	0
Testudines	1	1
Osteichthyes	9	1
Mollusca	1	2
Total	138	24

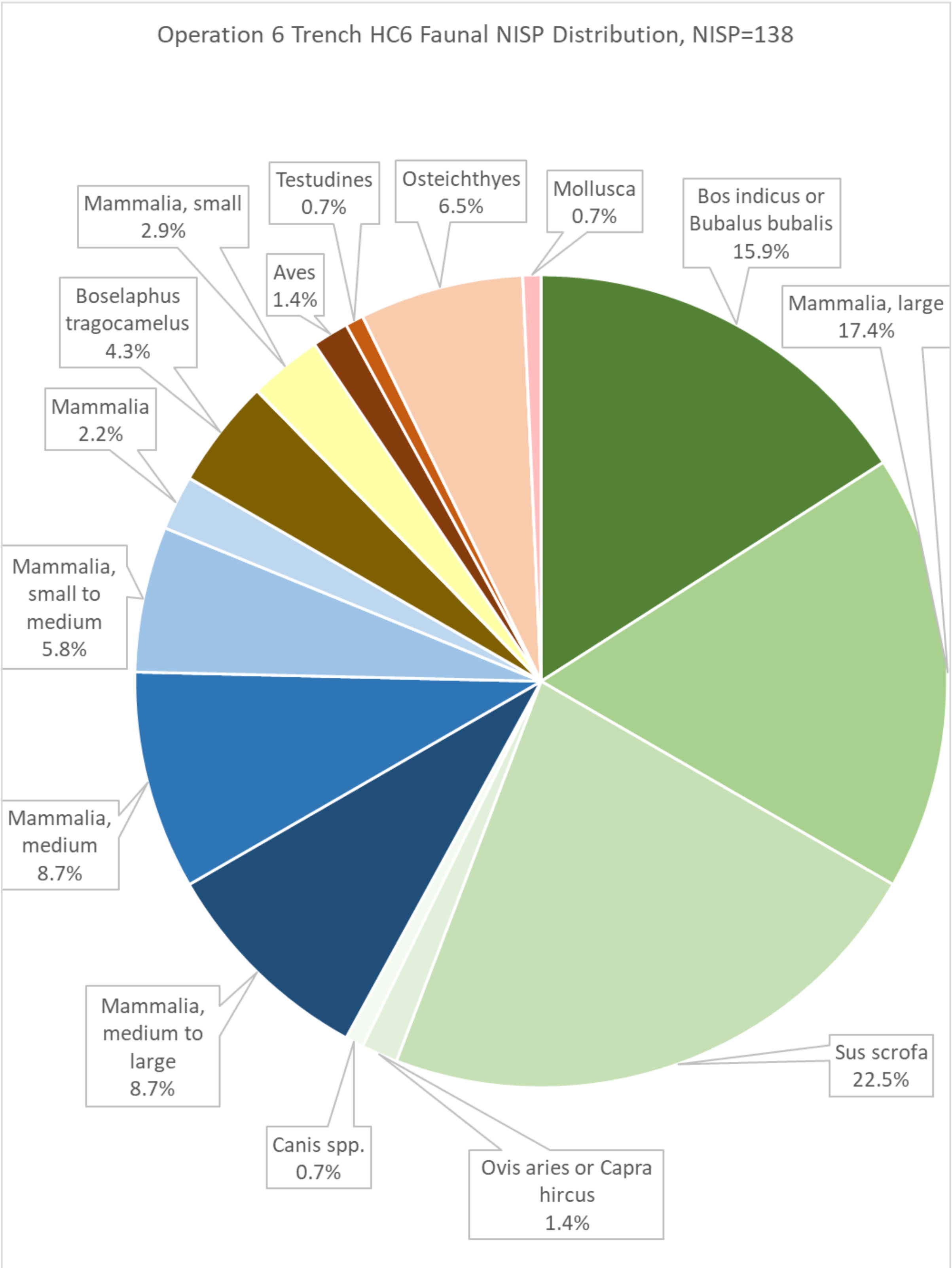


Figure 4-10 Ratio distribution of all faunal remains from Operation 6, Trench HC6

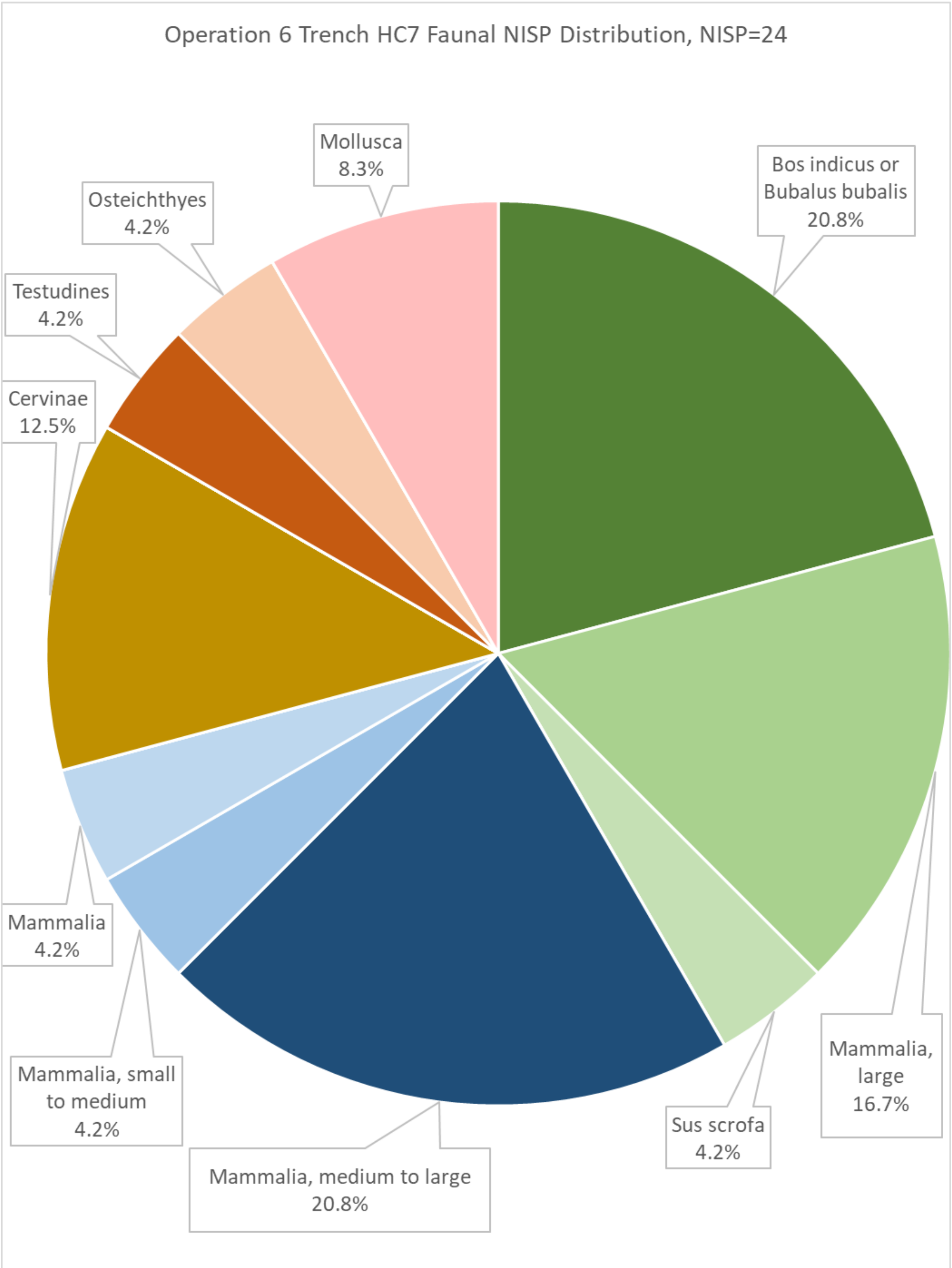


Figure 4-11 Ratio distribution of all faunal remains from Operation 6, Trench HC7

Table 4-19 Elements with cut marks from Operation 6, Trench HC6

Locus	Element	No. of elements	Taxon identification	Comment
51	Long bone fragment	1	Mammalia, large	Cut mark
52	Long bone fragment	1	Mammalia, large	Cut marks
53	Long bone fragment	1	Mammalia, medium to large	Cut marks
58	Long bone fragment	1	Mammalia	Chop marks on two axes
58	I^2, right	1	*Sus scrofa*	Cut marks, possible
72	Mandibular symphesis fragment	1	*Bos or Bubalus*	Cut marks
73	Unidentified fragments	1	N/A	Cut marks
75	Unidentified fragments	1	N/A	Cut mark

Table 4-20 Elements with evidence of burning from Operation 6, Trench HC6

Locus	Element	No. of elements	Taxon identification	Comment
12	Upper premolar, left	1	*Boselaphus tragocamelus*	Charred
32	Unidentified fragments	4	N/A	Cancelous bone
43	Tarsometatarsus	1	Aves, medium (*Gallus gallus* size)	Burnt black
48	Cranial fragment	1	*Bos indicus* or *Bubalus bubalis*	Burnt black
48	Long bone fragments	1	Mammalia, large	Burnt black, outer layer of bone splitting off
48	Long bone fragments	1	Mammalia, medium to large	Burnt black
48	Cranial fragment	1	Mammalia, medium to large	Charred
48	Vertebral fragment	1	Mammalia, medium to large	Charred
48	Unidentified fragments	1	N/A	Charred
49	Cranial fragment	1	Mammalia, medium to large	Burnt black
49	Unidentified fragments	1	N/A	Charred
53	Dental fragments	4	Mammalia, medium	Burnt black
53	Rib fragment	1	Mammalia, small (*Lepus* size)	Burnt black
53	Long bone fragments	2	N/A	Burnt black
55	Unidentified fragments	~10+	N/A	Burnt black
55	Unidentified fragments	2	N/A	Totally carbonized
58	Unidentified fragments	1	N/A	Burnt black
65	Lower incisor	1	*Sus scrofa*	Charred

Table 4-21 Elements with cut marks from Operation 6, Trench HC7

Locus	Element	No. of elements	Taxon identification	Comment
23	Shell	1	*Lamellidens* sp.	Parallel incised lines on outer surface
66	Long bone fragments	1	Mammalia, large	Cut mark, large and deep

Table 4-22 Elements with evidence of burning from Operation 6, Trench HC7

Locus	Element	No. of elements	Taxon identification	Comment
31	Unidentified fragments	1	N/A	Burnt white
54	Unidentified fragments	3	N/A	Burnt mixed black and white
60	Long bone fragments	1	Mammalia	Burnt white
60	Phalanx, epiphyses unfused or broken off	1	Mammalia, small to medium	Burnt mixed black and white
61	Spine	1	Osteichthyes, small to medium	Charred black, rear facing small serrations top and bottom
66	Antler fragments	1	Cervidae	Burnt white
67	Unidentified fragments	10	N/A	All burnt white
69	Antler fragments	3	Cervidae	Burnt white, single animal
69	Long bone fragments	24	Mammalia, large	Burnt white, splitting from heat and/or pressure
69	Disintegrating fragments, unidentified	~50	N/A	All burnt white

4.11 Operation 7

Operation 7 was an excavation of the westernmost gateway of the northern rampart and consisted of four areas. A north-south excavation measuring 5 x 40 m divided into 8 trenches (D7, E7, F7, G7, H7, J7, K7 and L7 running from north to south) and an intersecting east-west excavation measuring 2.5 x 25 m divided into 3 trenches (M6, M8, and M10 running from west to east) were intended to investigate both the interior passageway and the longitudinal extent of the gateway. Two detached trenches (Trenches N12 and P8) measuring 4.22 x 0.93 m and 2 x 2 m, respectively, were placed to investigate specific features of the gateway's architecture (Mohanty and Smith 2009). Identified faunal material was recovered from trenches E7, G7, H7, J7, and M8. A fragment of distal humerus epiphysis from a medium-sized felid was recovered from Trench J7, but has been grouped with "Mammalia, medium" for analytical purposes. Table

4-23 provides the total NISP of all faunal remains from Operation 7. Figure 4-12 shows the ratio distribution of each of these taxonomic groups.

There was some evidence of human modification to some of the faunal remains. Physical modification to animal remains was only represented in Operation 7 by a single worked bone point from an unidentified animal. 29 of the identified specimens showed evidence of exposure to fire, representing 28.7% of the total NISP from Operation 7. There were also unidentified bone fragments that showed evidence of fire. Table 4-24 shows the elements that show signs of exposure to fire.

Table 4-23 Number of Identified Specimens from Operation 7.

Taxon	E7	G7	H7	J7	M8	Total
Equus sp.	0	0	0	0	1	1
Bos indicus or *Bubalus bubalis*	1	1	3	2	9	16
Mammalia, large	0	1	10	4	25	40
Ovis aries or *Capra hircus*	1	0	0	0	0	1
Canis sp.	0	0	0	0	1	1
Mammalia, medium to large	2	3	3	3	6	17
Mammalia, medium	8	0	2	1	2	13
Cervinae	1	0	0	0	1	2
Rodentia	0	0	0	0	1	1
Aves	0	0	0	0	1	1
Testudines	0	0	0	0	7	7
Mollusca	0	0	0	0	1	1
Total	13	5	18	10	55	101

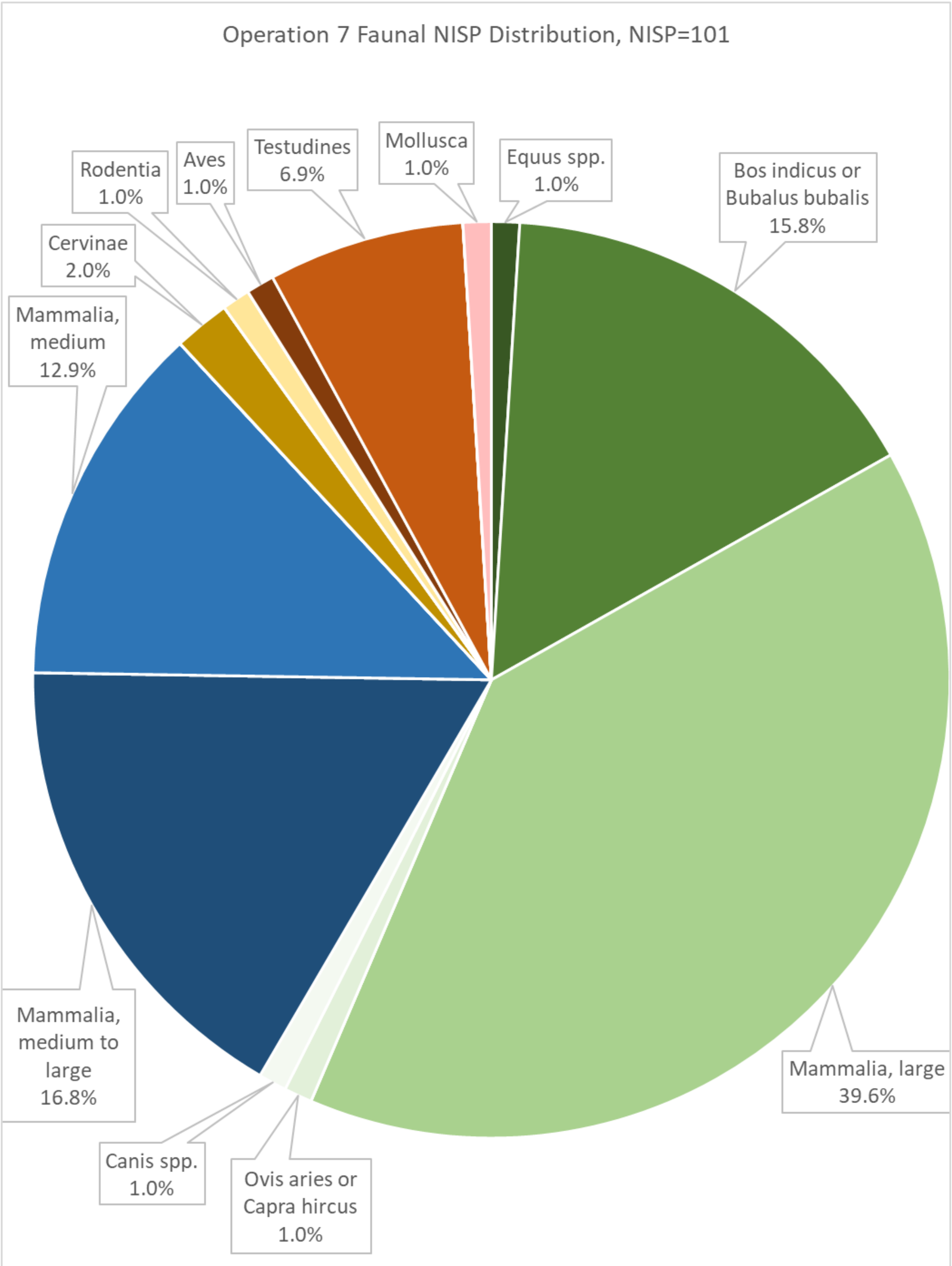


Figure 4-12 Ratio distribution of all faunal remains from Operation 7

Table 4-24 Elements with Evidence of Fire from Operation 7

Trench	Locus	Element	No. of elements	Taxon identification	Comment
E7	8	Long bone fragment	1	Mammalia, medium	Slightly charred exterior
E7	8	Long bone fragment	1	Mammalia, medium to large	Charred exterior
E7	9	Unidentified fragment	1	N/A	Burnt white
G7	8	Unidentified fragment	1	N/A	Burnt black
H7	1	Cheek tooth, lower	1	*Bos indicus*	Burnt black exterior
H7	3	Unidentified fragment	1	N/A	Burnt black
H7	6	Unidentified fragment	1	N/A	Charred
H7	7	Long bone fragment	1	Mammalia, large	Charred exterior
H7	8	Worked bone point?	1	N/A	Slightly charred
H7	9	Rib fragment	1	Mammalia, medium to large	Slightly charred
H7	9	Unidentified fragments	2	N/A	Slightly charred
H7	13	Tibia diaphysis fragment	1	Mammalia, large	Slightly charred
H7	14	Humerus distal diaphysis fragment	1	Mammalia, large	Charred
H7	19	Femur proximal diaphysis fragment	1	Mammalia, large	Burnt black
H7	19	Long bone fragment	1	Mammalia, medium to large	Burnt black
J7	3	Dental fragments	2	Mammalia, large	Lightly charred
J7	3	Dental fragments	3	Mammalia, medium to large	Burnt black
J7	3	Unidentified fragment	1	N/A	Burnt white
J7	9	Unidentified fragment	1	N/A	Lightly charred
J7	10	Humerus distal diaphysis	1	Felidae (small *Panthera pardus* size)	Burnt black with cracking
J7	10	Long bone fragment	1	Mammalia, large	Burnt black
M8	1	Unidentified fragment	1	N/A	Burnt white
M8	8	Unidentified fragment	1	N/A	Slightly charred exterior
M8	15	Unidentified fragment	1	N/A	Charred on one side
M8	20	Unidentified fragments	2	N/A	Charred exterior
M8	24	Long bone fragment	1	Mammalia, large	Burnt black and white
M8	25	Disintegrating fragments	N/A	N/A	Burnt black
M8	26	Unidentified fragment	1	N/A	Charred exterior
M8	33	Unidentified fragment	1	N/A	Charred
M8	34	Unidentified fragments	2	N/A	Burnt black
M8	39	Dental fragment	1	Mammalia, large	Burnt black
M8	39	Dental fragments	2	Mammalia, large	Burnt black on exterior
M8	42	Radius fragment, proximal epiphysis	1	Mammalia, medium	Slightly charred

Trench	Locus	Element	No. of elements	Taxon identification	Comment
M8	43	Long bone fragment	1	Mammalia, medium to large	Slightly charred surface
M8	44	P^4	1	*Bos indicus* or *Bubalus bubalis*	Broken, charred
M8	44	Unidentified fragments	3	N/A	Charred
M8	45	Carapace fragments	7	*Kachuga tecta*	Burnt black, probably from single individual
M8	45	Long bone fragments	2	Mammalia, large	Burnt black on exterior
M8	45	Dental fragment	1	Mammalia, large	Charred
M8	45	Unidentified fragment	1	N/A	Partially charred
M8	50	Long bone fragment	1	Mammalia, large	Burnt black
M8	52	Unidentified fragments	6	N/A	Burnt black
M8	54	Unidentified fragments	3	N/A	Slightly charred
M8	56	M_3 fragment, right	1	*Equus* sp.	Burnt black

4.12 Summary of Findings

In general, density of faunal remains recovered at Sisupalgarh is very low. However, by examining the findings in aggregate and by looking more closely at areas where density is higher, it is possible to draw conclusions about animal use at the site in the past. For example, later eras of the site's occupation seem to show both lower numbers of animal remains overall and decreased diversity relative to the earlier phases of occupation. Several possible explanations for this trend will be explored in subsequent chapters, including a taphonomic explanation and an ideological explanation.

The faunal remains at Sisupalgarh indicate a use of a broad range of environmental resources through the presence of a diverse range of taxa. The overall distribution of these remains from all analyzed material is shown in Figure 4-13. Remains include both wild and domestic mammals, wild birds and reptiles, freshwater and saltwater fish, and a range of aquatic and terrestrial mollusks. Especially in the earlier period of the city's occupation, this suggests a human population very tied into their surrounding environment. In some cases, this relationship may not have been simply a question of human exploitation of resources, but one of animals sharing the human environment. In all zooarchaeological studies a factor that must be considered is that the recovered material may not be an accurate depiction of the deposited material. Animal remains may be moved from their initial deposit location by many factors, including human, other animals, or natural forces. There may also be differing levels of degradation of the material after it is deposited, sometimes so severe that it is erased from the archaeological record. When this is the case, the fact that no material was found in a given location does not mean that no material was deposited there.

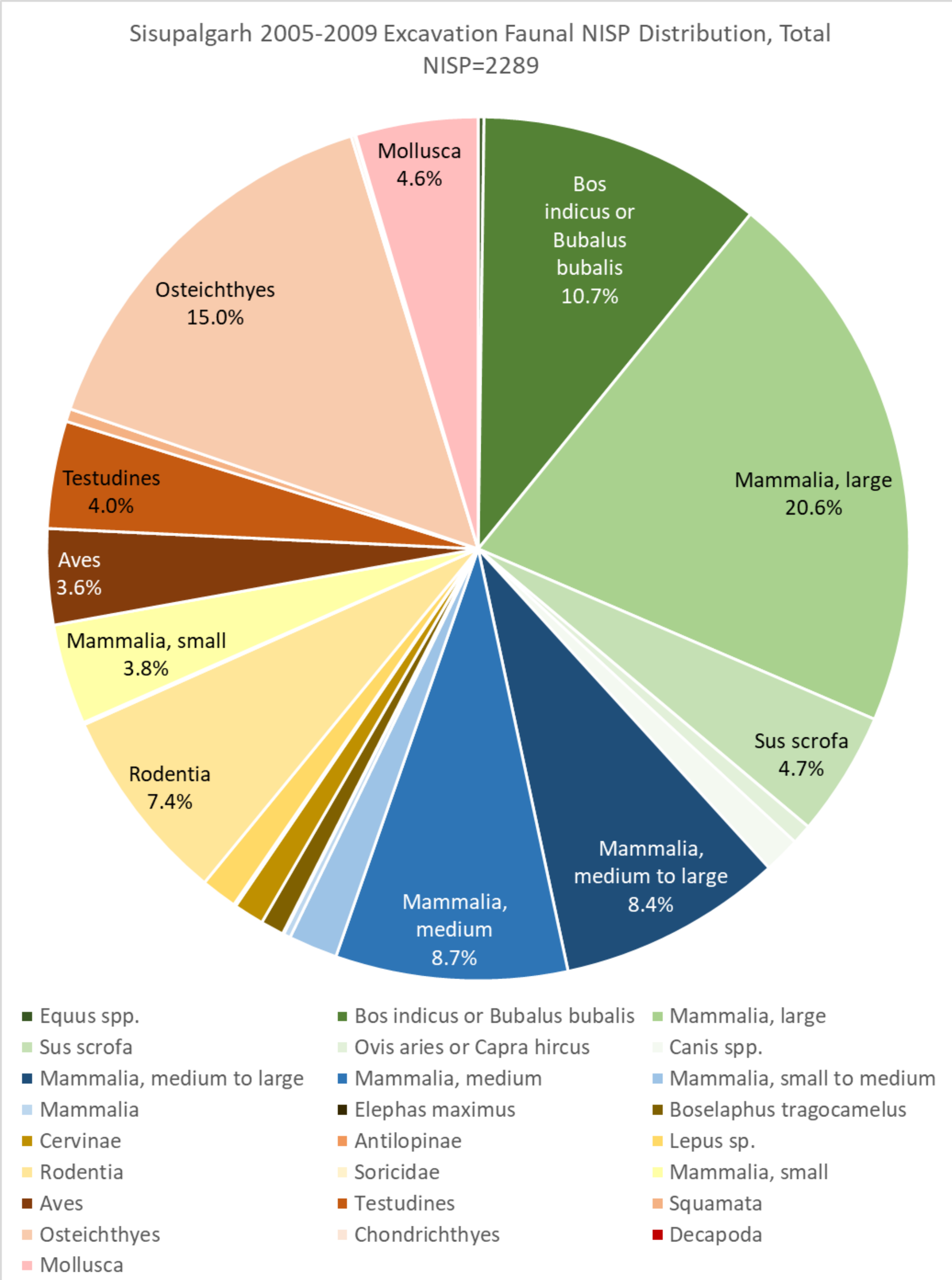


Figure 4-13 Ratio distribution of all analyzed faunal remains from the 2005-2009 excavations at Sisupalgarh

CHAPTER 5. NON-CULTURAL PROCESSES INFLUENCING THE RESULTS OF THE FAUNAL ANALYSES

5.1 Why Consider Non-Cultural Effects?

Using faunal remains recovered from Sisupalgarh to interpret past human-animal interactions requires an understanding of the processes that changed the remains from a living animal into the archaeological remains that were recovered. The process of change starts with the deposition of the faunal elements which are then modified by cultural, animal, biological, chemical, and geological factors, ultimately culminating in archaeological collection (and possibly post-collection curation). Each step of this process may have had an appreciable effect on the samples being analyzed. As stated by Rainsford and O'Conner (2018:93), "It is quite obvious that the circumstances of formation of the excavated assemblage, and the range of processes that have acted between the death of the animals concerned and the point of analysis, will have amended the characteristics of the assemblage, possibly to the point of occluding any trace of the original human activities," so, it is vital to understand to what extent site formation processes affected the samples being analyzed before drawing any zooarchaeological conclusions regarding the relationship between animals and people. As archaeologists primarily interested in faunal remains from the perspective of what they can tell us about human-animal interactions, understanding the cultural processes affecting the deposition of animal remains is important to interpreting their significance, while comprehending the non-cultural processes affecting the remains helps us to understand how the patterns observed in the collected remains may differ from the patterns of initial deposition.

5.2 Taphonomic Processes

Taphonomic processes are continuous phenomena, but do not necessarily proceed at the same rate through time, nor begin at the same point. Many cultural processes can alter the durable animal remains (those remains not quickly degraded by decomposition processes, such as bone, antler, tooth, and shell) prior to their deposition. Some of these processes may affect how the taphonomic processes that act on the remains after they are finally deposited play out.

Generally when an animal dies, its soft tissues (i.e., skin, muscle, viscera) decay much more rapidly than the durable remains through a combination of processes that may include consumption by predators or scavengers and biochemical decay. Importantly, processes which disperse the durable remains are usually delayed until the soft tissues containing them are substantially removed. This means that the durable remains of animals which experience soft tissue removal immediately after death are more readily disturbed in the immediate aftermath. Animal remains which are insulated from certain taphonomic processes prior to their decomposition (for example, by burial) are more likely to appear together in the archaeological record.

When remains are not isolated by processes such as burial, taphonomic changes to faunal material usually start with surface processes immediately after deposition. Obviously, when an animal first dies its skeletal elements tend to be fully articulated, but this may not be the case even when remains are first deposited and is seldom the case when remains are recovered archaeologically (Lyman 1994:150). How humans treat animal carcasses prior to deposition may have an influence on later taphonomic processes. For example, if bones are fractured for marrow extraction and boiled for grease extraction, they will be less attractive to scavengers than if they had not been treated (Qu et al. 2018). Also, if remains are immediately buried, the surface taphonomic processes are usually curtailed because scavengers and most insects will not disturb them (Lyman 1994:142).

Burning of animal remains can also result in differential deposition patterns in the archaeological record. Burnt bone tends to fracture more easily and be more vulnerable to chemical decomposition than unburnt bone, and the resulting fragmentation can result in pieces of bone too small to be collected or at least too broken to be readily identifiable (Lyman 1994:389-391). Burnt bones from Sisupalgarh included remains which show evidence of differential exposure to fire (see Chapter 4). For example, bones which were burnt black, or carbonized, may have resulted from proximity to natural or anthropogenic fires, while bones which were burnt white, or calcined, suggest longer-term burning at higher temperatures which could probably only be achieved by intentional burning of animal remains (Lyman 1994:385-388, Shipman et al. 1984). At Sisupalgarh, the recovery of these animal bones with evidence of burning suggests that some amount of faunal material may have been lost as a result of degradation after exposure to fire. This exposure could have occurred accidentally through proximity to intentional or unintentional fires, as part of cooking or roasting, or as a strategic method of disposal to avoid attracting scavengers, all of which would have resulted in differential degradation of cortical versus cancellous bone (c.f. Gifford-Gonzales 1989), thereby removing some remains from the assemblage and skewing the resulting findings.

If unburnt animal remains are left on the surface, they may be transported from their initial deposition site by scavengers (for example, in an urban setting these scavengers may be free-roaming dogs). For the most part, these vectors are interested in the soft tissue and not the bones, but less-dense bones (especially those of smaller animals) may also be consumed in their entirety, removing them from the archaeological record. Faith and Thompson (2018) observed a significant difference in the survival of dense bone (e.g., long-bone shafts, cranium, mandibula) over cancellous bone from eight different bone collections sites in Africa (6) and Eurasia (2) and considered this to be primarily due to the action of carnivores, but concluded the results are expected to be valid for other taphonomic processes as well.

Once the faunal remains become buried, the primary taphonomic process that acts on them is chemical. The matrix in which they are buried can have significant effects. The dissolution of bone is highly dependent on soil pH, with acidic soils leading to more rapid degradation than alkaline soils. Apatite, the mineral fraction of bone, is found to be most stable at pH 7.8, and the dissolution of this mineral controls early diagenesis (Kendall et al. 2018:6). If bone is deposited with soft tissue still attached, the decay of the soft tissue will tend to lower the local pH of the soil. Soils that contain a large amount of decaying organic matter (such as in forests or bogs) also have low pH. In conditions such as those at Sisupalgarh, high rainfall and high decomposition of organic matter make a low pH soil most likely, although pH measurements were not available for this analysis.

Soil structure and its associated hydrological processes can also have a large effect on the bones deposited within it. Hydrological environments can be divided into flow, recharge, and diffusive regimes. In the flow regime, the soil has a matrix with a very open structure that allows water to flow rapidly through and will have large amounts of oxygen available (both dissolved in the water and within the pore space). This environment leads to significant loss of collagen and recrystallization of the apatite. The remaining bones will appear as intact, with limited surface deposition of iron, but they are extremely fragile and crumble easily if not handled and curated with care (Rainsford and O’Conner 2018:98). This appears to be the case for many of the bones recovered from the upper strata at Sisupalgarh. The recharge regime is the most detrimental to bone preservation. In this environment the soil is alternately saturated and then dry, leading to repeated swelling and shrinking of the bone that ultimately causes cracking, flaking, and spalling (Kendall et al. 2018:6). In the recovery from the core sequences at Sisupalgarh (excavated during the dry winter months), the water table was at approximately 2 to 2.6 meters below the surface. During the monsoon season the water table is likely to rise almost to the surface, so at least in the current situation this region would be expected to have poorer preservation than strata that are below the water table.

A diffusive regime is created in fine-grained soil that is high in clay that limits the flow of water and replacement of ions so that bone quickly comes into equilibrium with its environment and further decomposition is prevented. The surface of bones recovered from such an environment are typically stained dark brown from iron deposits (Rainsford and O'Conner 2018:99). This is likely the current hydrological regime in the lower strata of Sisupalgarh, accounting for the improved preservation of bones recovered from these levels. During excavation of the core sequences, water had to be pumped out of excavations. When the pumping stopped, water quickly filled into the resulting empty space through gaps in the sides of the pit but seemed not to seep in extensively through the matrix of the trench walls, suggesting a fairly impermeable soil matrix (Smith pers. Comm.). This is consistent with the sticky, clayey soil texture throughout the site both inside and outside the rampart, as observed in the excavation notes.

The chemical taphonomic 126rocessses that alter bones are expected to have a lesser effect on teeth because teeth are initially embedded in dense bone, they have a protective enamel cap, and they are less porous than bone (Hollund et al. 2015:901). Because of this, archaeological sites with poor bone preservation may demonstrate better overall preservation of teeth and a commensurately higher ratio of tooth to bone recovered than relative to the ratio of tooth to bone in the body prior to death. Examination of the tooth to bone recovery ratio can be used to determine whether or not there are significant changes in quality of preservation throughout the various zones of recovery at a site.

In many archaeological contexts worldwide, once a bone is buried its location is unlikely to change until the time of excavation. In some cases, however, this is not true. There are several mechanisms that can alter the position of archaeological artifacts and ecofacts. Perhaps the most obvious one is human modification of the stratigraphy, such as for the digging of footings or pits. This activity brings material that has already been deposited to a new location and results in the loss of provenance for displaced artifacts and ecofacts. In urban environments that are constantly experiencing construction and renewal, the probability that this type of redeposition has occurred increases dramatically (cf. Rainsford and O’Conner 2018:105). The longer and more intensive the occupation, the more chances there are for original depositions to be disturbed. At Sisupalgarh, the mounded pillar area in the center of the city was constructed approximately 700 years after the earliest occupation of the site and appears to be the result of soils from elsewhere in the site being transported to this location to create an elevated platform (Smith and Mohanty 2016:687). Supporting this notion is the fact that the faunal remains recovered from this area were heavily abraded and fragmentary. In acknowledging the depositional history of this area, the meaning of these faunal remains changes: they do not indicate consumption or use of animals at this location.

Humans are not the only agents to cause this type of reorganization of material. Burrowing animals can disturb the natural location of material. Floods and their erosive effects can also cause displacement of primary deposits. Turbation effects can also be caused by expansion/contraction of clay with changing water content, plants, changing water tables, differences in density, and earthquakes (Lyman 1994:432, see also Schiffer 1987:199-234).

The taphonomic processes discussed above can lead to distortions of the archaeological record as it pertains to faunal remains in a human context. There are four main categories of these distortions: 1) the specimen is not in the location where it was used by people; 2) the specimen is changed in a manner that masks or mimics a cultural modification; 3) the specimen is damaged to the point that it is unidentifiable; and 4) the specimen is destroyed or no longer recognizable as a faunal remain. As an example of the first type, consider a site where people who consume animals collect their refuse (including food waste) in a communal location. Excavation of this location would be expected to show a large quantity of bone from discarded meal waste. If non-human scavengers at this site removed much of the bone waste, archaeologists might be inclined to reach the incorrect conclusion that there was very little human meat consumption occurring at the site. An example of the second type is scavenger destruction of long-bone epiphyses that could leave long-bone shafts that are similar to those left from human grease extraction from these same epiphyses. If there is little diagenetic damage to the remaining shaft, distinction between the two types of epiphyseal damage is likely to be possible, but if the remaining shafts are highly degraded this may not be the case. Damage of the third type makes a bone that would have been identifiable and analyzed by the zooarchaeologist just another unidentifiable fragment. In the fourth type, diagenesis has progressed to the point that both the collagen and apatite portion of the bone are completely degraded and the remains are no longer distinguishable as bone. This process is more likely to affect smaller and less dense bones. The removal of these bones from the assemblage available to the zooarchaeologist can change the distributions of faunal elements and taxa.

At Sisupalgarh, all these types of distortions are at play. Being an urban site with long occupation, there was likely a large amount of human displacement of deposited bone. This is most obvious in the abraded bones of the central pillar mound, but also on the ramparts and likely in less obvious ways in other excavated areas. An urban site is also likely to be the home of many opportunistic animal scavengers (cf. Schwartz et al. 2018), and it is reasonable to assume that Sisupalgarh was no exception. While there is little direct evidence for this type of activity in the faunal assemblage from Sisupalgarh, the poor overall preservation of bone would make the telltale signs of scavenger action, such as gnaw-marks on bones, difficult to detect.

Certainly, unidentifiable fragments consisted of the majority of faunal material recovered at Sisupalgarh (out of 7369 fragments studied from the 2005-09 excavation areas, only 2465 were identifiable by the present author in the current analysis). Furthermore, many of the remains identified could not be categorized to the level of specific skeletal element or to the level of species. For example, some specimens were only identifiable as "long bone fragments" from "Mammalia, large." At Sisupalgarh, the preservation was so poor that much of the originally deposited faunal material appears not to have survived at all, and there is little to indicate how much material was lost. Over five years of excavation of hundreds of cubic meters of material in many different use areas of the site, only approximately 34 kg of bone were recovered. The identified bones included elements from many individuals, suggesting that a much larger amount of faunal material may have been originally present in the biomass of the site.

5.3 Recovery Processes

Beyond the taphonomic effects which influence which remains are preserved, the sample of faunal remains available for analysis is further determined by recovery processes. Selection of locations to excavate and extent of excavations delimit the remains at the site that could eventually be analyzed. To recover all information at a site, it would be necessary to excavate the entire site down to pre-occupation levels, but for urban sites, this is never possible—excavation sites are selected based on a number of criteria such as information visible at the surface or from geophysical survey, which may not reflect important details, especially of early periods of occupation, and sites are often chosen out of practical considerations of convenience or availability. Once excavation has commenced, it is rarely possible to expose large portions of the early periods at a site with a long occupation history due to expense and time constraints, especially if preserving the uppermost architectural remains *in situ* is a priority (which is usually the case in modern archaeological projects). Within the rampart of Sisupalgarh, less than 0.1% of the 130-hectare area of the site was excavated from 2005 to 2009, and only about 5.4 m^2 (the two core sequences) were excavated to a depth that captured all cultural levels.

Because the possibility of what to excavate relative to the size of the site is so limited, excavation sites must be selected by some set of criteria, which may or may not include factors that will maximize the recovery of faunal evidence. At Sisupalgarh, most excavations targeted architectural remains and residential areas, neither of which are likely sites for heavy deposition of faunal material given their presumably frequent everyday use during occupation and the presumably offensive odor and health risk of decaying animal remains.

Even within the limited volume which is examined in an archaeological investigation of any urban site, there is the possibility that individual faunal remains will not be recognized as relevant and recorded. The method chosen to parse what is excavated has an influence on the size of faunal remains that are recognized as such and recovered. When hand sorting, small remains are easily missed, and the level of experience of the excavator and field workers in recognizing archaeological material also affects recovery. On the other hand, when material is sieved, there is a much lower likelihood that relevant faunal material will be missed. In the upper levels of excavation at Sisupalgarh, all of the material was hand sorted, but the lower levels of the core sequences (those beneath the water table) were wet sieved. This means that it is difficult to say with certainty whether patterns suggesting the presence of more small animals in more ancient parts of the site are due to differences in collection technique or cultural differences.

5.4 Post-Recovery Processes

Another factor which can influence the successful identification and analysis of recovered faunal material is the amount of time that elapses between excavation and analysis. In the case of Sisupalgarh, my analysis of the remains took place in 2017 and 2018, several years after excavations ended in 2009. In the intervening time, many processes related to curation and storage affected my eventual findings. Perhaps the most notable of these is the missing material from Core Sequence 1, Split 9, the locus of the site which yielded the highest volume of animal remains based on reports at the time of excavation. The other major issue I encountered with the storage of the remains was the degradation of the plastic bags in which they had originally been archived. The use-life of these bags in the storage environment appears to be about ten years, and bags older than this had developed major tears which resulted in occasional spilling and mixing of faunal material. Generally, I was able to successfully establish from what location in the site remains had come in spite of this, but some small portion of remains had to be discounted from analysis because I was unable to determine their provenance. Long-term storage and transportation across the country from Odisha state to the city of Pune had also taken a toll on the integrity of some of the remains themselves, with post-recovery fractures and fragmentation sometimes occurring. In many cases, I was able to distinguish between new and old breaks in bone, but some of the counts of unidentified bone may have been increased through post-recovery fracturing.

5.5 Investigation of Non-Cultural Effects at Sisupalgarh

5.5.1 Conditions of Discovery

The site of Sisupalgarh is very large and only a very small portion of the total area that was utilized by occupants of the site was excavated, and in many of the excavation locations (for example, Operations 1, 2 and 4 as well as most of Operation 3), the investigations were only of the later portions of occupation, not the entire chronological sequence of the area represented by the trench. Moreover, the faunal assemblages that were recovered do not generally appear to represent primary contexts for the use of the animals—that is, faunal materials were displaced after people stopped actively using them. This suggests that the excavations did not encompass areas where processing of animal remains was frequently taking place. Only in rare cases were any remains recovered which obviously constituted more than one element of the skeleton of an individual animal, and these were never articulated. Complete single elements of the skeleton were also rare, most frequently appearing as whole teeth. In the deep portions of the excavation where bone preservation was better, the relatively small exposures mean that there is little context available for interpreting these remains. Throughout the entire site, approximately 7,000 individual pieces of faunal material were recovered, weighing altogether only about 34 kg.

While this state of preservation and recovery is not ideal for faunal analysis, the results of the faunal analysis are still useful. In order to draw conclusions about culture from this material, it is first necessary to demonstrate that taphonomic processes did not fully obscure patterns in the deposition of faunal remains as a result of cultural activity. In order to do this, I have assessed the relative quantity of teeth and bones as well as the relative quantity of identified vs.

unidentified specimens. For these two methods, I focused on Core Sequence 1 and Core Sequence 3, which provided a full spectrum of the preservation regimes at play in the site, from which generalizations about preservation in other areas can be extrapolated. Another method used to determine the extent that the patterns shown in the recovered remains were the result of cultural activities is to compare the types and locations of recovered bones from larger mammals, the remains of which can be expected to preserve best. For this method, I considered remains recovered from all excavations at the site.

5.5.2 Comparison of Teeth to Bones

I compared the relative abundance of teeth in the faunal assemblage for Core Sequence 1 and Core Sequence 3. If the lower number of specimens recovered in the upper levels of these core sequences was due primarily to diagenetic effects, it would be expected that a higher portion of the material would be from teeth, which generally preserve better than bone (Hollund et al. 2015:901). Figure 5-1 shows the ratio of mammal teeth to mammal bones recovered from Core Sequence 1 and Core Sequence 3 along with the number of identified mammal bones recovered in each split. If there were no cultural differences throughout the period of deposition, one would expect the highest tooth to bone ratio in the splits with the worst preservation (and therefore the lowest number of identified elements). The data presented in Figure 5-1 does not show this trend, and therefore supports the fact that differences in the number of identified bones are a result of cultural practices rather than taphonomic factors.

Furthermore, if the pattern of which remains were preserved were purely one of taphonomy, the trend seen in Core Sequence 1 should be replicated in Core Sequence 3. This does not appear to be the case. For example, in Core Sequence 1, the ratio of tooth to bone generally increases with depth, whereas in Core Sequence 3, it decreases with depth.

Teeth belonging to many different taxa were recovered and identified in the core sequences, including Rodentia, *Lepus* sp., *Canis* spp., *Capra hircus*, *Antilope cervicapra*, Cervinae, *Sus scrofa*, *Bos indicus*, *Bubalus bubalis*, *Equues* spp., and *Elephas maximus*. Regardless of depth, the ratio of teeth to bone in most splits of both core sequences is higher than the ratio of tooth to bone in a complete animal skeleton. This could be due to either deposition processes (i.e., that teeth from a carcass were deposited here while bone was consumed or deposited elsewhere in the site), preservation, or simply that teeth are more easily identifiable than bone during both excavation and analysis. It is very likely that a combination of these factors is responsible for the high proportion of teeth.

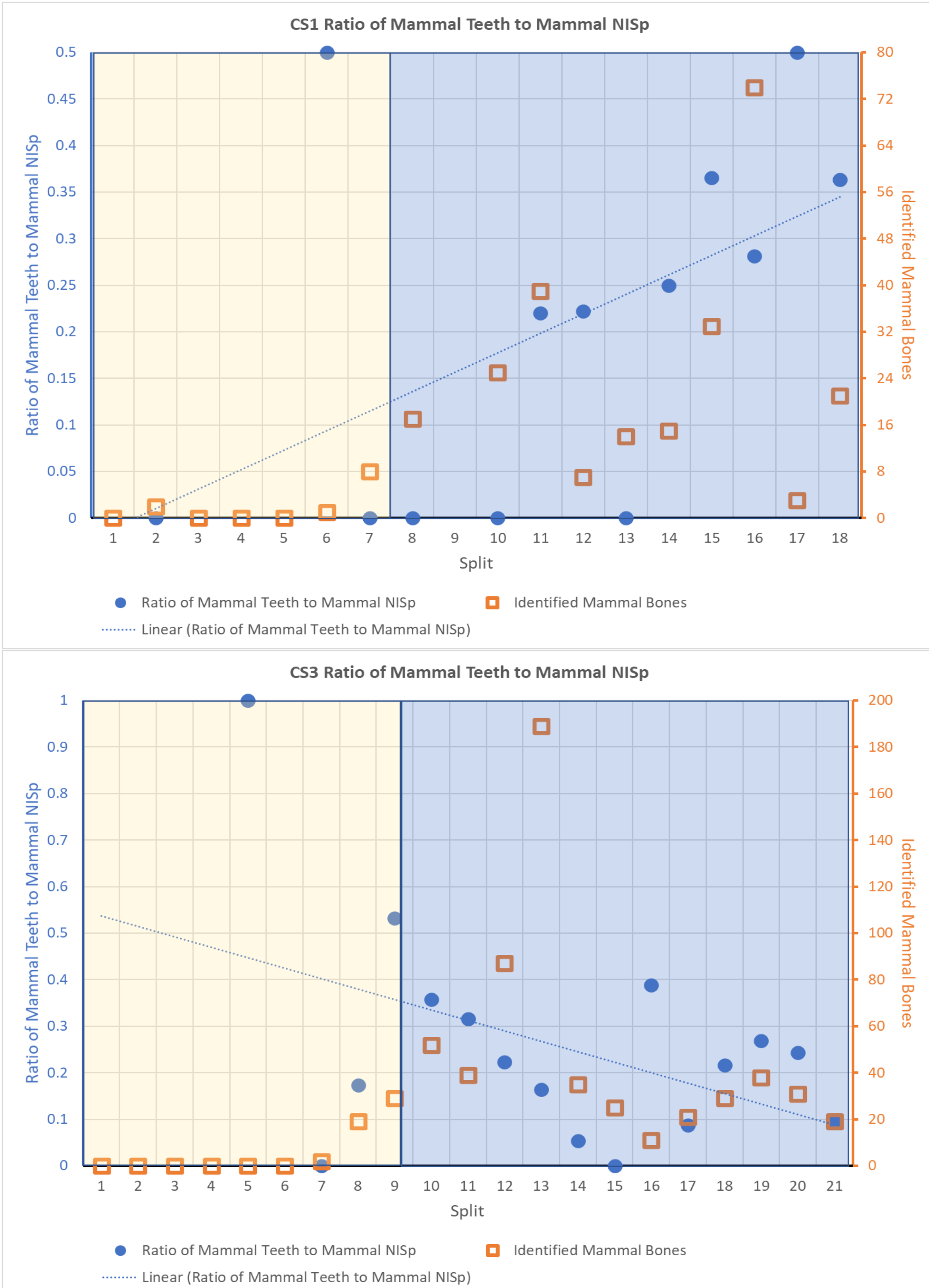
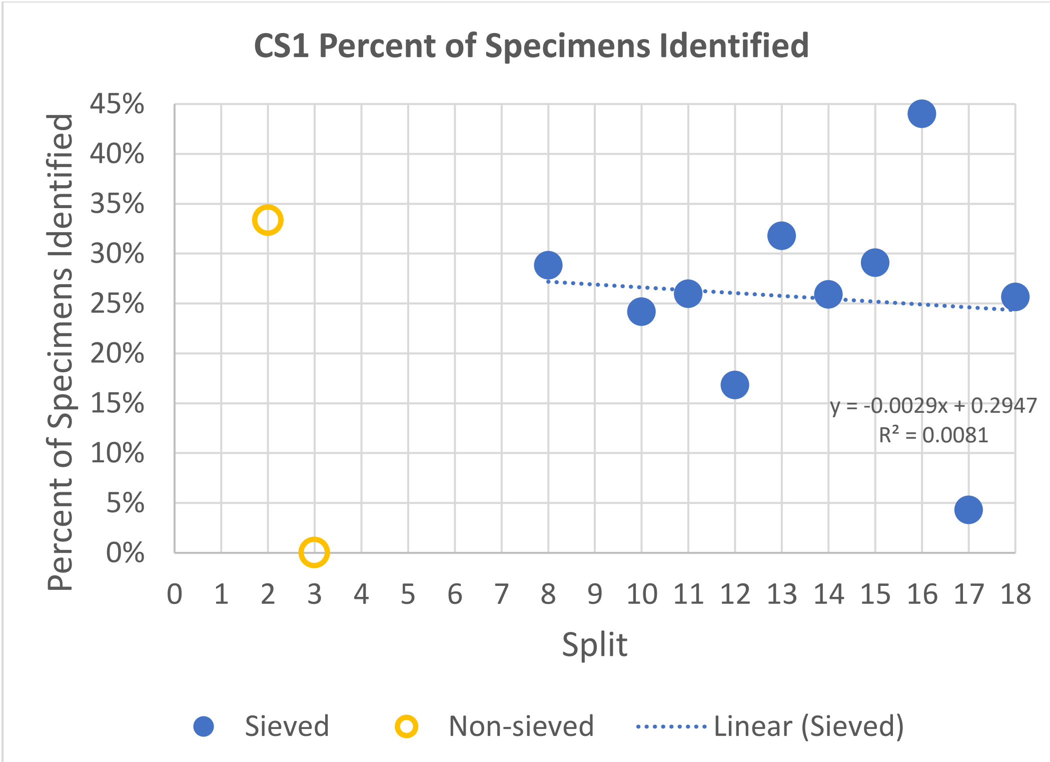


Figure 5-1 Comparison between ratio of mammal teeth to mammal NISP and NISP of mammal bone (excluding teeth) recovered in each split of CS1 and CS3

5.5.3 Identified vs. Unidentified Specimens

Another possible metric of quality of preservation is the proportion of identifiable specimens to the total number of specimens recovered. This is because better-preserved specimens are, in general, more possible to identify. Figure 5-2 shows the percentage of specimens identified in each split of the core sequences. Notably, this percentage is relatively unrelated to depth (at least below the water table) in both core sequences. In general, one would expect older bones, which have had more time to degrade, would show poorer overall preservation and identification, but this does not appear to be strongly true, at least when using percentage identified as a metric for preservation. Also notable is how different the pattern appears between Core Sequence 1 and Core Sequence 3. In Core Sequence 1, the trend line through the data has a slight negative slope, which one would expect if older bones are less well preserved. Core Sequence 3, however, shows a slight positive slope to the trend in the data, suggesting some other process, likely cultural, is at play.



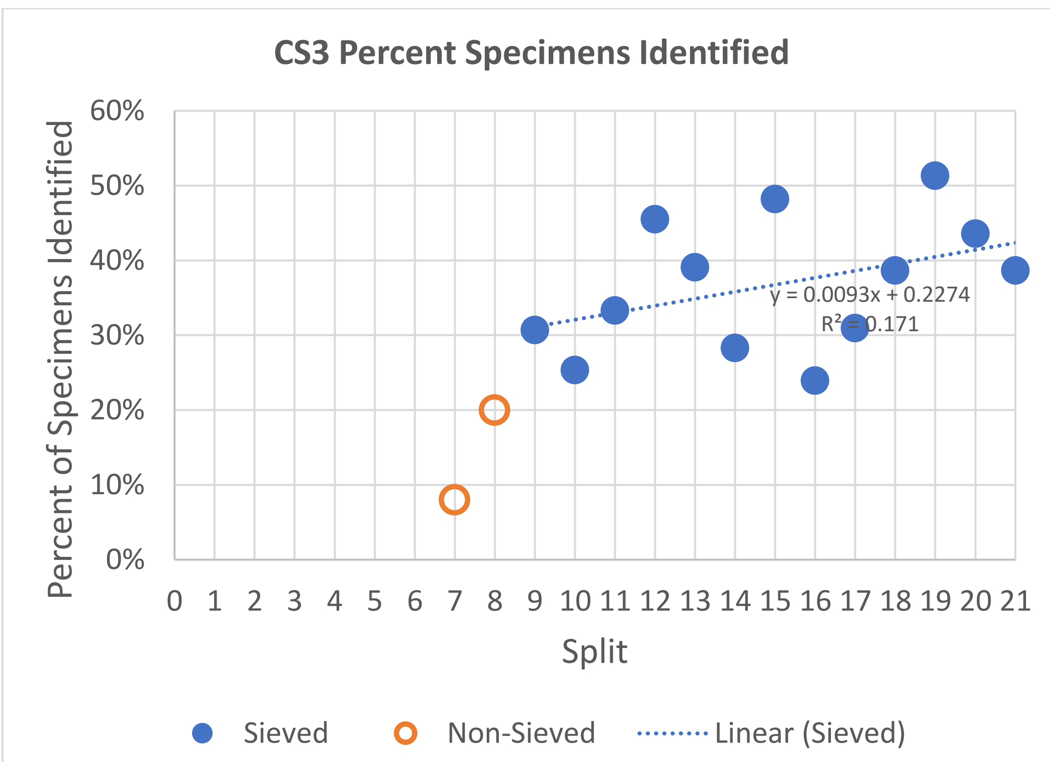


Figure 5-2 Percentage of specimens which were identifiable in CS1 and CS3

5.5.4 Location and Depth of Non-Bovine Ungulate Remains

One clear pattern that emerges from the faunal identifications is the high proportion of cattle (*Bos indicus* and *Bubalus bubalis*) teeth and bones in the upper portions of the excavations (see Chapter 4). To assess whether this is a pattern based on cultural processes or on preservation concerns, I looked at which loci from the entire excavation contained the remains of other taxa which might be expected to preserve comparably to cattle, namely other medium to large ungulates. These constitute the identified remains of *Antilope cervicapra*, Cervinae, *Boselaphus tragocamelus*, *Capra hircus*, *Equus* spp., *Ovis aries*, and *Sus scrofa*. Table 5-1 compares the number of locations with this type of faunal remains and the number of identified specimens for locations that are within two meters of the surface, locations that are more than two meters deep but above the water table at the time of recovery, and locations below the water table at the time of recovery.

Table 5-1 Findings of non-bovine ungulate remains

	0-2 m	**Deeper than 2 m, above water table at time of recovery**	**Deeper than 2 m, below water table at time of recovery**
NISP of non-bovine ungulates	41	34	85
Number of loci with non-bovine ungulate remains	37	20	44

There are roughly as many identified remains of these taxa above the water table as below the water table, suggesting that the remains of these types of animals do preserve even in the environment where preservation is poor. This suggests that preservation at Sisupalgarh is good enough to at least draw conclusions about the ratios of medium and large mammals recovered over time. This may not be the case for the remains of smaller animals such as birds, rodents, and fish, which were preferentially recovered below the water table as a result either of preservation or recovery method.

5.6 Discussion

The level of the water table is clearly a major factor affecting preservation at Sisupalgarh, and its distance from the surface was clearly variable at different excavation locations and probably also varied over time in response to climatic and hydrological changes associated with both anthropogenic and non-anthropogenic factors. Excavations reached depths below two meters in the two core sequences, Operation 3, Operation 6, and Operation 7. However, excavations only continued below the water table in Core Sequence 1, where the water table was reached about 2.1 m below ground level, and Core Sequence 3, where the water table was reached about 2.6 m below ground level. In Operation 3, the maximum excavation depth of 3.42 m did not reach the water table; nor did the maximum excavation depths of 4.28 m in Operation 6 or 6.58 m in Operation 7. What accounts for these significant differences in ground water depth? Core Sequences 1 and 3 are further away from the rampart than any of the other locations with high depths reached within the rampart. The extreme depth reached without reaching the water table in Operation 7 could have to do with the depth of in-fill against the rampart—the ground elevation at the location of Trench M8, where the maximum depth was reached, is not substantially lower than the level of the top of the rampart. A similar, albeit reduced effect could account for the depth reached in Operation 3, which was also closer to the rampart than either core sequence. The topographic study performed at the site in 2007 created the map shown in Figure 5-3, which clearly shows the elevation at the location of Core Sequence 1 is lower than that of Core Sequence 3, and both are lower than the regions of Operation 3 and especially of Operation 7. The fact that excavations were carried out in different years also likely plays a role in the depth to groundwater. 2004 was a much wetter year than 2005 in the Khordha district of Odisha (where Sisupalgarh is located) (Pattanayak et al. 2018), so it is possible that the groundwater level in January 2005 (when Core Sequence 1 was excavated) would have been lower than it was in January 2006 (when Core Sequence 3 was excavated). Many wells in Odisha show changes in water level of over 2 meters throughout the year in addition to significant year-to-year changes (Central Ground Water Board 2020).

In the case of Operation 6, which was located 200 m north of the northern rampart (where the ground elevation is much lower than that of either core sequence or of Operation 7) but which still demonstrated a groundwater level much further from the surface than in either core sequence. In this instance, the depth to groundwater cannot be explained by differences in surface elevation. This suggests that the groundwater level within the rampart is much higher than outside the rampart. This could be explained by the rampart acting as a reservoir, preventing accumulated rainwater from flowing easily out of the site and resulting in a buildup of groundwater within its boundaries (R.K. Mohanty pers. comm.).

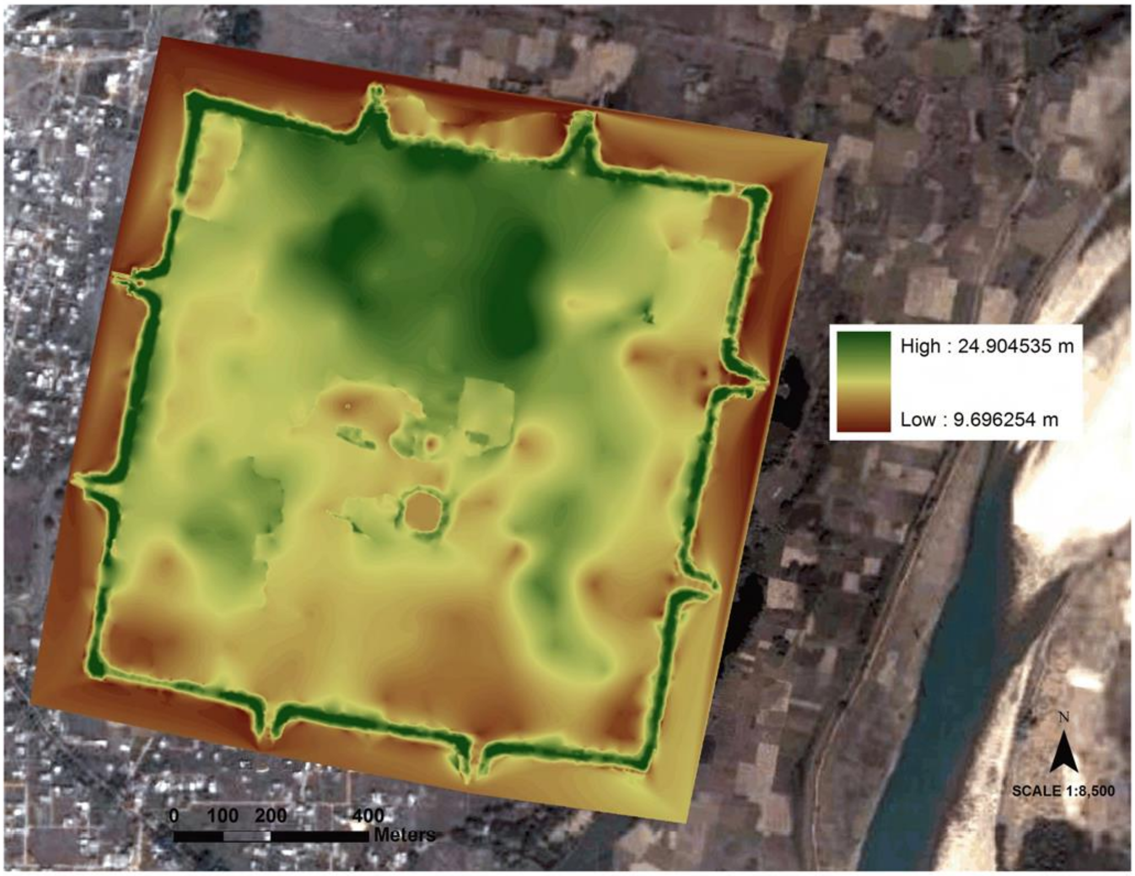


Figure 5-3 Topographic map of Sisupalgarh (Mohanty and Smith 2007:6)

The best preservation regime for faunal remains at Sisupalgarh occurs for remains that are recovered from depths which are consistently below the water table, and for cultural levels, this appears to only occur within the rampart. The earliest levels of occupation at the site appear to predate the rampart's construction, so the faunal material in these levels would not have immediately benefited from better preservation provided by the raised groundwater level within the site's interior. In a monsoonal climate like that at Sisupalgarh, a site with a relatively high groundwater level is likely to experience significant fluctuations in that level between the wet and dry seasons. The excavations of Core Sequence 1 and Core Sequence 3 were both conducted in late January and early February, about four months after the end of the monsoon season. This likely means that the observed groundwater level is near its annual minimum, reinforcing the idea that remains above this level are likely to experience alternating saturation and drying, conditions especially harsh for the preservation of bone. In locales such as Operations 6 and 7, much of the material is likely high enough above the groundwater level that even during the monsoon, the soil there is not entirely saturated (that is, the preservation there is subject to a flow regime rather than the more damaging recharge regime), leading to better preservation than at least in the upper levels of the core sequences.

In addition to differential preservation, biases in the faunal material available for analysis can also be introduced depending on recovery technique. While the preservation is likely better at Sisupalgarh in the contexts which were sieved, part of the higher identifiability in those zones was also due to the types of remains recovered by sieving: for example, small fish and rodent bones and teeth, which are unlikely to be found by hand sorting, are relatively easy to identify to some taxonomic level. However, sieving also leads to a higher recovery of small fragments of larger bones, which are more difficult to identify.

5.7 Chapter Summary

Taphonomy, recovery, and curation have definitely had an impact on the faunal assemblage that I was able to analyze. These effects have resulted in a reduced sample size and difficult identification of remains. However, these processes seem to be fairly uniform for all remains within the site, which suggests that differences in the makeup of faunal assemblages from different locations in the site are the result of cultural differences rather than post-depositional processes. With an understanding of what factors have modified the assemblage between deposition and analysis, it is possible to control for these obfuscating factors and still draw broad conclusions about human-animal interactions at Sisupalgarh.

CHAPTER 6. A REVIEW OF RELEVANT TEXTS IN INTERPRETING ARCHAEOLOGICAL FINDINGS AT SISUPALGARH

Interpretation of archaeological data is assisted by the application of analogy and supplementary data. In the case of times and regions where textual evidence is available, archaeologists have the opportunity to use analogies based on the impressions and statements left behind by people whose lived experiences encompassed the milieu that is represented by archaeological material. In this sense, textual information can provide the same basis for analogy as ethnographic information. The archaeological evidence presented in the preceding three chapters can, therefore, be interpreted through the lens of the texts surviving from Early Historic South Asia. These texts originate from a broad geographical and chronological range but are demonstrably applicable to the context of Sisupalgarh (cf. Lal 1991, Smith 2018).

6.1 History of Texts in the Early Historic Period

Study of the Early Historic Period in South Asia is facilitated by the existence of decipherable texts such as the Ashokan Edicts and other inscriptions, religious texts such as the *Atharvaveda* (a book of chants for practical rituals) and the Pali Canon (the collection of the earliest surviving Theravada Buddhist texts), and secular texts such as the *Arthashastra* (a treatise on governance). Texts with their origins in the Early Historic Period frequently demonstrate a connectedness to the past and to the broader overall region of South Asia, so their usefulness goes beyond the time and place in which they were first written down. Other than the inscriptional texts, which are preserved more or less in their original form thanks to the durability of their writing, it is known that these texts have complex compositional histories, with the extant versions having undergone many iterations. For example, the Vedic Texts are thought to have been passed down orally for many centuries prior to the first written version (Jamison and

Brereton 2014). In the case of the Pali Canon, the teachings of the Buddha were transmitted orally for at least several centuries before being written down (Collins 2005:76-77). The *Arthashastra* is thought to have been compiled from texts written by a number of authors over a period of centuries (Olivelle 2013, Trautmann 1971). Relatively few of these texts can be directly associated with Sisupalgarh (with the notable exceptions of the Ashokan Edicts at Dhauli located approximately 4 km south of the site and the Hathigumpha Inscription of Kharavela at the Udayagiri caves approximately 8 km northwest of the site, which share a close connection with the site by dint of their physical proximity). Because of the broad regional and historical focus of the texts, all of this textual evidence might provide insight into how life was led and business conducted at Sisupalgarh and in other areas of South Asia.

Many of the texts available from the Early Historic Period act as encapsulations of the knowledge their authors had of their historical and geographical milieu. Maintaining a putatively accurate historical record of the life of the Buddha was and continues to be an important tenet of the Theravada school of Buddhism (Collins 2005:80). The Buddhist teachings and texts collected to form the Pali Canon (the Theravada school's canonical texts) were originally written down in part at the end of the first century BCE but were further compiled and redacted into the surviving version around the fifth century CE based upon an oral tradition of Buddhist scholarship as preserved in Sri Lanka (76-77). Maintaining this record of events that occurred thousands of kilometers away and hundreds of years previously indicates a transcendence of space and time in the historical value of these texts: that is, they are relevant to a time and place far removed from the location of their transcription. In spite of being compiled in comparatively distant Sri Lanka, sections of the Pali Canon such as the Jatakas found in the *Khuddakanikaya* section of the second of the Pali Canon's three divisions, the *Suttapitaka,* are full of references to locations substantially further north in South Asia such as Benares (Varanasi), Vesali (Vaishali), Rajagaha (Rajgir), and even Kalinga (cf. Cowell 1981). Although it was written outside of the Theravada tradition, the *Arthashastra* similarly demonstrates an awareness of a deep historical past and broad regional associations. In comparisons of the quality of products, the text frequently assigns value based on region of origin—for example, the best elephants are said to come from Kalinga and Angara (Olivelle 2013:102), while the finest silk is from Suvarnakudya (126). The *Arthashastra* also touches on the views that people might have on outsiders, for example recommending a fine when someone insults another person based on their country of origin (218). The text's historical basis is clear in its allusions to past events. For example, when admonishing a king to be cautious in dealings with his wife, the text calls upon a litany of past rulers who were supposedly murdered by their wives (95). All this suggests a text deeply couched in a far-spanning, long-term context. Even much shorter texts such as the Hathigumpha inscription demonstrate a concern with creating a cosmopolitan image built on long history. In the inscription, King Kharavela refers to his own broad-reaching military achievements and describes his actions in relation to earlier rulers, such as the Nandas and the Mauryas (Sahu 1984). Together, these texts paint a picture of an Early Historic South Asia with strong links and many shared cultural conceptions. Thus, even texts assembled far from Sisupalgarh can provide important contextual information that can be used to formulate hypotheses about the archaeological material from the site.

The texts described above hardly constitute a comprehensive catalogue of the available writings from the Early Historic Period. For example, there exists an extensive Jain literature which outlines the philosophical positions of and monastic regulations for Jain monks. From Tamil Nadu, the poetic Sangam literature colorfully describes urban life in that part of the subcontinent. While these and other sources might provide useful insights into everyday life and interactions with animals at Sisupalgarh, the justification for utilizing these texts is slightly weaker than for those selected in this analysis. In the case of the Jain literature, there is relatively little focus on everyday life compared to the vivid descriptions of texts such as the Jatakas. In the case of the Sangam literature, cultural connections between Tamil Nadu and Odisha during this time period, while likely to have existed, are not as clearly illustrated in the inscriptional evidence that is firmly associated with Sisupalgarh, which refers more frequently and specifically to places and practices of the Gangetic Plain and other parts of northern South Asia.

6.2 Types of Texts

Inscriptional texts represent a direct transmission of intended meaning from the inscriber of the text to the form in which we have it without the difficulty of generations of copying and perhaps editing (the effect of them being "written in stone"). Whether these texts are accurate depictions of real events in the past is less certain. In the case of the Ashokan Major Edicts, which appear in more or less identical form through all of their instantiations across South Asia, we can be very confident that they contained the information of the intended message (although we can be less certain that our current understanding of the intended message is completely accurate). The non-portable, permanent nature of inscriptions also provides clear evidence of their provenance and context and prevents these texts from being regularly updated or modified as language and culture change, which could lead to the exact meaning of the inscription becoming lost. However, the fact that these texts are inscribed into large pieces of stone rather than on a more portable medium such as paper also means that relatively less information can be transmitted compared to lengthy texts such as the *Arthashastra* or the Pali Canon, which are far too long to be inscribed in stone, but which are therefore more vulnerable to change over time.

Pursuant to Sisupalgarh, there is textual evidence in the form of inscriptions (the Ashokan Edicts and the Hathigumpha Inscription, which are securely dated to the time frame of the site and physically in close proximity to the site); texts which were composed and transmitted orally before or during the occupation of the site which were only written down in the later part of the period of occupation (the Vedic texts and the Pali Canon); and texts which were compiled from various sources and assembled in their collated version in the middle to late part of the occupation (the *Arthashastra*). Of these texts, only the inscriptions can be directly associated with Sisupalgarh or even Kalinga in general. However, the other texts reflect a common cultural context which seems to have spanned across much of the subcontinent and which allow us to cautiously extend their descriptions to the region of Sisupalgarh. Indeed, some of these texts make reference to Kalinga and places in it (place-names mentioned in texts include Tosali, Kalinganagari, and Dantapura, all or some of which may be names for the site now referred to as Sisupalgarh).

6.3 Texts and Sisupalgarh

In order to create a complete picture of attitudes toward animals during the period in which Sisupalgarh was occupied, I will include a diverse set of textual evidence in my analysis. It is important to emphasize that the non-inscriptional texts generally have a complex composition history which needs to be taken into account when using them as sources. Many of these non-inscriptional texts incorporate material from several centuries during the Early Historic Period or earlier which were initially transmitted orally (Sarao and Sharma 2014). Furthermore, they explicitly originate in regions outside of Kalinga. Because of this, I will use these texts not as a literal record of people's daily interactions, but rather to reconstruct a broader ethos toward animals that existed in South Asia from the second half of the first millennium BCE to the first half of the first millennium CE.

Combining these various texts will provide an initial point of comparison for evaluating the animal remains recovered from Sisupalgarh. Identifying how the remains actually found at Sisupalgarh line up with the expectation laid out in text will be a useful proxy for how accepted ideologies were deployed by the citizens of urban centers in a pre- and post-Buddhist context. In this sense, the texts will support the archaeological evidence from the animal remains in painting a picture of human animal relationships as well as filling in areas that are not visible archaeologically at all. The Hathigumpha Inscription is the key to using texts when interpreting Sisupalgarh, as it is the only autochthonous source available to us from the time period. Its temporal and physical proximity to Sisupalgarh assures that it is relevant to the site. The relevance of other textual evidence needs to be justified, which it often can be through the material realities of the site itself or by the wording in the Hathigumpha Inscription.

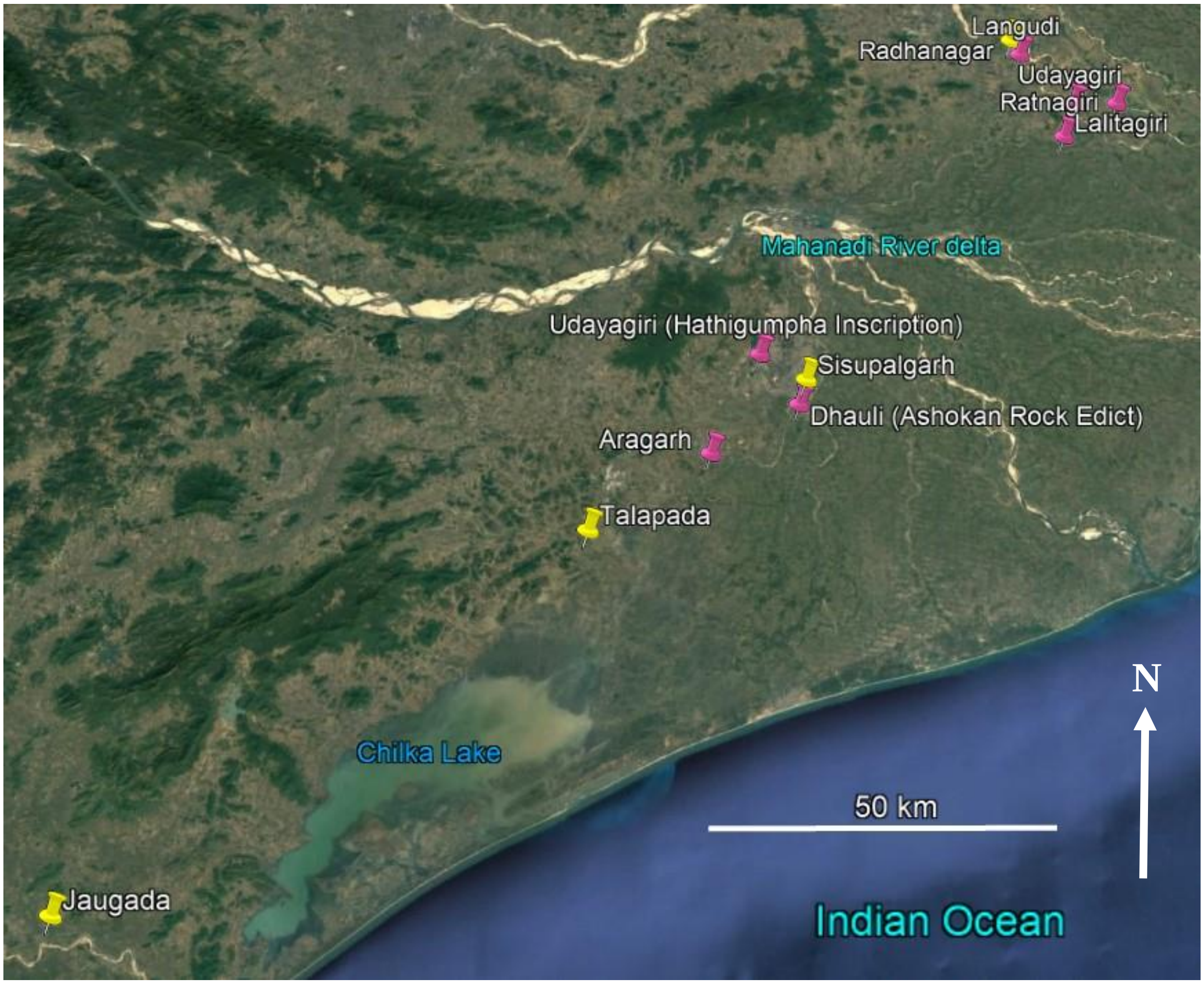


Figure 6-1 Location of Sisupalgarh and select Early Historic sites in its vicinity (Google Earth 2022)

6.3.1 Hathigumpha Inscription

The Hathigumpha Inscription represents the longest (17 lines covering an area of approximately 4.6 m long and 1.6 m high) (Kant 1971) and most legible of the very few local texts from the Early Historic Period in Odisha. Commissioned by King Kharavela in the 1st century BCE, the inscription provides a record of the early life and rule of the king (Sahu 1984). It is carved into the rock face of Udayagiri hill, just a few kilometers northwest of Sisupalgarh and includes numerous references to Kharavela's capital city (Kalinganagari) (Lal et al. 2014:617), which is presumed to be Sisupalgarh. Because this text was produced locally, on the orders of a local ruler, it provides a good basis for evaluating to what extent contemporary texts produced in other parts of South Asia (even the Ashokan edicts, which were commissioned by a ruler based in the Gangetic Plain) might have bearing on the interpretation of material from Sisupalgarh.

The Kalinga described in the Hathigumpha Inscription is a territory deeply tied into broad regional networks with substantial relationships with other parts of South Asia. For example, one passage describes how Kharavela "generated great fear among the people of Magadha while making the elephants and horses drink in the Ganges" (approximately 600 km north of Sisupalgarh) and "brought back the image of Kalinga Jina with its throne and endowment that had been taken away by King Nanda and the jewels plundered by him (King Nanda) from the Kalinga royal palace" (Sahu 1984:342) (King Nanda was ruler of a polity centered on Magadha prior to the Mauryans; Singh 2009:321). Other passages describe Kharavela's campaigns as far away as the Krishna River (Sahu 1984:335), approximately 640 km to the south. Even if the exploits of King Kharavela described in the Hathigumpha Inscription are exaggerated, the references to far-off locations indicate some substantial knowledge of the geography and history of other parts of South Asia.

The inscription focuses on the life and deeds of Kharavela, but it also includes passages that suggest connections with Vedic texts and the *Arthashastra*. For example, it describes Kharavela's education "in writing, coinage, arithmatic [*sic*], law and procedure and … all arts" (Sahu 1984:333) and lauds his mastery of the *Gandharva Veda* (335), a text on art derived from earlier Vedic material. Also described are activities relating to construction and maintenance of infrastructure, civic architecture, and monuments as well as financial and economic decisions made by the king. While the inscription does not attribute these royal functions to any particular philosophy or knowledge, these roles of a ruler are discussed in detail in the *Arthashastra*. The inscription describes Kharavela as “the worshiper of all religious orders, the repairer of all shrines of gods” (Sahu 1984:346) and details his construction of residencies for ascetics, clearly indicating a social and economic investment in religion by the ruling authority. While the inscription does not delve deeply into details of everyday life, some clues as to how the writer viewed interactions with animals are present. For example, the text mentions horses and elephants in a military application (Sahu 1984:335, 339) and refers to “ploughs drawn by asses” (Sahu 1984:341). Nowhere does the inscription mention animals as a source of food, either as meat or through their secondary products such as milk.

6.3.2 Other Inscriptions in the Vicinity of Sisupalgarh

There are other inscriptions dating from the Early Historic Period in Odisha, such as those at Lalitgiri (Mishra 2013) and Sitabhinji (Ramachandran 1951) as well as others at Udayagiri (Barua 1929), but none of these provide significant amounts of information that can be used to glean cultural meaning, generally only consisting of short dedications (cf. Barua 1929, Mitra 1975). They do, however, show that script was being used in other areas of Odisha during the Early Historic Period. Furthermore, the Lalitgiri and Sitabhinji inscriptions are less geographically and temporally relevant to Sisupalgarh as they are located further away and date to around the 5th or 6th century CE, approximately the time at which Sisupalgarh ceased to function as an urban center.

6.3.3 Ashokan Edicts

Ashoka was the third ruler of the Mauryan polity (Singh 2012), a political entity that originated in the Ganges valley in the middle of the third century BCE (Sugandhi 2013). The Ashokan edicts were emplaced in the period between 258 and 243 BCE, during his reign and after his conversion to Buddhism. Written primarily in Brahmi script, the edicts are important because they constitute the onset of Indian epigraphy (Chakravarti 2014:235). They are inscribed on boulders and stone pillars and occur over a vast geographical expanse within the Indian subcontinent (Sugandhi 2013; Gillespie et al. 2016). Their purpose was to pronounce this Mauryan ruler's embracing of Buddhist ideals, and they promulgate sociopolitical and religious reforms and inform the reader of biographic facts from Ashoka's life (Sugandhi 2013). The Ashokan inscriptions are roughly grouped into five types, denoted by the surface they are carved on. These are, in approximate chronological order, the Minor Rock Edicts, the Major Rock Edicts, the Kalinga Rock Edicts (mostly the same as, and probably contemporaneous with, the Major Rock Edicts with three substitutions), the Minor Pillar Edicts, and the Seven Pillar Edicts (Dhammika 1993).

Ashoka has been characterized as a practicing Buddhist but did not enforce Buddhist ideology as a state religion (Thapar 2012) – a similar attitude toward religious freedom to Kharavela's. There is an Ashokan rock edict at Dhauli, located about 4 km south of the center of Sisupalgarh, and another one within the rampart of Jaugada, a contemporary urban-sized site with a similar layout to Sisupalgarh located about 130 km to the southwest. The presence of these inscriptions reinforces the idea that Kalinga shared robust connections with other parts of South Asia over a long timeframe.

Similar inscriptions occur all across South Asia (Gillespie et al. 2016), written in several different languages (Thapar 2012), but with a nearly identical message. An exception to this general similarity is that the two inscriptions in Kalinga omit Major Rock Edicts XI-XIII (Hultzsch 1925). Significant is that one of these omitted Edicts (XIII) details the carnage of the Kalinga war during which Ashoka claims to have either killed or deported hundreds of thousands of people to conquer Kalinga (Sugandhi 2013), the regret for which caused Ashoka to dedicate himself to Buddhist ideologies of non-violence. While the reason for this difference is not clear, the importance that Kalinga plays in Ashoka's narrative as it is presented elsewhere in the sub-continent further highlights the connection of Kalinga to other parts of South Asia.

Ashoka, referred to as King Piyadasi in his inscriptions, clearly embraces the concept of non-violence and extends its application not only to humans but also to wild and domesticated animals (Singh 2012). As an example, Major Rock Edict I states:

> Beloved-of-the-Gods, King Piyadasi, has caused this Dhamma edict to be written. Here (in my domain) no living beings are to be slaughtered or offered in sacrifice. Nor should festivals be held, for Beloved-of-the-Gods, King Piyadasi, sees much to object to in such festivals, although there are some festivals that Beloved-of-the-Gods, King Piyadasi, does approve of.
> Formerly, in the kitchen of Beloved-of-the-Gods, King Piyadasi, hundreds of thousands of animals were killed every day to make curry. But now with the writing of this Dhamma edict only three creatures, two peacocks and a deer are killed, and the deer not always. And in time, not even these three creatures will be killed (Dhammika, 1993).

This edict shows that Ashoka was giving up a carnivorous diet (and suggesting that his subjects do so as well) because of concern for the well-being of animals. Furthermore, Major Rock Edict II states in part:

> Everywhere has Beloved-of-the-Gods, King Piyadasi, made provision for two types of medical treatment: medical treatment for humans and medical treatment for animals. Wherever medical herbs suitable for humans or

> animals are not available, I have had them imported and grown. Wherever medical roots or fruits are not available I have had them imported and grown. Along roads I have had wells dug and trees planted for the benefit of humans and animals (Dhammika, 1993).

This edict shows Ashoka's concern for animals goes beyond just their use (or not) as sources of meat. Also, Major Rock Edicts III and IV discuss that it is good not to kill other living beings and that Ashoka promotes restraint in the killing of humans and animals. This ethos of non-violence towards animals could be one of the driving forces behind the changes in the distribution of recovered animal remains at Sisupalgarh over time.

In addition to the Major Rock Edicts and the Pillar Edicts, there are a number of Minor Rock Edicts that have inscriptions that are different from those found on the other edicts. These edicts are widely dispersed throughout South Asia and pre-date the Major Rock Edicts and Pillar Edicts (Hultzsch 1925). One of these Minor Rock Edicts, initially located at Bairat in Rajasthan, states in part (Hultzsch 1925: 173):

> The Mȧgadha king Priyadarśin, having saluted the *Saṁgha*, hopes they are both well and comfortable. It is known to you, Sirs, how great is my reverence and faith in the Buddha, the *Dharma*, (and) the *Saṁgha*. Whatsoever, Sirs, has been spoken by the blessed Buddha, all that is quite well spoken.

and a Minor Rock Edict located at Rupnath in Madhya Pradesh states in part (Hultzsch 1925: 173):

> Two and a half years and somewhat more (have passed) since I am openly a Śakya. But (I had) not been very zealous. But a year and somewhat more (has passed) since I have visited the *Saṁgha* and have been very zealous.

These inscriptions, along with the Buddhist views described by the Major Rock Edicts (particularly, the endorsement of *ahimsa*) clearly show that Ashoka had embraced the teachings of the Buddha and had become pious in his following of Buddhism.

6.3.4 The *Arthashastra*

The *Arthashastra* is a treatise on political economy often attributed to Kautilya, the chief advisor of the first Mauryan ruler, Chandragupta Maurya, and thus often considered to date to the Mauryan period (Chakravarti 2014:234). Written in Sanskrit, it presents detailed information about economy, politics, and social issues in its times, providing an exhaustive treatment of everything from urban planning to task policy and ideal parameters for fortified cities (see Olivelle 2013).

The dating and authorship of the text has been controversial. In the introduction to his translation of the *Arthashastra*, Olivelle (2013) suggests the treatise was modified in a number of recensions by several authors over a period of several hundred years. In his view, the text was originally assembled from older sources in the 1st century CE by a single author (Kautilya, in this case not identified with the Maurya emperors) and redacted into the version known to modern scholarship by around 300 CE (Olivelle 2013:25-31, see also Trautmann 1971). Regardless of whether or not the text dates directly from the Mauryan period, it provides us with a valuable source of information regarding what sorts of concerns faced people living in South Asian cities in the Early Historic Period more broadly.

The *Arthashastra* goes into great detail on how a city should be constructed. The layout of Sisupalgarh fits quite closely with the description of a fort, including ramparts, gates, moats, and roadways (Olivelle 2013:103-5, Lal 1949). Because the construction of Sisupalgarh is this similar to the idealized description of a fort in the *Arthashastra*, it is probable that they both draw from a shared cultural context. This shared cultural context is likely to encompass more than just the layout of the site, and therefore it is very possible that other aspects of the *Arthashastra* describe the activities within the city more or less closely. Other than the use of ramparts, gates, moats, and roadways, the *Arthashastra* also provides instruction on how activities within the city should be segregated. Among other specific locations, it calls for elephant stables, kitchens, and storehouses to be in the east-southeast sector; the storage facility for forest products and the armory should be in the south-southwest sector; the stables for donkeys and camels and workshops should be in the west-northwest sector; the treasury as well as cattle and horses should be in the north-northeast sector; and shrines and the royal residence should be in the middle of the city. Also specified are the locations of residence for various groups of people. Kshatriyas and traders dealing in perfumes, garlands, and juices should be in the eastern direction; the city manager, the director of factories, military officers, grain dealers, and traders of cooked food, liquor, and meat as well as Vaisyas should live in the southern direction; workers in wool, yarn, bamboo, leather, armor, weapons, and shields as well as Sudras should reside in the western direction; and the residences of the deities of the city and the king, workers in metal and gems, and Brahmanas should be in the northern direction. Individual householders are allowed to have gardens and orchards and storage facilities for grain and merchandise. A compound with ten families should have its own well. The *Arthashastra* also gives instruction on activities that should be outside the city walls. For example, exiting the city to the cemetery should be through the southern gate and the residences for religious orders are around the cemetery while sanctuaries, holy places, groves, and reservoirs should be constructed approximately 200 meters outside the moat (Olivelle 2013:106). While the exact specifications of the layout of a city prescribed in the *Arthashastra* may not have been applied at Sisupalgarh, it is highly likely that the concepts espoused there, such as having specific areas of the city for various activities, were enacted.

The *Arthashastra* is a useful text for assessing the economic and logistical concerns surrounding animals in the Early Historic Period. It includes responsibilities of officials whose role was to manage animals and their owners or caretakers. The text outlines everything from the kinds of foods animals should be fed to the fines associated with the loss of animals (Olivelle 2013). One passage related to protection of wild animals states "The Superintendent of Abattoirs should impose the highest fine for tying up, killing, or injuring deer, game animals, birds, or fish that are legally protected from harm and are living in sanctuaries" (Olivelle 2013:157). This is not to say that these animals were never hunted for meat, as another responsibility of the Superintendent of Abattoirs dealt with the sale of meat from deer and other game animals (Olivelle 2013:158). A passage on the fines for failure to dispose of the dead says "For discarding a dead cat, dog, mongoose, or snake within the city, the fine is three Panas; a dead donkey, camel, mule, horse, or farm animal, six Panas; and a dead human being, 50 Panas" (Olivelle 2013:176). Regarding the feeding of animals, the *Arthashastra* has several requirements, one of which is:

> For bullocks with nose strings and capable of pulling at the pace of a gentle horse, the ration is half a load of green fodder, twice that much of grass, a Tula of oilcake from the oil press, ten Adhakas of broken grain, five Palas of

> rock salt, one Kuduba of oil for the nose and one Prastha for drink, a Tula of meat and an Adhaka of curd, a Drona of barley or Masa-bean porridge; a Drona of milk or half an Adhaka of liquor, a Prastha of fat, 10 Palas of sugar, and a Pala of ginger as a stimulating drink—one-quarter less of these for mules, cows, and donkeys; and twice as much for buffaloes and camels. In the case of working bullocks and milk cows used to suckle calves, rations should be allocated according to the time of the work and according to the yield, respectively; for all, as much grass and water as they want (Olivelle 2013:164-5).

The level of detail in the dietary prescription of this quote shows that at least some people were giving great attention to the diets of their animals. There are also provisions for the care of animals and penalties for not taking proper care, such as this one for horses:

> Those that hold the reins, tie the horses, give green fodder, cook the rations, guard the stalls, and groom the hair, and experts in the cure of poisons should take care of the horses according to their respective tasks. And if any of them neglects his tasks, moreover, he should deduct a day's wages. … In case a sickness becomes worse because treatment or medicine was delayed, the fine is twice the amount spent for the cure. If because of their fault something unfortunate happens, the fine is the price of the animal (Olivelle 2013:167).

This suggests an expectation of care for domestic animals and concern with their welfare. The same is true for captured wild animals, as there is even a description of the role for an official charged with the oversight of elephants.

> The Superintendent of Elephants should provide for the following: the protection of the elephant forests; stables, stalls, and places for lying down for male and female elephants and cubs that are under training or capable of work; the amount of work, rations, and green fodder assigned for them; allotting of work to them; their fastenings and equipment; their military trappings; and the retinue of attendants such as veterinarians and elephant trainers (Olivelle 2013:168).

Not all of the animals that are mentioned in the *Arthashastra* were valued members of the community, and there are descriptions on what should be done to reduce the population of animals perceived as pests, such as rats: “When there is a danger from rats, cats and mongooses should be released. If these [cats and mongooses] are captured or killed, the fine is 12 Panas” (Olivelle 2013:230); and snakes: “When there is a danger from snakes, experts in the cure of poisons should set to work with incantations and medicines. Or else, people should get together and kill the snakes. Or, experts in the Atharvaveda should perform magic spells” (230).

From these citations and other locations in the *Arthashastra*, one would expect that there was a large array of different animals associated with Early Historic Period South Asian cities. There are several factors though that make the archaeological finding of faunal remains in Sisupalgarh not necessarily reflect this full diversity. For one, there was limited sampling of the entire site, there is generally poor preservation of faunal remains, and as noted in the passage regarding disposal of the dead, there may have been an attempt to keep carcasses out of the city because of a concern for cleanliness.

6.3.5 The Pali Canon

In the first centuries after the life of the Buddha, the adoption and popularization of Buddhism in South Asia benefited from the support of elite patrons. Epigraphic and textual evidence (most famously, the inscriptions of Ashoka found throughout much of South Asia) attest to investments that rulers made in Buddhism. The flourishing of monastic and ritual complexes throughout South Asia demonstrates the growth of a faith community devoted to Buddhism. Examples of these Buddhist ritual complexes include Sanchi in Madhya Pradesh (Shaw 2013), the monastic complexes in the area around Ujjain (Skilling 2011), many locations within the Gangetic plain (Hawkes and Shimada 2009), Anuradhapura in Sri Lanka (Gilliland et al. 2013), the cave complexes in the western Deccan such as Bhaja (Ray 1988), and later sites in the eastern Indian region at Aragarh (c. 200 BCE-400 CE and 800-1100 CE, Patnaik 2016), Lalitgiri (c. 200 BCE-1400 CE, Patnaik 2019), Ratnagiri (c. 600-1300 CE, Patra 2015), and Udayagiri (c. 800-1300 CE, Patnaik 2019). In the immediate vicinity of Sisupalgarh, a circular laterite feature uncovered in excavations by B.K. Thapar in 1950 and portions of stupa railings recovered from the Bhubaneswar area have been interpreted as evidence of stupa construction and Buddhist practice at the site (Ota 2007).

Less clear are what impacts these elite adoptions of Buddhist ideology had on the lives of everyday people living in urban centers in these areas. Cities are often sites where diverse religious practices and expressions exist in close proximity, and therefore it is highly probable that at Sisupalgarh not all of the residents were subscribing to the ideologies visibly espoused by its leaders. This is especially true in times of change, where the textual record of the ideologies of the elite may not reflect the beliefs and practices of the general populace.

The period between the sixth and fourth centuries BCE not only represents a period of urbanization but also a period corresponding to the increasing popularity of heterodox faiths such as Buddhism and Jainism. There is evidence that both of these religions were practiced in the area around Sisupalgarh at around the time of its occupation (for example, the Jain complex at Udayagiri and the Buddhist complex at Aragarh). Sisupalgarh is linked to the adoption of Buddhism not only because of the increasingly wide distribution of the religion's practice taking place during the Early Historic Period, but also because of its proximity to the Dhauli edict and its interpretation as the location of the Kalinga war mentioned in Major Rock Edict XIII of Ashoka.

Buddhists texts provide fruitful avenues for interpreting the human-animal interactions at Sisupalgarh. The composition of the earliest of these texts dates to the period between the sixth and the second centuries BCE, and they are largely considered the primary source of South Asian history in these times, particularly in the sixth century BCE (Sarao and Sharma 2014:127). This literature includes both prescriptive texts, which deal with the rules to be followed by monastic and lay followers of Buddhist ideologies, as well as stories, many of which include or even revolve around animals. For example, the Buddhist Jatakas describe the past lives of the historical Buddha, during some of which he is reincarnated in the form of an animal (Sarao and Sharma 2014:127-144).

The Jatakas present morality tales within the context of everyday stories often focused on animals. Because of this, they are useful for examining human attitudes about and interactions with animals. The Jatakas are part of the *Sutta Pitaka*, the second of three divisions of the Pali Canon. The Pali Canon includes the teachings of Buddha and his disciples that were collated into a canonical version for subsequent oral transmission during the first Buddhist council, which was held shortly after the death of the Buddha. Much of these texts has been securely dated to the Early Historic Period (Sarao and Sharma 2014). The Jatakas are stories that recount the past lives of the Buddha. These stories often include tales in which Buddha either experiences reincarnation in the form of an animal or interacts with animals (cf. Cowell 1981). References to animals in these texts serve as the baseline for an understanding of the Buddhist approach to animals in the Early Historic Period.

The Jatakas cover a wide range of topics depending on the particular rebirth they are discussing and often end with a moralistic message. What we learn about human-animal interactions is generally not the moral of the story, but rather a fact shown in the telling of the story. For example, in the *Kapota-Jataka*, a story of the Buddha's rebirth as a pigeon in Benares (Cowell 1981, v1:112-4) the moral of which relates to avoiding temptation and greed, the particular circumstances in which the pigeon-Bodhisatta finds himself provide insight into the relationship between humans and commensal animals which were certainly not the intent of the story. In the *Munika-Jataka*, wherein the Buddha is reborn as an ox, he admonishes his brother not to envy a pig that is being well fed, because gifts such as good meals often do not lead to lasting pleasure (Cowell 1981, v1:75-6). This story suggests that oxen are valued more as beasts of burden, while pigs are used for food. These and other details within the Jatakas speak to the shared cultural understanding of the audience for these stories. Because of this, they can also provide the basis for hypotheses about the treatment of animals at Sisupalgarh.

6.3.6 Vedic Texts

The Vedic texts, transmitted orally for centuries preceding the Early Historic Period, were written down during this time (Jamison and Brereton 2014), presumably as a part of their continued active use. The Vedas include the *Rigveda*, the *Yajurveda*, the *Samaveda*, and the *Atharvaveda*. The *Atharvaveda*, with its focus on everyday ritual (cf. Jamison and Brereton 2014, Griffith 1895) provides a particularly useful baseline for the perceptions of animals held by common people living in cities. Furthermore, the *Arthashastra* advises deploying experts in the *Atharvaveda* to resolve certain problems (e.g., Olivelle 2013:230-231). The *Atharvaveda* contains formulas and incantations for addressing all sorts of problems that may arise. Many of these have to do with animals. Like the *Arthashastra*, the *Atharvaveda* provides advice on what should be done in cases such as the banishment of vermin, the protection of cattle, and the treatment of snake bites, covering various types of human-animal interactions (cf. Griffith 1895). Unlike the *Arthashastra*, this advice tends more toward the esoteric or spiritual rather than the economic or practical. For example, many of the hymns in the *Atharvaveda* relate to animal sacrifice or omens represented by animals. In spite of this spiritual dimension, the *Atharvaveda* is an excellent source for understanding the social and ecological ills that people felt needed to be addressed through ritual (cf. Ortner 1995). Understanding what problems were faced by everyday people living in South Asia during the Early Historic Period is crucial to interpreting the animal remains they left behind. The *Atharvaveda*, with its focus on the sublime, provides a very different perspective from the economically grounded *Arthashastra* or the politically grounded Ashokan edicts. It is important to keep in mind that the early original composition dates of the Vedic Texts mean that they do not address issues of urban living that must have been important in the Early Historic Period but would not yet have been a concern during the Vedic Period, which largely predates the urbanizing social organization which is characteristic of many settlements in the Early Historic Period.

6.4 Using Texts to Interpret Sisupalgarh

None of the texts referenced were intended to be depictions of life in a Early Historic Period city in general or at Sisupalgarh specifically. They were not encyclopedia entries. The Hathigumpha inscriptions may include a greater or lesser degree of boastful exaggeration, but it likely paints a general story of Kharavela's reign and of how he imagined his kingdom and its historical and geographical association with its surroundings. The Ashokan Edicts tell of how the king wanted people to act, and his investment in Buddhism promoted the expansion of the religion into Kalinga. Historical and archaeological evidence confirms that Buddhist institutions were in place in Kalinga during the time of Sisupalgarh's occupation (cf. Ray 2008). The *Arthashastra* is meant to be guidance for a ruler, and it provides a framework of what was viewed as possible and necessary during life in the Early Historic Period, if not an exact depiction of how solutions were actually implemented at any particular place or time. While the Jatakas include many supernatural or heightened elements, it is very probable that their overall depiction of life in the Early Historic Period can be used to glean the reality of certain aspects of that life. Even though the incantations of the *Atharvaveda* may no longer be as actively used for their intended practical purpose, the fact that these charms exist at least tells us some of the problems of the day which people were seeking to resolve through a variety of available means. All of these texts were written (or at least transcribed) by people who were living within the social and physical environment of an urbanizing Early Historic South Asia, so their views were formed in response to similar lived realities that affected themselves and other members of the general populace. Within this context, specific examples of how these texts relate to aspects of life in Early Historic cities in general and Sisupalgarh in particular are given in the sections below.

6.4.1 Relevance of Textual Evidence to Sisupalgarh

In order for the textual evidence to be relevant for assessing the interaction between humans and animals at Sisupalgarh, the relevance of that textual evidence must be demonstrated. Clearly, the Hathigumpha inscription is relevant, due to its close geographic proximity, the time of its inscription being within the time of occupation, and its apparent direct reference to what is now the archaeological site of Sisupalgarh in its discussion of Kalinganagari. Similarly, the presence of the Ashokan Major Rock Edict at the nearby Dhauli hill is clear evidence of the relevance of the inscriptions of Ashoka to Sisupalgarh. This is further amplified by the specific references to Kalinga within the very similar Major Rock Edicts and Pillar Edicts found throughout the Indian subcontinent (but not part of the two known inscriptions in Kalinga, at Dhauli and Jaugada). The "separate edicts" of the inscription at Jaugada, which is located within the rampart of the city, are addressed to the "*Mahāmātras* of Samāpā," (suggesting that Samāpā was the contemporary name for that site), while the Dhauli "separate edicts" are addressed to the "*Mahāmātras* of Tōsalī" (probably a name for Sisupalgarh) (Hultzsch 1925). This specificity of address tells us that the location of the inscription was probably chosen because of its relevance to the officials of the surrounding region, and in the case of the inscription at Dhauli, we can presume this meant the officials of Sisupalgarh.

Both the Hathigumpha inscription and the Ashokan inscriptions demonstrate clear ties between Kalinga and other parts of the Indian subcontinent. In the case of the Ashokan edicts, their prevalence throughout the lands controlled or at least influenced by the Mauryans is one indication of interconnectedness, but the "separate edicts" of Ashoka's Kalinga inscriptions also command regular inspections from the far-off locations of Ujjain and Taxila (about 1000 km and 2000 km distant, respectively) indicating an ongoing connectedness between Sisupalgarh and other regions of the Mauryan Empire. The Hathigumpha inscription's descriptions of Kharavela's interactions with regions as far away as the Krishna River (approximately 640 km to the south) and to Mathura on the Yamuna River (approximately 1200 km to the northwest), indicating that the trans-regional connectivity of Sisupalgarh continued well after the period of the Mauryan Empire.

It is highly likely that the values of residents of an interconnected Sisupalgarh were also aligned with the directives of the *Arthashastra*. A clear indication of this is the form of the city, but also the text of the *Arthashastra* specifically mentions Kalinga as a source of various high-quality cotton textiles (Olivelle 2013:126), touchstones (131), and elephants (102) as well as specific places within Kalinga such as Indravana for diamonds (123). These references to Kalinga are juxtaposed with other locations throughout the Indian subcontinent and beyond, reinforcing the concept of an interconnected South Asia and the relevance of the *Arthashastra* to Sisupalgarh.

The broad spectrum of interaction of Sisupalgarh assures that many belief systems and practices were at least known to some set of the residents. The Ashokan Edicts state that Ashoka was tolerant and even encouraging piety to all religions, but the Minor Rock Edicts, and also the tone of the Major Rock Edicts, show that Ashoka himself was a follower of Buddhism. This makes it highly likely that a significant fraction of at least the elites at Sisupalgarh would be familiar with the teachings of the religion and the stories that would eventually be written as the Pali Canon. The Pali Canon itself demonstrates a clear understanding of the geography and interconnectivity of the sub-continent. The *Kurudhamma-Jataka* describes a trip from Dantapura in Kalinga to Indapatta in Kuru (Cowell 1981, v2:252). Many of the Jatakas provide insights into urban living and these insights may apply to Sisupalgarh. For example, the *Tandulanali-Jataka* (Cowell 1981, v1:22) talks of a horse trader coming to the city of Benares with 500 horses to sell and the king buying them all and directing them to be taken to his stables. This story not only shows that there was trade from outside the city, but also that horses were used and stabled within the city. The *Apannaka-Jataka* (Cowell 1981, v1:4) talks about a wealthy merchant taking his costly goods via a 500-cart caravan from city to city, again emphasizing inter-city trade.

6.4.2 Textual Evidence of Animal Usage

6.4.2.1 Animals as food

Animals were widely used during the Early Historic Period, even or perhaps especially within an urban setting. One type of usage is as a source of food, as in the Ashokan Major Rock Edict I which refers to the many thousands of animals that were formerly killed each day to supply meat (and the reduction to only one deer and two peacocks and hopeful elimination of the killing of animals for food) (Dhammika 1993). The *Arthashastra* contains several references to professional hunters and fowlers, who presumably take wild animals to be used for food, and of land set aside for the purpose of hunting (Olivelle 2013). There is also a passage indicating that deer and other animals are used for meat and how their meat should be sold: "They shall sell boneless meat of deer and game animals that have been freshly killed. For meat containing bones, they should pay compensation" (Olivelle 2013:158). The Jatakas contain many references to the hunting of wild animals for food. For example, the *Mamsa-Jataka* tells of a hunter who loads his cart with venison and takes it to the city to sell (Cowell 1981, v3:33). There is also textual evidence of domestic animals being used as a source of food. The *Arthashastra* refers to buffalo being raised for meat (Olivelle 2013:163) and that the meat of cattle that have died from "justifiable cause" may be sold either fresh or dried (164). The *Nanguttha-Jataka* tells of a group of hunters that find an ox tied outside a hut and then kill and eat it and take the remaining meat with them (Cowell 1981, v1:308). The story in the *Munika-Jataka* about how well the pig is fed indicates that domestic pigs are used as sources of meat (v1:75-6) and the *Tundila-Jataka* also says that a pig's purpose is to be eaten (v3:181-2). Within the entirety of the Jatakas there are many mentions of human consumption of meat (frequently in a negative context), so it is clear that the eating of meat was (or had been) a common practice.

Hunting of wild animals was also a pastime of the elites, with both the *Arthashastra* and the Jatakas providing textual evidence. The *Arthashastra* specifies an animal reserve shall be created for the king's pleasure including elephants to ride on during the hunt (Olivelle 2013:101-2). The *Sattigumba-Jataka* tells of a king going forth in his chariot with a large retinue to hunt deer (Cowell 1981, v4:268) and the *Sarabha-Miga-Jataka* talks of a king that much enjoyed hunting (v4:169). Ashokan Major Rock Edict VIII tells that in the past kings would include hunts as part of the entertainment when they were traveling, but Ashoka replaced these hunts with charitable and religious activities.

There is also textual evidence for the avoidance of killing animals for food. In addition to the Ashokan edict that tells of the reduction and hopeful elimination of animals as a food source, Pillar Edicts #5 and #7 proclaim that many animals must be protected (but interestingly beside the list of specific animals it includes "and all four footed creatures that are neither useful nor edible") (Dhammika 1993). In the *Nigrodhamiga-Jataka* there is a king who loved to hunt and ate meat with every meal. He spent so much time hunting that he neglected the duties of the king so the people decided to drive many deer into the gardens of the king, so he would spend less time hunting. The leader of these deer was the Bodhisatta, a magnificent golden stag that the king had declared sacred. The Bodhisatta noticed that many of his herd were being wounded while the king was attempting to kill only one each day, so he came up with a plan that on each day one deer chosen at random would sacrifice themselves so that the other deer would not be wounded in the attempt to kill only one. One day the chosen deer was a doe heavy with fawn who asked to be spared until her fawn was born, since sacrificing her would be effectively killing two deer. She appealed to the Bodhisatta that she be spared, and in not wanting to force another of his deer to take her turn, he offered himself as sacrifice. When the king saw which deer was to be killed, knowing it was the sacred leader, he asked why. The Bodhisatta explained the reason and the king was so moved by the selflessness of the Bodhisatta that he agreed to spare both the Bodhisatta and the doe. The dialogue between the Bodhisatta and the king then went on:

> "Though two be spared, what shall the rest do, O king of men?" "I spare their lives too, my lord." "Sire, only the deer in your pleasaunce will thus have gained immunity; what shall all the rest do?" "Their lives too I spare, my lord." "Sire, deer will thus be safe; but what will the rest of four-footed creatures do?" “I spare their lives too, my lord." "Sire, four-footed creatures will thus be safe; but what will the flocks of birds do?" "They too shall be spared, my lord." "Sire, birds will thus be safe; but what will the fishes do, who live in the water?" "I spare their lives also, my lord." After thus interceding with the king for the lives of all creatures, the Great Being arose, established the king in the Five Commandments, saying, "Walk in righteousness, great king. Walk in righteousness and justice towards parents, children, townsmen, and countryfolk, so that when this earthly body is dissolved, you may enter the bliss of heaven." (Cowell 1981, v1:39-41)

This Jataka is an illustration of the notion of ahimsa—that all life, both human and animal, is sacred, and that people should therefore avoid killing any living thing.

6.4.2.2 Animals as tools

Humans use animals for many purposes other than food. The use of animal hides was commonplace in the Early Historic period, and the *Arthashastra* provides a long list of different skins and where they are from (Olivelle 2013:125) while the Jatakas include many references to leather used for clothing (e.g. Cowell 1981, v3:55), sacks (v3:77), and thongs (v4:258), as well as dress of deer skins (v5:201), robes made of tiger skin (v6:30) and a mattress covered with squirrel skins (v6:116). Another animal product that is usually procured from a dead animal is elephant ivory. The *Arthashastra* says that anyone that kills an elephant should be put to death, while a reward is given to someone who brings in the two tusks of an elephant that has died naturally (Olivelle 2013:102). The *Silavanaga-Jataka* (Cowell 1981, v1:176) tells of a man who was allowed to cut off the tusks of the Bodhisatta (who had been reborn as an elephant) but was not grateful for the gifts and was thence swallowed by the earth and burned in the fires of hell. The *Cassava-Jataka* (v2:139) also talks of a man who made a living from killing elephants and selling their ivory.

Other uses of animals do not necessarily harm the animal. The Hathigumpha inscription talks about using animals for war (horses and elephants) and using donkeys to pull plows. The *Arthashastra* talks about using cattle and buffalo as beasts of burden and as sources of milk (Olivelle 2013:162-4), about using animals for tractive power (251), about using goats and the like (i.e., sheep) for their wool (164, 574), the hair of many animals for textiles (126), the military and ritualistic use of horses (166-7), and the use of elephants for riding and warfare (169-70). It also talks about using domestic or tamed animals for protection against snakes and vermin (94-5, 108, 230). The Jatakas also talk about many uses of animals as tools, such as sources for transportation and tractive power. In the *Samgamavacara-Jataka* (Cowell 1981, v2:63) the use of an elephant for riding and warfare in the context of besieging the city of Benares is discussed. This story describes the strength of the elephant and its utility for defeating the defenses of the city. In the *Kanaha-Jataka* (Cowell 1981, v1:73) the Bodhisatta has been reincarnated as a bull and is used to pull the ox-drawn carts of a merchant's caravan across a particularly difficult ford which the merchant's oxen were unable to accomplish, clearly demonstrating that oxen are used for tractive power. In the *Gandatindu-Jataka* (v5:54) a herdsman laments that the demands for milk keep increasing, which requires the milking of cows that had not been milked before and in the *Sambhava-Jataka* a line of verse (v5:36) states the value of a cow is by the amount of milk it produces. These stories indicate the importance of animals as sources of secondary products which do not involve killing the animal.

6.4.2.3 Ritualistic use of animals

The people of the Early Historic Period in South Asia lived closely with animals, so it is not surprising that animals would play a part in some of their rituals. The most obvious of these is animal sacrifice, which is mentioned in many of the Jatakas, generally in negative context. An example is the *Dummedha-Jataka* (Cowell 1981, v1:126-7), which states "Now in those days the Benares folk were much given to festivals to 'gods,' and used to shew honour to 'gods.' It was their wont to massacre numbers of sheep, goats, poultry, swine, and other living creatures, and perform their rites not merely with flowers and perfumes but with gory carcasses." In this Jataka the Bodhisatta is reborn as a prince, and when he ascends the throne he reminds the residents that animal sacrifice is sinful and that 1000 sinners shall be sacrificed, efficiently ending the animal sacrifice without having any person sacrificed. In the *Mahasupina-Jataka* the Bodhisatta tells a king "Henceforth, O king, join not…in slaughtering animals for sacrifice" (v1:194). The *Lohakumbhi-Jataka* talks of a king planning a fourfold sacrifice of every living creature "men, bulls, horses, elephants, down to quails and other birds" in order to protect his kingdom (v3:29) but is convinced by the Bodhisatta that what he feared is the cries of four tortured souls in hell and the sacrifice is not needed, thereby sparing the lives of the multitude. In addition to the

Jatakas having a negative view of animal sacrifice, in Ashokan Major Rock Edict I it is ordered that no living beings should be offered in sacrifice (Dhammika 1993). This textual evidence is an indication that the Buddhist philosophical perception of animals changed social norms in such a way that animal sacrifice was no longer viewed as appropriate.

Another ritual that involves animals is the "lustration rite", which is a purification ritual performed periodically for horses and elephants (Olivelle 2013:168, 171, 576). The *Susima-Jataka* tells of an elephant festival (Cowell 1981, v2:131-4) that uses 100 elephants dressed in gold. In the *Vatagga-Sindhava-Jataka* the Bodhisatta is reborn as the king's ceremonial horse (v2:233). According to the *Vaddhaki-Sukara-Jataka* three shells are used to sprinkle the king during a coronation (v2:278). The *Atharvaveda* also suggests that people viewed the coming of certain animals as omens of misfortune, and there are three charms which may be used to forestall this misfortune (Griffith 1895:a212-4). Also, a cow giving birth to twin calves was seen as a sign of bad luck, and there is a charm to change this into good luck (a100).

6.4.2.4 Treatment of animal remains

There is also textual evidence for how dead animals should be disposed of. The fines established in the *Arthashastra* for disposing of dead animals within the city suggest that for the most part dead animals will be taken outside of the city. In the *Cullaka-Setthi-Jataka* (Cowell 1981, v1:20), the Bodhisatta sees the carcass of a dead mouse on the road and foretells that whoever is willing to pick it up would become wealthy. This story suggests that the average city dweller of the time might be unwilling to handle the carcass of a mouse and only someone who is entrepreneurial will be able to see value in it, or at least that the carcass of a mouse might usually be ignored.

6.4.2.5 Care of animals

With the importance of animals to urbanites during the Early Historic Period, it is not surprising that there would be textual evidence related to the care of those animals. In the second of the Ashokan Major Rock Edicts, Ashoka commands that measures be taken to ensure the availability of medical care and water for both humans and animals (Dhammika 1993). This edict places equal importance to the care of animals as the care of humans. The *Arthashastra* specifically discusses veterinary care for elephants and horses and recommends that similar practices be implemented for the care of other animals (Olivelle 2013:167-70). It also talks about ritual treatment of ill animals (229). The *Atharvaveda* also provides ritual solutions to certain ailments. In hymn 32 of the 2nd volume a means for curing cattle of worms is given (Griffith 1895:a60). Other passages in the *Arthashastra* discuss the feeding of various animals, for example cattle (Olivelle 2013:164-5), horses (166), and elephants (169). The responsibilities of specific officials or workers involved in the care of animals are also given, such as the Superintendent of Cattle, the Superintendent of Horses, the Superintendent of Elephants, as well as for herders and others entrusted with the care of animals.

The feeding of animals is also discussed within the Jatakas. For example, in the *Maha-Ummagga-Jataka* (Cowell 1981, v6:161) a comparison is made between feeding cattle on grass vs. "They have drunk rice gruel and have been fed on sesame flour and kidney beans." The contrast being made between the simple fare a poor farmer can afford to feed his cattle with the extravagant fare which a presumptuous owner might feed them. This same Jataka also describes a dog “which had fed all its days upon the bones, skin, and refuse of the royal kitchen” (176), perhaps indicating that it was common practice to feed dogs with these types of scraps.

6.4.2.6 Non-domesticated animals in cities

At Sisupalgarh and other Early Historic cities of South Asia not all the animals/animal products present were from domesticated species. Wild animals (or parts thereof) were intentionally brought into the city by its human inhabitants and they also entered the city under their own agency. There is abundant textual evidence regarding animals in both of these categories. In the first of the Major Rock Edicts, Ashoka tells about how formerly many animals were killed to make curry, but now only two peacocks and a single deer (both non-domesticated species) are killed. Also, in the Major Rock Edicts it is told how previously when kings were visiting other areas there would be arranged hunts for entertainment. It seems probable that the meat from the animals killed during these hunts was brought into the cities to be eaten. In the Pillar Edicts a list of protected animals is given which is mainly made up of wild animals. If these animals are now to be protected by order of the edict, previously they must have been hunted (at least occasionally).

The *Arthashastra* also has many passages that discuss non-domesticated animals. There are guides for how to capture and tame wild elephants (Olivelle 2013:169-70), where the best elephants come from (101-2), where within the city trained elephants should be stabled (106), and that elephants undergoing training or vicious elephants should be kept outside of the city (168). The Jatakas also have many references to elephants with many stories of wild elephants, but even more references to elephants being ridden, generally by a king or prince, or for their use in warfare (Cowell 1981). The *Arthashastra* also talks about parrots repeating conversations that are meant to be confidential (Olivelle 2013:84), the use of commensal birds as sentries against snakes and poison (94-5), and the desirability of having commensal animals (deer, peafowl, monkeys, mongooses, partridges, parrots, and myna birds) where horses are stabled (165). There is also a passage that implies that many species of birds (e.g., hawks, crows, vultures, parrots, mynas, owls, and pigeons) move freely from within the city to the surrounding area (415), which indicates that there are many environments within a city that are attractive to birds. The Jatakas also talk about pet parrots. In the *Kalabahu-Jataka* (and others) two parrots are captured by a fowler and given to the king to be kept as pets where they achieved "the highest degree of profit and honour" (Cowell 1981, v3:65-6). This same Jataka also talks about a captured monkey that is given to the king as a pet. In the *Kapota-Jataka* a pigeon is welcomed in the kitchen of an official and is free to seek food elsewhere (v1:112).

The *Arthashastra* also includes guidance on how the meat of deer and other game should be introduced into the city (Olivelle 2013:158), the provisioning of kept non-domestic animals (138), and that having a deer forest is better than an elephant forest because deer provide a good source of meat and hides (342). All of these passages are indicative that humans are intentionally bringing animals and animal products into the city, as well as managing external landscapes to both enhance the availability of animal resources and to ensure the welfare of the animals in those managed landscapes. Jatakas also include many stories that have hunters of wild animals that take the spoils of their hunt to their homes. In some of the stories, the hunter is the king, and the meat is taken to the palace, presumably within a city. In the *Vattaka-Jataka* a story is told about a quail-catcher who would go to the forest and catch quail and then bring them home to fatten before selling them in the market to make a living (Cowell 1981, v1:262).

In addition to the animals that are intentionally brought into the city, there are others that enter the city by their own volition. The *Arthashastra*'s guidance on the use of domestic or tame animals to eliminate vermin is a clear indication that there are unwanted animals within the city. The *Atharvaveda* also provides a charm to banish vermin and noxious creatures (Griffith

1895:a48), one to destroy vermin (a223), and many dealing with snakes (e.g., a170, a226, a310). The *Arthashastra* also recommends the use of someone versed in the *Atharvaveda* to get rid of snakes (Olivelle 2013:230), which indicates that even in the instructions for the king of a city the hymns of the *Atharvaveda* are still relevant. The Jatakas also include stories about unwanted animals within cities. In the *Mamgala-Jataka* mice have gnawed through the cloths of a brahmin (Cowell 1981, v1:217) and in the *Kuta-Vanija-Jataka* a dishonest trader claims that mice have eaten goods that belonged to another trader, when he had actually sold the goods himself (v2:127). These two stories show the common problems of mice infestations—their gnawing of things either to make passages, for food, or for nesting material; and their eating of goods intended for other purposes. The Jatakas also talk about larger unwanted animals within cities. There are many references to jackals, including in the *Sigala-Jataka* a story of a jackal that makes its way into the city via the sewer (v1:255).

6.5 Discussion

The texts discussed above provide copious information on human-animal interaction in the Early Historic Period, but they all should be taken as a window into certain people's view rather than as an absolute record of day-to-day life within any Early Historic Period South Asian city. All of these texts represent the viewpoints (perhaps idealized) of people in positions of political or religious power and may not reflect the experience of a typical citizen living at Sisupalgarh. While not written from the perspective of a typical citizen, these texts reflect the shared realities that all people living in Early Historic cities would have needed to cope with. All of these texts provide a view into what the concerns of their authors were or what the authors perceived to be the concerns of the populace, and suggest a way to ameliorate those concerns, whether through organizational practices, military preparations, religious teachings, or incantations.

Several things that are implied by this textual evidence which could influence the faunal remains recovered include changes in ideologies surrounding the eating of meat, practices associated with the treatment of animal remains (both consumption and disposal), the roles played by domestic, wild, and commensal animals within the urban space, and peoples differing attitudes towards certain types of animals. These ideas, as presented in the texts, provide the basis for hypotheses which can be supported or refuted by data derived from the physical remains recovered during archaeological excavations. Correlations of text-based hypotheses with faunal remains will be provided in the next chapter of this dissertation.

CHAPTER 7. CREATING HYPOTHESES FROM TEXTS AND TESTING THEM USING FAUNAL EVIDENCE

Given the textual evidence in the previous chapter it is possible to create a picture of human-animal interactions in Early Historic cities in South Asia. Using the archaeological evidence and faunal analyses described in Chapters 3-5, in this chapter I evaluate the accuracy of this depiction at Sisupalgarh. Information about the role of animals in cities derived from texts only provides the perspective of the text's author and is nuanced by the message the author is trying to convey, which may not be an accurate depiction of the experience of everyone living in Early Historic cities. Archaeological evidence can either bolster or refute this perspective. The comparison of archaeological and textual evidence demonstrates that, in many respects, Sisupalgarh appears to fit well into the textual depiction of South Asian Early Historic cities.

When using archaeological evidence to assess the culture of a site, it is important to also consider all aspects that could have influenced the material that was recovered from the site. With a large site, such as Sisupalgarh, it is generally not possible to excavate the entire site, or even a large fraction of it, and care must be taken in drawing conclusions for the site as a whole based on recovery from only a small portion of the site. As seen in chapter 5 on taphonomy, the faunal material recovered from a particular location within a site can vary due to a number of factors. The particular location within the site could be used (or not used) for different functions during different periods of the site's occupation or used at different intensities; there might be changes in the method of disposal of animal remains; there could be a change in the overall volume of animal usage; or there could be a change in the preservation of the faunal remains. Whether changes in quantities of animal remains recovered from a particular phase of occupation is due to overall changes in site usage or due to changes only in the way that animals are used can be calibrated by comparison to other types of archaeological evidence. In the case of Sisupalgarh, weight of ceramic recovered from excavations provides a useful proxy for changes in intensity or type of use. In general, changes in the quantity of animal remains recovered can also be the result of taphonomic processes, but in the case of Sisupalgarh, the analyses presented in Chapter 5 indicate that these processes are not the primary factor affecting the patterns of faunal recovery, therefore any differences should be the result of changes in cultural practices.

7.1 Expected Animal Remains Based on Texts

First, we might propose that based on the textual evidence of the preceding chapter, Early Historic cities had broad-based economies which relied on the use of many different animal resources from both wild and domestic species. There is ample textual evidence of the gathering of wild animal resources, primarily as a source of food, but also for other purposes. The Major Ashokan Rock Edicts mention wild animals used as food as well as the practice of hunting (Dhammika 1993). The *Arthashastra* discusses game animals (including mammals, birds, and reptiles) and products obtained from them as well as their use as a source of meat (Olivelle 2013:141, 158). The Jatakas also have many references to both hunters and fowlers (cf. Cowell 1981, v3:33, 121, v1:85, v5:178). There is also textual evidence that fish were a component of the diet for people in Early Historic cities. The Pillar Edicts of Ashoka proclaim protection for certain fishes on all days and prohibits the sale of all fish on certain days (Dhammika 1993). If there had not been an established usage of these fish, there would have been no need to proclaim protection for them. The *Arthashastra* has requirements for the taxation of fishermen as a fraction of their catch and the protection of fish (cf. Olivelle 2013:150, 157), and the Jatakas have many references to fishermen (cf. Cowell 1981, v1:87, 257, 299, v2:289).

The texts described in the preceding chapter have a great deal of evidence for human use of domestic animals in cities during the Early Historic Period. The Hathigumpha inscription mentions horses and donkeys (Sahu 1984:335, 341), and the Ashokan Edicts specifically refer to horses, cattle, pigs, sheep, goats, chickens, and pigeons as well as medicines for animals in general (Dhammika 1993). The *Arthashastra* has a great many references to domestic animals, including horses, camels, cattle, buffalo, pigs, goats, sheep, dogs, cats, and homing pigeons (Olivelle 2013). The Jatakas also talk of domestic horses, cattle, buffalo, pigs, goats, sheep, dogs, cats, and chickens (Cowell 1981) and the *Atharvaveda* includes mentions of domestic horses, cattle, buffalo, goats, sheep, and dogs (Griffith 1895). From all of these texts it is apparent that people in the Early Historic Period had deep relationships with domestic animals for food as well as for secondary products, traction, and companionship.

Wild species of animals were also extensively utilized by being tamed and kept either as pets or for use as tools. The most obvious example of this is the taming of wild elephants and the *Arthashastra* has much advice on the taming and keeping of tame elephants (Olivelle 2013) and the Jatakas contain many stories about elephants and elephant tamers (Cowell 1981). Other tamed species that are specifically mentioned include parrots, mongooses, and monkeys (Olivelle 2013:165, Cowell 1981, v3:65-6).

Secondly, Early Historic texts paint a picture of cities as ecologically complex spaces with multiple types of human-animal entanglements. In the Jatakas, city dwellers are depicted as deliberately encouraging animals to enter into urban spaces by providing them with food and shelter, as in the *Kapota-Jataka*, in which the Bodhisatta, reborn as a pigeon, lives in a basket in the kitchen of the Lord High Treasurer of the city of Benares. This story contrasts the pigeon's benign behavior with that of a crow who eagerly and greedily tries to access the food within the kitchen (Cowell 1981, v1:112-4). In this story, the crow and pigeon have different types of mutualistic relationships with humans which are both contingent upon the urban environment. The *Arthashastra* also depicts cities as locations with environments that are attractive to, or suitable for, wild animals (either intentionally or unintentionally), and these wild animals form multiple types of relationships with humans. In the directions for the keeping of horses, it is advised that there should be deer (within the texts there is generally little or no distinction between the different species of deer nor between deer and antelope, so this recommendation could encompass, of the taxa identified at Sisupalgarh, *Cervus unicolor, Axis axis, Boselaphus tragocamelus,* or *Antilope cervicapra*), monkeys, mongooses, and wild birds collocated with them (Olivelle 2013:165), indicating that the presence of these species is viewed favorably. The descriptions of the requirements for capturing and keeping of elephants makes it abundantly clear that these wild animals can be tamed and kept in cities (168-9). There are also passages regarding how to get rid of snakes and vermin (e.g. rats) where it is obvious that the presence of these wild species is undesirable (230). The Jatakas also include stories of animals that are unwanted within the city (Cowell 1981, v1:255).

Based upon the textual evidence of animal usage, it would be expected that remains of many different types of animals; wild mammals, birds, and reptiles; tamed wild animals; domestic animals; and commensal animals would be recovered.

The *Arthashastra* also describes the roles of various officials in an ideal city who would oversee the “correct” deployment and usage of animals within the city and surrounding areas. Among the activities that are described are the sale of meat from both wild and domestic animals (specifically, the *Arthashastra* suggests that this meat should be sold with the bones already removed; Olivelle 2013:158, 164 [although the same does not explicitly apply to the flesh of fish]), how to prevent animal remains from being disposed of within the city (the *Arthashastra* outlines a scheme of fines depending on what type of animal carcass is not properly disposed of; 176), and a variety of uses both practical and esoteric of many different body parts of a vast array of wild and domestic animals (Olivelle 2013). It also suggests that activities having to do with animals should be segregated to specific parts of the city (106). Having meat sold without bones, removal of animal carcasses from the city, and segregation of activities involving animals might suggest a reason for the relatively sparse faunal remains recovered from the excavations at Sisupalgarh as a whole.

7.2 Animal Remains Recovered at Sisupalgarh

The complex economic and social/ecological ties between humans and animals in Early Historic texts are corroborated by the diverse array of animal remains which were identified in the archaeological material from Sisupalgarh. In the portions of the site which were excavated to pre-cultural levels (Core Sequence 1, Core Sequence 3, and Operation 6 Trench HC6), a wide variety of wild and domestic animals are represented, although not uniformly throughout these contexts (see Table 7-1). These constitute animals which could be used for a variety of purposes (e.g., *Bos indicus* and *Bubalus bubalis*), ones that were most likely only used for meat (e.g., *Sus scrofa*, large wild animals such as Cervinae, and a variety of marine and freshwater Osteichthyes and Chondrichthyes), and an array of animals which may have been simply taking advantage of niches created by the urban environment (e.g., Rodentia, Aves, and possibly some Mollusca). Most of these remains do not show obvious signs of how they were used, so it is not possible to rule out that these animals may have been sources for many products beyond simply meat (such as the “skin, bones, bile, tendons, eyes, teeth, horns, hooves, and tails” of wild animals that the *Arthashastra* lists as valuable forest produce: Olivelle 2013:141). Indeed, some of the remains show definite signs of being worked to create tools or ornaments; obviously, many other potentially useful parts of animals are unlikely to preserve in the archaeological record. From throughout the site, a variety of domestic and wild animal remains were recovered. The percentage of remains representing probably domestic, probably wild, and uncertain if domestic or wild animals from each operation is shown in Table 7-2. Interestingly, although the *Arthashastra* contains many references to the keeping of elephants and specifically highlights Kalinga as a region with elephants of exceptional quality (Olivelle 2013:102), elephant is only represented at Sisupalgarh by a single tooth fragment from Core Sequence 3. A possible explanation for the dearth of elephant remains is that elephants are brought into the city as tamed animals in order to perform a specific function. When no longer able to provide a useful function, the animals were very likely released back into the wild or elephant reserves outside of the city.

Table 7-1 Taxa represented in soundings to natural soil (CS1, CS3, Op 6 Trench HC6)

Taxon	NISP in CS1	NISP in CS3	NISP in Op 6-HC6
***Equus* spp.**	0	3	0
Bos indicus* and *Bubalus bubalis	42	108	19
Mammalia, large	37	235	23
Sus scrofa	38	26	31
Ovis aries* and *Capra hircus	0	7	2
***Canis* spp.**	0	22	1
Mammalia, medium to large	37	60	16
Mammalia, medium	51	83	14
Mammalia, small to medium	19	9	8
Mammalia	0	0	2
Elephas maximus	0	1	0
Boselaphus tragocamelus	10	0	4
Cervinae	10	7	0
Antilopinae	0	2	0
***Lepus* sp.**	2	29	0
Rodentia	23	144	0
Soricidae	0	2	0
Mammalia, small	31	47	5
Aves	17	42	3
Testudines	26	32	1
Squamata	2	9	0
Osteichthyes	128	204	8
Chondrichthyes	0	3	0
Mollusca	0	24	1

Table 7-2 Distribution of remains of domestic vs. wild taxa throughout Sisupalgarh

Operation	NISP	Probably domestic	Uncertain wild or domestic	Probably wild
Core Sequence 1	473	25%	23%	53%
Core Sequence 3	1099	36%	14%	50%
Operation 1	71	56%	35%	8%
Operation 3 excluding Rampart Strip	127	53%	26%	21%
Operation 3 Rampart Strip	206	39%	17%	44%
Operation 4	2	50%	0%	50%
Operation 5	48	42%	33%	25%
Operation 6 Trench HC6	138	58%	25%	17%
Operation 6 Trench HC7	24	42%	29%	29%
Operation 7	101	58%	30%	12%
Total for site	2289	38%	19%	43%

7.3 Diachronic Changes in Animal Usage in Excavations to Natural Soil

The relationships with animals described in or implied by the *Atharvaveda*, the *Arthashastra*, and the Jatakas are those of people who were not structuring their lives around following Buddhist ideals such as *ahimsa*. At Sisupalgarh, this view of life would correspond to the period before the time of Ashoka, during whose reign appears the earliest evidence of Buddhism in Kalinga. Between the time of first occupation at the site and the reign of Ashoka, about two meters of cultural material were deposited, and the site was undergoing changes that were not necessarily brought about by changes in religious ideals. The Ashokan edicts are dated to the third century BCE (Chakravarti 2014), and the Hathigumpha inscription is dated to the first century BCE (Lal et al. 2014), providing a snapshot of the views of at least the elites that sponsored the creation of these inscriptions in Kalinga at each of these times. After Buddhism became widely adopted in Kalinga and the Ashokan Edicts at Dhauli were inscribed, and perhaps even more so in the time of Kharavela with his support of Jain beliefs, the practice of *ahimsa* would have changed the city from a society based upon the reliance on a broad spectrum of animal products as described in the texts to a society less reliant on animals as a source of meat.

Examining changes in the faunal assemblage over time at Sisupalgarh can indicate whether there was indeed a change in animal usage. Core Sequence 1, Core Sequence 3, and Operation 6 Trench HC6 were all excavated through to sterile soil, providing a complete sequence of remains for the entire occupation of that portion of the site. Because Core Sequence 1 and Core Sequence 3 were both excavated as deep soundings with uniform cross-sections throughout their depth, they provided an equal volume of material for each arbitrary unit of time represented by the 30-cm split depth. Operation 6, on the other hand, was an open excavation, divided into two square trenches which were separated into loci based on cultural features.

Trench HC6 was divided into 82 loci of non-uniform size, shape, and depth. This makes the data from HC6 somewhat more difficult to compare to the core sequences. During excavation, the depth of each locus was recorded, so it is possible to group the data from various loci into arbitrary 30-cm levels for the purposes of the present analysis (comparable to the splits which formed the basis of excavation in the core sequences). For example, all loci whose average depth was less than 0.3 m were grouped into Level 1, all loci whose average depth was between 0.3 and 0.6 m were grouped into Level 2, etc. This fails to account for the different areas excavated at each depth (compared to the consistent areas of the core sequences), but still allows us to sort findings by approximate stratigraphic depth. For validation of this particular hypothesis, the absolute quantities from each level are not as important. Rather, it is the variation in taxa represented over time which could refute the hypothesis that during the period of occupation at Sisupalgarh there was a change in animal usage over time due to changes in ideology brought about by the increased importance of Buddhist and Jain practice in the area.

The preservation condition of the faunal remains from Sisupalgarh frequently prevented them from being accurately attributed to a particular taxon (see chapters 4 and 5). When specific identification was not possible, bones were nonetheless usually categorized to the most specific possible taxonomic level and then grouped according to size (e.g., “Cervinae,” “Mammalia, large,” or “Aves”). Because of the difficulty of distinguishing *Bos indicus* (cattle) from *Bubalus bubalis* (water buffalo) in most cases, and because when differentiation was possible these two taxa frequently appeared together, for this analysis I have elected to group them together as “*Bos indicus* or *Bubalus bubalis*” or simply “bovines.” For the purposes of this analysis, I have grouped the taxa into three categories: “domestic or probably domestic” “uncertain domestic or wild,” and “wild.” Certain species, such as nilgai (*Boselaphus tragocamelus*) are easy to assign to a category (wild, in the case of the nilgai). Others are somewhat more contentious, given that both wild and domestic populations with similar physiologies might have been present in the area of Sisupalgarh, but in the case of dogs (*Canis*) and pigs (*Sus*), these have been attributed to the "domestic or probably domestic" category as the more parsimonious explanation (even though stories from the Jatakas include both domestic pigs and dogs as well as wild boar, wolves, and jackals). Categories such as "Mammalia, medium" are very difficult to assign in the wild/domestic binary: for example, a medium mammal might be the definitely wild spotted deer (*Axis axis*) or the definitely domestic goat (*Capra hircus*), and Aves might represent the definitely wild little egret (*Egretta garzetta*) or the domestic chicken (*Gallus gallus domesticus*). For this type of case, taxa were assigned to the "uncertain domestic or wild" category. In a broad-based economy, one would expect to find a diverse range of both wild and domestic taxa. In a society becoming more attuned to the ideal of *ahimsa* (non-violence), the expectation would be for an overall lessening of animal remains and a preference for animals which can be utilized in ways that do not require them to be killed, such as for secondary products and labor; animals such as pigs or most wild game, which are primarily useful as sources of meat or for other body parts, would become less common if *ahimsa* were of increasing concern.

7.3.1 Core Sequence 1

Figure 7-1 shows the ratio of number of identified specimens of each taxon recovered from each split of Core Sequence 1 grouped into the categories "probably domestic," "uncertain wild or domestic," and "probably wild." Figure 7-2 combines this data into a composite of all taxa as a function of depth and compares this to weight of ceramic recovered at each depth. (Neither Figure 7-1 nor Figure 7-2 include faunal data from Core Sequence 1 Split 9, which was not available for analysis; see Chapters 4 and 5. In Figure 7-2, this gap is represented by a dashed line.) Figure 7-2 also includes an estimate of how the splits correspond to historical events (the construction of the encircling rampart, the supposed date of the Kalinga War, and the reign of Kharavela) based on radiocarbon dating. The three radiocarbon dates that were obtained from charcoal samples in Core Sequence 1 (Smith and Mohanty 2016) are shown in Table 7-3.

Figure 7-1 Ratio of NISP of each taxon per split: Core Sequence 1

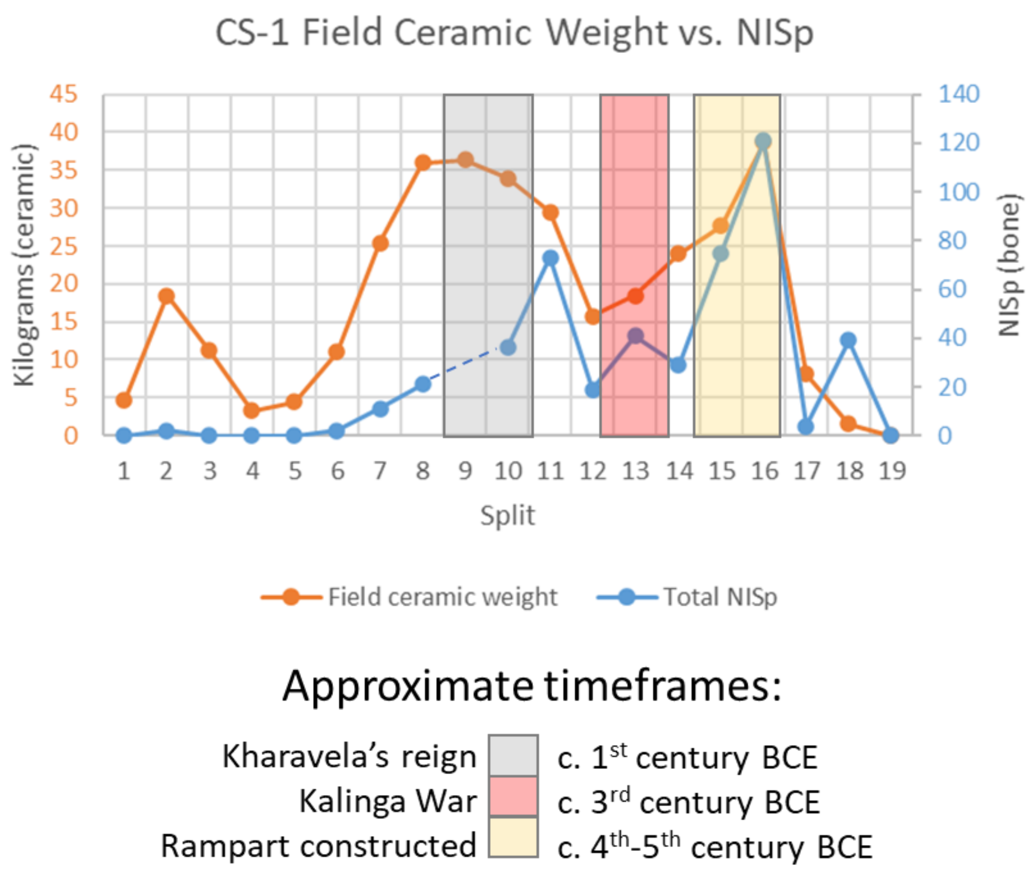


Figure 7-2 Faunal NISP compared to ceramic weight for each split: Core Sequence 1

Table 7-3 Radiocarbon dates from CS1 (after Smith and Mohanty 2016:693)

Sample ID	Split	Calibrated 1-sigma	Calibrated 2-sigma
CS-14-1	14	347-109 BCE	356-51 BCE
CS 1-17-1	17	706-409 BCE	751-402 BCE
CS 1-18-1	18	746-414 BCE	755-408 BCE

In Core Sequence 1, located just inside of the northern gateway of the western rampart, the only identified domestic animals were bovine and pig, but a large variety of wild animals were represented, including mammals ranging in size from nilgai to rats as well as a variety of birds, reptiles, and fish. Peak diversity occurred at the same depths as the highest number of identified animal remains, around the time period of the construction of the rampart. Using the mass of ceramic recovered as a proxy for overall site activity, this area seems to have been intensively used around this time. Another peak occurs in ceramic recovery at the time around the reign of Kharavela, but animal use does not appear to have been as intensive in this area as earlier in the site's occupation. After this time, nearly all of the remains identified were from bovines. These patterns support the hypothesis that by the time of Kharavela's reign, the city of Sisupalgarh was more influenced by the idea of *ahimsa* than it had been in earlier periods.

7.3.2 Core Sequence 3

Figure 7-3 shows the ratio of number of identified specimens of each taxon recovered from each split of Core Sequence 3 grouped into the categories "probably domestic," "uncertain wild or domestic," and "probably wild." Figure 7-4 combines this data into a composite of all taxa as a function of depth and compares this to weight of ceramic recovered at each depth. Figure 7-4 also includes an estimate of how the splits correspond to historical events (the construction of the encircling rampart, the supposed date of the Kalinga War, and the reign of Kharavela) based on radiocarbon dating. Six radiocarbon dates were obtained from charcoal samples in Core Sequence 3. Table 7-4 shows these dates (Smith and Mohanty 2016).

Figure 7-3 Ratio of NISP of each taxon per split: Core Sequence 3

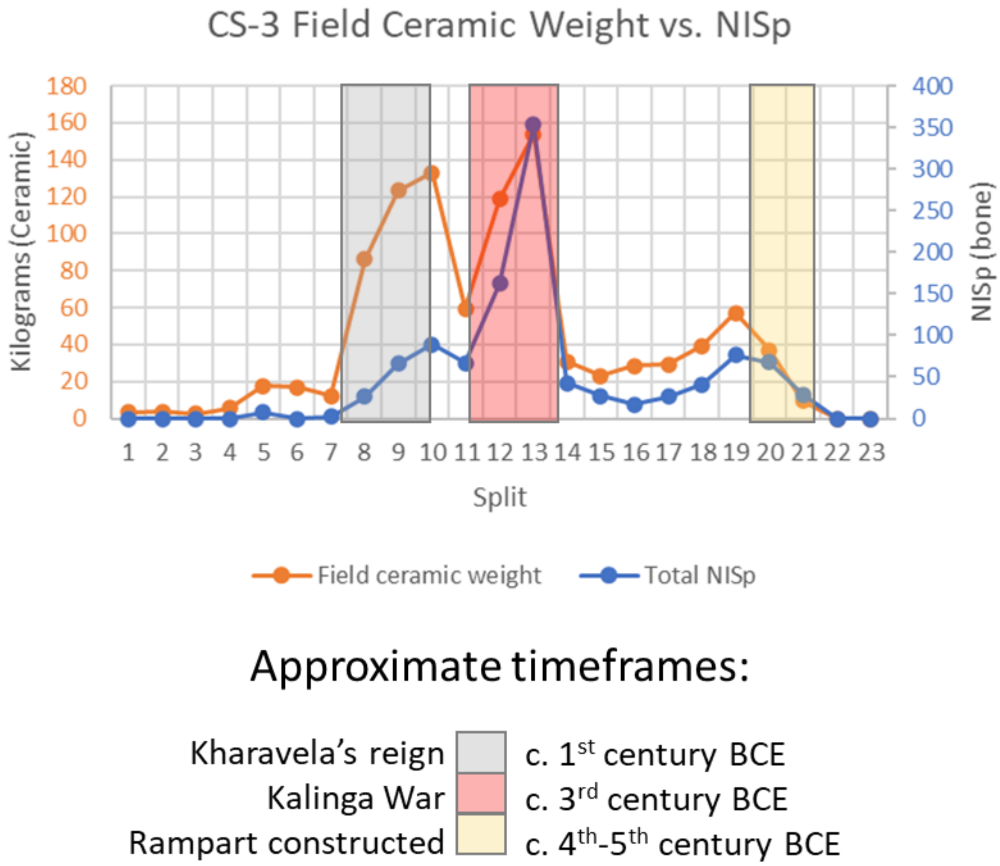


Figure 7-4 Faunal NISP compared to ceramic weight for each split: Core Sequence 3

Table 7-4 Radiocarbon dates from CS3 (after Smith and Mohanty 2016:693)

Sample ID	Split	Calibrated 1-sigma	Calibrated 2-sigma
CS 3-09-1	9	168-53 BCE	344 BCE-2 CE
CS 3-12	12	354-180 BCE	372-117 BCE
CS 3-15	15	406-364 BCE	485-210 BCE
CS 3-18	18	406-368 BCE	486-211 BCE
CS 3-19-1	19	395-235 BCE	400-209 BCE
CS 3-19	19	804-669 BCE	811-551 BCE

In Core Sequence 3, located near the middle of the northern rampart, there was again a broad range of taxa represented, but very little large wild mammal (with the exception of the single elephant tooth, which was recovered from this part of the excavation). In this location, peak animal usage appears to have occurred later in the site's history than at the location of Core Sequence 1, approximately at the purported time of the Kalinga War. This area appears to have been used more intensively after the construction of the rampart clearly identified it as being "inside" the formal boundaries of the city. Like Core Sequence 1, this area shows a high level of diversity at the same time as its peak animal usage, as well as a later peak in ceramic usage that corresponds to a time of relatively low animal use. Again, this conforms to the expected pattern for a city with increasing regard for *ahimsa*.

7.3.3 Operation 6, Trench HC6

Figure 7-5 shows the ratio of number of identified specimens of each taxon recovered from each consolidated level of Operation 6 Trench HC6 grouped into the categories "probably domestic," "uncertain wild or domestic," and "probably wild." Figure 7-6 combines this data into a composite of all taxa as a function of depth and compares this to weight of ceramic recovered at each depth. Figure 7-6 also includes an estimate of how the levels correspond to historical events (the construction of the encircling rampart, the supposed date of the Kalinga War, and the reign of Kharavela) based on radiocarbon dating. Four radiocarbon dates were obtained from charcoal samples in Operation 6 Trench HC6. Table 7-5 shows these dates (Smith and Mohanty 2016).

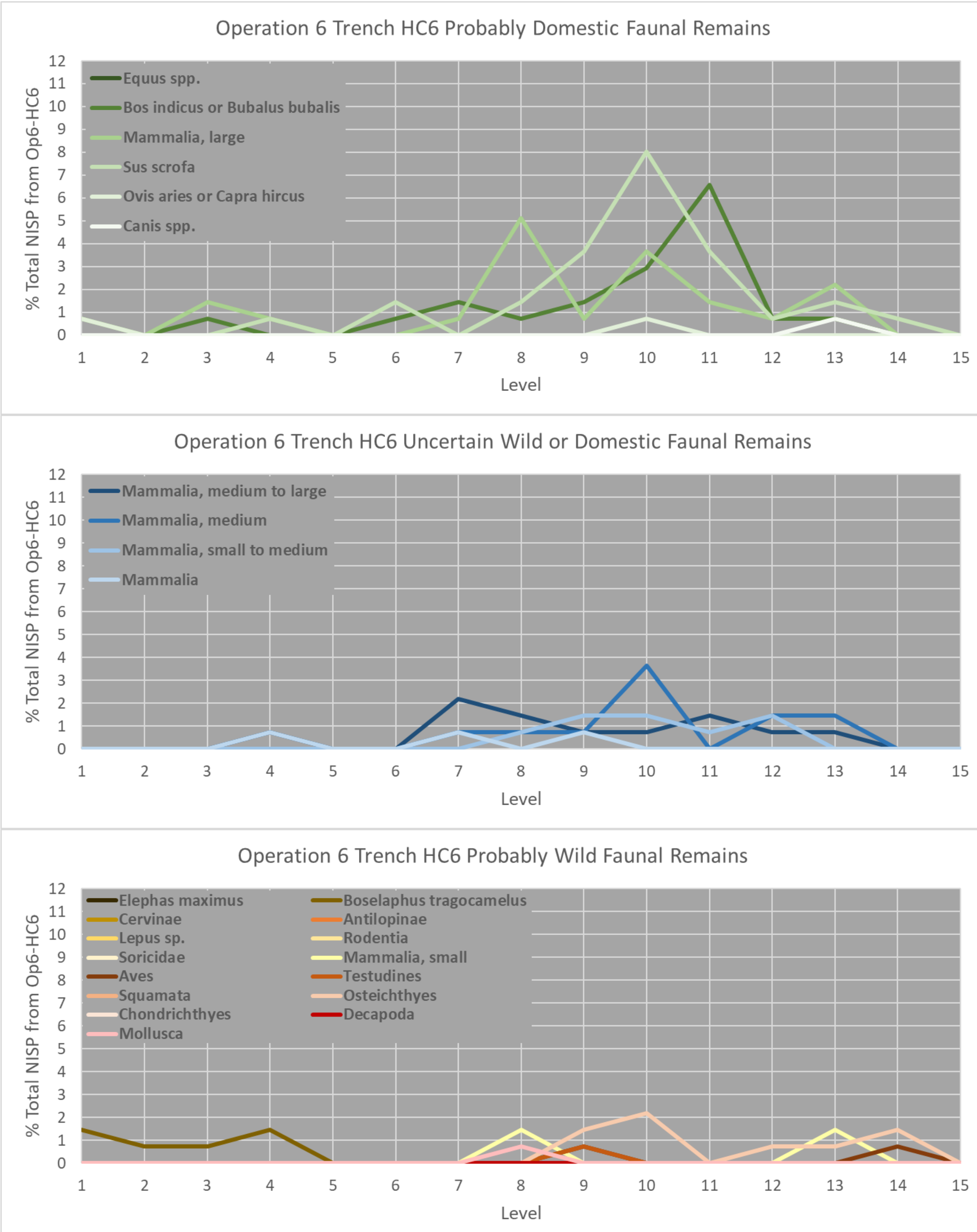


Figure 7-5 Ratio of NISP of each taxon per level: Operation 6 Trench HC6

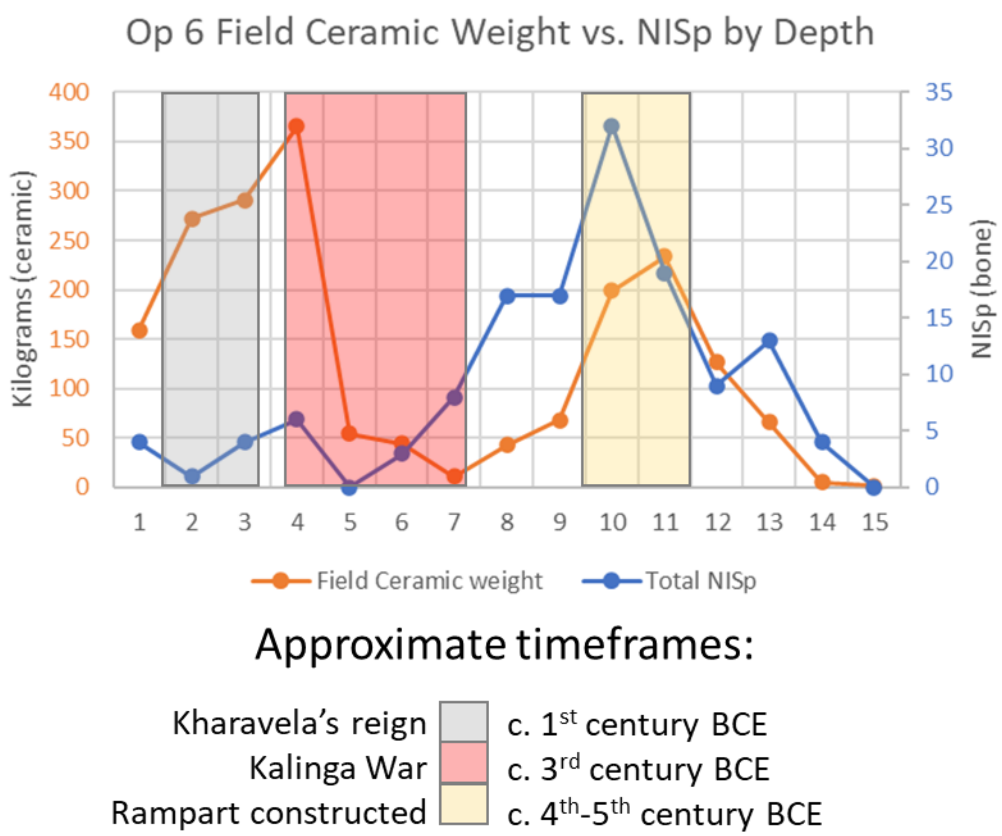


Figure 7-6 Faunal NISP compared to ceramic weight for each level: Operation 6 Trench HC6

Table 7-5 Radiocarbon dates from Operation 6 (after Smith and Mohanty 2016:693)

Sample ID	Level	Calibrated 1-sigma	Calibrated 2-sigma
Op 6 HC6-31-2	3	359-54 BCE	480 BCE-126 CE
Op 6 HC6-54-2	9	503-386 BCE	703-372 BCE
Op 6 HC6-54-3	9	401-260 BCE	407-210 BCE
Op 6 HC6-78-2	13	793-555 BCE	802-520 BCE

In Operation 6, outside the rampart on the north side of the site, animal usage was highest prior to or during the construction of the rampart. This time period also saw a relatively large amount of ceramic deposition, which supports an interpretation of intensified occupation. After the rampart's construction, both deposition of animal remains and deposition of ceramics dramatically declined, suggesting that this area was not used for habitation during this time frame. After the purported time of the Kalinga War, ceramic deposition dramatically increased, but few animal remains were recovered, mostly of nilgai (possibly as an agricultural pest in this context, in the same sense that deer are described in the *Lakkhana-Jataka*, the *Nigrodhamiga-Jataka*, and the *Kandina-Jataka* (Cowell 1981, v1:35, 41, 42)). During the period of peak usage (before the rampart was constructed), bovine and pig are the most common domestic remains recovered, with relatively little recovery of wild animal remains. Overall, the density of animal remains recovered in this area is significantly less than in either of the deep soundings located within the rampart. As in the core sequences, there is one peak of ceramic deposition earlier in the site's history that corresponds to a high level of animal use, and another later in the history of the site which corresponds to a low level of animal use, again supporting the hypothesis that the city's residents became more devoted to *ahimsa*.

7.3.4 Diachronic Changes in Presence of *Sus scrofa* Remains

The change in prevalence of remains from pigs, a domestic animal raised only as a source of meat (e.g., the *Munika-Jataka*: Cowell 1981, v1:75-6), is a good test for the hypothesis that the people of Sisupalgarh are becoming more invested in the practice of *ahimsa*. Looking at Core Sequence 1, a substantial amount of pig remains found in Splits 13-18, which is generally the period before or during the reign of Ashoka, while there are no pig remains found above Split 10, which is approximately during the reign of Kharavela. A similar trend holds for Core Sequence 3, where a significant amount of pig remains in Splits 17-20, which is before the time of Ashoka, but no pig remains are found above Split 9, which again corresponds to the period of Kharavela's reign. In Operation 6, Trench HC6, a significant amount of pig remains were found from Levels 8-11, which are before the reign of Ashoka, but no pig remains found above Level 4, which probably predates the reign of Kharavela. While there are some pig remains from other excavations at the site, they amount to a very small quantity, so the results from these three excavations are the best data to use to show that indeed the people of Sisupalgarh had drastically reduced, or maybe even completely stopped, eating pork by the time of Kharavela's reign or shortly thereafter. This provides a further validation of the hypothesis that the ideal of *ahimsa* was being put into practice.

7.3.5 Summary of Changes over Time

Summing up the results from these three excavation areas, patterns in deposition of animal remains and deposition of ceramics track very closely during the early part of the site's history. A wide variety of wild animal remains were recovered from deposits dating to this period, both before and after the construction of the rampart, indicating a broad animal-based economy as suggested by the texts of the *Arthashastra* and Jatakas. Later in the site's occupation, after the period roughly corresponding to the reported date of the Kalinga War in the third century BCE, ceramic deposition was high, while deposition of animal remains is significantly lower. The animal remains corresponding to this time period are also generally less diverse, with a much higher proportion of bovine remains, indicating a probable expansion of the ideal of *ahimsa* espoused by the Ashokan Edicts and Buddhist and Jain religions. These patterns are consistent across Core Sequence 1, Core Sequence 3, and Operation 6, even though the scales of material recovered differ between these areas (with the most material recovered from Core Sequence 3 and the least from Operation 6). A comparison of the percent of animal remains representing wild animals compared to those that represent domestic animals for these three excavation areas is shown in Figure 7-7. It is significant to note that the peak period of animal and ceramic deposition in Core Sequence 3 is significantly later in the site's occupation than in either Core Sequence 1 or Operation 6 but shows a diversity of wild animal resources similar to the peak period in Core Sequence 1. While the trends in Operation 6 are similar to those observed in the deep soundings, the data from this operation is skewed because the excavation depth was not uniform across the entire area, and only part of the excavation reached the deepest levels. If this had not been the case, the amount of animal remains and ceramics recovered from the oldest phases of occupation would likely have been even higher. This may at least partially account for why in Operation 6 Trench HC6 wild animal remains exceeded those from domestic animals only in Group 14, while in both core sequences there were large periods where more remains from wild than domestic animals were recovered.

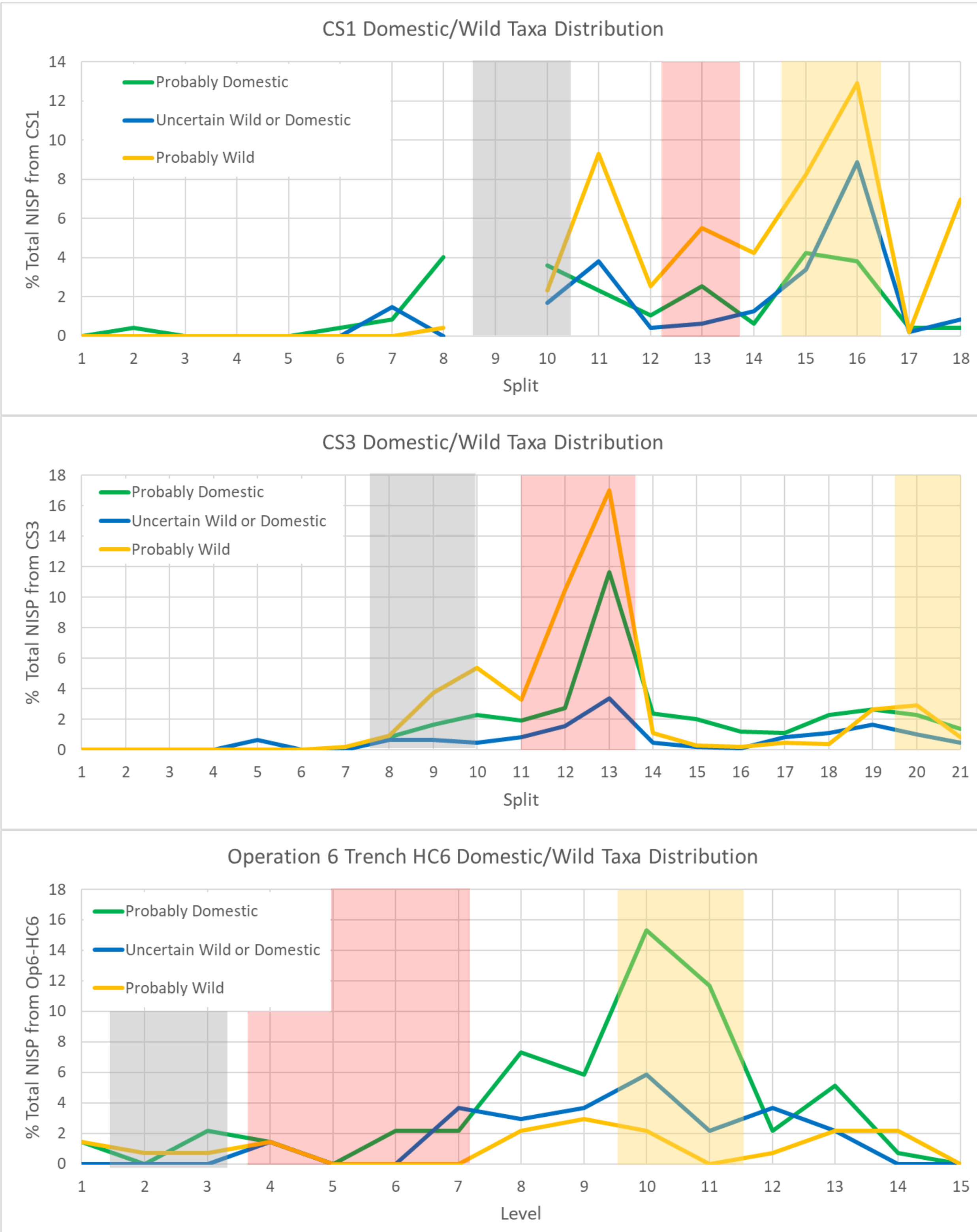


Figure 7-7 Comparison of domestic vs. wild animal remains from excavations to natural soil (Core Sequence 1, Core Sequence 3, and Operation 6 Trench HC6). Background shadings indicate approximate time frame (see figures 7-2, 7-4, 7-6)

Excavations at other parts of the site which did not reach down to sterile soil consisted primarily of depths which are roughly equivalent to the time period during or after Kharavela's reign in the core sequences. The remains recovered from these depths in Operations 1 and 3 follow the pattern for these depths in the core sequences, with relatively low density and diversity (see chapter 4). Importantly, the parts of Operation 3, Square G with the most faunal remains (Loci 37-46), are similar to Core Sequence 3, Split 9 in terms of faunal remains recovered, suggesting that contexts with more diverse and numerous animal remains would likely be found under the excavated portion of Operation 3.

The adoption of Buddhist and Jain practice at Sisupalgarh would suggest a reduction in the usage of animals for food and therefore a reduction in faunal remains from animals which would be primarily valuable as sources of meat (such as deer, antelope, pigs, and fish) recovered from the excavations. Animals such as bovines, which provide secondary products such as milk and labor, would not necessarily be subject to this decreased usage, and therefore the remains from these species would be expected to be recovered in a higher proportion than those from animals exclusively consumed as food. This expectation is reflected in the results of the faunal analysis at Sisupalgarh, which show heavy use of wild resources prior to the periods associated with Ashoka and Kharavela, but which show a marked decrease in overall deposition of animals, especially non-bovines, in the archaeological record after this time.

7.4 Changes in Animal Usage by Location

The *Arthashastra* spells out that different regions of the city should be used for different purposes and that people of different classes should live in separate areas of the city (Olivelle 2013:105-7). While this depiction of the distribution of cities from the *Arthashastra* is most likely idealized, most cities even today are not homogenous. Given this, it would be expected that the pattern of faunal remains recovered from Core Sequence 1 would not necessarily be the same as those recovered from Core Sequence 3 (and Operation 6, Trench HC-6). The total number of identified specimens (NISP) from Core Sequence 3 was 1119, while from Core Sequence 1 it was only 473 (although the remains from Split 9 were unavailable for analysis). Some of this difference is due to the fact that Core Sequence 1 was a square shaft 1.5 m x 1.5 m while Core Sequence 3 was a circular shaft with a 2 m diameter (a 40% greater cross-sectional area). Core Sequence 3 was also slightly deeper, with a depth of 6.3 m as opposed to the 5.4 m depth of Core Sequence 1 (a 16.7% increase), although both represented the entire cultural sequence down to natural soil. If we scale up the NISP from Core Sequence 1 by the ratio of areas (the ratio of depths is not used because both core sequences capture the entirety of the site's occupation), it would be 660, still considerably less than Core Sequence 3.

In addition to the differences in the raw number of specimens from these two core sequences, there is also a difference in the taxa represented and the timing of their presence. Table 7-6 shows the percentage of the NISP represented by each taxon in each of the excavations. Comparing Core Sequence 1 with Core Sequence 3, there is a much higher percentage of the animals that were likely used as sources of meat (*Sus*, antelope and deer, medium mammals, fish, and possibly turtles) in Core Sequence 1 than in Core Sequence 3. The timing of the appearance of the various taxa is also different in the two core sequences. The wild resources and pigs appear primarily in the first half of the period of occupation for Core Sequence 1, while these resources are more prevalent in the middle of the period of occupation for Core Sequence 3 (see Figure 7-1 and Figure 7-3). There is also some difference in which wild taxa are represented by this trend. In Core Sequence 1 there is a greater relative presence of fish, deer, and antelope, while in Core Sequence 3 there is a greater relative presence of rodents and rabbits. These differences support the hypothesis that different locations within the city were used for different purposes or were the residential locations for different types of people.

Table 7-6 Percentage of NISP Represented by Various Taxa in Each Excavation

Species	Operation 1	Core Sequence 1	Operation 3 (excluding Rampart Strip)	Operation 3 Rampart Strip	Core Sequence 3	Operation 5	Operation 6 Trench HC6	Operation 6 Trench HC7	Operation 7
Equus spp.	0	0	1	0	0	0	0	0	1
Bos indicus or *Bubalus bubalis*	16	9	24	4	10	2	13	22	16
Mammalia, large	37	8	19	32	21	32	18	17	40
Mammalia, medium to large	20	8	21	7	5	15	12	22	17
Antilopinae and Cervinae	4	4	2	0	1	6	3	13	2
Sus scrofa	3	8	6	0	2	0	23	4	0
Ovis aries or *Capra hircus*	0	0	2	0	1	9	1	0	1
Canis spp.	1	0	2	1	2	0	1	0	1
Mammalia, medium	13	11	4	9	8	17	10	0	13
Mammalia, small to medium	1	4	1	1	1	2	6	4	0
Lepus sp.	0	0	0	0	3	0	0	0	0
Rodentia	0	5	1	0	14	0	0	0	1
Mammalia, small	0	7	2	1	4	0	4	0	0
Aves	0	4	7	2	4	13	2	0	1
Testudines	4	5	9	4	3	0	1	4	7
Squamata	0	0	0	0	1	0	0	0	0
Osteichthyes and Chondrichthyes	0	27	1	0	18	0	6	4	0
Mollusca	0	0	0	37	2	4	1	9	1

Another area of the site that exhibited a significantly different faunal assemblage was the Rampart Strip that was excavated as part of Operation 3. The *Arthashastra* suggests that the rampart should be built up from material that was excavated to form the moat (Olivelle

2013:103). This same source of material is likely to be used in later augmentations of the rampart. The large percentage of mollusks recovered in the excavation of the Operation 3 Rampart Strip (especially from the top and outward slope; see Table 4-13) is an indication that some of the soil used in the augmentation was likely excavated from the moat. The presence of these remains is more an indication of the agency of the mollusks in utilizing the moat as a habitat than of the humans purposefully exploiting the mollusks.

The *Arthashastra* also indicates that excess material from digging the moat could be used as fill for the royal residence or other construction (Olivelle 2013:103). Although we do not know if the pillar mound was the site of a royal residence, we do know that this area of the site was unique in its construction and character, and it is possible that some of the soil used to construct this mound could have been from excavations of the moat or enlarging other water features of the site that are nearer to the pillar mound. Operation 5 (excavations of the pillar mound) saw the second highest percentage of mollusks within the rampart (Op 6 Trench HC7, which also had a higher percentage of mollusks, is located outside of the rampart and moat). The bones recovered in Operation 5 showed a much higher degree of fragmentation and abrasion than those recovered from other areas of the site which is an indication that the soil excavated in Operation 5 was not in its original context. A result of this larger degree of fragmentation and abrasion is an increased difficulty in assigning the bones to a specific taxon, and therefore most of the bones from this operation are classed as unidentified mammals of various sizes. This is also supported by the poor condition of the ceramics recovered in Operation 5 relative to those recovered from other locations (Mohanty and Smith 2008). The presence of aquatic mollusks is an indication that at least some of the material used to create the pillar mound was of an aquatic origin, but the presence of animal bones and ceramics is an indication that not all of it was.

The large percentages of fish from the core sequences may be in part the result of the material recovery technique employed for the lower portions of these deep soundings (wet sieving). These are the only locations that utilized this recovery method. The upper splits from the core sequences that were wet sieved (8 and 10 from Core Sequence 1 [recalling that Split 9 was not available for analysis], and 9, 10, and 11 from Core Sequence 3) still did not include a significant amount of fish bones. It is also interesting to note that the next highest percentage of fish bones is from Operation 6, Trench HC6, which is the only other excavation that extended through the entire occupation history of the site, and all the fish bones came from the deeper portions of this excavation (indeed the reduction in fish remains in Operation 6, Trench HC6 appears to have occurred even earlier in the site's history than the reductions seen in Core Sequence 1 and Core Sequence 3). The results from the locations where fish bones were recovered may be an indication that fish were more heavily utilized during the early part of the period of occupation than in the later part. This could be in response to views similar to those Ashoka expressed in his Fifth Pillar Edict that fish should be protected.

7.5 Alignment of Texts and Faunal Remains

The textual evidence suggests that Early Historic cities had an economy that relied on the usage of a broad range of wild and domestic animals. Based on the faunal material recovered from the deepest portions of the excavations, Sisupalgarh seems to have fit this pattern during the early parts of its occupation. The texts also describe many non-domestic animals which took advantage of the human environment (that is, human niche construction as well as animal niche construction in the human-modified environment) to behave in ways that would not have been possible without the human context. At Sisupalgarh, this type of taking advantage of human niche construction is apparent in mollusks' use of the moat as a new habitat and in the presence of animals which would likely have been “pests,” such as rodents and small birds, which took advantage of urban resource accumulation on the part of humans as a reliable source of food for themselves.

The textual evidence suggests that over time there should be a decrease in the amount of animal usage and animal diversity as the people of the site adopt the *ahimsa* ideal of Buddhism and Jainism. The faunal evidence supports this change, with faunal remains recovered from later portions of the site’s occupation being much less diverse than the earlier periods with a preponderance of *Bos* and *Bubalus* remains and a much lower NISP count per cubic meter of excavated material.

The *Arthashastra* directs that different areas of the city should be used for different purposes. The significant differences in the faunal remains recovered from Core Sequence 1 and Core Sequence 3 indicate that these two areas were used differently, at least in the early portions of the site’s occupation.

The texts mention domestic pigs as a source of meat, but they do not seem to indicate that this is a major source of sustenance. The excavations from the earliest period of occupation at Sisupalgarh had a large percentage of the faunal remains from pigs (in some contexts over 20% of the NISP), indicating that at that time at this site pork was a major component of the diet.

The texts barely mention turtles as a source of animal products, while overall 4% of the faunal remains came from turtles. It is possible that some of these turtle remains were from commensal animals taking advantage of the site’s environment, but this is not true for all of these remains since some of them show evidence of intentional human modification. In addition to the worked turtle shells, there were several antlers that had been modified and several large mammal bones that showed evidence of being worked, probably the scrap left over from cutting objects out of the bone. There is no mention in the texts of the use of any of these materials for tools or ornaments, but there is mention of using ivory for vessels (Olivelle 2013:216), handles (Cowell 1981, v5:158), and ornaments (Cowell 1981, v2:139). However, the *Arthashastra* does provide a long list of animal products that can be commodified and regulated, including bone and antlers as well as animal parts that would not preserve (Olivelle 2013:141), presumably indicating a known use for these items which it was not felt necessary to record.

7.6 Role of Centralization and Regional Interconnectivity

At an urban site such as Sisupalgarh, where the long-term investments in massive architectural projects such as the rampart, the gateways, the regular network of roads, and the pillar mound indicate some degree of centralized organization at the site over much or all of its occupation, the centralized authority would have had further impacts on many aspects of life, including regulating, or at least opining on, the range of acceptable interactions between people and animals. The faunal evidence from Sisupalgarh, however, does not clearly support or refute a supposition that a centralized power was directly affecting the deposition of animal remains within the cities, while textual evidence implies that the milieu in which humans interacted with animals was deeply affected by the policies and decisions of centralized authorities. For example, the *Arthashastra* suggests that officials appointed by the king should manage specific aspects of animal husbandry (Olivelle 2013: 162-168), the parameters of carefully managed wilderness preserves (140-141), and the slaughter of animals and sale of their meat (157-158), as well as instructing the king to arrange urban space in such a way that animals would primarily be kept in specific areas of the city (105-107) and to impose fines upon improper disposal of animal remains (176). The Ashokan edicts also demonstrate that Ashoka, at least, expected to be able to impose his perspectives onto the foodways of people within his realm (Dhammika 1993). In the conclusion of the *Nigrodhamiga-Jataka*, a king makes sweeping changes to the legal protections for deer and other wild animals in his kingdom, having some unforeseen consequences to agricultural production which the Bodhisatta then needs to resolve (Cowell 1981, v1:40-41). This textual evidence suggests that, at least theoretically, the perspectives of elites could have a significant influence on the foodways of the people they governed, but to what degree this kind of influence was regularly exercised (or to what extent the exertion of that influence was even possible) at Sisupalgarh is unclear.

The textual evidence described in Chapter 6 suggests a level of inter-regional connectivity of Kalinga with broader South Asia. There is also faunal evidence from Sisupalgarh of a gathering of products from across a spectrum of ecological areas, including animals that appear to have lived in forests, open fields, fresh water, and salt water, although the distance which these products traveled to reach Sisupalgarh is not clear from the available evidence (for example, the shark vertebra recovered from Core Sequence 3, Split 10C, probably came from a body of salt water, possibly as close as the mouth of the Mahanadi River approximately 40 km from Sisupalgarh, but potentially from much further away). Commonalities of material culture between Sisupalgarh and other Early Historic South Asian sites (as in the use of coinage) further suggest that Sisupalgarh exchanged at least ideas with other areas of South Asia. This regional connectivity may have provided the residents of Sisupalgarh with a broader sense of security in terms of access to resources (although evidence for importation of goods or materials to Sisupalgarh during any period is relatively limited; Smith 2005:304), which could have inspired experimentation with more costly forms of human-animal engagement such as a comparatively calorically inefficient vegetarian diet. If this were the case, we would expect to see a return to a broader-based food economy as the site entered a period of population decline near the end of its period of occupation, which does not appear to have been the case based on the available faunal evidence.

7.7 Chapter Summary

The available textual evidence and archaeological findings paint a general picture of how animals were being used at Sisupalgarh. The texts suggest to us what kinds of problems and opportunities people faced when interacting with animals in this time period, and some of the possible solutions which people employed. Clearly, these included a wide variety of relationships with both wild and domestic animals. In the early part of the site's history, patterns of deposition of animal remains are reflective of the type of broad-based economy and complex ecology reflected in secular texts such as the *Arthashastra*, as well as in portions of the Pali Canon such as the Jatakas which refer to a time prior to the influence of Buddhist thought. Later in the site's history, animal products appear to be less central to the economy, reflecting the kinds of changes promoted by elites such as Ashoka and Kharavela. In this way, the Early Historic texts can act as a kind of ethnographic analogy to help envision the urban landscape at Sisupalgarh and other archaeological cities in South Asia.

CHAPTER 8. CONCLUSION

Urbanism is a major component of the modern human environment, so investigating how humans and animals interact within this environment has far reaching applicability. South Asia is one of the regions with the fastest growing urban population and is ideally suited for the study of human animal interactions in early urban settings because of the large biodiversity and rich textual repository available from the time of the urbanization which started in the first millennium BCE and corresponds to the Early Historic Period of South Asia.

The interactions between humans and non-human animals in urban environments stem from much more ancient ecological relationships among all animals. Urban environments, which are a manifestation of human action, still offer many types of relationships with other animals, some human-driven and others animal-driven. The human changes to the environment impact other animals by either creating or destroying opportunities for those animals to extract necessary resources from the environment. Within a city, the specialization of people's labor reduces the direct interactions that some of the populace have with animals, but their use of animal products or products derived from animal labor creates direct human-animal interactions somewhere along the supply chain, either within or outside of the city (or both). The degree of complexity of urban societies still requires an overall ecological embeddedness that includes other animals. This dissertation has evaluated the faunal remains recovered from excavations at Sisupalgarh to examine human-animal interactions within an urban environment and the relationships of those interactions to other aspects of the culture of Early Historic Period South Asian cities.

As recounted in Chapter 4, the faunal remains recovered from the excavations at Sisupalgarh provide a diachronic history of animal usage at the site throughout its period of occupation. When researching a large urban site such as Sisupalgarh, it is not possible to fully excavate the entire site, so reliance is placed on a relatively small fraction of the site that can be sampled and excavated. At Sisupalgarh the excavations only covered a small amount of the overall city and care must be taken in assuming the results from the few square meters that were excavated to a depth that represented the entire period of occupation are applicable to the over 1,200,000 square meters of the city enclosed by the rampart. The small amount of Sisupalgarh that was excavated likely led to an omission of some of the human-animal interactions that were taking place within the city, especially because the usage of the entire city was not likely to have been uniform either spatially or temporally.

A city has a resource catchment area that is much larger than the city itself, and human-animal interactions that take place within that catchment area have influence on the people living within the city. Examples of this include inter-regional trade, hunting of wild game, fishing, and farming. Excavations within the city itself or from areas adjacent to the city are unlikely to uncover use areas that encompass the full extent of these human-animal interactions. Therefore, establishing the degree of human-animal interactions within an urban environment requires additional information (e.g., ethnographic, textual, comparative) to make reasonable extrapolations from the faunal material recovered.

To aid in the interpretation of the culture of an archaeological city, texts can be used as a source of ethnographic data. The textual evidence from the Early Historic Period was not written with the intention of describing any single place, and definitely not with the aim of providing a comprehensive depiction of a specific city such as Sisupalgarh. Any textual record is likely to encompass the biases of its creator, and for texts originally written in a different language, also the biases of the translator. An example of this in the Early Historic texts is in the use of the term "deer." It is quite likely that this is a generic term for animals of several different species, and probably also including species that we now classify as antelope. Therefore, when using texts to portray past cultures it is helpful to have a method to validate those texts. One such method is comparison to archaeological material recovered from the time being discussed in the text. When the text is not specifically written about the site being excavated, another task is to determine if the text is applicable to that location. In the case of Sisupalgarh, I have demonstrated that texts such as the *Arthashastra* and the Jatakas can provide useful information beyond what is available archaeologically to help reconstruct life as it was in the city. This information can both fill in the blanks left by the archaeological record and also direct interpretation of the archaeological findings themselves. For a location with a larger portion of the site excavated or with specific texts written about it, the use of archaeological data as a comparison to the textual data could be even more successful. For Sisupalgarh, the only Early Historic Period text that is specifically written about the city is the Hathigumpha Inscription, which was not intended to be descriptive of the lives of the inhabitants or of how people interacted with animals but can be used to understand the expectations when "reading between the lines."

As discussed in Chapter 6, important texts from this period include inscriptional ones, such as the Ashokan Edicts (c. 250 BCE) and the Hathigumpha Inscription (c. 100 BCE); religious ones, such as the *Atharvaveda* and Pali Canon; and secular ones, such as the *Arthashastra*. All of these non-inscriptional texts had their beginnings as oral traditions, and the written forms available to us today are from later during the Early Historic Period, but they provide context to a time nearer to the beginning of the Early Historic Period. These texts have been used in this dissertation to provide hypotheses on animal usage in urban settings during the Early Historic Period.

Based upon the texts, it appears that Early Historic cities in South Asia had an economy that was based upon the usage of many different animals, as a source of food, pelts and leather, secondary products such as milk and wool, for transportation and physical labor or other types of work, and for companionship. Specific animals that were most likely used as sources of meat include domestic pigs, deer and antelope, fish, and many types of birds. Pelts and leather could come from deer, antelope, cattle, water buffalo, pigs, and wild carnivores. Secondary products could come from cattle, water buffalo, goats, and sheep. Animals used for transportation and tractive power include horses, donkeys, cattle, water buffalo, and elephants. Animals used to drive away snakes or other vermin include mongooses and peafowl. Dogs, cats, parrots, and monkeys are described as animals that are kept as pets (even though at least dogs and cats may serve work functions as well). The faunal analysis of the animal remains from Sisupalgarh identified all of these animals except mongoose, cat, and monkey as being present. This suggests that at least this aspect of the depiction of Early Historic cities from the texts was accurate at Sisupalgarh.

The occupational period of Sisupalgarh includes the time when the practice of Buddhism became popular in Kalinga. The most obvious textual evidence of the Buddhist influence are the Ashokan Edicts at Dhauli and Jaugada, but the slightly later Buddhist monastic complexes at Aragarh, Lalitgiri, Ratnagiri, and Udayagiri, established starting in the 2nd century BCE, are further evidence that Buddhism was becoming increasingly popular in coastal Odisha during and after the Early Historic Period. The Hathigumpha inscriptions are located at a Jain monastic site, indicating that Jainism was also a significant religion in the region during this time and was probably patronized by King Kharavela given that his inscription appears there. Both Buddhism and Jainism subscribe to the ideal of *ahimsa* in general, which in its ideal form includes the stricture that animals should not be harmed. The shift observed in the faunal remains from Sisupalgarh from a broad-based economy including many animals that would have been primarily useful as a source of meat to a much more restricted animal economy using only a few taxa matches the pattern expected f the people of the city were increasingly structuring their lives based on these philosophies. In Core Sequence 1, such a shift is observed to have taken place between Splits 10 and 13, or roughly in the time between the reigns of Ashoka and Kharavela. In Core Sequence 3 the shift is seen between Splits 9 and 12, roughly corresponding to the same time frame. This is a strong indication that indeed the people of Sisupalgarh had reduced their usage of animals as a source of meat by the time of Kharavela. This shift occurred during what appears to have been a time of economic prosperity for the site, with high levels of consumption and deposition of ceramics and the construction of the monumental pillar mound. The prosperity and stability of this period could have enabled a shift toward a more vegetarian diet and less reliance on wild meat resources, but if this were the only driver, one would expect a return to a broader-based consumption strategy as the site's prosperity diminished near the end of its period of occupation, which was not evidenced by the faunal assemblage recovered. The shift away from wild animal resources could be partially explained by changes in the surrounding environment caused by agricultural intensification to support a booming human population, but this would not account for the decrease in the remains of marine resources or those of domestic pigs which are temporally aligned with the overall reduction of wild animal use.

Most cities do not have a uniform distribution of activities throughout their area of usage. According to the *Arthashastra*, this was true in Early Historic South Asia, with segregation of activities and residences. If this were the case at Sisupalgarh, the faunal assemblage (as well as other archaeological material) recovered from different excavation locations could be expected to be different. The lower portions of Core Sequence 3 consisted of a much higher density of faunal remains than what was recovered from analogous locations of Core Sequence 1. The taxa represented in those lower portions of Core Sequence 1 included a much higher incidence of animals that were likely used for food, such as pig, antelope and deer, medium mammals, fish, and possibly turtles while Core Sequence 3 contained more large mammals and rodents. The peak in NISP for Core Sequence 1 also occurred much earlier in the site history, approximately at the time of the construction of the rampart, than was the case for Core Sequence 3, where the peak in NISP occurred approximately at the time of Ashoka's reign. Both of these peaks in NISP also correspond with peaks in mass of ceramic material recovered. Another area that has a significant difference in the faunal assemblage recovered is the pillar mound region. This region has the lowest percentage of *Bos indicus* or *Bubalus bubalis* bones identified from any excavation, and most of the bones recovered from this area were highly fractured and severely abraded. This suggests that the bones found in this area may have been brought in with soil that was used to create the mound and that there was even less deposition of bone directly in this area than in other parts of the site. The Operation 3 Rampart Strip is another area that had a faunal distribution significantly different than other areas of the site. This is not surprising in that the rampart itself was probably not a habitation location, and the faunal assemblage recovered is more likely representative of how the rampart was constructed. Especially significant is the high proportion of freshwater mollusks. This is especially true in Operation 3 Rampart Strip EE, which was on the outer slope of the rampart, where 79% of the NISP was from freshwater mollusks. The most probable explanation for this is that the material used for the construction of this portion of the rampart was acquired by enlarging the moat, and the shells had either been deposited within this soil or the living mollusks were incorporated within the material as it was being dug from the moat. The presence of the mollusks in the soil from the moat is an indication that these animals were taking advantage of the human-created environment and thriving in an area where they would not have been found if the moat had not been constructed. The usage of soil dug from the construction of the moat in construction of the rampart is discussed in the *Arthashastra*, and the faunal evidence suggests that this was true at Sisupalgarh.

Not all of the findings from the faunal analysis match so neatly with the textual descriptions of human-animal interactions. The texts mention pigs and at least imply that they are raised for food, but do not depict them as a major source of meat. In contrast to this, the faunal assemblage in some locations at Sisupalgarh had a significant portion of the NISP represented by pigs (over 30% in Group 10 of Operation 6, Trench HC6 and approximately 15% in Splits 13 and 15 of Core Sequence 1 and Split 18 of Core Sequence 3). With pigs apparently being such a significant source of sustenance, it would have been expected that they be mentioned more in the texts. A possible reason they do not feature more prominently is that they were more a function of the household level economy instead of the municipal-scale economy that political texts such as the *Arthashastra* and the inscriptions of Ashoka and Kharavela pertain to. Another class of animals that are represented in the faunal assemblage but not in the texts is turtles. Overall at the site, 4% of the NISP is from freshwater turtles, but they are barely mentioned in the texts as a source of animal products. The Fifth Ashokan Pillar Edict includes tortoises in a list of protected animals, and the Jatakas include two stories that involve people trying to catch tortoises for food, so there is some evidence of people using turtles for food, but at least one of the turtle shells recovered showed evidence that the shell was worked to produce a tool or ornament, and there is no textual evidence for turtles being used in this manner.

On the opposite of the spectrum of textual evidence vs. faunal remains recovered are elephants and horses. The texts are full of references to these two species, but only a small portion of a single elephant tooth was recovered and only a very small number of horse remains (total NISP≤5). Given the importance of these two species and their large size, the fact that they are barely discernible in the faunal assemblage is an indication that their remains, if they were indeed used at the site, must have been deposited elsewhere. This might suggest that the urban landscape of Sisupalgarh was divided into different areas of animal usage and that horses and elephants were more typically used for elite purposes, while bovines and pigs were more accessible at the household level and their remains more likely to appear in residential areas, such as the locations of Operations 1 and 3.

In general, changes seen in the faunal analyses can be the result of things other than changes in the culture from which the faunal remains were collected. Other factors which could play a role are depletion of resources, differential preservation of faunal remains, changes in recovery methods, changes in depositional processes, disturbances in the sequence of deposits, and ability to identify remains. In the analysis of the faunal remains recovered from Sisupalgarh, all of these factors were considered and determined to not play a major role in biasing the results. Rather, the analysis suggests that the evidence fits well with the explanation that ideological changes related to the adoption of traditions related to *ahimsa* resulted in changes of policy or practice that created different patterns of deposition of faunal material.

The excavations at Sisupalgarh yielded a total of only 34 kg of faunal remains, compared to thousands of kg of ceramics. Almost all of the animal remains recovered were from non-primary locations (almost no instances of complete bones or multiple bones from the same individual recovered). The low amount of faunal material recovered and what was recovered being from non-primary depositional locations are an indication that none of the excavations were conducted in areas of the site (including outside of the rampart) where animal remains were being intensely deposited. In a similar manner to the resource utilization area of an urban site is much larger than the city itself, the deposition locations for material used in the city is much greater than the area of the city. The relatively large amount of ceramic material recovered in the excavations is an indication that some waste material was being deposited in the locations that were excavated, but deposition of ceramic waste and animal waste are not necessarily done in the same location, nor do they necessarily carry the same implications. For instance, the *Arthashastra* does not provide a list of fines for disposing of ceramics like it does for disposing of dead animals within the city (presumably because having dead animals within the city creates problems with odor, sickness, and ritual impurity, whereas broken ceramics do not). The excavations of Operation 1 and Operation 3 (along with their Core Sequences) were in areas that were primarily residential. In both modern and historical cities, this is not likely to be the primary depositional location for animal remains. Similarly, Operation 5 was on the pillar mound, another unlikely location for primary deposition of animal remains.

If the people of Sisupalgarh were indeed disposing of any dead animals in areas outside the city in compliance with the recommendations of the *Arthashastra*, even if the entire area within the rampart had been excavated this material would have not been recovered. Not knowing how large the area for resource acquisition and waste disposal is for an urban site will always be a problem for archaeologists studying these areas (cf. McMahon et al. 2013:217). Since much of archaeology is the study of what people have thrown away (since what people are currently using generally does not show up in the archaeological record), not being able to identify disposal locations relative to usage locations will skew the analysis of the site.

Comparison of textual evidence with archaeological evidence provides a means to validate at least some components of the textual evidence. The texts, however, contain many nuances of complex cultural relationships which the archaeological record cannot readily substantiate. For example, the archaeological record can rarely shed light on individual human's relationships with individual animals, which is often the crux of the narratives surrounding animals in texts such as the Jatakas. In reading these texts it is difficult or impossible to know if the relationship described is unique or one that is commonplace. The faunal analysis can only identify the presence (or absence) of animals, and in cases with good preservation, perhaps the age of the animal at the time of its death, but the exact relationships between the recovered animals and humans or other animals living at the site is a matter of inference. It is usually not possible to discern such aspects of human-animal relationships as ownership or reverence.

In this dissertation I have used a combination of faunal analyses and textual evidence to determine that the people of Sisupalgarh in the early part of the occupational history were utilizing a broad spectrum of wild and domestic animals to meet their needs. As the influence of Buddhism and Jainism increased within Kalinga, the animal usage at Sisupalgarh changed to one that relied on animals to fulfill needs other than sustenance, which required far fewer animals than the economy from earlier in the site's history. Other data that could be used to support this change in lifestyle include ethnobotanical analyses and residue analyses on the recovered ceramics, but data from these types of analyses at Sisupalgarh are not available at the time of this writing.

The processes identified by the findings of this study at Sisupalgarh are likely to have been mirrored at other Early Historic urban sites in Kalinga, and the possibility of someone wanting to compare the changes that took place at Sisupalgarh with other locations is the reason that the full set of data from my faunal analysis is included in the Appendix. The analyses presented here can provide a model to determine if Buddhism and Jainism had similar impacts on human-animal interactions at other Early Historic sites in broader areas of Asia. Pursuing this type of analysis will offer new insights into the relationships between urbanization, ideology, and human-environmental interaction, a crucial intersection in our rapidly urbanizing modern world.

APPENDIX A: IDENTIFICATIONS OF FAUNAL MATERIAL FROM 2005-2009 EXCAVATIONS AT SISUPALGARH

This appendix is a compilation of all identifications of faunal material from the 2005-2009 excavations at Sisupalgarh, which are curated in the Archaeozoology Lab at the Department of Archaeology at Deccan College in Pune, India. Identifications were made during several trips to Deccan College during February to March and August to November of 2017 and during February to March and August of 2018. Included are tables with all identifications and notes made at the time of analysis. In the body of this dissertation, identifications have been standardized and grouped for ease of presentation and data analysis, but in order to preserve the original intention of any observations, they are presented as made at the time of identification in this appendix.

A 1 Identifications of faunal remains from 2005-2009 excavations at Sisupalgarh

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	2	Intact	Long bone fragment	1	*Bos or Bubalus*	N/A	N/A	Interior burnt white, exterior appears unburnt
CS1	2	Intact	Tibia, distal fragment	1	*Bos or Bubalus*	N/A	N/A	Interior burnt white, exterior appears unburnt
CS1	2	Intact	Unidentified fragments	4	N/A	N/A	<30	All burnt white
CS1	3	Torn, provenance secure, lots of material probably lost	Unidentified fragments	9	N/A	N/A	<30	N/A
CS1	3	Intact	Unidentified fragments	8	N/A	N/A	<30	All burnt white
CS1	6	Intact	Radius and ulna (fused)	1	*Bos or Bubalus*	Adult	N/A	Proximal end of articular surface missing, recent breaks at distal end
CS1	6	Intact	Upper cheek tooth	1	*Bos or Bubalus*	N/A	N/A	N/A
CS1	7	Intact	Ulna, left, proximal, head and articulation with humerus	1	*Bubalus*	Adult	N/A	Large specimen
CS1	7	Intact	Long bone fragment	1	mammal	N/A	>50	N/A
CS1	7	Intact	Long bone fragment	2	mammal, large	N/A	>50	N/A
CS1	7	Intact	Long bone fragment	3	mammal, large	N/A	30-50	N/A
CS1	7	Intact	Long bone shaft	1	mammal, medium to large	N/A	N/A	Cut marks
CS1	8	Intact	Left humerus	1	*Bos*	Adult	SD-43.7, BT-88.5	N/A
CS1	8	Torn, provenance secure	Cranium fragment	1	*Bos or Bubalus*	N/A	~70	N/A
CS1	8	Torn, provenance secure	Cranium fragment	1	*Bos or Bubalus*	N/A	~50	N/A
CS1	8	Intact	Cranium fragment including portions of both frontals and parietal	1	*Bos* or *Bubalus*	Adult	very large	N/A
CS1	8	Intact	Horn core	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS1	8	Torn, provenance secure	Humerus fragment including deltoid crest	1	*Bos* or *Bubalus*	N/A	~65	N/A
CS1	8	Intact	Proximal radius	1	*Bos* or *Bubalus*	Adult	very large	N/A
CS1	8	Intact	Centrotarsal	1	*Bos* or *Bubalus*, more closely resembles *Bubalus*	N/A	N/A	N/A
CS1	8	Torn, provenance secure	Fragment with cut mark	1	*Bos or Bubalus*, probable	N/A	N/A	Cut mark
CS1	8	Torn, provenance secure	Large fragment, possibly worked	1	*Bos* or *Bubalus*, probable	N/A	N/A	End appears rounded, large cut marks

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	8	Intact	Horn core	1	*Bubalus*	N/A	N/A	N/A
CS1	8	Torn, provenance secure	Horn core fragment	1	*Bubalus*	N/A	~90	N/A
CS1	8	Intact	Proximal horn core	1	*Bubalus*	Adult	greatest dia of base-86.4, least dia of base-53.8	N/A
CS1	8	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	8	Torn, provenance secure	Plastron fragment	1	*Lissemys*	N/A	~30	N/A
CS1	8	Intact	Cranium fragment	1	mammal, large	N/A	N/A	N/A
CS1	8	Torn, provenance secure	Cranium fragment	1	mammal, large	N/A	~70	Cut mark
CS1	8	Intact	Humerus	1	mammal, large	N/A	N/A	N/A
CS1	8	Torn, provenance secure	Possible scapula fragment	1	medium ruminant (sheep/goat size)	N/A	~40	N/A
CS1	8	Torn, provenance secure	Fragment with cut mark	1	N/A	N/A	N/A	Cut mark
CS1	8	Intact	Unidentified fragments	5	N/A	N/A	30-50	N/A
CS1	8	Intact	Unidentified fragments	25	N/A	N/A	<30	N/A
CS1	8	Torn, provenance secure	Unidentified fragments	2	N/A	N/A	>50	N/A
CS1	8	Torn, provenance secure	Unidentified fragments	4	N/A	N/A	30-50	N/A
CS1	8	Torn, provenance secure	Unidentified fragments	6	N/A	N/A	<30	N/A
CS1	10	Intact	Humerus, right, distal end	1	*Axis axis*	Adult	N/A	N/A
CS1	10	Intact	Scapula, glenoid process, left	1	*Axis axis*	Young adult	N/A	Recently fused
CS1	10	Intact	Ulna, proximal	1	bird, medium sized; should be identifiable	N/A	N/A	Cut marks
CS1	10	Intact	1st phalanx, anterior	1	*Bos indicus*	Adult	Glpe = 57.0, Bp = 27.7, Bd = 25.5, SD = 23.4	Complete, articulates with metacarpal, distal end charred
CS1	10	Intact	Metacarpal, right, fused	1	*Bos indicus*	Adult	Bp = 55.4, Bd = 55.1, GL ~ 219, SD = 30.5	Complete, articulates with 1st phalanx, distal end charred
CS1	10	Intact	M_1	1	*Bos or Bubalus*	N/A	N/A	N/A
CS1	10	Intact	P_3, right	1	*Bos or Bubalus*	N/A	N/A	Recently erupted

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	10	Intact	Metapodial, proximal, unfused	1	mammal, large	Juvenile	N/A	Lightly charred
CS1	10	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS1	10	Intact	Rib fragment	2	mammal, medium to large	N/A	N/A	N/A
CS1	10	Intact	Unidentified fragments	2	N/A	N/A	>50	N/A
CS1	10	Intact	Unidentified fragments	5	N/A	N/A	30-50	N/A
CS1	10	Intact	Unidentified fragments	6	N/A	N/A	<30	N/A
CS1	11	Intact	Antler fragment	1	*Axis axis*	N/A	N/A	N/A
CS1	11	Intact	Metatarsal, proximal, fused	1	*Axis axis*	N/A	N/A	N/A
CS1	11	Intact	Tibia, distal, unfused	1	*Axis axis*	Juvenile	N/A	N/A
CS1	11	Intact	Long bone shaft	1	bird, medium to large	N/A	N/A	N/A
CS1	11	Intact	Cervical vertabra fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
CS1	11	Intact	M_3 right	1	*Bos or Bubalus*, probably *Bos*	N/A	N/A	N/A
CS1	11	Intact	Mandibular cheek tooth fragment	1	*Canis*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Scaphoid	1	*Cervus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Neurocranial fragment	3	fish	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Probable dentary	2	fish	N/A	N/A	Honeycomb appearance resembles palatal bones of *Ritha*
CS1	11	Torn, provenance secure	Spine fragments	9	fish	N/A	N/A	Multiple taxa
CS1	11	Torn, provenance secure	Vertebral centrum	4	fish, large	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Vertebral centrum	1	fish, medium	N/A	N/A	N/A
CS1	11	Intact	Vertebra	1	fish, medium to large	N/A	N/A	N/A
CS1	11	Intact	Neurocranial fragment	1	fish, very large	N/A	N/A	N/A
CS1	11	Intact	Pectoral spine	1	fish, very large	N/A	N/A	N/A
CS1	11	Intact	Patella	1	large cervid	N/A	N/A	Slightly charred, no match with *Axis axis* or *Cervus unicolor*
CS1	11	Torn, provenance secure	Cheek tooth	1	*Lepus*	N/A	N/A	Burnt black, very worn, compare *Lepus* tooth from CS1, Split 12
CS1	11	Torn, provenance secure	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	11	Intact	Mandibular fragments	2	mammal, large	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	11	Intact	Partial thoracic vertebra	1	mammal, large	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Sternum fragment	1	mammal, large	N/A	N/A	N/A
CS1	11	Intact	Thoracic vertebral spine	1	mammal, large	N/A	N/A	N/A
CS1	11	Intact	Vertebral fragment	2	mammal, large	N/A	N/A	N/A
CS1	11	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS1	11	Intact	Femoral head	1	mammal, medium	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Long bone fragment	1	mammal, medium	N/A	N/A	Cut marks
CS1	11	Torn, provenance secure	Tooth fragments	4	mammal, medium (possible Sus)	N/A	N/A	1 fragment burnt
CS1	11	Torn, provenance secure	Cranial fragment	1	mammal, medium to large	N/A	N/A	N/A
CS1	11	Intact	Rib fragment	9	mammal, medium to large	N/A	N/A	N/A
CS1	11	Intact	Vertebral spine	1	mammal, medium to large	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Caudal vertebra	1	mammal, small to medium	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Lumbar vertebra	1	monitor lizard	N/A	N/A	N/A
CS1	11	Intact	Deciduous upper cheek tooth fragments	2	nilgai	N/A	N/A	N/A
CS1	11	Intact	M^3	1	nilgai	N/A	N/A	Broken
CS1	11	Intact	Radius, left, fused	1	nilgai	N/A	BFp = 43.7, Bp = 46.2, SD = 27.4, GL ~ 222	Complete
CS1	11	Intact	Radius, left, proximal, fused	1	nilgai	N/A	BFp = 38.2, Bp = 40.1	N/A
CS1	11	Intact	Tibia, left, distal	1	nilgai	N/A	N/A	Gnaw marks? Cut marks
CS1	11	Intact	Ulna, proximal portion at articulation with humerus	1	nilgai	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Humerus, right	1	*Rattus rattus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Humerus. Left	1	*Rattus rattus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Radius and ulna	2	*Rattus rattus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	11	Torn, provenance secure	Scapula	1	*Rattus rattus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Ulna, left	1	*Rattus rattus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Ulna, right	1	*Rattus rattus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	1st incisor, upper left	1	*Sus*	N/A	N/A	N/A
CS1	11	Torn, provenance secure	Unidentified fragments	4	N/A	N/A	>50	N/A
CS1	11	Torn, provenance secure	Unidentified fragments	10	N/A	N/A	30-50	N/A
CS1	11	Torn, provenance secure	Unidentified fragments	>100	N/A	N/A	<30	N/A
CS1	11	Intact	Unidentified fragments	2	N/A	N/A	>50	N/A
CS1	11	Intact	Unidentified fragments	3	N/A	N/A	30-50	N/A
CS1	11	Intact	Unidentified fragments	19	N/A	N/A	<30	N/A
CS1	11	Intact	Unidentified fragments	10	N/A	N/A	>50	N/A
CS1	11	Intact	Unidentified fragments	25	N/A	N/A	30-50	N/A
CS1	11	Intact	Unidentified fragments	35	N/A	N/A	<30	N/A
CS1	12	Small tear, provenance secure	Tibiotarsus, distal	1	bird, chicken sized	N/A	N/A	Does not appear to be *Gallus*
CS1	12	Intact	Femoral head	1	*Bos or Bubalus*, probable	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Vertebral centrum	1	fish, large	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Neurocranial fragment	3	fish, medium	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Vertebral centrum	2	fish, medium	N/A	N/A	N/A
CS1	12	Intact	Spine	1	fish, medium to large	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Pectoral spine	1	fish, medium/large	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	12	Small tear, provenance secure	Cheek tooth	1	*Lepus*	N/A	N/A	Burnt black, very worn
CS1	12	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Large long bone fragment	1	mammal, large	N/A	N/A	Cut marks, one large gouge, several smaller cuts
CS1	12	Intact	Mandibular fragment	1	mammal, large	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Vertebral fragment	2	mammal, large	N/A	N/A	N/A
CS1	12	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
CS1	12	Intact	Vertebral fragment	1	mammal, medium	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Vertebra	1	monitor lizard	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Right M1	1	*Sus*	N/A	N/A	N/A
CS1	12	Small tear, provenance secure	Unidentified fragments	8	N/A	N/A	30-50	N/A
CS1	12	Small tear, provenance secure	Unidentified fragments	~50	N/A	N/A	<30	5 burnt black
CS1	12	Intact	Unidentified fragments	6	N/A	N/A	30-50	N/A
CS1	12	Intact	Unidentified fragments	11	N/A	N/A	<30	N/A
CS1	12	Intact	Unidentified fragments	7	N/A	N/A	30-50	N/A
CS1	12	Intact	Unidentified fragments	12	N/A	N/A	<30	N/A
CS1	13	Intact	Antler	1	*Axis axis*	Adult	N/A	Fork where brow tine juts off
CS1	13	Intact	3rd phalanx	1	bird, chicken sized	N/A	N/A	N/A
CS1	13	Intact	Rib head, left	1	bird, chicken sized	N/A	N/A	N/A
CS1	13	Intact	Plastron fragment	1	*Chitra*	N/A	N/A	N/A
CS1	13	Intact	Fish bone	1	fish	N/A	N/A	Id?
CS1	13	Intact	Neurocranial fragments	2	fish	N/A	N/A	N/A
CS1	13	Intact	Spines	6	fish	N/A	N/A	At least 3 distinct taxa
CS1	13	Intact	Vertebral spines	2	fish	N/A	N/A	N/A
CS1	13	Intact	Vertebral centrum	2	fish, large	N/A	N/A	N/A
CS1	13	Intact	Vertebral centrum	1	fish, medium	N/A	N/A	N/A
CS1	13	Intact	Vertebral centrum	1	fish, small	N/A	N/A	N/A
CS1	13	Intact	Canine	3	large carnivore?	N/A	N/A	N/A
CS1	13	Intact	Plastron fragment	4	*Lissemys*	N/A	N/A	N/A
CS1	13	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	13	Intact	Mysterious bone	1	mammal	N/A	N/A	Cut mark
CS1	13	Intact	Femoral head	1	mammal, large	N/A	N/A	Charred
CS1	13	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Cut marks

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	13	Intact	Mandibular fragment, without teeth or alveoli	1	mammal, large	N/A	N/A	N/A
CS1	13	Intact	Rib shaft fragment	1	mammal, large	N/A	N/A	N/A
CS1	13	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS1	13	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS1	13	Intact	Tooth root	1	mammal, medium	N/A	N/A	N/A
CS1	13	Intact	Cranial fragment	1	mammal, medium to large	N/A	N/A	N/A
CS1	13	Intact	Scapula fragment	1	mammal, small to medium	N/A	N/A	Burnt black, cut mark
CS1	13	Intact	Calcaneus, right, unfused	1	nilgai	Juvenile	GB = 43.5	Nearly complete; cut marks
CS1	13	Intact	Pelvis, right	1	*Rattus rattus*	N/A	N/A	N/A
CS1	13	Intact	2nd phalanx, proximal, unfused	1	small ruminant (e.g., *Muntiacus*?)	Juvenile	N/A	N/A
CS1	13	Intact	1st incisor, upper	1	*Sus*	N/A	N/A	N/A
CS1	13	Intact	2nd incisor, upper	1	*Sus*	N/A	N/A	N/A
CS1	13	Intact	Cheek tooth fragment	3	*Sus*	N/A	N/A	N/A
CS1	13	Intact	Radius, proximal	1	*Sus*	N/A	N/A	Very small specimen
CS1	13	Intact	Unidentified fragments	46	N/A	N/A	<30	N/A
CS1	13	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
CS1	13	Intact	Unidentified fragments	6	N/A	N/A	30-50	1 burnt white
CS1	13	Intact	Unidentified fragments	5	N/A	N/A	<30	1 burnt black
CS1	13	Intact	Unidentified fragments	4	N/A	N/A	>50	N/A
CS1	13	Intact	Unidentified fragments	7	N/A	N/A	30-50	N/A
CS1	13	Intact	Unidentified fragments	19	N/A	N/A	<30	8 charred
CS1	14	Intact	Pelvic fragment, ischium with acetabulum	1	*Axis axis*	N/A	N/A	N/A
CS1	14	Intact	Tibia, proximal, fused	1	*Axis axis*	Adult	N/A	N/A
CS1	14	Torn, contents probably reliable	Neurocranial fragment	2	fish	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Operculum	1	fish, medium	N/A	N/A	N/A
CS1	14	Intact	Neurocranial fragment	1	fish, medium to large	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Spines	3	fish, small to medium	N/A	N/A	At least two taxa
CS1	14	Torn, contents probably reliable	Vertebral fragments	3	fish, small to medium	N/A	N/A	N/A
CS1	14	Intact	Mandibular fragment	1	mammal, medium	N/A	N/A	Including alveoli, but no dental fragments

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	14	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
CS1	14	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Rib head	1	mammal, medium	N/A	N/A	Charred
CS1	14	Intact	Scapula	1	mammal, medium	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Vertebral fragment	1	mammal, medium	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Caudal vertebra	1	mammal, small	N/A	N/A	Charred
CS1	14	Torn, contents probably reliable	Hyoid	1	mammal, small	N/A	N/A	N/A
CS1	14	Intact	Molar fragments	2	nilgai	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Femur, left	1	*Rattus rattus*	N/A	N/A	Articulates with pelvis
CS1	14	Torn, contents probably reliable	Pelvis, left	1	*Rattus rattus*	N/A	N/A	Articulates with femur
CS1	14	Torn, contents probably reliable	Radius	1	*Rattus rattus*	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Tibia, right	1	*Rattus rattus*	N/A	N/A	N/A
CS1	14	Intact	Metapodial, unfused	1	small antelope or gazelle sized	Juvenile	N/A	N/A
CS1	14	Intact	M^2, possibly deciduous	1	*Sus*	N/A	N/A	Just errupted, no wear
CS1	14	Intact	P^4	1	*Sus*	N/A	N/A	N/A
CS1	14	Torn, contents probably reliable	Tooth fragment, emergent cheek tooth	1	*Sus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	14	Torn, contents probably reliable	Unidentified fragments	1	N/A	N/A	30-50	N/A
CS1	14	Torn, contents probably reliable	Unidentified fragments	~50	N/A	N/A	<30	N/A
CS1	14	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
CS1	14	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
CS1	14	Intact	Unidentified fragments	1	N/A	N/A	>50	N/A
CS1	14	Intact	Unidentified fragments	5	N/A	N/A	30-50	N/A
CS1	14	Intact	Unidentified fragments	21	N/A	N/A	<30	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Humerus, distal	1	*Anser*	N/A	N/A	Charred
CS1	15	Badly mixed, likely includes material from much of CS1	Tarsometatarsus, distal	1	*Anser*	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	1st phalanx	4	bird, duck-sized	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Vertebrae	3	bird, medium	N/A	N/A	N/A
CS1	15	Intact	Base of spine from thoracic vertabra	1	*Bos or Bubalus*	N/A	N/A	N/A
CS1	15	Intact	Left mandible, fragment with emerging M_3	1	*Bos or Bubalus*	Juvenile	15a: height of mandible behind M_3 (probably inaccurate because M_3 not fully emerged) = 70.9	Possibly from same individual as right mandible in same context

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	15	Intact	Right lower incisor	1	*Bos or Bubalus*	N/A	N/A	N/A
CS1	15	Intact	Right mandible, fragment with M_2 and M_3	1	*Bos or Bubalus*	Juvenile	N/A	Possibly from same individual as left mandible in same context: 1 cusp of M_3 broken, little tooth wear
CS1	15	Intact	Right scapula fragment	2	*Bos or Bubalus*	N/A	N/A	Cut marks
CS1	15	Intact	3rd phalanx	1	*Bubalus,* possible	N/A	Ld = 36.44, MBs = 16.8	N/A
CS1	15	Intact	Left tibia, proximal, unfused	1	*Canis lupus*	Juvenile	N/A	N/A
CS1	15	Intact	Right tibia, distal, fused	1	*Canis lupus*	Adult	Bd = 18.9, Dd = 14.8	N/A
CS1	15	Torn, provenance definitely secure	Shed antler	1	*Cervus unicolor, probable*	Adult	N/A	Modified with tines cut cleanly, polish on one side of smaller tine
CS1	15	Intact	Plastron fragment	1	*Chitra?*	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Neurocranial fragments	6	fish	N/A	N/A	N/A
CS1	15	Intact	Spine	1	fish	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Spine	1	fish, large to very large	N/A	N/A	Rasp-like texture, unbarbed
CS1	15	Badly mixed, likely includes material from much of CS1	Spine	5	fish, medium	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Vertebra	1	fish, medium to large	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	15	Badly mixed, likely includes material from much of CS1	Vertebrae	4	fish, small	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Vertebrae	6	fish, small to medium	N/A	N/A	N/A
CS1	15	Intact	Neurocranial fragment with tooth socket	1	fish, very large	N/A	N/A	N/A
CS1	15	Intact	Vertebral fragments	2	fish, very large	N/A	N/A	N/A
CS1	15	Intact	Plastron fragment	1	*Kachuga*	N/A	N/A	N/A
CS1	15	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	15	Intact	Dental fragments	2	mammal	N/A	N/A	N/A
CS1	15	Intact	Rib fragment	1	mammal, large	N/A	N/A	Cut marks
CS1	15	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Caudal vertebra	1	mammal, medium	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Mandibular fragment	1	mammal, medium	N/A	N/A	N/A
CS1	15	Intact	Vertebral spine	1	mammal, medium	N/A	N/A	N/A
CS1	15	Intact	Vertebral epiphyses	2	mammal, medium	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	15	Badly mixed, likely includes material from much of CS1	Vertebral spine	1	mammal, medium	N/A	N/A	N/A
CS1	15	Intact	Cervical vertebra fragment	2	mammal, medium/large	N/A	N/A	N/A
CS1	15	Intact	Cranial fragment	1	mammal, medium/large	N/A	N/A	Cut mark
CS1	15	Intact	Cranial fragment, postorbital process	1	mammal, medium/large	N/A	N/A	N/A
CS1	15	Intact	Cranial fragment, zygomatic process	1	mammal, medium/large	N/A	N/A	N/A
CS1	15	Intact	Long bone fragment	1	mammal, medium/large	N/A	N/A	Cut mark(s)
CS1	15	Intact	Long bone fragment	1	mammal, medium/large	N/A	N/A	Possible cut mark
CS1	15	Intact	Mandibular fragment	2	mammal, medium/large	N/A	N/A	N/A
CS1	15	Intact	Scapula fragment	1	mammal, medium/large	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Scapula	1	mammal, small	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Fibula	1	mammal, small to medium	N/A	N/A	N/A
CS1	15	Intact	Procoelus caudal vertebra	1	possibly small reptile?	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Femur, left	1	*Rattus rattus*	N/A	N/A	Not from same rat as right femur

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	15	Badly mixed, likely includes material from much of CS1	Femur, right	1	*Rattus rattus*	N/A	N/A	Not from same rat as left femur
CS1	15	Badly mixed, likely includes material from much of CS1	Right mandible	1	*Rattus rattus*	N/A	N/A	Complete
CS1	15	Intact	Right M_2	1	sheep or goat	N/A	N/A	N/A
CS1	15	Intact	Lower cheek tooth fragment	1	sheep/goat size, probable bovid	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	2nd phalanx	1	small carnivore	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Mandibular fragment with incisor	1	small rodent, probably *Mus*	N/A	N/A	N/A
CS1	15	Intact	Atlas	1	*Sus*	N/A	N/A	N/A
CS1	15	Badly mixed, likely includes material from much of CS1	Teeth	11	*Sus*	N/A	N/A	Three lower incisors and two molar fragments
CS1	15	Intact	Unidentified fragments	~30	N/A	N/A	30-50	N/A
CS1	15	Intact	Unidentified fragments	3	N/A	N/A	>50	N/A
CS1	15	Intact	Unidentified fragments	~50	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	15	Badly mixed, likely includes material from much of CS1	Unidentified fragments	>100	N/A	N/A	N/A	N/A
CS1	16	Intact	Proximal radius	1	antelope?	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Mandible	1	anuran?	N/A	N/A	N/A
CS1	16	Intact	Right femur	1	bird (chicken sized)	Old juvenile/ young adult	N/A	N/A
CS1	16	Intact	Distal radius	1	bird (pigeon sized)	N/A	N/A	N/A
CS1	16	Torn, provenance secure	3rd phalanx	1	bird, medium (~crow size)	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Humerus	1	bird, medium (smaller than typical chicken)	Juvenile	N/A	N/A
CS1	16	Torn, provenance secure	Proximal humerus	1	bird, medium (smaller than typical chicken)	Adult	Bp-13.4	Unusually flattened
CS1	16	Torn, provenance secure	Proximal tibiotarsus	1	bird, medium (smaller than typical chicken)	Adult	N/A	N/A
CS1	16	Intact	Proximal tibiotarsus	1	bird, small	N/A	N/A	N/A
CS1	16	Intact	Carpal or tarsal	2	*Bos* or *Bubalus*	N/A	N/A	N/A
CS1	16	Intact	Fragment of proximal end of humerus	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS1	16	Intact	Proximal phalanx	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS1	16	Intact	Scaphoid	1	*Bos or Bubalus*	N/A	N/A	N/A
CS1	16	Intact	Vertebral spine	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS1	16	Intact	Proximal tibia	1	*Canis lupus*	Adult	N/A	N/A
CS1	16	Intact	Incisor	i	deer?	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Cranial fragments	4	fish	N/A	N/A	N/A
CS1	16	Intact	Cranial fragments	2	fish	N/A	N/A	N/A
CS1	16	Intact	Vertebral centrum	1	fish	N/A	max dia 16.1	N/A
CS1	16	Torn, provenance secure	Spines	6	fish, appear to belong to at least 3 distinct species	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	16	Torn, provenance secure	Vertabrae	22	fish, possibly *Labeo*	N/A	2.4-10.5 dia	N/A
CS1	16	Intact	Dental fragments	3	large deer to cattle sized	N/A	N/A	N/A
CS1	16	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Plastron fragment	4	*Lissemys*	N/A	N/A	N/A
CS1	16	Intact	Mandible	2	mammal, large	N/A	N/A	Lower proximal portion at the angle of the mandible
CS1	16	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Caudal vertebra	1	mammal, medium	N/A	N/A	N/A
CS1	16	Intact	Cranial fragments	10	mammal, medium	N/A	N/A	N/A
CS1	16	Intact	Jugal?	1	mammal, medium	N/A	N/A	Cut mark
CS1	16	Torn, provenance secure	Rib shaft	8	mammal, medium	N/A	N/A	N/A
CS1	16	Intact	Rib shaft	1	mammal, medium	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Vertebral centrum	1	mammal, medium	Juvenile	N/A	N/A
CS1	16	Torn, provenance secure	Vertebral spine	1	mammal, medium (sheep/goat size)	N/A	N/A	N/A
CS1	16	Intact	Vertebral centrum	1	mammal, medium (smaller than sheep/goat)	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Scapula fragment	1	mammal, medium, possibly Canis	N/A	N/A	N/A
CS1	16	Torn, provenance secure	1st phalanx	4	mammal, small	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Caudal vertebrae	3	mammal, small	N/A	N/A	Charred
CS1	16	Torn, provenance secure	Proximal femur	1	mammal, small	Adult	N/A	N/A
CS1	16	Torn, provenance secure	Tibia	1	mammal, small	Adult	GL-19.8	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	16	Torn, provenance secure	Ulna	1	mammal, small	Adult	N/A	N/A
CS1	16	Torn, provenance secure	Femur	2	mammal, small (rodent)	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Cranial fragments	8	mammal, small to medium	N/A	N/A	N/A
CS1	16	Intact	Long bone fragment	1	mammal, small/medium	N/A	N/A	Completely charred
CS1	16	Torn, provenance secure	Long bone shafts	6	mammal, small/medium	N/A	N/A	N/A
CS1	16	Intact	Unidentified fragments	1	mammal, very large	N/A	>50	Long bone fragment, burnt black
CS1	16	Intact	Horn core or antler fragment	1	medium/large ruminant	N/A	N/A	N/A
CS1	16	Intact	Upper molar	1	medium/large ruminant	N/A	N/A	N/A
CS1	16	Intact	3rd phalanx	1	*Muntiacus*	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Left mandible	1	Myomorphic rodent (probably rat)	N/A	N/A	N/A
CS1	16	Intact	Metacarpal shaft	2	nilgia or chital size	N/A	N/A	N/A
CS1	16	Intact	Metacarpal shaft	1	nilgia or chital size	N/A	N/A	Cut marks
CS1	16	Intact	Metatarsal shaft	1	nilgia or chital size	N/A	N/A	N/A
CS1	16	Intact	Proximal humerus	1	*Pavo cristatus?*	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Maxilla	1	reptile?	N/A	N/A	Appears to have pleurodont teeth
CS1	16	Torn, provenance secure	Possible coracoid	1	reptile?	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Pteragoid	1	reptile?	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Left maxilla	1	rodent (rat size)	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Humerus	1	small animal	Adult	GL-10.3	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	16	Torn, provenance secure	Long bone shafts	~60	small animal	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Medial rib heads	17	small animal	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Scapula	1	small animal	N/A	N/A	N/A
CS1	16	Torn, provenance secure	Incisor	1	*Sus*	N/A	N/A	N/A
CS1	16	Intact	Left mandible fragment, with partial M_1 and complete M_2	1	*Sus*	Juvenile	N/A	M_2 not fully erupted
CS1	16	Intact	Lower canine	1	*Sus*	N/A	N/A	N/A
CS1	16	Intact	M^1	1	*Sus*	Juvenile	N/A	Crown broken
CS1	16	Intact	M^3 left	1	*Sus*	N/A	breadth-15.7, length-32.6	N/A
CS1	16	Intact	Right M^2	1	*Sus*	Juvenile	N/A	N/A
CS1	16	Intact	Right maxilla, with M^2	1	*Sus*	Adult	N/A	N/A
CS1	16	Intact	Left mandible	1	*Sus*, probably wild	N/A	N/A	Includes broken canine and premolars
CS1	16	Torn, provenance secure	Tooth fragments	12	unidentified	N/A	N/A	N/A
CS1	16	Intact	Unidentified fragments	10	N/A	N/A	30-50	N/A
CS1	16	Intact	Unidentified fragments	50	N/A	N/A	<30	N/A
CS1	16	Intact	Unidentified fragments	6	N/A	N/A	>50	N/A
CS1	16	Intact	Unidentified fragments	27	N/A	N/A	30-50	N/A
CS1	16	Intact	Unidentified fragments	~60	N/A	N/A	<30	N/A
CS1	16	Torn, provenance secure	Unidentified/unidentifiable fragments	1	N/A	N/A	N/A	N/A
CS1	16	Intact	Vertebral fragments	3	N/A	N/A	N/A	N/A
CS1	17	Intact	Tibia, proximal, fused	1	mammal, small to medium	N/A	N/A	Very worn
CS1	17	Intact	Carpal, possibly pisiform	1	medium ruminant (*Axis*? Antelope?)	N/A	N/A	N/A
CS1	17	Intact	Dental fragments	1	ruminant	N/A	N/A	N/A
CS1	17	Intact	Right M^2	1	*Sus*	N/A	N/A	N/A
CS1	17	Intact	Right M^2, with attached maxillary fragment	1	*Sus*	N/A	N/A	N/A
CS1	17	Intact	Carapace fragment	1	turtle	N/A	N/A	Surface too accreted to identify species
CS1	17	Intact	Unidentified fragments	8	N/A	N/A	30-50	N/A
CS1	17	Intact	Unidentified fragments	35	N/A	N/A	<30	N/A
CS1	17	Intact	Unidentified fragments	3	N/A	N/A	30-50	Burnt black
CS1	17	Intact	Unidentified fragments	9	N/A	N/A	<30	Burnt black
CS1	17	Intact	Unidentified fragments	5	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	17	Intact	Unidentified fragments	29	N/A	N/A	<30	N/A
CS1	18	Intact	Pelvis	1	bird, chicken sized	N/A	N/A	N/A
CS1	18	Intact	Ulna, distal, fused	1	bird, duck sized	N/A	N/A	N/A
CS1	18	Intact	Neurocranial fragment	4	fish	N/A	N/A	N/A
CS1	18	Intact	Pectoral spine	1	fish, medium	N/A	N/A	N/A
CS1	18	Intact	Spine	2	fish, small to medium	N/A	N/A	N/A
CS1	18	Intact	Spine	1	fish, small to medium	N/A	N/A	Not barbed
CS1	18	Intact	Vertebrae	2	fish, small to medium	N/A	N/A	N/A
CS1	18	Intact	Molar	1	human	Adult?	N/A	N/A
CS1	18	Intact	Caudal vertebra	1	mammal, medium	N/A	N/A	Burnt black
CS1	18	Intact	Occipital condyle	1	mammal, medium	N/A	N/A	N/A
CS1	18	Intact	Occipital condyle	1	mammal, medium to large	N/A	N/A	N/A
CS1	18	Intact	Vertebral centrum	1	mammal, medium to large	N/A	N/A	Burnt black
CS1	18	Intact	Femur, proximal fused	1	mammal, small	Adult	N/A	N/A
CS1	18	Intact	Humerus, distal fused, proximal unfused	2	mammal, small	N/A	N/A	N/A
CS1	18	Intact	Humerus, fused	1	mammal, small	Adult	N/A	N/A
CS1	18	Intact	Long bone/rib shafts	7	mammal, small	N/A	N/A	N/A
CS1	18	Intact	Lumbar vertebra	1	mammal, small	N/A	N/A	N/A
CS1	18	Intact	Tibia, fused	1	mammal, small	Adult	N/A	N/A
CS1	18	Intact	Ulna, fused	1	mammal, small	Adult	N/A	N/A
CS1	18	Intact	Dental fragments	4	mammal, small, possible young pig	N/A	N/A	Charred
CS1	18	Intact	Humerus, unfused	1	mammal, very small	Juvenile	N/A	N/A
CS1	18	Intact	Incisor	1	*Rattus rattus*	N/A	N/A	Likely from same individual as mandible fragments
CS1	18	Intact	Left mandible with cheek teeth and incisor	1	*Rattus rattus*	N/A	N/A	Likely from same individual as right mandible fragment and incisor
CS1	18	Intact	Right mandible fragment with 1 molar	1	*Rattus rattus*	N/A	N/A	Likely from same individual as left mandible fragment and incisor
CS1	18	Intact	Scapula?	1	small reptile?	N/A	N/A	N/A
CS1	18	Intact	Deciduous molar	1	*Sus*	Juvenile	N/A	Completely burnt (black)
CS1	18	Intact	Deciduous molar	1	*Sus*	Juvenile	N/A	N/A
CS1	18	Intact	Unidentified fragments	~50	N/A	N/A	<30	N/A
CS1	18	Intact	Unidentified fragments	4	N/A	N/A	30-50	N/A
CS1	18	Intact	Unidentified fragments	8	N/A	N/A	<30	N/A
CS1	18	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
CS1	18	Intact	Unidentified fragments	~50	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Long bone, partial diaphysis (possibly ulna)	1	bird, medium	N/A	N/A	Cut marks
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Premolar fragment	1	*Canis*	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Antler fragment	1	cervid	N/A	N/A	Worked, polished on one end, hole drilled partly through
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Femur, proximal	1	closely resembles nilgai, but too small for adult nilgai; does not resemble blackbuck	Young adult	Bp = 55.4, DC = 24.2	Fused, but fusion lines still slightly visible
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Neurocranial fragment	1	fish, medium to large	N/A	N/A	Burnt black

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Carapace fragment	1	*Kachuga tecta*	N/A	N/A	Slightly charred
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Plastron fragment	5	*Lissemys*	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Rib fragment	2	mammal, large	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Vertebral fragment	2	mammal, large	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Vertebral spine	1	mammal, large	N/A	N/A	Cut mark

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Pelvic fragment	1	mammal, medium	N/A	N/A	Cut marks
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Pelvic fragment, ischium	1	mammal, medium	N/A	N/A	Long cut marks
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Scapula, proximal	1	mammal, medium	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Maxillary fragment	1	mammal, medium to large	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Rib fragment	2	mammal, medium to large	N/A	N/A	Cut marks

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Mandibular fragment, left	1	*Sus*	N/A	N/A	Teeth broken off at root
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Maxillary fragment	1	*Sus*	Juvenile	N/A	Includes ancellou tooth, light charring in one area
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Scapula, proximal, fused	1	*Sus*	Adult	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Ulna, semilunar notch	1	*Sus*	N/A	N/A	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Unidentified fragments	8	N/A	N/A	>50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Unidentified fragments	27	N/A	N/A	30-50	N/A
CS1	3,10, 10a	3 bags torn and combined into single bag, majority of material likely from split 10	Unidentified fragments	65	N/A	N/A	<30	N/A
CS3	5	Intact	Dental fragment	1	mammal, medium	N/A	N/A	N/A
CS3	5	Intact	Dental fragment	6	mammal, medium	N/A	N/A	N/A
CS3	7	Intact	Humerus, distal	1	rodent, small (*Mus* size)	N/A	N/A	Broken
CS3	7	Intact	Scapula fragment, glenoid process	1	rodent, small (*Mus* size)	N/A	GLP-3.5	N/A
CS3	7	Intact	Unidentified fragment	5	N/A	N/A	<30	N/A
CS3	7	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
CS3	7	Intact	Unidentified fragment	17	N/A	N/A	<30	N/A
CS3	8	Torn, provenance secure	Long bone fragment	1	bird, medium	N/A	N/A	Unfused
CS3	8	Intact	Humerus, distal fragment	1	cervid (*Axis* size)	N/A	N/A	Cut mark, not same bone as above
CS3	8	Torn, provenance secure	Vertebral fragment	1	fish, large	N/A	N/A	N/A
CS3	8	Intact	Vertebra	1	fish, small to medium	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Cranial fragment	1	mammal, large	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Long bone fragment	2	mammal, large	N/A	N/A	N/A
CS3	8	Intact	Pelvic fragment	1	mammal, large	N/A	N/A	N/A
CS3	8	Intact	Long bone fragment	1	mammal, large	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	8	Intact	Long bone fragment	1	mammal, large	N/A	>50	N/A
CS3	8	Intact	Metapodial fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	8	Intact	Radius fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Radius fragment, proximal	1	mammal, medium	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Rib fragment	1	mammal, medium	N/A	N/A	N/A
CS3	8	Torn, provenance secure	M_3, deciduous	1	mammal, medium	N/A	N/A	Very worn
CS3	8	Intact	Humerus shaft fragment	1	mammal, medium (*Axis* size)	N/A	N/A	N/A
CS3	8	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	Slightly charred
CS3	8	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Humerus fragment	1	mammal, small (*Mus* size)	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Caudal vertebra	1	mammal, small to medium	N/A	N/A	N/A
CS3	8	Intact	1st phalanx	1	mammal, very small (*Mus* size)	N/A	N/A	N/A
CS3	8	Intact	Humerus fragment, distal	1	mammal, very small (*Mus* size)	N/A	N/A	N/A
CS3	8	Torn, provenance secure	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	8	Intact	Molar fragment	2	rodent, small (*Mus* size)	N/A	N/A	N/A
CS3	8	Intact	Unidentified fragment	24	N/A	N/A	<30	N/A
CS3	8	Intact	Unidentified fragment	23	N/A	N/A	<30	N/A
CS3	8	Torn, provenance secure	Unidentified fragment	6	N/A	N/A	30-50	N/A
CS3	8	Torn, provenance secure	Unidentified fragment	~40	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	8	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
CS3	8	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
CS3	8	Intact	Unidentified fragment	2	N/A	N/A	30-50	N/A
CS3	8	Intact	Unidentified fragment	7	N/A	N/A	<30	N/A
CS3	9	Intact	Long bone fragment	1	bird, medium	N/A	N/A	Unfused
CS3	9	Intact	Humerus, shaft fragment	1	bird, medium (*Anser indicus* size)	N/A	N/A	Cut marks
CS3	9	Intact	Shell fragment	1	bivalve	N/A	N/A	N/A
CS3	9	Intact	Tibia, shaft fragment	1	*Bos* or *Bubalus*	N/A	N/A	Cut mark
CS3	9	Intact	Carpal (sphenoid)	1	*Bos* or *Bubalus*	N/A	N/A	Almost complete
CS3	9	Intact	Cheek tooth fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	9	Intact	Centrotarsal fragment	1	*Bubalus*	N/A	N/A	N/A
CS3	9	Torn, provenance secure	I^3	1	*Canis*	N/A	N/A	N/A
CS3	9	Intact	Premolar	1	*Canis familiaris*	N/A	N/A	N/A
CS3	9	Intact	Shell fragment	1	cerithiidae (estuarine snail)	N/A	N/A	N/A
CS3	9	Torn, provenance secure	Molar fragment	1	*Elephas maximus*	N/A	N/A	N/A
CS3	9	Intact	Spine	1	fish, medium	N/A	N/A	No serration
CS3	9	Intact	Vertebral fragment	1	fish, medium	N/A	N/A	N/A
CS3	9	Intact	Spine fragment	1	fish, medium	N/A	N/A	N/A
CS3	9	Intact	Vertebra	1	fish, small	N/A	N/A	N/A
CS3	9	Intact	Incisor	3	*Lepus*	N/A	N/A	N/A
CS3	9	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS3	9	Intact	Tibia, proximal fragment	1	mammal, large	N/A	N/A	Unfused
CS3	9	Intact	Femur, distal fragment	2	mammal, large	N/A	N/A	N/A
CS3	9	Torn, provenance secure	Rib fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	Charred exterior
CS3	9	Intact	Vertebral fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	9	Intact	Vertebral fragment	1	mammal, medium	N/A	N/A	N/A
CS3	9	Intact	Dental fragment	1	mammal, medium	N/A	N/A	Burnt black and white
CS3	9	Intact	Dental fragment	1	mammal, medium	N/A	N/A	N/A
CS3	9	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	9	Intact	Caudal vertebra	1	mammal, small	N/A	N/A	N/A
CS3	9	Intact	Rib fragment	1	mammal, small	N/A	N/A	N/A
CS3	9	Intact	Humerus fragment	3	mammal, small	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	9	Intact	Caudal vertebra	1	mammal, small	N/A	N/A	N/A
CS3	9	Intact	1st phalanx	1	mammal, small to medium	N/A	N/A	N/A
CS3	9	Intact	Rib fragment	1	mammal, small to medium	N/A	N/A	N/A
CS3	9	Intact	Humerus, distal fragment	1	mammal, small to medium (cat or fox size)	N/A	N/A	N/A
CS3	9	Intact	Mandible fragment	1	*Rattus*	N/A	N/A	Includes incisor and molars
CS3	9	Intact	Ulna	1	*Rattus*	N/A	N/A	N/A
CS3	9	Intact	Humerus	2	*Rattus*	N/A	N/A	N/A
CS3	9	Intact	Femur, proximal	1	*Rattus*	N/A	N/A	N/A
CS3	9	Intact	Pelvis	1	*Rattus*	N/A	N/A	N/A
CS3	9	Intact	Humerus, distal fragment	1	rodent (*Mus* size)	N/A	N/A	N/A
CS3	9	Torn, provenance secure	Incisor	2	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	9	Torn, provenance secure	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	9	Torn, provenance secure	Mandible fragment	1	rodent (*Rattus* size)	N/A	N/A	Includes molars
CS3	9	Intact	Incisor	10	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	9	Torn, provenance secure	M_1 or M_2	1	sheep or goat	N/A	N/A	N/A
CS3	9	Intact	Metatarsal fragment	1	sheep or goat	N/A	N/A	N/A
CS3	9	Intact	Mandible fragment	1	shrew	N/A	N/A	Including incisor and one cheek tooth
CS3	9	Torn, provenance secure	Molar fragment, deciduous	1	*Sus*	N/A	N/A	N/A
CS3	9	Torn, provenance secure	Molar fragment, deciduous	3	*Sus*	N/A	N/A	Large individual, from at least 2 separate teeth
CS3	9	Intact	Molar fragment	1	*Sus*	N/A	N/A	Recently erupted
CS3	9	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
CS3	9	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
CS3	9	Intact	Unidentified fragment	~30	N/A	N/A	<30	N/A
CS3	9	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	>50	N/A
CS3	9	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	9	Torn, provenance secure	Unidentified fragment	9	N/A	N/A	<30	N/A
CS3	9	Intact	Unidentified fragment	5	N/A	N/A	30-50	N/A
CS3	9	Intact	Unidentified fragment	~100	N/A	N/A	<30	N/A
CS3	10	Intact	P^2, right	1	*Axis axis*	N/A	N/A	N/A
CS3	10	Intact	M^1	1	*Axis axis*	N/A	N/A	N/A
CS3	10	Intact	Tarsometatarsus, distal fragment	1	bird (*Eudynamys scolopacea* size)	N/A	N/A	N/A
CS3	10	Intact	Radius fragment	1	bird, medium (*Anser indicus* size)	N/A	N/A	N/A
CS3	10	Intact	Humerus, proximal	1	bird, small	N/A	N/A	N/A
CS3	10	Intact	1st phalanx fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	10	Intact	Incisor	1	*Lepus*	N/A	N/A	N/A
CS3	10	Intact	Long bone fragment	2	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	10	Intact	Long bone fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	10	Intact	Sacral vertebra	1	medium frog or toad	N/A	N/A	N/A
CS3	10	Intact	Molar	1	*Rattus*	N/A	N/A	N/A
CS3	10	Intact	Pelvis	1	*Rattus*	N/A	N/A	N/A
CS3	10	Intact	Femur, proximal	1	*Rattus*	N/A	N/A	N/A
CS3	10	Intact	Humerus	1	*Rattus*	N/A	N/A	N/A
CS3	10	Intact	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	10	Intact	Molar fragment	2	rodent, small (*Mus* size)	N/A	N/A	N/A
CS3	10	Intact	M^2, right	1	*Sus*	N/A	N/A	Extremely worn
CS3	10	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
CS3	10	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	10	Intact	Unidentified fragment	14	N/A	N/A	<30	N/A
CS3	10	Intact	Unidentified fragment	4	N/A	N/A	30-50	N/A
CS3	10	Intact	Unidentified fragment	~40	N/A	N/A	<30	N/A
CS3	10A	Torn, provenance secure	Femur, proximal	1	bird, medium (approximately pigeon size)	N/A	N/A	N/A
CS3	10A	Torn, provenance secure	Tibiotarsus, proximal	1	bird, medium (approximately pigeon size)	N/A	N/A	N/A
CS3	10A	Torn, provenance secure	Femur, proximal	1	bird, small	N/A	N/A	N/A
CS3	10A	Intact	Carapace fragment	1	*Lissemys*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	10A	Torn, provenance secure	Long bone fragment	1	mammal, large	N/A	N/A	N/A
CS3	10A	Intact	Dental fragment	1	mammal, medium	N/A	N/A	N/A
CS3	10A	Torn, provenance secure	Incisor	2	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	10A	Intact	Unidentified fragment	6	N/A	N/A	<30	N/A
CS3	10A	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	30-50	N/A
CS3	10A	Torn, provenance secure	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	10B	Torn, provenance secure	Long bone fragment	2	bird, small	N/A	N/A	N/A
CS3	10B	Torn, provenance secure	Spine	1	fish, small	N/A	N/A	Serrations on one side
CS3	10B	Torn, provenance secure	Probable rib fragment	1	mammal, large	N/A	N/A	Worked
CS3	10B	Torn, provenance secure	Long bone fragment	2	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	10B	Intact	Caudal vertebra	1	mammal, small	N/A	N/A	N/A
CS3	10B	Torn, provenance secure	Pelvis	1	*Rattus*	N/A	N/A	Broken
CS3	10B	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	10B	Torn, provenance secure	Unidentified fragment	3	N/A	N/A	30-50	N/A
CS3	10B	Torn, provenance secure	Unidentified fragment	~30	N/A	N/A	<30	N/A
CS3	10C	Torn, provenance secure	M_1	1	*Antilope cervicapra*	N/A	N/A	N/A
CS3	10C	Intact	Long bone fragment	1	bird, medium	N/A	N/A	N/A
CS3	10C	Intact	Thoracic vertebra	3	*Canis familiaris*	N/A	N/A	Almost complete
CS3	10C	Intact	Ulna, proximal	1	*Canis familiaris*	N/A	N/A	N/A
CS3	10C	Intact	Metapodial fragment	5	*Canis familiaris*	N/A	N/A	From 5 separate bones
CS3	10C	Intact	Vertebral fragment	1	fish, medium	N/A	N/A	Burnt black
CS3	10C	Intact	Cranial fragment	1	fish, small to medium	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	10C	Intact	Plastron fragment	2	*Kachuga*	N/A	N/A	N/A
CS3	10C	Intact	Cranial fragment (temporal)	1	large cervid	N/A	N/A	N/A
CS3	10C	Intact	Incisor	4	*Lepus*	N/A	N/A	N/A
CS3	10C	Intact	Cranial fragment	1	mammal, large	N/A	N/A	N/A
CS3	10C	Intact	Mandible fragment	1	mammal, large	N/A	N/A	N/A
CS3	10C	Intact	Vertebral fragment	2	mammal, large	N/A	N/A	N/A
CS3	10C	Intact	Long bone fragment	4	mammal, large	N/A	N/A	N/A
CS3	10C	Intact	Rib fragment	2	mammal, medium (sheep/goat size)	N/A	N/A	N/A
CS3	10C	Intact	1st phalanx, distal fragment	1	mammal, small (cat size)	N/A	N/A	N/A
CS3	10C	Intact	Femur, proximal fragment	1	mammal, small (hare size)	N/A	N/A	N/A
CS3	10C	Intact	Mandible fragment	2	*Rattus*	N/A	N/A	1 including incisor, 1 including incisor and molars
CS3	10C	Intact	Femur	1	*Rattus*	N/A	N/A	Unfused at distal end
CS3	10C	Intact	Humerus fragment	1	*Rattus*	N/A	N/A	N/A
CS3	10C	Intact	Femur, proximal	2	*Rattus*	N/A	N/A	N/A
CS3	10C	Intact	Tibia, proximal	1	*Rattus*	N/A	N/A	N/A
CS3	10C	Intact	Femur, distal	2	*Rattus*	N/A	N/A	N/A
CS3	10C	Torn, provenance secure	Mandible fragment	5	rodent (*Rattus* size)	N/A	N/A	All including either incisors, molars, or both
CS3	10C	Intact	Incisor	4	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	10C	Intact	Ulna, proximal fragment	1	rodent, small (*Mus* size)	N/A	N/A	N/A
CS3	10C	Intact	Incisor	1	rodent, small to medium (~rat size)	N/A	N/A	N/A
CS3	10C	Intact	Vertebra	1	shark (possibly dog fish)	N/A	N/A	N/A
CS3	10C	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	10C	Intact	Worked bone (point)	1	N/A	N/A	N/A	N/A
CS3	10C	Intact	Unidentified fragment	6	N/A	N/A	<30	Burnt white
CS3	10C	Intact	Unidentified fragment	2	N/A	N/A	>50	N/A
CS3	10C	Intact	Unidentified fragment	~20	N/A	N/A	30-50	N/A
CS3	10C	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	11A	Intact	Femur, distal	1	bird, medium (*Gallus* size)	N/A	N/A	N/A
CS3	11A	Intact	Humerus	1	bird, small	N/A	N/A	N/A
CS3	11A	Intact	Humerus, distal	1	bird, small	N/A	N/A	N/A
CS3	11A	Intact	Long bone fragment	1	bird, small	N/A	N/A	Unfused
CS3	11A	Intact	Tibiotarsus, proximal fragment	1	bird, small to medium	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	11A	Torn, provenance secure	M^1 or M^2	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	11A	Intact	Tibia, distal	1	*Canis familiaris*	N/A	N/A	N/A
CS3	11A	Intact	Radius, distal	1	*Canis familiaris*	N/A	N/A	N/A
CS3	11A	Intact	Femur, proximal	1	*Canis familiaris*	N/A	N/A	N/A
CS3	11A	Torn, provenance secure	I_2, left	1	*Equus*	N/A	N/A	N/A
CS3	11A	Intact	Spine fragment	1	fish, small	N/A	N/A	N/A
CS3	11A	Intact	Incisor	7	*Lepus*	N/A	N/A	N/A
CS3	11A	Intact	Plastron fragment	4	*Lissemys*	N/A	N/A	N/A
CS3	11A	Intact	Vertebral fragment	2	mammal, large	N/A	N/A	N/A
CS3	11A	Intact	Vetebral centrum fragment	1	mammal, large	N/A	N/A	Unfused
CS3	11A	Intact	Radius fragment	1	mammal, large	N/A	N/A	N/A
CS3	11A	Intact	Long bone fragment	10	mammal, large	N/A	N/A	N/A
CS3	11A	Intact	Pelvic fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	Large cut marks
CS3	11A	Intact	Rib fragment	2	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	11A	Intact	Dental fragment	1	mammal, medium	N/A	N/A	N/A
CS3	11A	Intact	Rib fragment	3	mammal, medium	N/A	N/A	N/A
CS3	11A	Torn, provenance secure	Dental fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	11A	Intact	Cranial fragment	3	mammal, medium to large	N/A	N/A	N/A
CS3	11A	Intact	Caudal vertebra	2	mammal, small	N/A	N/A	N/A
CS3	11A	Intact	Scapula fragment	1	mammal, small (*Rattus* size)	N/A	N/A	N/A
CS3	11A	Intact	Tibia, proximal	2	mammal, small (*Rattus* size)	N/A	N/A	N/A
CS3	11A	Intact	Femur, distal fragment	1	mammal, small (*Rattus* size)	N/A	N/A	N/A
CS3	11A	Intact	Rib fragment	1	mammal, small to medium	N/A	N/A	N/A
CS3	11A	Intact	Femur, proximal	2	*Rattus*	N/A	N/A	N/A
CS3	11A	Intact	Femur	1	*Rattus*	N/A	N/A	Complete
CS3	11A	Intact	Humerus, distal	1	*Rattus*	N/A	N/A	N/A
CS3	11A	Intact	Incisor fragment	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	11A	Torn, provenance secure	Mandible fragment	1	rodent (*Rattus* size)	N/A	N/A	Including all cheek teeth

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	11A	Intact	Pelvic fragment	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	11A	Intact	Incisor	5	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	11A	Intact	Vertebral fragment	1	small reptile	N/A	N/A	N/A
CS3	11A	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	11A	Intact	Unidentified fragment	3	N/A	N/A	>50	N/A
CS3	11A	Intact	Unidentified fragment	11	N/A	N/A	30-50	N/A
CS3	11A	Intact	Unidentified fragment	~100	N/A	N/A	<30	N/A
CS3	12	Intact	M_3	1	antelope or gazelle	N/A	N/A	N/A
CS3	12	Intact	Humerus, distal	1	bird, medium	N/A	N/A	N/A
CS3	12	Intact	Humerus, proximal fragment	1	bird, medium (*Gallus* size)	N/A	N/A	N/A
CS3	12	Intact	Tibiotarsus fragment	1	bird, medium (*Gallus* size)	N/A	N/A	N/A
CS3	12	Intact	Rib fragment	1	bird, medium to large	N/A	N/A	N/A
CS3	12	Intact	Coracoid fragment	1	bird, medium to large (approx. hawk size)	N/A	N/A	N/A
CS3	12	Intact	Tibiotarsus, proximal	1	bird, small	N/A	N/A	N/A
CS3	12	Intact	Coracoid	1	bird, small	N/A	N/A	N/A
CS3	12	Intact	Radius, proximal	1	bird, small to medium	N/A	N/A	N/A
CS3	12	Intact	Humerus fragment	1	bird, small to medium	N/A	N/A	N/A
CS3	12	Intact	Tibia, distal	1	*Bos*	N/A	N/A	Large cut marks
CS3	12	Intact	Cervical vertebra fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	12	Intact	Vertebral fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	12	Intact	Radius fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	12	Intact	Carpal	1	*Bos* or *Bubalus*	N/A	N/A	Broken
CS3	12	Intact	Calcaneum fragment	1	*Bubalus*	N/A	N/A	N/A
CS3	12	Intact	Vertebra	9	fish, large	N/A	N/A	N/A
CS3	12	Intact	Cranial fragment	2	fish, large	N/A	N/A	N/A
CS3	12	Intact	Spine fragment	1	fish, large	N/A	N/A	N/A
CS3	12	Intact	Vertebra	3	fish, medium	N/A	N/A	N/A
CS3	12	Intact	Cranial fragment	9	fish, medium	N/A	N/A	N/A
CS3	12	Intact	Dentary fragment	1	fish, medium	N/A	N/A	N/A
CS3	12	Intact	Spine fragment	2	fish, medium to large	N/A	N/A	N/A
CS3	12	Intact	Spine	1	fish, small	N/A	N/A	Serrations on inside curve
CS3	12	Intact	Vertebra	7	fish, small to medium	N/A	N/A	N/A
CS3	12	Intact	Spine fragment	6	fish, small to medium	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	12	Intact	Incisor	5	*Lepus*	N/A	N/A	N/A
CS3	12	Intact	Carapace fragment	1	*Lissemys*	N/A	N/A	N/A
CS3	12	Intact	Plastron fragment	2	*Lissemys*	N/A	N/A	N/A
CS3	12	Intact	Thoracic vertebra fragment	1	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Dental fragment	1	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Vertebral fragment	6	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	Unfused
CS3	12	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Cranial fragment	1	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Metapodial fragment	1	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Long bone fragment	10	mammal, large	N/A	N/A	N/A
CS3	12	Intact	Scapula, glenoid process fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	12	Intact	Rib head fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	12	Intact	Vertebral fragment	2	mammal, medium	N/A	N/A	N/A
CS3	12	Intact	Rib fragment	7	mammal, medium	N/A	N/A	N/A
CS3	12	Intact	Tibia, proximal fragment	1	mammal, medium	N/A	N/A	N/A
CS3	12	Intact	Tibia fragment	1	mammal, medium	N/A	N/A	N/A
CS3	12	Intact	1st phalanx fragment	1	mammal, medium (not artiodactyl)	N/A	N/A	N/A
CS3	12	Intact	Cranial fragment	3	mammal, medium to large	N/A	N/A	N/A
CS3	12	Intact	Humerus, distal fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	12	Intact	Mandible fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	12	Intact	Caudal vertebra	3	mammal, small	N/A	N/A	N/A
CS3	12	Intact	1st phalanx	1	mammal, small	N/A	N/A	N/A
CS3	12	Intact	Femur fragment	1	mammal, small (not rodent)	N/A	N/A	N/A
CS3	12	Intact	Vertebral fragment	3	mammal, small to medium	N/A	N/A	N/A
CS3	12	Intact	Rib head	1	mammal, small to medium	N/A	N/A	N/A
CS3	12	Intact	Tibia	1	mammal, very small (*Mus* size)	N/A	N/A	N/A
CS3	12	Intact	Shell fragment	~5	mollusk	N/A	N/A	N/A
CS3	12	Intact	Pelvic fragment	6	*Rattus*	N/A	N/A	N/A
CS3	12	Intact	Femur	1	*Rattus*	N/A	N/A	N/A
CS3	12	Intact	Femur, proximal fragment	6	*Rattus*	N/A	N/A	N/A
CS3	12	Intact	Mandible	5	*Rattus*	N/A	N/A	Almost complete, including molars and incisor
CS3	12	Intact	Humerus fragment	4	*Rattus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	12	Intact	Tibia fragment	5	*Rattus*	N/A	N/A	N/A
CS3	12	Intact	Mandible	1	rodent (*Rattus* size)	N/A	N/A	Molars intact, incisor broken
CS3	12	Intact	Incisor	6	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	12	Intact	Mandible fragment	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	12	Intact	Femur, distal fragment	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	12	Intact	Scapula fragment	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	12	Intact	Vertebra	2	shark (very small)	N/A	N/A	N/A
CS3	12	Intact	Vertebra	1	snake	N/A	N/A	N/A
CS3	12	Intact	Plastron fragment	1	*Trionyx*	N/A	N/A	Burnt white
CS3	12	Intact	Unidentified fragment	~30	N/A	N/A	<30	N/A
CS3	12	Intact	Unidentified fragment	~40	N/A	N/A	<30	N/A
CS3	12	Intact	Unidentified fragment	4	N/A	N/A	>50	N/A
CS3	12	Intact	Unidentified fragment	~20	N/A	N/A	30-50	N/A
CS3	12	Intact	Unidentified fragment	~100	N/A	N/A	<30	N/A
CS3	13	Intact	Rib	1	bird, medium	N/A	N/A	N/A
CS3	13	Intact	Radius, proximal	1	bird, medium (pigeon size)	N/A	N/A	N/A
CS3	13	Intact	Humerus, distal	1	bird, small	N/A	N/A	N/A
CS3	13	Intact	Humerus, proximal	1	bird, small	N/A	N/A	N/A
CS3	13	Intact	Long bone fragment	3	bird, small to medium	N/A	N/A	N/A
CS3	13	Intact	Radius, proximal	1	*Bos*	N/A	N/A	N/A
CS3	13	Intact	Radius, proximal fragment	1	*Bos*	N/A	N/A	Not same individual as above
CS3	13	Intact	Ulna, proximal fragment	1	*Bos*	N/A	N/A	Cut marks on blade and articular surface
CS3	13	Torn, provenance secure	M_3, deciduous	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Torn, provenance secure	M_3, left	1	*Bos* or *Bubalus*	N/A	N/A	Broken
CS3	13	Torn, provenance secure	M_1 or M_2, right	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Torn, provenance secure	Upper premolar	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Torn, provenance secure	M_1 or M_2	1	*Bos* or *Bubalus*	N/A	N/A	Crown broken off, 4 holes (probably natural)
CS3	13	Intact	Pelvic fragment, acetabulum	1	*Bos* or *Bubalus*	N/A	N/A	Broken into 2 pieces
CS3	13	Intact	2nd phalanx, distal fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Intact	Scapula fragment, glenoid fosa	1	*Bos* or *Bubalus*	N/A	N/A	Burnt black

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	13	Intact	Femur, proximal epiphysis (head)	1	*Bos* or *Bubalus*	N/A	N/A	Unfused
CS3	13	Intact	Lumbar vertebra	1	*Bos* or *Bubalus*	N/A	N/A	Unfused
CS3	13	Intact	Mandible fragment	3	*Bos* or *Bubalus*	N/A	N/A	Including dental alveoli
CS3	13	Intact	Lower premolar, deciduous	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Intact	Thoracic vertebra, spine fragment	7	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Intact	Mandible fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13	Intact	Calcaneum, distal fragment	1	*Bubalus*	N/A	N/A	N/A
CS3	13	Intact	3rd phalanx	1	*Bubalus*	N/A	MBS-21.0, Ld-52.4	Almost complete
CS3	13	Intact	Calcaneum, distal	1	*Bubalus*	N/A	N/A	Not same individual as above
CS3	13	Intact	Upper canine	1	*Canis lupus*	N/A	N/A	N/A
CS3	13	Intact	Plastron fragment	2	*Chitra*	N/A	N/A	N/A
CS3	13	Torn, provenance secure	I^2, left	1	*Equus*	N/A	N/A	N/A
CS3	13	Intact	Spine fragment	7	fish	N/A	N/A	N/A
CS3	13	Intact	Vertebral fragment	1	fish, large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	3	fish, large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	5	fish, large	N/A	N/A	N/A
CS3	13	Intact	Spine fragment	1	fish, large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	4	fish, large	N/A	N/A	N/A
CS3	13	Intact	Spine fragment	8	fish, large	N/A	N/A	Probably single species, marine, no serrations, channel on inner curve
CS3	13	Intact	Vertebra	1	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Spine	1	fish, medium	N/A	N/A	Burnt black
CS3	13	Intact	Spine	1	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	1	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Vertebra	4	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Vertebra	7	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	6	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Spine fragment	1	fish, medium	N/A	N/A	Serrated on both sides
CS3	13	Intact	Vertebral spine	2	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Spine fragment	4	fish, medium	N/A	N/A	N/A
CS3	13	Intact	Vertebra	9	fish, medium to large	N/A	N/A	N/A
CS3	13	Intact	Vertebra	3	fish, small	N/A	N/A	N/A
CS3	13	Intact	Spine	1	fish, small	N/A	N/A	N/A
CS3	13	Intact	Spine	1	fish, small	N/A	N/A	Burnt black
CS3	13	Intact	Spine fragment	1	fish, small	N/A	N/A	Serrated on interior curve
CS3	13	Intact	Spine	1	fish, small to medium	N/A	N/A	N/A
CS3	13	Intact	Vertebra	1	fish, small to medium	N/A	N/A	N/A
CS3	13	Intact	Spine fragment	7	fish, small to medium	N/A	N/A	N/A
CS3	13	Intact	Dentary fragment	1	fish, very large	N/A	N/A	Probably marine

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	13	Intact	1st phalanx, proximal fragment	1	*Gallus*	N/A	N/A	N/A
CS3	13	Intact	Carapace fragment	1	*Kachuga*	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	1	reptile, large	N/A	N/A	N/A
CS3	13	Intact	Incisor fragment	3	*Lepus*	N/A	N/A	N/A
CS3	13	Intact	Incisor	2	*Lepus*	N/A	N/A	N/A
CS3	13	Intact	Plastron fragment	2	*Lissemys*	N/A	N/A	N/A
CS3	13	Intact	Carapace fragment	1	*Lissemys*	N/A	N/A	N/A
CS3	13	Intact	Plastron fragment	5	*Lissemys*	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	2	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Long bone cancalous bone fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Long bone fragment	2	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Rib fragment	2	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Scapula fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	2	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Pelvic fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Scapula, glenoid process fragment	3	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Radius fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Vertebral fragment	7	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Femur, distal fragment	1	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	6	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Scapula fragment	3	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Carpal fragment	2	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Long bone fragment	11	mammal, large	N/A	N/A	N/A
CS3	13	Intact	Rib fragment	14	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	13	Intact	Tibia, proximal fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	Unfused
CS3	13	Intact	Humerus, proximal fragment	2	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	13	Intact	Astragalus fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	13	Intact	Rib fragment	1	mammal, medium	N/A	N/A	Lightly charred
CS3	13	Intact	Rib fragment	4	mammal, medium	N/A	N/A	N/A
CS3	13	Intact	Mandible fragment	1	mammal, medium	N/A	N/A	N/A
CS3	13	Intact	Scapula fragment	1	mammal, medium	N/A	N/A	N/A
CS3	13	Intact	Vertebral fragment	7	mammal, medium	N/A	N/A	N/A
CS3	13	Intact	Carpal fragment	1	mammal, medium	N/A	N/A	N/A
CS3	13	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	1	mammal, medium to large	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	13	Torn, provenance secure	Dental fragment	3	mammal, medium to large	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	1	mammal, medium to large	N/A	N/A	Cut mark
CS3	13	Intact	Rib head	1	mammal, medium to large	N/A	N/A	N/A
CS3	13	Intact	Dental fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	13	Intact	Vertebral fragment	3	mammal, medium to large	N/A	N/A	N/A
CS3	13	Intact	Long bone fragment	1	mammal, small	N/A	N/A	Unfused
CS3	13	Intact	Calcaneum	1	mammal, small	N/A	N/A	N/A
CS3	13	Intact	Scapula fragment	1	mammal, small	N/A	N/A	N/A
CS3	13	Intact	Ulna	1	mammal, small	N/A	N/A	N/A
CS3	13	Intact	Scapula	1	mammal, small	N/A	N/A	N/A
CS3	13	Intact	Caudal vertebra	1	mammal, small to medium	N/A	N/A	N/A
CS3	13	Intact	Metapodial	1	mammal, small to medium	N/A	N/A	N/A
CS3	13	Intact	Rib fragment	1	mammal, small to medium	N/A	N/A	N/A
CS3	13	Intact	Cranial fragment	1	medium catfish	N/A	N/A	N/A
CS3	13	Torn, provenance secure	Mandible fragment	3	*Rattus*	N/A	N/A	All 3 include I incisor and cheek tooth
CS3	13	Intact	Femur, proximal	1	*Rattus*	N/A	N/A	N/A
CS3	13	Intact	Mandible fragment	1	*Rattus*	N/A	N/A	Including molars
CS3	13	Intact	Femur	3	*Rattus*	N/A	N/A	N/A
CS3	13	Intact	Pelvic fragment	1	*Rattus*	N/A	N/A	N/A
CS3	13	Intact	Tibia	5	*Rattus*	N/A	N/A	N/A
CS3	13	Intact	Cleithrum	1	*Rita*	N/A	N/A	N/A
CS3	13	Intact	Incisor	1	rodent *(Rattus* size)	N/A	N/A	N/A
CS3	13	Intact	Incisor	1	rodent *(Rattus* size)	N/A	N/A	N/A
CS3	13	Intact	Incisor	1	rodent *(Rattus* size)	N/A	N/A	N/A
CS3	13	Intact	Mandible fragment	1	rodent (*Rattus* size)	N/A	N/A	Including molars
CS3	13	Intact	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	13	Intact	Pelvic fragment	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	13	Intact	Maxilla fragment	1	rodent (*Rattus* size)	N/A	N/A	Including molars
CS3	13	Intact	Radius, proximal fragment	1	sheep or goat	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	13	Intact	Astragalus	1	sheep or goat	N/A	GLl-21.0, GLm-20.9, Bd-14.2	N/A
CS3	13	Intact	Humerus fragment	1	sheep or goat	N/A	N/A	N/A
CS3	13	Torn, provenance secure	Molar fragment	1	*Sus*	N/A	N/A	Recently erupted, large individual
CS3	13	Intact	Humerus	1	very small animal	N/A	GL-10.0	N/A
CS3	13	Intact	Unidentified fragment	10	N/A	N/A	<30	N/A
CS3	13	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	13	Intact	Unidentified fragment	12	N/A	N/A	<30	N/A
CS3	13	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	13	Intact	Unidentified fragment	1	N/A	N/A	>50	N/A
CS3	13	Intact	Unidentified fragment	~15	N/A	N/A	30-50	N/A
CS3	13	Intact	Unidentified fragment	~100	N/A	N/A	<30	N/A
CS3	13	Intact	Unidentified fragment	~10	N/A	N/A	>50	N/A
CS3	13	Intact	Unidentified fragment	~50	N/A	N/A	30-50	N/A
CS3	13	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	13A	Intact	Humerus, distal fragment	2	*Axis axis*	N/A	N/A	N/A
CS3	13A	Intact	Tarsometatarsus	1	bird, medium (bigger than pigeon, smaller than chicken)	N/A	N/A	N/A
CS3	13A	Intact	Metatarsal, proximal	1	*Bos*	N/A	Bp-45.3	N/A
CS3	13A	Intact	Cervical vertebra fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13A	Intact	Rib head	2	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13A	Intact	Caudal vertebra	4	*Bos* or *Bubalus*	N/A	N/A	Young individual
CS3	13A	Intact	P^3	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13A	Intact	Vertebral centrum	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	13A	Intact	Cervical vertebra	1	*Canis familiaris*	N/A	N/A	N/A
CS3	13A	Intact	Metapodial	1	*Canis familiaris*	N/A	N/A	N/A
CS3	13A	Intact	Cranial fragment	1	fish	N/A	N/A	N/A
CS3	13A	Intact	Vertebra	1	fish, extremely large	N/A	N/A	Marine
CS3	13A	Intact	Vertebra	3	fish, large	N/A	N/A	N/A
CS3	13A	Intact	Vertebral fragment	1	fish, medium	N/A	N/A	N/A
CS3	13A	Intact	Spine	4	fish, medium	N/A	N/A	From 4 different species
CS3	13A	Intact	Vertebral fragment	1	fish, medium	N/A	N/A	N/A
CS3	13A	Intact	Fish bone fragment	1	fish, medium	N/A	N/A	Burnt white
CS3	13A	Intact	Cranial fragment	1	fish, medium to large	N/A	N/A	N/A
CS3	13A	Intact	Cranial fragment	4	fish, medium to large	N/A	N/A	N/A
CS3	13A	Intact	Cranial fragment	4	fish, medium to large	N/A	N/A	N/A
CS3	13A	Intact	Spine	2	fish, small	N/A	N/A	N/A
CS3	13A	Intact	Spine	1	fish, small	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	13A	Intact	Vertebra	1	fish, small to medium	N/A	N/A	N/A
CS3	13A	Intact	Spine	1	fish, small to medium	N/A	N/A	N/A
CS3	13A	Intact	Cranial fragment	1	fish, small to medium	N/A	N/A	N/A
CS3	13A	Intact	Incisor	3	*Lepus*	N/A	N/A	N/A
CS3	13A	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
CS3	13A	Intact	Rib fragment	3	mammal, large	N/A	N/A	N/A
CS3	13A	Intact	Pelvic fragment	1	mammal, large	N/A	N/A	N/A
CS3	13A	Intact	Vertebral fragment	4	mammal, large	N/A	N/A	N/A
CS3	13A	Intact	Cranial fragment	2	mammal, large	N/A	N/A	N/A
CS3	13A	Intact	Tibia fragment	3	mammal, large	N/A	N/A	N/A
CS3	13A	Intact	Long bone fragment	1	mammal, large	N/A	N/A	N/A
CS3	13A	Intact	Long bone fragment	2	mammal, large	N/A	N/A	Burnt black
CS3	13A	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Worked, cut marks (probably for tool-making purpose), polished edge
CS3	13A	Intact	Cranial fragment	1	mammal, medium	N/A	N/A	N/A
CS3	13A	Intact	Rib fragment	3	mammal, medium	N/A	N/A	N/A
CS3	13A	Intact	Long bone fragment	2	mammal, medium	N/A	N/A	N/A
CS3	13A	Intact	Vertebral fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	13A	Intact	Femur	1	mammal, small	N/A	N/A	Unfused
CS3	13A	Intact	Rib	1	mammal, small	N/A	N/A	N/A
CS3	13A	Intact	Caudal vertebra	1	mammal, small	N/A	N/A	N/A
CS3	13A	Intact	Metapodial	1	mammal, small (cat size)	N/A	N/A	N/A
CS3	13A	Intact	Tibia	1	mammal, small (*Rattus* size)	N/A	N/A	N/A
CS3	13A	Intact	Mandible	1	*Rattus*	N/A	N/A	Almost complete
CS3	13A	Intact	Pelvic fragment	2	*Rattus*	N/A	N/A	N/A
CS3	13A	Intact	Tibia fragment	1	*Rattus*	N/A	N/A	N/A
CS3	13A	Intact	Femur	1	*Rattus*	N/A	N/A	N/A
CS3	13A	Intact	Femur fragment	2	*Rattus*	N/A	N/A	N/A
CS3	13A	Intact	Humerus fragment	1	*Rattus*	N/A	N/A	N/A
CS3	13A	Intact	Vertebra	2	reptile, small to medium	N/A	N/A	N/A
CS3	13A	Intact	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	13A	Intact	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	13A	Intact	Astragalus	1	sheep or goat	N/A	GLl-34.9, GLm-30.9, D1-18.1	Complete
CS3	13A	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
CS3	13A	Intact	Unidentified fragment	~40	N/A	N/A	<30	N/A
CS3	13A	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	13A	Intact	Unidentified fragment	~40	N/A	N/A	<30	N/A
CS3	13A	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
CS3	13A	Intact	Unidentified fragment	~40	N/A	N/A	<30	N/A
CS3	13A	Intact	Worked bone (point)	1	N/A	N/A	N/A	N/A
CS3	13A	Intact	Unidentified fragment	9	N/A	N/A	>50	N/A
CS3	13A	Intact	Unidentified fragment	~20	N/A	N/A	30-50	N/A
CS3	13A	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	14	Intact	1st phalanx	1	*Bos*	N/A	GLpe-58.5, Bp-27.6, SD-23.7, Bd-26.2	N/A
CS3	14	Intact	1st phalanx	1	*Bos*	N/A	GLpe-52.6, Bd-26.5	Broken, belongs to Individual A
CS3	14	Intact	2nd phalanx	1	*Bos*	N/A	GL-38.7, Bp-27.7, SD-23.8(?), Bd-23.2	Complete, belongs to Individual A
CS3	14	Intact	3rd phalanx	1	*Bos*	N/A	DLS-60.2, Ld-48.2, MBS-18.9	Complete, belongs to Individual A
CS3	14	Intact	Astragalus	1	*Bos*	N/A	GLl-61.8	N/A
CS3	14	Intact	Radius fragment, proximal	1	*Bos* or *Bubalus*	N/A	N/A	2 pieces refit, ancient break
CS3	14	Intact	Rib head	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	14	Intact	Sesamoid	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	14	Intact	Cuneiform	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	14	Intact	Lunate	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	14	Intact	1st phalanx, distal fragment	1	*Bubalus*	N/A	Bd-31.5	N/A
CS3	14	Intact	Antler fragment	1	cervid	N/A	N/A	N/A
CS3	14	Intact	Vertebra	3	fish, medium to large	N/A	N/A	N/A
CS3	14	Intact	Cranial fragment	3	fish, medium to large	N/A	N/A	N/A
CS3	14	Intact	Incisor	1	*Lepus*	N/A	N/A	N/A
CS3	14	Intact	Vertebral fragment	5	mammal, large	N/A	N/A	N/A
CS3	14	Intact	Tibia fragment	2	mammal, large	N/A	N/A	Probably same bone, no refit
CS3	14	Intact	Long bone fragment	1	mammal, large	N/A	N/A	N/A
CS3	14	Intact	Vertebral fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	14	Intact	Rib fragment	5	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	14	Intact	Rib fragment	3	mammal, medium	N/A	N/A	N/A
CS3	14	Intact	Dental fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	14	Intact	Pelvic fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	14	Intact	1st phalanx	1	mammal, small (cat size)	N/A	N/A	N/A
CS3	14	Intact	Pelvic fragment	1	*Rattus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	14	Intact	Tibia	2	*Rattus*	N/A	N/A	N/A
CS3	14	Intact	Tibia, distal fragment	1	*Sus*	N/A	Bd-27.0	Large individual
CS3	14	Intact	Unidentified fragment	24	N/A	N/A	<30	N/A
CS3	14	Intact	Unidentified fragment	15	N/A	N/A	<30	N/A
CS3	14	Intact	Unidentified fragment	~20	N/A	N/A	30-50	N/A
CS3	14	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	15	Intact	Horn core	1	*Bos*	N/A	N/A	N/A
CS3	15	Intact	Cranial fragment	7	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	15	Intact	Vertebral fragment	1	fish, large	N/A	N/A	N/A
CS3	15	Intact	Cranial fragment	1	fish, medium	N/A	N/A	N/A
CS3	15	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
CS3	15	Intact	Long bone fragment	9	mammal, large	N/A	N/A	N/A
CS3	15	Intact	Metapodial fragment	1	mammal, large	N/A	N/A	N/A
CS3	15	Intact	Tibia, proximal fragment	1	mammal, large	N/A	N/A	N/A
CS3	15	Intact	Femur, proximal fragment	2	mammal, large	N/A	N/A	N/A
CS3	15	Intact	Rib fragment	2	mammal, medium	N/A	N/A	N/A
CS3	15	Intact	Humerus, distal	1	*Rattus*	N/A	N/A	N/A
CS3	15	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
CS3	15	Intact	Unidentified fragment	8	N/A	N/A	30-50	N/A
CS3	15	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	16	Intact	1st phalanx, proximal	1	*Bos* or *Bubalus*	N/A	Bp-30.5	N/A
CS3	16	Intact	M^1 or M^2	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	16	Intact	Centrotarsal fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	16	Intact	2nd phalanx	1	*Equus*	N/A	GL-46.4, Bp-53.5, Dp-30.0, SD-45.9, Bd-47.1	Complete
CS3	16	Intact	Radius, proximal fragment	1	mammal, large	N/A	N/A	N/A
CS3	16	Intact	Dental fragment	5	mammal, large	N/A	N/A	N/A
CS3	16	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS3	16	Intact	Cranial fragment	1	mammal, large	N/A	N/A	N/A
CS3	16	Intact	Femur, proximal fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	16	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
CS3	16	Intact	Femur, distal fragment	1	mammal, small	N/A	N/A	N/A
CS3	16	Intact	Ulna fragment	1	mammal, small	N/A	N/A	N/A
CS3	16	Intact	M^1 or M^2	1	*Sus*	N/A	N/A	Attached maxilla fragment
CS3	16	Intact	Unidentified fragment	3	N/A	N/A	<30	N/A
CS3	16	Intact	Unidentified fragment	13	N/A	N/A	<30	N/A
CS3	16	Intact	Unidentified fragment	2	N/A	N/A	>50	N/A
CS3	16	Intact	Unidentified fragment	6	N/A	N/A	30-50	N/A
CS3	16	Intact	Unidentified fragment	~30	N/A	N/A	<30	N/A
CS3	17	Intact	Metapodial fragment	1	artiodactyl, medium	N/A	N/A	N/A
CS3	17	Intact	1st phalanx, distal fragment	1	*Bos or Bubalus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	17	Intact	1st phalanx	1	*Bubalus*	N/A	GLpe-61.1, SD-29.5, Bd-34.5	Almost complete
CS3	17	Intact	Vertebral fragment	2	mammal, large	N/A	N/A	N/A
CS3	17	Intact	Mandible fragment	1	mammal, large	N/A	N/A	N/A
CS3	17	Intact	Long bone fragment	4	mammal, large	N/A	N/A	N/A
CS3	17	Torn, provenance secure	Vertebral fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	17	Intact	Scapula fragment	1	mammal, medium	N/A	N/A	N/A
CS3	17	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	N/A
CS3	17	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	17	Torn, provenance secure	Long bone fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	17	Intact	Tibia fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	17	Intact	Cranial fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	17	Intact	Femur	1	*Rattus*	N/A	N/A	N/A
CS3	17	Intact	Incisor	1	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	17	Intact	Vertebra	1	snake	N/A	N/A	Burnt black
CS3	17	Torn, provenance secure	Incisor fragment	1	*Sus*	N/A	N/A	Burnt white, broken post-fire
CS3	17	Intact	Metapodial, distal	1	*Sus*	N/A	Bd-14.5	N/A
CS3	17	Intact	Vertebra	2	*Varanus*	N/A	N/A	N/A
CS3	17	Intact	Unidentified fragment	3	N/A	N/A	<30	N/A
CS3	17	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt white
CS3	17	Torn, provenance secure	Unidentified fragment	3	N/A	N/A	<30	N/A
CS3	17	Intact	Unidentified fragment	1	N/A	N/A	>50	N/A
CS3	17	Intact	Unidentified fragment	~10	N/A	N/A	30-50	N/A
CS3	17	Intact	Unidentified fragment	~40	N/A	N/A	<30	N/A
CS3	18	Intact	1st phalanx	1	*Bos*	N/A	N/A	Almost complete
CS3	18	Torn, provenance secure	Dental fragment	1	*Bos* or *Bubalus*	N/A	N/A	Extremely worn
CS3	18	Intact	Radius, proximal	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	Radius, shaft fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	1st phalanx, distal fragment	3	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	Mandible fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	Tibia, distal fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	I_2	1	*Bos* or *Bubalus*	Old	N/A	Very worn
CS3	18	Intact	Mandibular molar fragment	1	*Bos* or *Bubalus*	Old	N/A	Crown almost completely worn

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	18	Intact	Vertebral fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	3rd phalanx, proximal	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	18	Intact	1st phalanx	1	*Bubalus*	N/A	N/A	Almost complete
CS3	18	Intact	2nd phalanx	1	*Canis*	N/A	N/A	N/A
CS3	18	Torn, provenance secure	Cranial fragment	1	fish	N/A	N/A	N/A
CS3	18	Intact	Cranial fragment	1	fish, extremely large	N/A	N/A	Marine
CS3	18	Intact	Vertebra	1	fish, medium	N/A	N/A	N/A
CS3	18	Torn, provenance secure	Spine	1	fish, small	N/A	N/A	Burnt black
CS3	18	Intact	Cranial fragment	2	mammal, large	N/A	N/A	N/A
CS3	18	Intact	Tibia fragment	1	mammal, large	N/A	N/A	N/A
CS3	18	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	Burnt white
CS3	18	Intact	Rib head	1	mammal, medium	N/A	N/A	N/A
CS3	18	Intact	Scapula fragment	1	mammal, medium	N/A	N/A	N/A
CS3	18	Intact	Tibia, distal fragment	2	mammal, medium	N/A	N/A	N/A
CS3	18	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	N/A
CS3	18	Torn, provenance secure	Cancelous bone fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	18	Torn, provenance secure	Dental fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	18	Intact	Cranial fragment	1	mammal, medium to large	N/A	N/A	N/A
CS3	18	Intact	Vertebral fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	18	Intact	Tibia fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	18	Intact	P_3 or P_4	1	*Sus*	N/A	N/A	Worn
CS3	18	Intact	Incisor, bottom	1	*Sus*	N/A	N/A	Very worn, pathology?
CS3	18	Intact	Dental fragment	1	*Sus*	N/A	N/A	N/A
CS3	18	Torn, provenance secure	Molar fragment	2	*Sus*	N/A	N/A	Partly burnt
CS3	18	Intact	Tibia, distal	1	*Sus*	N/A	N/A	N/A
CS3	18	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	Burnt black
CS3	18	Intact	Unidentified fragment	6	N/A	N/A	<30	N/A
CS3	18	Intact	Unidentified fragment	9	N/A	N/A	>50	N/A
CS3	18	Intact	Unidentified fragment	~15	N/A	N/A	30-50	N/A
CS3	18	Intact	Unidentified fragment	~30	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	19	Intact	Tibiotarsus, distal fragment	1	bird, medium (pigeon size)	N/A	N/A	N/A
CS3	19	Intact	2nd phalanx	2	*Bos*	N/A	N/A	From 2 different individuals
CS3	19	Intact	P_2	2	*Bos*	N/A	N/A	N/A
CS3	19	Intact	M_3, right	1	*Bos* or *Bubalus*	N/A	N/A	Burnt black
CS3	19	Intact	I_2, right	1	*Bos* or *Bubalus*	N/A	N/A	Burnt black, worn
CS3	19	Torn, provenance secure	I_2	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	19	Intact	Metapodial, distal fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	19	Intact	Carpal	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	19	Intact	Calcaneum fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	19	Intact	Radius fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	19	Intact	Carpal	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	19	Intact	I_3	1	*Bos* or *Bubalus*	N/A	N/A	Extremely worn
CS3	19	Intact	Cheek tooth fragment	1	*Canis*	N/A	N/A	Broken into 2 pieces, burnt black
CS3	19	Intact	M^1, right	1	*Canis familiaris*	N/A	N/A	Broken, burnt black
CS3	19	Intact	Cranial fragment	5	fish	N/A	N/A	Burnt black
CS3	19	Intact	Vertebra	1	fish, medium	N/A	N/A	N/A
CS3	19	Intact	Spine fragment	1	fish, medium to large	N/A	N/A	N/A
CS3	19	Intact	Cranial fragment	1	fish, medium to large	N/A	N/A	N/A
CS3	19	Intact	Vertebra	1	fish, small	N/A	N/A	N/A
CS3	19	Intact	Spine	1	fish, small	N/A	N/A	Burnt black
CS3	19	Torn, provenance secure	Spine	1	fish, small	N/A	N/A	Burnt black, serrations on one side
CS3	19	Intact	Spine	1	fish, small to medium	N/A	N/A	Burnt black, serrations on one side
CS3	19	Intact	Cranial fragment	1	fish, very large	N/A	N/A	Marine
CS3	19	Intact	Humerus	1	*Gallus*	N/A	GL-49.6	Small individual
CS3	19	Intact	Plastron fragment	2	*Lissemys*	N/A	N/A	N/A
CS3	19	Intact	Dental fragment	1	mammal, large	N/A	N/A	N/A
CS3	19	Intact	Long bone fragment	2	mammal, large	N/A	N/A	N/A
CS3	19	Intact	Femur, distal epiphysis	1	mammal, large	Juvenile	N/A	Unfused
CS3	19	Intact	Long bone fragment	1	mammal, large	N/A	N/A	N/A
CS3	19	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
CS3	19	Intact	Cranial fragment	3	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	19	Intact	Tibia fragment	1	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	19	Intact	Vertebral fragment	1	mammal, medium	N/A	N/A	N/A
CS3	19	Intact	Rib fragment	3	mammal, medium	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	19	Intact	Humerus, distal fragment	1	mammal, medium	N/A	N/A	N/A
CS3	19	Intact	Femur, proximal fragment	1	mammal, medium	N/A	N/A	N/A
CS3	19	Intact	Vertebral fragment	1	mammal, medium	N/A	N/A	N/A
CS3	19	Intact	Metapodial	1	mammal, medium	Juvenile	N/A	Unfused
CS3	19	Intact	Cranial fragment	7	mammal, medium to large	N/A	N/A	N/A
CS3	19	Intact	Maxilla fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	19	Intact	2nd phalanx fragment	1	mammal, small to medium	N/A	N/A	N/A
CS3	19	Intact	Shell fragment	10	mollusk	N/A	N/A	N/A
CS3	19	Torn, provenance secure	Mandible fragment	1	*Rattus*	N/A	N/A	Including incisor and 2 molars
CS3	19	Torn, provenance secure	Mandible, right	1	shrew	N/A	N/A	N/A
CS3	19	Torn, provenance secure	M^3, deciduous	1	*Sus*	N/A	L-27.8, B-16.2	Recently erupted, large individual, burnt black
CS3	19	Torn, provenance secure	Lower incisor	2	*Sus*	N/A	N/A	N/A
CS3	19	Intact	Tibia, proximal epiphysis	1	*Sus*	N/A	N/A	Unfused
CS3	19	Intact	Unidentified fragment	4	N/A	N/A	<30	N/A
CS3	19	Intact	Unidentified fragment	12	N/A	N/A	<30	Burnt black
CS3	19	Intact	Unidentified fragment	4	N/A	N/A	>50	N/A
CS3	19	Intact	Unidentified fragment	4	N/A	N/A	30-50	N/A
CS3	19	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	19	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt white
CS3	19	Intact	Unidentified fragment	1	N/A	N/A	30-50	Burnt black
CS3	19	Intact	Unidentified fragment	6	N/A	N/A	30-50	N/A
CS3	19	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	20	Intact	Femur, proximal	1	*Anser* (probably)	N/A	N/A	N/A
CS3	20	Intact	Rib fragment	1	bird, medium	N/A	N/A	N/A
CS3	20	Intact	Long bone fragment	2	bird, medium	N/A	N/A	N/A
CS3	20	Intact	Femur, distal	1	bird, small	N/A	N/A	N/A
CS3	20	Intact	M^1 or M^2	2	*Bos* or *Bubalus*	N/A	N/A	From 2 different individuals, both burnt (one more than the other)
CS3	20	Intact	Femur, proximal (head) fragment	2	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	20	Intact	M^2	1	*Canis familiaris*	N/A	N/A	Burnt partly black
CS3	20	Intact	I^3	1	*Canis familiaris*	N/A	N/A	N/A
CS3	20	Intact	Spine fragment	1	fish, large	N/A	N/A	N/A
CS3	20	Intact	Vertebra	5	fish, medium	N/A	N/A	N/A
CS3	20	Intact	Dentary fragment	1	fish, medium to large	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	20	Torn, provenance secure	Spine	1	fish, small	N/A	N/A	Burnt black
CS3	20	Torn, provenance secure	Vertebral fragment	1	fish, small	N/A	N/A	N/A
CS3	20	Intact	Spine	1	fish, small	N/A	N/A	Burnt black, serrations on one side
CS3	20	Intact	Spine fragment	1	fish, small	N/A	N/A	Serrations on interior curve
CS3	20	Torn, provenance secure	Cranial fragment	2	fish, small to medium	N/A	N/A	N/A
CS3	20	Torn, provenance secure	Vertabra	1	fish, very small	N/A	N/A	Burnt black
CS3	20	Intact	Shell fragment	2	*Lamellidens*	N/A	N/A	N/A
CS3	20	Intact	Carapace fragment	6	*Lissemys*	N/A	N/A	N/A
CS3	20	Intact	Worked bone, prob. Pelvis	1	mammal, large	N/A	N/A	Polished on both faces and on edge, broken, many cut marks on one face
CS3	20	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
CS3	20	Intact	Cervical vertebra fragment	1	mammal, large	N/A	N/A	N/A
CS3	20	Intact	Mandible fragment	1	mammal, large	N/A	N/A	N/A
CS3	20	Intact	Long bone fragment	10	mammal, large	N/A	N/A	1 burnt black
CS3	20	Intact	Dental fragment	3	mammal, medium	N/A	N/A	N/A
CS3	20	Intact	Rib head	1	mammal, medium	N/A	N/A	N/A
CS3	20	Intact	Rib fragment	2	mammal, medium	N/A	N/A	N/A
CS3	20	Intact	Cranial fragment	3	mammal, medium to large	N/A	N/A	N/A
CS3	20	Intact	Vertebral fragment	2	mammal, medium to large	N/A	N/A	N/A
CS3	20	Torn, provenance secure	Vertebral fragment	1	mammal, small	N/A	N/A	Burnt black
CS3	20	Torn, provenance secure	Scapula fragment	1	mammal, small	N/A	N/A	N/A
CS3	20	Intact	1st phalanx	1	mammal, small	N/A	N/A	N/A
CS3	20	Intact	Femur, proximal	1	*Rattus*	N/A	N/A	N/A
CS3	20	Intact	Pelvic fragment, ischium	1	sheep or goat	N/A	N/A	Cut marks
CS3	20	Intact	Molar fragment	1	*Sus*	N/A	N/A	Partly burnt black
CS3	20	Intact	Lower incisor	1	*Sus*	N/A	N/A	Burnt black
CS3	20	Intact	Canine fragment	1	*Sus*	N/A	N/A	N/A
CS3	20	Intact	Metapodial fragment	1	*Sus*	N/A	N/A	N/A
CS3	20	Torn, provenance secure	2nd phalanx	1	unknown small animal, probably mammal	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	20	Torn, provenance secure	Unidentified fragment	4	N/A	N/A	<30	N/A
CS3	20	Torn, provenance secure	Unidentified fragment	16	N/A	N/A	<30	Burnt black
CS3	20	Intact	Unidentified fragment	3	N/A	N/A	>50	N/A
CS3	20	Intact	Unidentified fragment	~15	N/A	N/A	30-50	N/A
CS3	20	Intact	Unidentified fragment	~50	N/A	N/A	<30	N/A
CS3	21	Intact	M^1 or M^2	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	21	Intact	Mandible fragment	1	*Bos* or *Bubalus*	N/A	N/A	Including dental alveoli
CS3	21	Intact	Magnum	1	*Bubalus*	N/A	N/A	N/A
CS3	21	Intact	Cranial fragment	2	fish, medium to large	N/A	N/A	N/A
CS3	21	Intact	Vertebra	1	fish, small	N/A	N/A	N/A
CS3	21	Intact	Mandible fragment	2	mammal, large	N/A	N/A	N/A
CS3	21	Intact	Long bone fragment	4	mammal, large	N/A	N/A	N/A
CS3	21	Intact	Rib fragment	5	mammal, large (*Bos/Bubalus* size)	N/A	N/A	N/A
CS3	21	Intact	Cranial fragment	5	mammal, medium to large	N/A	N/A	N/A
CS3	21	Intact	Caudal vertebra	1	mammal, small	N/A	N/A	N/A
CS3	21	Torn, provenance secure	Operculum fragment	5+	*Pila*	N/A	N/A	Whitened (sun-bleached?) But don't appear burnt
CS3	21	Intact	Incisor fragment	1	*Sus*	N/A	N/A	N/A
CS3	21	Intact	Unidentified fragment	8	N/A	N/A	<30	N/A
CS3	21	Intact	Unidentified fragment	8	N/A	N/A	30-50	N/A
CS3	21	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	Long bone fragment	5	bird, medium	N/A	N/A	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	Premolar, deciduous	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	P^2	1	*Bos* or *Bubalus*	N/A	N/A	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	M_1	1	*Bos* or *Bubalus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
CS3	9, 10C, 11A, 13A	Torn and mixed	Incisor	1	human	N/A	N/A	Shovel shaped incisor
CS3	9, 10C, 11A, 13A	Torn and mixed	Pelvic fragment	1	mammal, large	N/A	N/A	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	Dental fragment	1	mammal, medium	N/A	N/A	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	Mandible fragment	3	rodent (*Rattus* size)	N/A	N/A	2 include incisors and molars
CS3	9, 10C, 11A, 13A	Torn and mixed	Incisor fragment	6	rodent (*Rattus* size)	N/A	N/A	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	M_1 or M_2, deciduous	1	*Sus*	N/A	N/A	Recently erupted, small individual
CS3	9, 10C, 11A, 13A	Torn and mixed	Unidentified fragment	1	N/A	N/A	>50	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	Unidentified fragment	4	N/A	N/A	30-50	N/A
CS3	9, 10C, 11A, 13A	Torn and mixed	Unidentified fragment	~100	N/A	N/A	<30	N/A
1, A	2	Intact	Long bone fragment	1	large mammal	N/A	N/A	Burnt
1, A	2	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	Fresh breaks
1, A	2	Torn, provenance secure	Unidentified fragment	11	N/A	N/A	<30	Fresh breaks
1, A	3	Torn, provenance secure	Molar	1	*Bos* or *Bubalus*	N/A	N/A	Broken

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, A	3	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
1, A	4	Torn, provenance secure	Molar fragment	1	*Bos* or *Bubalus*	N/A	N/A	Broken into 2 fragments
1, A	4	Torn, provenance secure	Long bone fragment	2	large mammal	N/A	N/A	Fresh breaks, no obvious refit
1, A	4	Torn, provenance secure	Unidentified fragment	6	N/A	N/A	<30	N/A
1, A	4	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
1, A	5	Torn, provenance secure	Cancelous bone fragment	1	large mammal	N/A	N/A	N/A
1, A	5	Badly torn, may include out of context material	Scapula fragment	1	large mammal (*Bos* or *Bubalus* size)	N/A	N/A	Broken into 3 pieces with refits
1, A	5	Badly torn, may include out of context material	Unidentified fragment	4	N/A	N/A	<30	N/A
1, A	6	Torn, provenance secure	Unidentified fragment	6	N/A	N/A	<30	Burnt
1, A	6 and 9	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench A	Cheek tooth fragment	4	*Bos* or *Bubalus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, A	6 and 9	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench A	Rib fragment	2	large mammal	N/A	N/A	N/A
1, A	6 and 9	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench A	Cancelous bone fragment	2	large mammal	N/A	N/A	N/A
1, A	6 and 9	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench A	Unidentified fragment	~30	N/A	N/A	<30	N/A
1, A	6 and 9	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench A	Long bone fragment	2	medium to large mammal	N/A	N/A	N/A
1, A	8	Torn, provenance secure	Molar	1	*Bos* or *Bubalus*	N/A	N/A	Broken into approximately 10 fragments in addition to main body of tooth
1, A	8	Torn, provenance secure	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, A	8	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
1, A	16	Intact	Unidentified fragment	~5	N/A	N/A	30-50	Embedded in brown clay, very friable
1, A	16	Intact	Unidentified fragment	~30	N/A	N/A	<30	Embedded in brown clay, very friable
1, A	17	Torn, provenance secure	Unidentified fragment	~10	N/A	N/A	<30	N/A
1, A	20	Torn, provenance secure	Cancelous bone fragment	1	N/A	N/A	N/A	N/A
1, A	26	Torn, provenance secure	Long bone fragment	2	large mammal	N/A	N/A	N/A
1, A	26	Intact	Cheek tooth fragment	1	large mammal	N/A	N/A	Broken into 5 pieces
1, A	26	Torn, provenance secure	Long bone fragment	1	medium to large mammal	N/A	N/A	N/A
1, A	26	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
1, A	27	Badly torn, may include out of context material	Molar fragment	1	*Bos* or *Bubalus*	N/A	N/A	N/A
1, A	27	Badly torn, may include out of context material	Long bone fragment	1	large mammal	N/A	N/A	N/A
1, A	27	Torn, provenance secure	Rib fragment	2	medium mammal (sheep/goat size)	N/A	N/A	N/A
1, A	27	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
1, A	27	Badly torn, may include out of context material	Unidentified fragment	12	N/A	N/A	<30	N/A
1, B	2	Torn, provenance secure	Rib fragment	1	large mammal	N/A	N/A	Broken into 2 fragments and small bits, refit
1, B	4	Intact	Cheek tooth fragment	1	*Bos or Bubalus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, B	8	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	N/A
1, B	8	Torn, provenance secure	Long bone fragment	1	medium mammal	N/A	N/A	Charred
1, B	8	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	Burnt white
1, B	4 and 13	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench B	Sacrum fragment	1	large mammal	N/A	N/A	N/A
1, B	4 and 13	Badly torn and co-mingled, possibly including material from other torn bags from Op1 Trench B	Unidentified fragment	~15	N/A	N/A	<30	N/A
1, B	13	Intact	Carapace fragment	1	*Chitra indica*	N/A	N/A	Burnt exterior, gnaw marks
1, B	13	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
1, B	13	Torn, provenance secure	Dental fragment	1	large mammal	N/A	N/A	N/A
1, B	13	Torn, provenance secure	Long bone fragment	1	medium mammal	N/A	N/A	N/A
1, B	13	Intact	Rib fragment	1	medium mammal (sheep/goat size)	N/A	N/A	N/A
1, B	13	Torn, provenance secure	M^3, deciduous	1	*Sus*	N/A	N/A	Broken
1, B	13	Torn, provenance secure	Unidentified fragment	13	N/A	N/A	<30	N/A
1, B	13	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, B	14	Intact	Cheek tooth fragment	1	*Sus*	N/A	N/A	N/A
1, B	14	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt
1, B	15	Torn, provenance secure	Dental fragment	1	large mammal	N/A	N/A	N/A
1, B	15	Torn, provenance secure	Unidentified fragment	8	N/A	N/A	<30	N/A
1, B	17	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	Burnt white
1, B	17	Torn, provenance secure	Molar fragment	1	large ruminant	N/A	N/A	Broken
1, B	17	Torn, provenance secure	Dental fragment	1	mammal	N/A	N/A	N/A
1, B	17	Torn, provenance secure	Unidentified fragment	~20	N/A	N/A	<30	N/A
1, B	21	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
1, B	23	Torn, provenance secure	Dental fragment	1	large mammal	N/A	N/A	Broken into 8 pieces
1, B	23	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	Charred
1, B	23	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	N/A
1, B	23	Torn, provenance secure	Unidentified fragment	~15	N/A	N/A	<30	N/A
1, B	25	Torn, provenance secure	Carpal	1	medium to large mammal	N/A	N/A	N/A
1, B	27	Intact	Long bone fragment	1	small to medium mammal	N/A	N/A	N/A
1, B	28	Intact	Axis	1	*Canis domesticus*	N/A	LCDe=39.0	N/A
1, B	28	Intact	Vertebral fragment	1	medium mammal	N/A	N/A	N/A
1, B	28	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
1, B	29	Torn, provenance secure	Long bone fragment	1	medium to large mammal	N/A	N/A	Burnt white
1, B	29	Torn, provenance secure	Unidentified fragment	~15	N/A	N/A	<30	Burnt

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, B	30	Intact	Unidentified fragment	~10	N/A	N/A	<30	N/A
1, D	3	Torn, provenance secure	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
1, D	3	Intact	Long bone fragment	1	large mammal	N/A	<30	Burnt white
1, D	4	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
1, D	5	Torn, provenance secure	Long bone fragment	2	medium to large mammal	N/A	N/A	N/A
1, D	5	Torn, provenance secure	Tibia, proximal fragment, fused	1	nilgai	N/A	N/A	N/A
1, D	5	Torn, provenance secure	Unidentified fragment	9	N/A	N/A	<30	N/A
1, D	6	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
1, D	7	Torn, provenance secure	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken
1, D	7	Torn, provenance secure	Calcaneum fragment	1	nilgai	N/A	N/A	N/A
1, D	7	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	N/A
1, D	7	Torn, provenance secure	Unidentified fragment	~15	N/A	N/A	<30	N/A
1, D	9	Torn, provenance secure	Long bone fragment	2	large mammal	N/A	<30	One burnt white
1, D	9	Torn, provenance secure	Unidentified fragment	14	N/A	N/A	<30	N/A
1, D	18	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
1, E	15	Intact	Carpal	1	medium mammal	N/A	N/A	Burnt black and white
1, E	15	Intact	Unidentified fragment	5	N/A	N/A	<30	Embedded in brown and red clay
1, E	18	Intact	Long bone fragment	5	medium to large mammal	N/A	30-50	N/A
1, E	18	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
1, E	20	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
1, E	22	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	Burnt white

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
1, E	24	Torn, provenance secure	Dental fragment	1	medium to large mammal	N/A	N/A	N/A
1, E	24	Intact	Unidentified fragment	3	N/A	N/A	<30	N/A
1, E	24	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
1, E	25	Intact	Dental fragment	1	medium mammal	N/A	N/A	N/A
1, E	25	Intact	Unidentified fragment	8	N/A	N/A	<30	N/A
1, E	27	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
1, E	27	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
1, E	34	Intact	Unidentified fragment	2	N/A	N/A	<30	Embedded in brown clay
1, E	36	Intact	Long bone fragment	11	large mammal	N/A	30-50	Probably originally one piece
1, E	36	Intact	Metatarsal shaft	1	nilgai	N/A	N/A	Gnaw marks, possibly from dog
1, E	38	Intact	Unidentified fragment	1	N/A	N/A	<30	Charred
1, E	39	Intact	Cancelous bone fragment	2	medium mammal	N/A	N/A	Probably originally one piece
1, E	39	Intact	Unidentified fragment	~20	N/A	N/A	<30	Probably originally one piece
1, E	40	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
2, C	2	Intact	Unidentified fragments	~10	N/A	N/A	<30	N/A
3, F	3	Torn, provenance secure	Upper M^1 or M^2 fragment	1	*Bos or Bubalus*	Juvenile	N/A	Freshly erupted
3, F	6	Torn, provenance secure	M_2	1	*Bos or Bubalus*	N/A	N/A	Deep gouged on labial surface perpendicular to axis of tooth
3, F	16	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	Burnt white
3, F	18	Torn, provenance secure	Humerus fragment	1	large mammal	N/A	N/A	Surface peeling, very friable
3, F	18	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	Very friable, peeling/cracking
3, F	18	Torn, provenance secure	Unidentified fragment	10	N/A	N/A	<30	Very friable, peeling/cracking
3, F	38	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	Broken into 6 pieces
3, F	38	Intact	Unidentified fragment	5	N/A	N/A	<30	N/A
3, F	43	Torn, provenance secure	Cheek tooth fragment	1	large ruminant	N/A	N/A	Broken into 3 pieces
3, F	45	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	Partially burnt black (carbonized)
3, F	51	Intact	Deciduous molar fragment	1	*Sus*	Juvenile	N/A	Recently erupted, very fragile
3, F	51	Intact	Plastron fragment	1	*Trionyx*	N/A	N/A	N/A
3, F	51	Intact	Unidentified fragment	10	N/A	N/A	<30	Tag suggests that it used to be single fragment

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, F	52	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, F	52	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, F	57	Torn, provenance secure	Incisor, bottom left	1	*Rattus rattus*	N/A	N/A	Small mandibular fragment attached
3, F	59	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
3, F	66	Intact	Unidentified fragment	9	N/A	N/A	<30	N/A
3, F	69	Intact	Incisor, upper	1	*Sus*	N/A	N/A	Broken
3, F	69	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
3, F	72	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	N/A
3, F	72	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
3, F	73	Intact	Unidentified fragment	6	N/A	N/A	<30	N/A
3, G	9	Intact	Centrotarsal	1	*Bos indicus*	N/A	N/A	Broken into 2 large fragments plus crumbs. Not complete
3, G	12	Intact	Proximal humerus fragment	1	small bird	N/A	N/A	N/A
3, G	12	Intact	Long bone fragment	1	small bird	N/A	N/A	N/A
3, G	12	Intact	Unidentified fragment	3	N/A	N/A	<30	N/A
3, G	14	Intact	First phalanx, distal fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	14	Intact	First phalanx, proximal fragment fused	1	*Bubalus*	N/A	N/A	N/A
3, G	14	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	14	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
3, G	16	Intact	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken into 10+ pieces
3, G	16	Intact	Patella	1	cervid (*Axis or Cervus)*	N/A	N/A	N/A
3, G	18	Intact	Hypsodont tooth fragment	1	large ruminant	N/A	N/A	Broken into 10 pieces
3, G	19	Intact	Centrotarsal fragment	1	*Bos or Bubalus*	N/A	N/A	Reddish tint
3, G	19	Intact	Deciduous molar fragment	1	*Sus*	Juvenile	N/A	Very little wear
3, G	20	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	20	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	23	Intact	M^1	1	*Capra*	N/A	N/A	Very friable
3, G	24	Torn, provenance secure	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
3, G	25	Intact	Unidentified fragment	~10+	N/A	N/A	<30	Very friable
3, G	31	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	Cut marks
3, G	33	Intact	Long bone shaft	1	small to medium mammal	N/A	N/A	N/A
3, G	33	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, G	33	Intact	Unidentified fragment	3	N/A	N/A	<30	N/A
3, G	33	Intact	Unidentified fragment	5	N/A	N/A	30-50	Bad condition
3, G	33	Intact	Unidentified fragment	~20	N/A	N/A	<30	Bad condition
3, G	33	Intact	Unidentified fragment	~6+	N/A	N/A	N/A	N/A
3, G	35	Intact	M^1 or M^2	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	35	Intact	Incisor	1	*Canis*, domestic size	N/A	N/A	Crumbled during analysis
3, G	35	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	35	Intact	Unidentified fragment	5	N/A	N/A	<30	N/A
3, G	37	Intact	P_3	1	*Equus asinus*	N/A	N/A	N/A
3, G	37	Intact	Humerus shaft	1	large bird	N/A	N/A	N/A
3, G	37	Intact	Humerus head fragment	1	large bird, *Anser* size	N/A	Bp=18.9	Head much more rounded and defined than in any compared specimen
3, G	37	Intact	Plastron fragment	2	*Lissemys*	N/A	N/A	N/A
3, G	37	Intact	Mandible fragment	1	medium mammal	N/A	N/A	N/A
3, G	37	Intact	Maxillary fragment, right, including M^1 and M^2	1	*Sus*	N/A	N/A	N/A
3, G	37	Intact	Unidentified fragment	9	N/A	N/A	<30	N/A
3, G	38	Intact	Femur, distal	1	bird, between duck and peafowl sized	N/A	N/A	N/A
3, G	38	Intact	M_3	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	38	Intact	M^3	1	*Bubalus*	N/A	N/A	Occlusal surface broken off
3, G	38	Intact	Long bone fragment	1	medium bird	N/A	N/A	N/A
3, G	38	Intact	Dental fragment	2	medium to large mammal	N/A	N/A	N/A
3, G	38	Intact	I_1	1	*Sus*	N/A	N/A	N/A
3, G	38	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	38	Intact	Unidentified fragment	8	N/A	N/A	<30	N/A
3, G	38	Intact	Unidentified fragment	~10+	N/A	N/A	<30	N/A
3, G	39	Intact	Unidentified fragment	2	large mammal	N/A	N/A	N/A
3, G	39	Intact	M^2 deciduous	1	*Sus*	Very young	N/A	Very little wear
3, G	40	Intact	Fragmented cheek tooth	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	40	Intact	Upper cheek tooth fragment	1	*Capra*	N/A	N/A	N/A
3, G	40	Intact	Probable tarsometatarsus	1	Galliform species, probably chicken size, male	N/A	N/A	N/A
3, G	40	Intact	Long bone fragment	3	large mammal	N/A	N/A	N/A
3, G	40	Intact	Cheek tooth fragment	1	large ruminant	N/A	N/A	N/A
3, G	40	Intact	Upper molar fragment, deciduous	1	*Sus*	N/A	N/A	N/A
3, G	40	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	40	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	40	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	41	Intact	Vertebral fragment	2	large mammal	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, G	41	Intact	Rib fragment	1	large mammal	N/A	N/A	Cut marks on both sides, charred on interior (not exterior)
3, G	41	Intact	Plastron fragment	2	*Trionyx*	N/A	N/A	N/A
3, G	41	Intact	Unidentified fragment	5	N/A	N/A	30-50	N/A
3, G	41	Intact	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, G	41	Intact	Unidentified fragment	12	N/A	N/A	<30	N/A
3, G	42	Intact	Humerus, proximal epiphysis fragment	1	*Axis axis*	Juvenile	N/A	Unfused
3, G	42	Intact	Humerus, shaft fragment	1	bird, *Gallus* size	N/A	N/A	N/A
3, G	42	Intact	M^1 or M^2 right	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	42	Intact	Scaphoid	1	*Bos or Bubalus*	N/A	N/A	Chop mark
3, G	42	Intact	Rib fragment	1	medium mammal	N/A	N/A	N/A
3, G	42	Intact	Proximal tibia fragment	1	medium mammal	N/A	N/A	N/A
3, G	42	Intact	Hypsodont tooth fragment	1	medium to large mammal	N/A	N/A	Charred, unusual texture
3, G	42	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	42	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	42	Intact	Unidentified fragment	13	N/A	N/A	<30	N/A
3, G	42	Intact	Unidentified fragment	1	N/A	N/A	>50	N/A
3, G	45	Intact	Long bone shaft (probable femur)	1	*Bos or Bubalus*	N/A	N/A	Recent breaks, gnaw marks from large rodent?
3, G	46	Intact	Second phalanx	1	*Bos indicus*	N/A	GL=56.2, Bp=40.1, SD=30.4, Bd=32.2	N/A
3, G	46	Intact	Carapace fragment	1	*Kachuga tecta*?	N/A	N/A	Unmarked surface
3, G	46	Intact	Carapace fragment	1	*Kachuga tecta?*	N/A	N/A	Three pieces. Two of these are worked in some way with a shelf cut into the bone and polished
3, G	46	Intact	Rib fragment	1	large mammal	N/A	N/A	N/A
3, G	46	Torn, provenance secure	Tarsometatarsus fragment with broken spur	1	*Pavo cristatus*	N/A	N/A	Male
3, G	46	Intact	Pelvis, right	1	small mammal (mouse size)	N/A	N/A	N/A
3, G	46	Torn, provenance secure	Rib shaft	1	very small mammal	N/A	N/A	N/A
3, G	46	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, G	46	Intact	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, G	46	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	47	Intact	Humerus, distal fragment	1	N/A	N/A	N/A	Prominent root encrustations
3, G	49	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
3, G	49	Intact	Rib fragment	1	large mammal	N/A	N/A	N/A
3, G	49	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, G	49	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
3, G	49	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	49	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	50	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	50	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	51	Intact	Long bone shaft fragment (probable tibia)	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	52	Intact	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, G	52	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
3, G	52	Intact	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, G	52	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, G	53	Intact	Tibia, distal fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
3, G	53	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, G	54	Intact	Worked bone point	1	N/A	N/A	N/A	Worked
3, H	19	Intact	Unidentified fragment	1	N/A	N/A	<30	Recent break into 2 pieces
3, J	4	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	N/A
3, J	6	Intact	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken into many pieces
3, J	11	Torn, provenance secure	Hypsodont tooth fragment	1	large mammal	N/A	N/A	N/A
3, J	11	Torn, provenance secure	Unidentified fragment	7	N/A	N/A	<30	N/A
3, J	12	Torn, provenance secure	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken into approximately 6 fragments
3, J	13	Intact	Deciduous molar fragment	1	medium mammal, probably *Sus*	N/A	N/A	No wear
3, J	31	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
3, J	39	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	Cancelous bone from end of single lone bone broken into 6 pieces
3, J	40	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, J	48	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, J	44	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	N/A
3, K	10	Intact	Unidentified fragment	~4+	N/A	N/A	30-50	N/A
3, K	11	Torn, provenance secure	Vertebral fragment	1	large mammal	N/A	N/A	N/A
3, K	11	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, K	11	Torn, provenance secure	Dental fragment	1	large mammal	N/A	N/A	Six pices, probably single tooth
3, K	11	Torn, provenance secure	Unidentified fragment	~20	N/A	N/A	<30	N/A
3, K	14	Intact	Unidentified fragment	3	N/A	N/A	<30	N/A
3, K	16	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
3, K	8 and 18	Torn, content mixed (may also include material from torn locus 11 bag)	Long bone fragment	5	N/A	N/A	N/A	Recent breaks, probably single bone
3, K	8 and 18	Torn, content mixed (may also include material from torn locus 11 bag)	Unidentified fragment	~20	N/A	N/A	<30	N/A
3, L	20	Torn, provenance secure	Hypsodont tooth fragment	~1	medium to large mammal	N/A	N/A	Badly fragmented, probably single tooth
3, L	28	Torn, provenance secure	Unidentified fragment	~6+	N/A	N/A	<30	N/A
3, L	33	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
3, N	1	Torn, provenance secure	M^1 or M^2	1	*Bos or Bubalus*	Juvenile	N/A	Broken into 4 pieces, recently erupted
3, N	4	Torn, provenance secure	M^3 right	1	*Bos or Bubalus*	N/A	N/A	Broken
3, P	16	Intact	Hypsodont cheek tooth	1	large mammal	N/A	N/A	Broken
3, P	18	Intact	Radius, proximal	1	bird, falcon size	N/A	N/A	N/A
3, Q	10	Torn, provenance secure	Unidentified fragment	~10	N/A	N/A	<30	N/A
3, Q	24	Intact	Dental fragment	3	medium to large mammal	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, Q	24	Intact	Dental fragment	1	medium to large mammal	N/A	N/A	N/A
3, Q	29	Intact	Dental fragment	1	medium to large mammal	N/A	N/A	Broken into two pieces with refit
3, Q	33	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	Burnt white with cut mark
3, Q	33	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, Q	35	Intact	Cheek tooth fragment	1	*Sus*	N/A	N/A	N/A
3, R	10	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, T	3	Intact	Hypsodont tooth fragment	1	medium to large mammal	N/A	N/A	Broken into 2 or more pieces
3, T	15	Intact	Unidentified fragment	1	N/A	N/A	<30	Broken into unidentifiable crumbs
3, T	26	Intact	Cheek tooth fragment	1	medium to large mammal	N/A	N/A	Broken into approximately 10 pieces
3, T	26	Intact	Cheek tooth fragment	1	medium to large mammal	N/A	N/A	Broken into 3 pieces plus crumbs
3, T	26	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, T	26	Intact	Unidentified fragment	~5+	N/A	N/A	<30	N/A
3, T	28	Intact	Spine	1	medium fish	N/A	N/A	Rear-facing serrations on posterior, forward facing on anterior. Burnt white
3, T	32	Torn, provenance secure	Unidentified fragment	~30	N/A	N/A	<30	N/A
3, V	7	Intact	Long bone fragment	1	medium mammal	N/A	N/A	N/A
3, V	7	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
3, V	11	Intact	Mandibular molar fragment	1	*Bos or Bubalus*	N/A	N/A	Broken
3, V	11	Torn, provenance secure	Third phalanx	1	*Canis*	N/A	N/A	Relatively large, probably *C. Lupus* or *C. Domesticus*
3, V	13	Torn, provenance secure	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	Broken into 4 pieces
3, V	13	Torn, provenance secure	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	Broken into approximately 10 pieces
3, V	13	Torn, provenance secure	Dental fragment	1	large ruminant	N/A	N/A	Broken
3, V	13	Torn, provenance secure	Long bone fragment	3	medium to large mammal	N/A	N/A	N/A
3, V	13	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, V	15	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
3, V	17	Torn, provenance secure	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
3, V	18	Torn, provenance secure	Unidentified fragment	3	N/A	N/A	<30	N/A
3, V	23	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	Three pieces, probably from single bone. Burnt white on one side and inside bone, exterior appears unburnt
3, V	26	Torn, provenance secure	Plastron fragment	1	*Trionyx*	N/A	N/A	N/A
3, V	33	Torn, provenance secure	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken
3, V	35	Intact	Cancelous bone fragment	2	N/A	N/A	<30	N/A
3, V	36	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt white
3, V	37	Intact	M^1 or M^2	1	*Bos indicus*	N/A	N/A	Broken
3, W	4	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, W	4	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, W	28	Torn, possibly mixed contents	Long bone fragment	4	medium to large mammal	N/A	30-50	N/A
3, W	28	Torn, possibly mixed contents	Long bone fragment	1	medium to large mammal	N/A	<30	N/A
3, W	28	Torn, possibly mixed contents	Unidentified fragment	6	N/A	N/A	<30	N/A
3, W	31	Intact	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken
3, W	31	Torn, provenance secure	Unidentified fragment	4	N/A	N/A	<30	N/A
3, W	33	Torn, provenance secure	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	Broken
3, W	33	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
3, W	33	Intact	Unidentified fragment	~3+	N/A	N/A	<30	N/A
3, W	33	Intact	Unidentified fragment	2	N/A	N/A	<30	Burnt white

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, W	34	Torn, provenance secure	Cancelous bone fragment	~10	N/A	N/A	<30	N/A
3, W	35	Intact	Unidentified fragment	~20+	N/A	N/A	<30	Extremely small crumbs
3, W	35	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, W	38	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, W	38	Intact	Unidentified fragment	7	N/A	N/A	<30	N/A
3, W	39	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt white
3, W	40	Torn, provenance secure	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken into eight or more fragments
3, W	40	Intact	Dental fragment	3	medium to large mammal	N/A	N/A	N/A
3, W	40	Intact	Unidentified fragment	7	N/A	N/A	<30	N/A
3, X	13 and 16	Torn, content mixed	Unidentified fragment	~20+	N/A	N/A	<30	N/A
3, Y	8	Torn, provenance secure	Molar	1	*Bos or Bubalus*	N/A	N/A	Broken
3, AA	8	Torn, provenance secure	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	Young, large individual. Little wear
3, AA	11	Intact	Dental fragment	1	medium mammal	N/A	N/A	N/A
3, AA	11	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, AA	12	Intact	Unidentified fragment	~15	N/A	N/A	<30	Fresh breaks, probably formerly one fragment
3, AA	12	Intact	Unidentified fragment	~10	N/A	N/A	<30	Some still attached to ceramic sherd
3, AA	13	Intact	Vertebral fragment	2	medium mammal	N/A	N/A	N/A
3, AA	13	Torn, provenance secure	Unidentified fragment	~20	N/A	N/A	<30	Fresh breaks, probably formerly one fragment
3, AA	16	Intact	Ulna fragment?	1	medium mammal	N/A	N/A	Does not match *Capra, Axis, Sus, Equus, or Canis*
3, AA	16	Intact	Radius fragment	1	small to medium mammal	N/A	N/A	N/A
3, AA	17	Intact	Unidentified fragment	1	N/A	N/A	N/A	Crumbs, probably formerly single fragment
3, AA	19	Intact	Sacrum fragment, posterior articular surface	1	large mammal	N/A	N/A	N/A
3, AA	19	Intact	Plastron fragment	1	*Trionyx*	N/A	N/A	N/A
3, AA	19	Intact	Unidentified fragment	1	N/A	N/A	30-50	Probably part of sacrum fragment
3, AA	19	Intact	Unidentified fragment	1	N/A	N/A	<30	Probably part of sacrum fragment
3, AA	19	Intact	Unidentified fragment	~9+	N/A	N/A	<30	Probably initially single piece
3, AA	19	Intact	Unidentified fragment	1	N/A	N/A	30-50	Burnt white
3, AA	19	Intact	Unidentified fragment	4	N/A	N/A	<30	Burnt white
3, AA	20	Intact	Cancelous bone fragment	15	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, AA	20	Intact	Unidentified fragment	~4+	N/A	N/A	<30	Probably used to be single fragment
3, AA	23	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
3, AA	23	Intact	Rib fragment	1	large mammal, probably *Bos or Bubalus*	N/A	N/A	N/A
3, AA	23	Intact	Tibia fragment	1	medium to large mammal	N/A	N/A	Burnt white
3, AA	23	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	Interior burnt white, exterior appears unburnt
3, AA	23	Intact	Unidentified fragment	8	N/A	N/A	<30	N/A
3, AA	23	Intact	Unidentified fragment	1	N/A	N/A	30-50	Broken into 3+ pieces, burnt white
3, AA	24	Intact	Rib fragment	1	small mammal (rat size)	N/A	N/A	Burnt white
3, AA	24	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
3, AA	25	Intact	Dental fragment	2	medium to large mammal	N/A	N/A	N/A
3, AA	25	Intact	Long bone fragment	1	small mammal	N/A	N/A	N/A
3, AA	25	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, AA	25	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, AA	26	Intact	Long bone fragment	1	large mammal	N/A	30-50	Charred on exterior surface
3, AA	26	Torn, provenance secure	Tibia, proximal fragment	1	medium mammal (sheep/goat size)	N/A	N/A	N/A
3, AA	26	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	Likely initially part of tibia fragment
3, AA	26	Torn, provenance secure	Unidentified fragment	4	N/A	N/A	<30	Likely initially part of tibia fragment
3, AA	27	Intact	Upper molar	1	*Bos or Bubalus*	N/A	N/A	Broken. Very old individual
3, AA	27	Intact	Vertebral fragment	1	large mammal	N/A	N/A	N/A
3, AA	27	Intact	Long bone fragment	1	large mammal	N/A	30-50	N/A
3, AA	27	Intact	Cranial fragment	1	medium mammal	N/A	N/A	N/A
3, AA	27	Intact	Shell fragment	1	*Pila*	N/A	N/A	N/A
3, AA	27	Intact	Plastron fragment	1	*Trionyx*	N/A	N/A	Broken into approximately 8 pieces
3, AA	27	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, AA	27	Intact	Long bone fragment	1	N/A	N/A	30-50	N/A
3, AA	27	Intact	Long bone fragment	~10+	N/A	N/A	<30	Probably from single fragment
3, AA	27	Intact	Cancelous bone fragment	1	N/A	N/A	<30	N/A
3, AA	27	Intact	Unidentified fragment	1	N/A	N/A	30-50	Fresh break
3, AA	27	Intact	Unidentified fragment	2	N/A	N/A	<30	Fresh breaks, probably from single piece
3, AA	27	Intact	Cancelous bone fragment	2	N/A	N/A	30-50	N/A
3, AA	27	Intact	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, AA	27	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, AA	28	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	Broken into 6 pieces

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, AA	29	Intact	Rib fragment	1	medium mammal (dog size)	N/A	N/A	Burnt black
3, AA	29	Intact	Third phalanx	1	small bird	N/A	N/A	N/A
3, AA	29	Intact	Long bone fragment	2	small bird	N/A	N/A	N/A
3, AA	29	Intact	Dental fragment	1	small to medium mammal	N/A	N/A	N/A
3, AA	29	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	Burnt black and white
3, AA	29	Torn, provenance secure	Unidentified fragment	10	N/A	N/A	<30	Burnt black and white, probably from single piece
3, AA	4, 7, 8, 9	Torn, contents mixed (may also contain material from other torn bags from Operation 3, Strip AA)	Dental fragment	3	medium to large mammal	N/A	N/A	N/A
3, AA	4, 7, 8, 9	Torn, contents mixed (may also contain material from other torn bags from Operation 3, Strip AA)	Unidentified fragment	3	N/A	N/A	30-50	N/A
3, AA	4, 7, 8, 9	Torn, contents mixed (may also contain material from other torn bags from Operation 3, Strip AA)	Unidentified fragment	~30+	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, BB	20	Intact	Unidentified fragment	~5-10+	N/A	N/A	<30	Probably originally single piece
3, BB	20	Torn, provenance secure	Unidentified fragment	~20+	N/A	N/A	<30	N/A
3, BB	21	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, BB	21	Torn, provenance secure	Unidentified fragment	15+	N/A	N/A	<30	N/A
3, BB	21	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	Burnt black and white
3, BB	22	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, BB	22	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, BB	24	Torn, provenance secure	Long bone fragment	3	large mammal	N/A	N/A	N/A
3, BB	25	Intact	M^2 left, deciduous	1	*Sus*	Juvenile	N/A	Little wear, broken
3, BB	26	Torn, provenance secure	Long bone fragment	3	medium to large mammal	N/A	30-50	N/A
3, BB	26	Torn, provenance secure	Long bone fragment	3	medium to large mammal	N/A	<30	N/A
3, BB	27	Intact	Long bone fragment	2	large mammal	N/A	30-50	N/A
3, BB	27	Intact	Long bone fragment	3	large mammal	N/A	<30	N/A
3, BB	27	Intact	Long bone fragment	2	large mammal	N/A	N/A	N/A
3, BB	27	Intact	Unidentified fragment	5	N/A	N/A	<30	N/A
3, BB	28	Intact	Lower molar	1	*Bos or Bubalus*	N/A	N/A	Broken, recently erupted
3, BB	28	Intact	Long bone fragment	2	large mammal	N/A	N/A	N/A
3, BB	28	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, BB	28	Torn, provenance secure	Cancelous bone fragment	~3+	N/A	N/A	<30	N/A
3, BB	28	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, BB	28	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, BB	30	Intact	Cheek tooth fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
3, BB	30	Intact	Pelvic fragment	2	large mammal	N/A	N/A	No obvious refit
3, BB	30	Intact	Dental fragment	1	medium mammal	N/A	N/A	Burnt black, broken into 4 pieces
3, BB	30	Intact	Unidentified fragment	9	N/A	N/A	<30	Probably belonged to pelvic fragment
3, BB	30	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt white
3, BB	30	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, BB	30	Intact	Unidentified fragment	13	N/A	N/A	<30	1 fragment burnt black
3, BB	34	Intact	Tibia, proximal, unfused	1	*Bos or Bubalus*	Juvenile	N/A	Proximal end unusually flattened--chopping?
3, BB	34	Torn, provenance secure	Long bone fragment	3	large mammal	N/A	30-50	N/A
3, BB	34	Torn, provenance secure	Long bone fragment	11	large mammal	N/A	<30	N/A
3, BB	34	Torn, provenance secure	Long bone fragment	2	large mammal	N/A	N/A	N/A
3, BB	34	Intact	Plastron fragment	5	*Lissemys*	N/A	N/A	N/A
3, BB	34	Intact	Unidentified fragment	~20	N/A	N/A	<30	N/A
3, BB	34	Torn, provenance secure	Unidentified fragment	~30	N/A	N/A	<30	N/A
3, BB	36	Intact	Unidentified fragment	1	N/A	N/A	N/A	Crumbs and powder
3, BB	37	Intact	Upper molar	1	*Bos*	N/A	N/A	Broken
3, BB	37	Torn, provenance secure	Scapula fragment	1	*Bos or Bubalus*	N/A	N/A	Broken into 2 large pieces and 4 small pieces (fresh breaks, refits). Large individual
3, BB	37	Torn, provenance secure	Astragalus fragment	1	*Bubalus*	N/A	N/A	N/A
3, BB	37	Torn, provenance secure	Long bone epiphysis fragment (possibly tibia)	2	large mammal	N/A	N/A	N/A
3, BB	37	Torn, provenance secure	Long bone shaft fragment (probable femur)	1	large mammal	N/A	N/A	
3, BB	37	Torn, provenance secure	Pelvic fragment	1	large mammal	N/A	N/A	N/A
3, BB	37	Torn, provenance secure	Long bone fragment	7	large mammal	N/A	30-50	Fresh breaks; possibly associated with other material from locus 37, but no refits
3, BB	37	Torn, provenance secure	Rib fragment	2	large mammal	N/A	N/A	N/A
3, BB	37	Intact	Dental fragment	4	large mammal	N/A	N/A	N/A
3, BB	37	Torn, provenance secure	Rib fragment	1	large mammal	N/A	N/A	N/A
3, BB	37	Torn, provenance secure	Radius, possible. Proximal	1	large mammal, probably artiodactyl	N/A	N/A	Appears pathological. Articular surface with humerus not flat--rounded and not smooth

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, BB	37	Torn, provenance secure	Humerus	1	medium mammal (dog size)	N/A	N/A	Modified at end. Broken into 2 pieces during analysis
3, BB	37	Torn, provenance secure	Radius, proximal	1	sheep/goat	N/A	Bp=31.2	N/A
3, BB	37	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	N/A
3, BB	37	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	N/A
3, BB	37	Torn, provenance secure	Unidentified fragment	12	N/A	N/A	<30	N/A
3, BB	37	Torn, provenance secure	Unidentified fragment	~15+	N/A	N/A	<30	N/A
3, BB	41	Torn, provenance secure	Rib fragment	2	large mammal	N/A	N/A	Probably from single bone
3, BB	42	Torn, provenance secure	Long bone fragment	2	medium mammal	N/A	N/A	N/A
3, BB	42	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	Fresh breaks
3, BB	42	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	N/A
3, BB	42	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, BB	42	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, BB	43	Intact	Plastron fragment	1	*Lissemys*	N/A	N/A	N/A
3, DD	10	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	Broken into 2 pieces, fresh breaks
3, DD	39	Intact	Shell fragment	7	*Lamellidens*	N/A	N/A	Very thin fragments
3, DD	40	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, EE	1	Intact	Canine	1	*Canis domesticus*	N/A	N/A	N/A
3, EE	1	Torn, provenance secure	Tibiotarsus fragment	1	*Gallus domesticus*	N/A	N/A	Burnt white

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, EE	1	Torn, provenance secure	Long bone fragment	1	medium bird	N/A	N/A	Burnt white
3, EE	1	Torn, provenance secure	Long bone fragment	3	medium mammal	N/A	N/A	Probably from single bone
3, EE	3	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
3, EE	13	Intact	Unidentified fragment	8	N/A	N/A	<30	Burnt black
3, EE	15	Intact	Operculum fragment	1	*Bellamya*	N/A	N/A	N/A
3, EE	17	Intact	Shell	1	*Bellamya*	N/A	N/A	Partial
3, EE	17	Intact	Shell	1	*Bellamya*	N/A	N/A	Almost complete
3, EE	17	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
3, EE	17	Intact	Long bone fragment	1	medium mammal	N/A	N/A	Burnt black
3, EE	17	Intact	Shell	5+	*Pila*	N/A	N/A	Partial
3, EE	17	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
3, EE	18	Intact	Long bone fragment	2	large mammal	N/A	N/A	Fresh breaks, no obvious refit
3, EE	19	Intact	Shell	4	*Bellamya*	N/A	N/A	Partial
3, EE	20	Intact	Shell	1	*Pila*	N/A	N/A	Partial, in fragments
3, EE	21	Intact	Shell	4+	*Bellamya*	N/A	N/A	Partial
3, EE	21	Torn, provenance secure	Rib fragment	1	medium mammal	N/A	N/A	Accretions on surface
3, EE	21	Intact	Operculum	1	*Pila*	N/A	N/A	Partial
3, EE	22	Intact	Shell	1	*Bellamya*	N/A	N/A	Almost complete
3, EE	22	Intact	Shell fragment	1	*Bellamya*	N/A	N/A	N/A
3, EE	23	Intact	Shell	4+	*Pila*	N/A	N/A	Partial
3, EE	23	Intact	Shell fragment	5+	N/A	N/A	N/A	N/A
3, EE	24	Intact	Shell fragment	1	N/A	N/A	N/A	Very thin
3, EE	25	Intact	Shell	1	*Bellamya*	N/A	N/A	Partial
3, EE	25	Intact	Shell fragment	1	*Lamellidens*	N/A	N/A	N/A
3, EE	25	Intact	Shell	1	*Lamellidens*	N/A	length=11.4, width=16.0	Small hole, intentional i.e. Bead
3, EE	26	Intact	Shell	1	*Bellamya*	N/A	GL=20.0	Complete
3, EE	26	Intact	Long bone fragment	1	large mammal	N/A	N/A	Fresh breaks into multiple pieces
3, EE	26	Intact	Long bone fragment	1	large mammal	N/A	N/A	Fresh breaks
3, EE	26	Intact	Shell	1	*Melania*	N/A	N/A	Partial
3, EE	26	Intact	Shell	1	*Pila*	N/A	N/A	Partial, in fragments
3, EE	27	Intact	Shell	1	*Bellamya*	N/A	GL=22.3	Complete
3, EE	27	Intact	Shell	1	*Bellamya*	N/A	N/A	Partial, burnt white
3, EE	27	Intact	Operculum	1	*Bellamya*	N/A	N/A	N/A
3, EE	27	Intact	Shell	1	*Bellamya*	N/A	N/A	Partial
3, EE	27	Intact	Shell fragment	1	*Lamellidens*	N/A	N/A	N/A
3, EE	27	Intact	Vertebral fragment	1	medium mammal	N/A	N/A	Charred
3, EE	28	Intact	Shell	1	*Bellamya*	N/A	N/A	Almost complete

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
3, EE	28	Intact	Operculum	1	*Pila*	N/A	N/A	Partial
3, EE	30	Intact	Shell	1	*Bellamya*	N/A	GL=25.7	Complete
3, EE	30	Intact	Shell	1	*Bellamya*	N/A	N/A	Almost complete
3, EE	30	Intact	Mandibular fragment	2	*Canis domesticus*	N/A	N/A	Teeth bases present. No refit, but probably same individual
3, EE	30	Intact	Long bone fragment	1	large mammal	N/A	N/A	Interior charred, exterior appears normal. Very accreted
3, EE	30	Intact	Unidentified fragment	3	N/A	N/A	<30	Possibly associated with *C. Domesticus* mandible fragments
3, EE	31	Intact	Shell	6+	*Bellamya*	N/A	N/A	Partial
3, EE	31	Intact	Shell	15	*Melania*	N/A	N/A	Mostly complete
3, EE	32	Intact	Shell	3	*Melania*	N/A	N/A	Almost complete, probably from two different species
3, EE	32	Intact	Shell	1	*Pila*	N/A	N/A	Partial
3, FF	14	Intact	Long bone fragment	1	mammal	N/A	<30	Burnt white
3, GG	11	Intact	Shell	1	*Bellamya*	N/A	N/A	Partial
3, GG	11	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	30-50	Burnt white
3, GG	11	Torn, provenance secure	Unidentified fragment	~20	N/A	N/A	<30	Burnt white
3, GG	12	Intact	Shell fragment	1	*Pila*	N/A	N/A	N/A
3, GG	13	Intact	Shell	1	*Bellamya*	N/A	N/A	Partial
3, GG	13	Intact	Mandible fragment	1	*Bos or Bubalus*	Juvenile	N/A	Very young individual. Includes p_4 and broken m_1
3, GG	14	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
3, GG	14	Intact	Radius shaft fragment	1	medium mammal (sheep/goat size)	N/A	N/A	N/A
3, GG	24	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
4, GA	2	Intact	Atlas	1	*Canis domesticus*	N/A	GB=62.6, GL=30.3, H=25.4	Complete
4, GA	3	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
4, GA	7	Intact	Plastron fragment	1	*Lissemys*	N/A	<10	Very small, burnt white
4, GA	8	Intact	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	Broken
4, GA	10	Intact	Tibia fragment	1	medium mammal	N/A	N/A	Charred interior, uncharred exterior
4, GA	11	Intact	Long bone fragment	1	large mammal	N/A	>50	N/A
4, GA	11	Intact	Long bone fragment	6	large mammal	N/A	30-50	N/A
4, GA	11	Intact	Long bone fragment	3	large mammal	N/A	<30	N/A
4, GA	11	Intact	Unidentified fragment	~15	N/A	N/A	<30	N/A
5, GB	1	Intact	Long bone fragment	1	medium mammal	N/A	N/A	N/A
5, GB	1	Intact	Humerus	1	sheep/goat	N/A	N/A	N/A
5, GB	1	Intact	Pelvis	1	sheep/goat	N/A	N/A	N/A
5, GB	4	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
5, PF11	3	Intact	Unidentified fragment	2	N/A	N/A	<30	N/A
5, PG11	10	Intact	Unidentified fragment	1	N/A	N/A	<30	Burnt white

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
5, PG11	25	Intact	Long bone fragment	2	medium mammal	N/A	N/A	Burnt white
5, PH11	14	Torn, provenance secure	Unidentified fragment	~10	N/A	N/A	<30	Embedded in red clay, very friable
5, PH11	17	Intact	Unidentified fragment	1	N/A	N/A	30-50	N/A
5, PH11	17	Intact	Unidentified fragment	~10	N/A	N/A	<30	N/A
5, PH11	20	Intact	Rib head	1	medium mammal (sheep/goat size)	N/A	N/A	Partially charred
5, PH11	20	Intact	Crumbs	?	N/A	N/A	N/A	Crumbs embedded in reddish clay
5, PH11	20	Intact	Long bone outer shaft fragment	2	N/A	N/A	30-50	Charred
5, PH11	20	Intact	Long bone outer shaft fragment	~15	N/A	N/A	<30	Charred
5, PH11	22	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
5, PH11	24	Torn, provenance secure	Long bone fragment	3	large mammal	N/A	N/A	N/A
5, PH11	24	Intact	Radius shaft fragment	1	medium mammal	N/A	N/A	Burnt white
5, PH11	24	Intact	Unidentified fragment	5	N/A	N/A	<30	Burnt white
5, PH11	24	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
5, PH11	24	Torn, provenance secure	Unidentified fragment	1	N/A	N/A	<30	N/A
5, PH11	24	Torn, provenance secure	Unidentified fragment	~20	N/A	N/A	<30	Embedded in red clay
5, PH11	24	Torn, provenance secure	Unidentified fragment	5	N/A	N/A	<30	N/A
5, PH11	24	Intact	Crumbs	?	N/A	N/A	N/A	Crumbs embedded in red clay
5, PH11	25	Intact	Rib fragment	2	large mammal	N/A	N/A	N/A
5, PH11	25	Torn, provenance secure	Long bone fragment	1	large mammal	N/A	N/A	Broken into 2 pieces with fresh breaks
5, PH11	25	Intact	Long bone fragment	1	small to medium mammal	N/A	N/A	N/A
5, PH11	25	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	30-50	N/A
5, PH11	25	Torn, provenance secure	Unidentified fragment	2	N/A	N/A	<30	Embedded in red clay
5, PH11	26	Intact	Long bone fragment	1	medium mammal	N/A	N/A	N/A
5, PH11	26	Torn, provenance secure	Long bone fragment	1	medium to large mammal	N/A	30-50	Charred

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
5, PH11	26	Torn, provenance secure	Long bone fragment	2	medium to large mammal	N/A	<30	Charred
5, PH11	26	Intact	Patella fragment	1	nilgai	N/A	N/A	Charred
5, PH11	28	Intact	Long bone fragment	1	medium to large mammal	N/A	N/A	Burnt black on exterior and white on interior
5, PH11	28	Torn, provenance secure	Vertebral fragment	1	medium to large mammal	N/A	N/A	Slightly charred
5, PH11	30	Torn, provenance secure	Rib fragment	1	large mammal	N/A	N/A	N/A
5, PH11	30	Torn, provenance secure	Humerus	1	small bird	N/A	N/A	Broken into 2 pieces during analysis
5, PK11	2	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
5, PL11	31	Intact	Shell	1	*Lamellidens*	N/A	N/A	Broken, burnt white
5, PL11	31	Intact	Long bone fragment	2	medium to large mammal	N/A	N/A	N/A
5, PL11	31	Intact	Unidentified fragment	7	N/A	N/A	<30	N/A
5, PL11	32	Intact	Rib fragment	1	large mammal	N/A	N/A	N/A
5, PL11	32	Intact	Long bone fragment	1	large mammal	N/A	N/A	N/A
5, PL11	32	Intact	Unidentified fragment	5	N/A	N/A	<30	N/A
5, PL11	34	Intact	Rib fragment	1	small bird	N/A	N/A	N/A
5, PL11	34	Intact	Long bone shaft	1	small bird	N/A	N/A	N/A
5, PL11	45	Intact	Operculum	1	*Bellamya*	N/A	N/A	N/A
5, PL11	45	Intact	Long bone fragment	3	large mammal	N/A	N/A	N/A
5, PL11	45	Intact	Long bone fragment	1	small bird	N/A	N/A	N/A
5, PL11	46	Intact	Long bone shaft	1	small to medium bird	N/A	N/A	N/A
5, PL11	51	Intact	Carpal, distal, unfused	1	sheep/goat	Juvenile	N/A	N/A
5, PM17	6	Intact	Crab claw?	1	crab	N/A	N/A	N/A
5, PM17	7	Intact	Bone point	1	N/A	N/A	N/A	Tip broken, worked and burnt
5, PM17	8	Intact	Vertebral fragment	1	large mammal	N/A	N/A	N/A
5, PM17	8	Intact	Unidentified fragment	1	N/A	N/A	<30	N/A
5, PM17	9	Torn, provenance secure	Metatarsal	1	*Axis axis*	N/A	Bp=17.4	Broken into 2 pieces
5, PM17	9	Torn, provenance secure	Carpal	1	*Axis axis*	N/A	N/A	N/A
5, PM17	9	Torn, provenance secure	Long bone shaft	1	large mammal	N/A	N/A	Worked, flakes removed?
5, PN11	30	Intact	Humerus	1	*Gallus gallus*	N/A	Bp=13.7, SC=5.5	Missing distal end

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
5, PN12	8	Torn, provenance secure	Dental fragment	1	sheep/goat	N/A	N/A	Broken into approximately 9 pieces
5, PP12	10	Intact	Crumbs	?	N/A	N/A	N/A	Crumbs embedded in red clay
5, PS11	5	Intact	Femur shaft fragment	1	medium mammal (sheep/goat size)	N/A	N/A	Burnt white
5, PS12	6	Intact	Cheek tooth	1	*Bos or Bubalus*	N/A	N/A	Broken
5, PS12	7	Intact	Femoral head?	1	medium mammal (*Axis axis* size)	N/A	N/A	N/A
6, HC6	1	Intact	Hypsodont tooth fragments	5	ruminant	N/A	N/A	Probably from a single tooth
6, HC6	1	Intact	Phalanx 2	1	sheep or goat	N/A	N/A	N/A
6, HC6	2	Intact	Radius and ulna, proximal	1	nilgai	N/A	N/A	Outer surface flaking off
6, HC6	3	Intact	Upper molar fragment	1	nilgai	N/A	N/A	N/A
6, HC6	3	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
6, HC6	4	Intact	Long bone fragments	~20	mammal, large	N/A	N/A	Probably from single bone, fresh breaks
6, HC6	4	Intact	Unidentified fragments	~3+	N/A	N/A	<30	N/A
6, HC6	6	Intact	Unidentified fragments	5	N/A	N/A	<30	N/A
6, HC6	7	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	12	Intact	Upper premolar, left	1	nilgai (verify?)	N/A	N/A	Charred
6, HC6	17	Intact	Tooth fragments	4	large bovid	N/A	N/A	Probably from a single tooth
6, HC6	17	Intact	Unidentified fragments	6	N/A	N/A	<30	N/A
6, HC6	20	Intact	Dental fragments	10+	*Bos or Bubalus*	N/A	N/A	Probably all from one or two cheek teeth, very friable
6, HC6	20	Intact	Dental fragment	1	mammal, large hypsodont	N/A	N/A	Weathered
6, HC6	20	Intact	Maxillary cheek tooth fragments	5	nilgai	N/A	N/A	Probably from a single tooth
6, HC6	24	Torn, but damage was almost negligible, provenance secure	Dental fragments	10	nilgai	N/A	N/A	Probably from a single molar
6, HC6	24	Torn, but damage was almost negligible, provenance secure	M^2 left	1	nilgai	N/A	N/A	N/A
6, HC6	28	Intact	Rib fragment	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	32	Intact	Cheek tooth fragments	2	ruminant	N/A	N/A	N/A
6, HC6	32	Intact	Unidentified fragments	4	N/A	N/A	<30	Ancellous bone
6, HC6	39	Intact	Ancellous bone fragments	4	N/A	N/A	<30	N/A
6, HC6	39	Intact	Unidentified fragments	2+	N/A	N/A	<30	N/A
6, HC6	42	Intact	Cheek tooth fragments	2	*Sus*	N/A	N/A	No refit
6, HC6	43	Intact	Tarsometatarsus	1	bird, medium (chicken sized)	N/A	N/A	Burnt black

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC6	45	Intact	M^3	1	*Sus*	Adult	N/A	Roots completely missing
6, HC6	46	Intact	Dental fragment	1	ruminant, large	N/A	N/A	N/A
6, HC6	46	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
6, HC6	46	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	48	Intact	Centrotarsal fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	48	Intact	Cranial fragment	1	*Bos or Bubalus*	N/A	N/A	Burnt black
6, HC6	48	Intact	Long bone fragments	1	mammal, large	N/A	N/A	Burnt black, outer layer of bone splitting off
6, HC6	48	Intact	Cranial fragment	1	mammal, medium to large	N/A	N/A	Charred
6, HC6	48	Intact	Long bone fragments	1	mammal, medium to large	N/A	N/A	Burnt black
6, HC6	48	Intact	Vertebral fragment	1	mammal, medium to large	N/A	N/A	Charred
6, HC6	48	Intact	Unidentified fragments	4	N/A	N/A	<30	All ancellous bone
6, HC6	48	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
6, HC6	48	Intact	Unidentified fragments	6	N/A	N/A	<30	N/A
6, HC6	48	Intact	Unidentified fragments	1	N/A	N/A	<30	Charred
6, HC6	49	Intact	Cranial fragment	1	mammal, medium to large	N/A	N/A	Burnt black
6, HC6	49	Intact	Tooth fragments	~5	mammal, non-ruminant	N/A	N/A	N/A
6, HC6	49	Intact	Upper premolar fragment	1	*Sus*	N/A	N/A	Very worn
6, HC6	49	Intact	Unidentified fragments	1	N/A	N/A	>50	Charred
6, HC6	50	Intact	Rib end, medial	1	mammal, small to medium (fox sized)	N/A	N/A	N/A
6, HC6	51	Intact	Long bone fragments	1	mammal, large	N/A	30-50	N/A
6, HC6	51	Intact	Long bone fragments	1	mammal, large	N/A	>50	Cut mark
6, HC6	51	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
6, HC6	51	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	52	Intact	Long bone fragments	1	mammal, large	N/A	N/A	Cut marks
6, HC6	52	Intact	Operculum	1	*Pila*	N/A	N/A	N/A
6, HC6	52	Intact	P_2 left	1	*Sus*	N/A	N/A	N/A
6, HC6	52	Intact	Unidentified fragments	1	N/A	N/A	30-503	N/A
6, HC6	53	Intact	Pelvic fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	53	Intact	Long bone fragments	4	mammal, large	N/A	30-50	N/A
6, HC6	53	Intact	Dental fragments	4	mammal, medium	N/A	N/A	Burnt black
6, HC6	53	Intact	Long bone fragments	1	mammal, medium to large	N/A	N/A	Cut marks
6, HC6	53	Intact	Vertebral fragment	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	53	Intact	Radius, diaphysis	1	mammal, small (fox size)	N/A	N/A	N/A
6, HC6	53	Intact	Rib fragment	1	mammal, small (hare size)	N/A	N/A	Burnt black
6, HC6	53	Intact	Canine	1	*Sus*	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC6	53	Intact	Long bone fragments	2	N/A	N/A	30-50	Burnt black
6, HC6	53	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
6, HC6	53	Intact	Unidentified fragments	2	N/A	N/A	<30	N/A
6, HC6	54	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	54	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	54	Intact	Unidentified fragments	2	N/A	N/A	<30	N/A
6, HC6	55	Intact	Cheek tooth fragments	8	*Bos or Bubalus*	N/A	N/A	Probably from single tooth, friable
6, HC6	55	Intact	Unidentified fragments	~10+	N/A	N/A	<30	Burnt black
6, HC6	55	Intact	Unidentified fragments	2	N/A	N/A	<30	Totally carbonized
6, HC6	56	Intact	Spine	1	fish, small to medium	N/A	N/A	N/A
6, HC6	56	Intact	Cheek tooth fragments	1	*Sus*	N/A	N/A	N/A
6, HC6	56	Intact	M^2 right with attached maxillary fragment	1	*Sus*	N/A	N/A	N/A
6, HC6	56	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	56	Intact	Unidentified fragments	15+	N/A	N/A	<30	Very friable
6, HC6	58	Intact	Ulna	1	bird, medium (slightly larger than pigeon)	N/A	N/A	N/A
6, HC6	58	Intact	Patella	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	58	Intact	Humerus, distal fragment	1	*Bubalus bubalis*	N/A	N/A	N/A
6, HC6	58	Intact	Spine	1	fish, medium	N/A	N/A	Rear facing serrations on both sides
6, HC6	58	Intact	Plaston fragments	1	*Kachuga tecta*	N/A	N/A	Fairly large
6, HC6	58	Intact	Long bone fragments	1	mammal	N/A	N/A	Chop marks on two axes
6, HC6	58	Intact	Long bone fragments	1	mammal, large	N/A	>50	N/A
6, HC6	58	Intact	Clavicle, medial end, unfused	1	mammal, medium	Juvenile	N/A	N/A
6, HC6	58	Intact	Long bone fragments	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	58	Intact	Rib fragment	2	mammal, small to medium	N/A	N/A	N/A
6, HC6	58	Intact	I^1 right	1	*Sus*	N/A	N/A	Likely from the same individual as I^2 right from this locus
6, HC6	58	Intact	I^2 right	1	*Sus*	N/A	N/A	Possible cut marks
6, HC6	58	Intact	Upper canine	1	*Sus*	N/A	N/A	Large individual
6, HC6	58	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	58	Intact	Unidentified fragments	3	N/A	N/A	<30	N/A
6, HC6	58	Intact	Unidentified fragments	2	N/A	N/A	<30	N/A
6, HC6	58	Intact	Unidentified fragments	1	N/A	N/A	>50	N/A
6, HC6	58	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	58	Intact	Unidentified fragments	1	N/A	N/A	30-50	Burnt black
6, HC6	58	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	58	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	59	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	60	Intact	Mandibular fragments	1	mammal, medium	N/A	N/A	N/A
6, HC6	60	Intact	P^4, deciduous	1	*Sus*	Very young	N/A	No wear

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC6	62	Intact	Spine	1	fish, small to medium	N/A	N/A	No serrations
6, HC6	62	Intact	Long bone shaft	1	mammal, small	N/A	N/A	N/A
6, HC6	65	Intact	Pectoral spine	1	fish, medium	N/A	N/A	Triangular cross-section, no serrations
6, HC6	65	Intact	Pectoral spine	1	fish, small	N/A	N/A	Curved, no serrations
6, HC6	65	Intact	M^2	1	goat	N/A	N/A	N/A
6, HC6	65	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
6, HC6	65	Intact	Rib fragment	3	mammal, medium	N/A	N/A	N/A
6, HC6	65	Intact	Lower incisor	1	*Sus*	N/A	N/A	Charred
6, HC6	65	Intact	M^1 or M^2 deciduous	1	*Sus*	Juvenile	N/A	Very worn, probably shed or about to be shed
6, HC6	65	Intact	M^2	1	*Sus*	Young	N/A	N/A
6, HC6	65	Intact	M^2 with attached maxillary fragment	1	*Sus*	Young	N/A	No wear
6, HC6	65	Intact	P_3	1	*Sus*	Young	N/A	Little wear
6, HC6	65	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	65	Intact	Unidentified fragments	6	N/A	N/A	<30	N/A
6, HC6	66	Intact	M^1 left	1	*Bos indicus*	N/A	N/A	Probably same individual as P^4 left from same context
6, HC6	66	Intact	M^1 or M^2 left	1	*Bos indicus*	Very old	N/A	N/A
6, HC6	66	Intact	P^4 left	1	*Bos indicus*	N/A	N/A	Probably same individual as M^1 left from same context
6, HC6	66	Intact	Deciduous upper molar	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	66	Intact	Rib fragment	4	mammal, large (Cervus unicolor size)	N/A	N/A	N/A
6, HC6	66	Intact	Incisor fragment	1	mammal, medium (possible human?)	N/A	N/A	N/A
6, HC6	66	Intact	Rib, medial end (at sternum)	1	mammal, small to medium	N/A	N/A	N/A
6, HC6	66	Intact	Rib, medial end (at sternum)	1	mammal, small to medium (Muntjac sized)	N/A	N/A	N/A
6, HC6	66	Intact	Cheek tooth fragments	1	*Sus*	N/A	N/A	Permanent tooth
6, HC6	66	Intact	Deciduous cheek tooth fragment	1	*Sus*	Juvenile	N/A	N/A
6, HC6	66	Intact	Incisor, lower	1	*Sus*	N/A	N/A	N/A
6, HC6	66	Intact	Mandible fragment	1	*Sus*	N/A	N/A	N/A
6, HC6	66	Intact	Mandible fragment, left, including P_4 and M_1	1	*Sus*	N/A	N/A	N/A
6, HC6	66	Intact	Unidentified fragments	2	N/A	N/A	30-50	N/A
6, HC6	66	Intact	Unidentified fragments	2	N/A	N/A	30-50+	N/A
6, HC6	66	Intact	Unidentified fragments	6	N/A	N/A	<30	N/A
6, HC6	67	Intact	Long bone fragments	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	68	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	68	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	68	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC6	68	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	68	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	70	Intact	Metatarsal fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	70	Intact	Rib fragment	2	*Bos or Bubalus*, probably	N/A	N/A	N/A
6, HC6	70	Torn but contents completely intact	Long bone fragments	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	70	Intact	Pelvic fragment, pubis	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	70	Intact	Long bone shaft	1	mammal, small to medium	N/A	N/A	N/A
6, HC6	70	Intact	Canine fragment	1	*Sus*	N/A	N/A	N/A
6, HC6	70	Intact	Deciduous M^2 right	1	*Sus*	N/A	N/A	N/A
6, HC6	70	Intact	M^3 right, deciduous	1	*Sus*	Juvenile	N/A	N/A
6, HC6	70	Intact	Upper canine	1	*Sus*	N/A	N/A	Large individual
6, HC6	70	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	70	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	70	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	70	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	70	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	72	Intact	Lower cheek tooth	1	*Bos or Bubalus*	N/A	N/A	Occlusal surface broken off
6, HC6	72	Intact	M_3 left, with attached mandibular fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	72	Intact	Mandible fragment, left, including diastema and alveoli for P_1 and P_2	1	*Bos or Bubalus*	N/A	N/A	Teeth absent
6, HC6	72	Intact	Mandibular symphesis fragment	1	*Bos or Bubalus*	N/A	N/A	Cut marks
6, HC6	72	Intact	Thoracic vertebral spine	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	72	Intact	Mandibular fragments	5	*Bos or Bubalus*, probably	N/A	N/A	N/A
6, HC6	72	Intact	Long bone fragments	1	mammal, large	N/A	N/A	N/A
6, HC6	72	Intact	Rib fragment	1	mammal, large (Bos or Bubalus size)	N/A	N/A	N/A
6, HC6	72	Intact	Canine fragment	1	*Sus*	N/A	N/A	Small individual
6, HC6	72	Intact	Unidentified fragments	3	N/A	N/A	30-50	N/A
6, HC6	72	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
6, HC6	72	Intact	Unidentified fragments	1	N/A	N/A	>50	N/A
6, HC6	72	Intact	Unidentified fragments	2	N/A	N/A	30-50	N/A
6, HC6	72	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	73	Intact	Spine	1	fish, small	N/A	N/A	N/A
6, HC6	73	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
6, HC6	73	Intact	Rib fragment	1	mammal, small to medium	N/A	N/A	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC6	73	Intact	Tibia fragment	1	mammal, small to medium	N/A	N/A	N/A
6, HC6	73	Intact	I^1 left	1	*Sus*	N/A	N/A	N/A
6, HC6	73	Intact	Unidentified fragments	3	N/A	N/A	<30	N/A
6, HC6	73	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	73	Intact	Unidentified fragments	1	N/A	N/A	>50	Cut marks
6, HC6	74	Intact	Scapula, proximal	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC6	74	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
6, HC6	74	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
6, HC6	75	Intact	Vertebral fragment	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	75	Intact	Unidentified fragments	1	N/A	N/A	>50	N/A
6, HC6	75	Intact	Unidentified fragments	1	N/A	N/A	>50	Cut mark
6, HC6	75	Intact	Unidentified fragments	1	N/A	N/A	<30	Probably from fish
6, HC6	76	Intact	Mandible fragment, left, including alveoli for M_3 and M_2	1	*Canis domesticus*	N/A	N/A	N/A
6, HC6	76	Intact	Mandibular fragments	1	mammal, large	N/A	N/A	No teeth or alveoli
6, HC6	76	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
6, HC6	76	Intact	Tibia fragment	1	mammal, large	N/A	N/A	N/A
6, HC6	76	Intact	Vertebral centrum fragment	1	mammal, medium to large	N/A	N/A	N/A
6, HC6	76	Intact	M_2 right	1	*Sus*	N/A	N/A	N/A
6, HC6	76	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	76	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	76	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC6	78	Intact	Rib fragment	1	*Bos or Bubalus*, probably	N/A	N/A	N/A
6, HC6	78	Intact	Spine	1	fish, small	N/A	N/A	Serrated on one side
6, HC6	78	Intact	Rib fragment	1	mammal, medium	N/A	N/A	N/A
6, HC6	78	Intact	Occipital condyle	1	mammal, medium (size of pig, deer, or donkey?)	N/A	N/A	No match found for shape, some resemblance to pig or donkey
6, HC6	78	Intact	Long bone fragments	2	mammal, very small	N/A	N/A	N/A
6, HC6	78	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC6	79	Intact	M^1 or M^2	1	*Sus*	N/A	N/A	N/A
6, HC6	80	Intact	Rib	1	bird, small	N/A	N/A	N/A
6, HC6	80	Intact	Possible fish spine	1	fish?	N/A	N/A	Curved with grooves, no serrations, relatively dense
6, HC6	80	Intact	First phalanx	1	*Sus*	N/A	N/A	Intentionally abraded on distal end
6, HC6	81	Intact	Spine	1	fish, medium	N/A	N/A	Not serrated, channel on inward curve of spine
6, HC6	81	Intact	Unidentified fragments	2	N/A	N/A	30-50	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC6	balk trim-ming below Locus 47	Intact	Unidentified fragments	~5+	N/A	N/A	<30	N/A
6, HC6	N/A	Intact	Neurocranial fragments	2	fish	N/A	N/A	N/A
6, HC7	3	Intact	Plaston fragments	7	*Lissemys*	N/A	N/A	N/A
6, HC7	3	Intact	Unidentified fragments	5	N/A	N/A	<30	Probably also *Lissemys* shell fragments, but without distinctive pattern preserved
6, HC7	3	Intact	Unidentified fragments	5	N/A	N/A	<30	N/A
6, HC7	5	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC7	5	Intact	Unidentified fragments	1	N/A	N/A	>50	N/A
6, HC7	7	Intact	3^{rd} phalanx, proximal fragment	1	*Bos indicus*	N/A	N/A	N/A
6, HC7	9	Intact	Centrotarsal	1	*Bos indicus*	Adult	N/A	N/A
6, HC7	9	Intact	Left M_2 and M_3 with mandibular fragment on buccal side	1	*Bos or Bubalus*	Young	N/A	Mandibular fragment barely clinging to teeth, very fragile, M_3 just emerging
6, HC7	9	Intact	M^3, left	1	*Bos or Bubalus*	N/A	N/A	Heavy cancar accretion
6, HC7	9	Intact	Horn core fragments	2	bovid	N/A	N/A	N/A
6, HC7	9	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC7	9	Intact	Unidentified fragments	3	N/A	N/A	<30	N/A
6, HC7	11	Intact	Radius fragment	1	mammal, medium to large	N/A	N/A	Broken in half, weathered
6, HC7	23	Intact	Shell	1	*Lamellidens*	N/A	N/A	Parallel incised lines on outer surface
6, HC7	26	Intact	Dental fragments	3	ruminant, large	N/A	N/A	Probably from single tooth
6, HC7	31	Intact	Dental fragment	1	ruminant, large	N/A	N/A	N/A
6, HC7	31	Intact	Unidentified fragments	1	N/A	N/A	<30	Burnt white
6, HC7	32	Intact	M_2?	1	*Bos or Bubalus*	N/A	N/A	N/A
6, HC7	32	Intact	Unidentified fragments	9	N/A	N/A	<30	N/A
6, HC7	54	Intact	Cheek tooth fragments	3	*Sus*	N/A	N/A	N/A
6, HC7	54	Intact	Unidentified fragments	3	N/A	N/A	<30	Burnt mixed black and white
6, HC7	54	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC7	54	Intact	Unidentified fragments	10	N/A	N/A	<30	N/A
6, HC7	55	Intact	Dental fragment, cheek tooth	1	ruminant	N/A	N/A	N/A
6, HC7	55	Intact	Unidentified fragments	5	N/A	N/A	<30	N/A
6, HC7	60	Intact	M^3, left, broken	1	*Cervus unicolor*	N/A	N/A	N/A
6, HC7	60	Intact	Shell fragments	4	*Lamellidens*	N/A	N/A	Not burnt
6, HC7	60	Intact	Long bone fragments	1	mammal	N/A	<30	Burnt white
6, HC7	60	Intact	Phalanx, epiphyses unfused or broken off	1	mammal, small to medium	N/A	N/A	Burnt mixed black and white
6, HC7	61	Intact	Spine	1	fish, small to medium	N/A	N/A	Charred black, rear facing small serrations top and bottom
6, HC7	61	Intact	Vertebral fragment	1	mammal, medium to large	N/A	N/A	N/A
6, HC7	64	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC7	66	Intact	Antler fragments	1	cervid	N/A	N/A	Burnt white, c.f. Locus 69 remains

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
6, HC7	66	Intact	Long bone fragments	1	mammal, large	N/A	N/A	Cut mark, large and deep
6, HC7	66	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
6, HC7	66	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
6, HC7	67	Intact	Bone splinters embedded in dirt	?	N/A	N/A	N/A	N/A
6, HC7	67	Intact	Unidentified fragments	10	N/A	N/A	<30	All burnt white
6, HC7	69	Intact	Antler fragments	3	cervid	Adult	N/A	Burnt white, same animal
6, HC7	69	Intact	Long bone fragments	24	mammal, large	N/A	N/A	Burnt white, splitting from heat and/or pressure
6, HC7	69	Intact	Crumbles, unidentified	~50	N/A	N/A	<30	All burnt white
7, E7	2	Intact	1st phalanx, proximal left	1	sheep or goat	N/A	N/A	N/A
7, E7	5	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	Fresh breaks
7, E7	5	Intact	Unidentified fragments	1	mammal, medium to large	N/A	30-50	Fresh breaks
7, E7	6	Intact	Long bone fragment	3	mammal, medium	N/A	N/A	N/A
7, E7	8	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	Slightly charred exterior
7, E7	8	Intact	Long bone fragment	3	mammal, medium	N/A	N/A	N/A
7, E7	8	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	Charred exterior
7, E7	9	Intact	Cheek tooth fragments	38	*Bos* or *Bubalus*	N/A	N/A	Likely individual A
7, E7	9	Intact	Incisor fragments	5	*Bos* or *Bubalus*	N/A	N/A	Likely individual A
7, E7	9	Intact	Lower molar pieces	4	*Bos* or *Bubalus*	Young	N/A	Likely individual A
7, E7	9	Intact	M_1 or M_2	1	*Bos* or *Bubalus*	Young	N/A	Likely individual A
7, E7	9	Intact	M_1 or M_2, broken	2	*Bos* or *Bubalus*	Young	N/A	Likely individual A
7, E7	9	Intact	M_3 fragment, left	1	*Bos* or *Bubalus*	Young	N/A	Likely individual A
7, E7	9	Intact	M_3, right	1	*Bos* or *Bubalus*	Young	N/A	Large individual, likely individual A
7, E7	9	Intact	Upper cheek tooth pieces	3	*Bos* or *Bubalus*	Young	N/A	Likely individual A
7, E7	9	Intact	Antler fragment	2	cervid, medium to large	N/A	N/A	N/A
7, E7	9	Intact	Dental fragments	>100	mammal, large	N/A	N/A	Likely individual A
7, E7	9	Intact	Unidentified fragments	1	N/A	N/A	<30	Burnt white
7, F7	2	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, F7	4	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, G7	4	Intact	Femur fragment, distal	1	mammal, large	N/A	N/A	N/A
7, G7	4	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, G7	6	Intact	Long bone cancelous fragment	1	mammal, medium to large	N/A	N/A	N/A
7, G7	7	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, G7	8	Intact	Dental fragments	1	mammal, medium to large	N/A	N/A	N/A
7, G7	8	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	N/A
7, G7	8	Intact	Crumbs	~15	N/A	N/A	N/A	Fresh breaks
7, G7	8	Intact	Unidentified fragments	12	N/A	N/A	<30	Half with fresh breaks
7, G7	8	Intact	Unidentified fragments	1	N/A	N/A	<30	Burnt black
7, G7	9	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, G7	10	Intact	Premolar fragment	1	*Bos or Bubalus*	Old	N/A	Very worn

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
7, H7	1	Intact	Cheek tooth, lower	1	*Bos*	N/A	N/A	Burnt black exterior, recent breaks into 3 pieces
7, H7	3	Intact	Unidentified fragments	1	N/A	N/A	<30	Burnt black
7, H7	4	Intact	Dental fragments	1	*Bos or Bubalus*	N/A	N/A	Broken
7, H7	4	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	Embedded in clay, fresh breaks into ~10 fragments
7, H7	4	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
7, H7	5	Intact	Long bone fragment	1	mammal, large	N/A	N/A	N/A
7, H7	5	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, H7	5	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
7, H7	6	Intact	Unidentified fragments	1	N/A	N/A	30-50	Charred
7, H7	7	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Charred exterior
7, H7	7	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	Broken into 5+ fragments, fresh breaks
7, H7	7	Intact	Long bone fragment	1	mammal, medium	N/A	N/A	Embedded in clay, fresh breaks into ~10 fragments
7, H7	8	Intact	Worked bone, point?	1	N/A	N/A	N/A	Slightly charred
7, H7	9	Intact	Rib fragment	1	mammal, medium to large	N/A	N/A	Slightly charred
7, H7	9	Intact	Unidentified fragments	1	N/A	N/A	30-50	Slightly charred
7, H7	9	Intact	Unidentified fragments	1	N/A	N/A	<30	Slightly charred
7, H7	11	Intact	Unidentified fragments	1	N/A	N/A	<30	Fresh breaks
7, H7	12	Intact	M1 or M2, right	1	*Bos or Bubalus*	Young	N/A	Little wear
7, H7	12	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Embedded in clay, fresh breaks into ~20 fragments
7, H7	12	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
7, H7	12	Intact	Unidentified fragments	8	N/A	N/A	<30	N/A
7, H7	12	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
7, H7	12	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
7, H7	12	Intact	Unidentified fragments	~20	N/A	N/A	<30	N/A
7, H7	13	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Broken into ~10 pieces, fresh breaks
7, H7	13	Torn but damage was almost negligible	Long bone fragment	1	mammal, large	N/A	N/A	Broken into ~20 pieces, fresh breaks
7, H7	13	Intact	Tibia shaft fragment	1	mammal, large	N/A	N/A	Slightly charred
7, H7	13	Intact	Unidentified fragments	~15	N/A	N/A	<30	Embedded in clay
7, H7	13	Intact	Unidentified fragments	~10	N/A	N/A	<30	Embedded in clay
7, H7	13	Intact	Unidentified fragments	~10	N/A	N/A	<30	Fresh breaks
7, H7	13	Intact	Unidentified fragments	~20	N/A	N/A	<30	Fresh breaks
7, H7	13	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
7, H7	13	Intact	Unidentified fragments	2	N/A	N/A	<30	N/A
7, H7	13	Intact	Unidentified fragments	1	N/A	N/A	30-50	Embedded in red clay
7, H7	14	Intact	Humerus, distal fragment	1	mammal, large	N/A	N/A	Charred
7, H7	14	Intact	Rib fragment	1	mammal, medium to large	N/A	N/A	N/A
7, H7	14	Intact	Cancelous bone fragments	3	N/A	N/A	<30	N/A

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
7, H7	19	Intact	Femur fragment, head	1	mammal, large	N/A	N/A	Burnt black
7, H7	19	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	Burnt black
7, J7	3	Intact	Dental fragments	2	mammal, large	N/A	N/A	Lightly charred
7, J7	3	Intact	Dental fragments	3	mammal, medium to large	N/A	N/A	Burnt black
7, J7	3	Intact	Unidentified fragments	1	N/A	N/A	<30	Burnt white
7, J7	4	Intact	Premolar fragment	1	*Bos or Bubalus*	N/A	N/A	Relatively worn
7, J7	4	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Probable radius, cracked into >10 pieces, fresh breaks
7, J7	4	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, J7	5	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, J7	8	Intact	Metatarsal fragment, proximal	1	*Bos or Bubalus*	N/A	N/A	Fused
7, J7	9	Intact	Unidentified fragments	1	N/A	N/A	<30	Lightly charred
7, J7	10	Intact	Humerus, distal	1	felid, medium (~small *P. pardus* size)	N/A	N/A	Burnt black with cracking
7, J7	10	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Burnt black
7, M8	1	Intact	Unidentified fragments	1	N/A	N/A	<30	Burnt white
7, M8	3	Intact	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	5	Intact	Cheek tooth fragments	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	5	Intact	Rib fragment	1	mammal, large	N/A	N/A	N/A
7, M8	5	Intact	Dental fragments	1	ruminant, large	N/A	N/A	Broken into ~20 pieces
7, M8	6	Intact	Cheek tooth fragments	1	*Bos or Bubalus*	N/A	N/A	Broken into 2 pieces
7, M8	6	Intact	Dental fragments	1	mammal, medium to large	N/A	N/A	N/A
7, M8	6	Intact	Unidentified fragments	4	N/A	N/A	<30	N/A
7, M8	7	Intact	Dental fragments	1	mammal, large	N/A	N/A	N/A
7, M8	7	Intact	Cheek tooth fragments	1	ruminant, large	N/A	N/A	Broken into 6+ pieces
7, M8	7	Intact	Unidentified fragments	~10	N/A	N/A	<30	Fresh breaks
7, M8	7	Intact	Unidentified fragments	1	N/A	N/A	30-50	Embedded in clay
7, M8	8	Intact	Unidentified fragments	1	N/A	N/A	<30	Slightly charred exterior
7, M8	11	Intact	Cheek tooth fragments	1	ruminant, large	N/A	N/A	N/A
7, M8	15	Intact	Cancelous bone fragments	1	mammal, large	N/A	N/A	N/A
7, M8	15	Intact	Dental fragments	1	mammal, medium to large	N/A	N/A	N/A
7, M8	15	Intact	Unidentified fragments	1	N/A	N/A	<30	Charred on one side
7, M8	16	Intact	Cheek tooth fragments	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	16	Intact	Upper cheek tooth pieces	1	*Bos or Bubalus*	N/A	N/A	Fresh breaks into 9+ pieces
7, M8	16	Intact	Antler fragment	1	cervid	N/A	N/A	N/A
7, M8	16	Intact	Unidentified fragments	1	N/A	N/A	30-50	Embedded in clay
7, M8	17	Intact	Molar fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	18	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, M8	20	Intact	Incisor	1	rodent	N/A	N/A	Crumbling
7, M8	20	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
7, M8	20	Intact	Unidentified fragments	2	N/A	N/A	<30	Charred exterior

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
7, M8	20	Intact	Unidentified fragments	2	N/A	N/A	<30	N/A
7, M8	21	Intact	Crumbs	?	N/A	N/A	N/A	Embedded in clay
7, M8	24	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Broken into 7+ pieces, burnt black and white
7, M8	24	Intact	Unidentified fragments	1	N/A	N/A	30-50	Crumbling, embedded in clay
7, M8	24	Intact	Unidentified fragments	~10	N/A	N/A	<30	N/A
7, M8	25	Intact	Crumbs	?	N/A	N/A	N/A	Burnt black
7, M8	26	Intact	Unidentified fragments	1	N/A	N/A	<30	Fresh breaks into ~6 pieces
7, M8	26	Intact	Unidentified fragments	1	N/A	N/A	<30	Charred exterior
7, M8	28	Intact	Unidentified fragments	1	N/A	N/A	<30	Broken into 4 pieces, fresh breaks
7, M8	28	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, M8	29	Intact	Unidentified fragments	2	N/A	N/A	30-50	N/A
7, M8	29	Intact	Unidentified fragments	6	N/A	N/A	<30	N/A
7, M8	30	Intact	Dental fragments	1	ruminant, large	N/A	N/A	Broken into 4 pieces
7, M8	31	Intact	Unidentified fragments	~10	N/A	N/A	<30	N/A
7, M8	33	Intact	Mandible fragment	1	ruminant, medium (~sheep/goat size)	N/A	N/A	N/A
7, M8	33	Intact	Cancelous bone fragments	1	N/A	N/A	30-50	N/A
7, M8	33	Intact	Unidentified fragments	1	N/A	N/A	30-50	N/A
7, M8	33	Intact	Unidentified fragments	1	N/A	N/A	<30	Charred, fresh breaks
7, M8	34	Intact	Crumbs	?	N/A	N/A	N/A	Fresh breaks
7, M8	34	Intact	Unidentified fragments	2	N/A	N/A	<30	Burnt black
7, M8	36	Intact	Dental fragments	1	mammal, large	N/A	N/A	N/A
7, M8	36	Intact	Rib fragment	1	mammal, large	N/A	N/A	Broken into 2 pieces, fresh breaks
7, M8	36	Intact	Vertebral fragment	1	mammal, large	N/A	N/A	N/A
7, M8	38	Intact	Long bone fragment	1	mammal, large	N/A	N/A	N/A
7, M8	38	Intact	Pelvic fragment	3	mammal, large	N/A	N/A	N/A
7, M8	39	Intact	Dental fragments	1	mammal, large	N/A	N/A	Burnt black
7, M8	39	Intact	Dental fragments	2	mammal, large	N/A	N/A	Burnt black on exterior
7, M8	39	Intact	Unidentified fragments	1	N/A	N/A	<30	N/A
7, M8	40	Intact	Crumbs	?	N/A	N/A	N/A	Embedded in clay
7, M8	41	Intact	Mandible fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	42	Intact	M1 or M2 fragment	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	42	Intact	Radius fragment, proximal	1	mammal, medium	N/A	N/A	Slightly charred
7, M8	43	Intact	Long bone fragment	2	mammal, large	N/A	N/A	N/A
7, M8	43	Intact	Long bone fragment	1	mammal, medium to large	N/A	N/A	Slightly charred surface, ancient break into 2 pieces, refits
7, M8	43	Intact	Operculum	1	*Pila*	N/A	N/A	Broken
7, M8	44	Intact	P^4	1	*Bos or Bubalus*	N/A	N/A	Broken, charred
7, M8	44	Intact	Unidentified fragments	2	N/A	N/A	<30	N/A
7, M8	44	Intact	Unidentified fragments	3	N/A	N/A	<30	Charred
7, M8	45	Intact	Carapace fragment	7	*Kachuga*	N/A	N/A	Burnt black, probably from single individual
7, M8	45	Intact	Cranial fragment	1	mammal, large	N/A	N/A	N/A
7, M8	45	Intact	Long bone fragment	2	mammal, large	N/A	N/A	Burnt black on exterior
7, M8	45	Intact	Dental fragments	3	mammal, medium to large	N/A	N/A	N/A
7, M8	45	Intact	Dental fragments	1	ruminant, large	N/A	N/A	Charred

Operation, Trench	Split/ Locus	State of Bag	Element	No. of Elements	Identification	Age	Measurement (mm)	Comment
7, M8	45	Intact	Unidentified fragments	1	N/A	N/A	<30	Partially charred
7, M8	48	Intact	Cheek tooth fragments	1	*Bos or Bubalus*	N/A	N/A	N/A
7, M8	50	Intact	Long bone fragment	1	mammal, large	N/A	N/A	Burnt black
7, M8	52	Intact	Unidentified fragments	6	N/A	N/A	<30	Burnt black
7, M8	54	Intact	Unidentified fragments	3	N/A	N/A	<30	Slightly charred
7, M8	56	Intact	Humerus, distal	1	*Canis*	N/A	N/A	Recently fused, large individual
7, M8	56	Intact	M_3 fragment, right	1	equid	N/A	N/A	Burnt black
7, M8	56	Intact	Carpometacarpus	1	*Gallus*	N/A	GL-34.9, Bp-10.0	N/A

APPENDIX B. PHOTOGRAPHS OF FAUNAL REMAINS

B-1 *Equus* sp. I_2, left. From Core Sequence 3, Split 11a

B-2 *Equus* sp. I^3, left. From Core Sequence 3, Split 13

B-3 *Equus asinus* P_3. From Operation 3, Trench G, Locus 37

B-4 *Equus* sp. M_3, right, broken, burnt black. From Operation 7, Trench M8, Locus 56

B-5 *Bos indicus* or *Bubalus bubalis* upper cheek tooth. From Core Sequence 1, Split 6

B-6 *Bos indicus* right metacarpal and 1st right anterior lateral phalanx, complete and articulating. From Core Sequence 1, Split 10

B-7 *Bos indicus* or *Bubalus bubalis* M$_1$. From Core Sequence 1, Split 10

B-8 *Bos indicus* or *Bubalus bubalis* M_3. From Core Sequence 1, Split 11

B-9 *Bos indicus* or *Bubalus bubalis* left mandible fragment with emerging M_3. From Core Sequence 1, Split 15

B-10 *Bos indicus* or *Bubalus bubalis* I_2, right, worn and burnt black. From Core Sequence 3, Split 19

B-11 *Bos indicus* or *Bubalus bubalis* M_3, right, burnt black. From Core Sequence 3, Split 19

B-12 ***Bos indicus*** **2nd phalanx. From Operation 3, Trench G, Locus 46**

B-13 ***Bos indicus*** **or** ***Bubalus bubalis*** **M^3, broken. From Operation 3, Trench N, Locus 4**

B-14 ***Bos indicus*** **or** ***Bubalus bubalis*** **lower molar, broken, recently erupted. From Operation 3 Rampart Strip, Trench BB, Locus 28**

B-15 *Bos indicus* or *Bubalus bubalis* mandible fragment including P_4 and broken M_1, from a very young individual. From Operation 3 Rampart Strip, Trench GG, Locus 13

B-16 *Sus scrofa* M^1, right. From Core Sequence 1, Locus 12

B-17 *Sus scrofa* dental fragments. From Core Sequence 1, Locus 13

B-18 *Sus scrofa* mandible, left, including broken canine and premolars. From Core Sequence 1, Locus 16

B-19 *Sus scrofa* maxilla fragment, right with M^2. From Core Sequence 1, Split 16

B-20 *Sus scrofa* P_2, left. From Operation 6, Trench HC6, Locus 52

B-21 *Sus scrofa* I^1, right. From Operation 6, Trench HC6, Locus 58

B-22 *Sus scrofa* mandible fragment, left, with P_4 and M_1. From Operation 6, Trench HC6, Locus 66

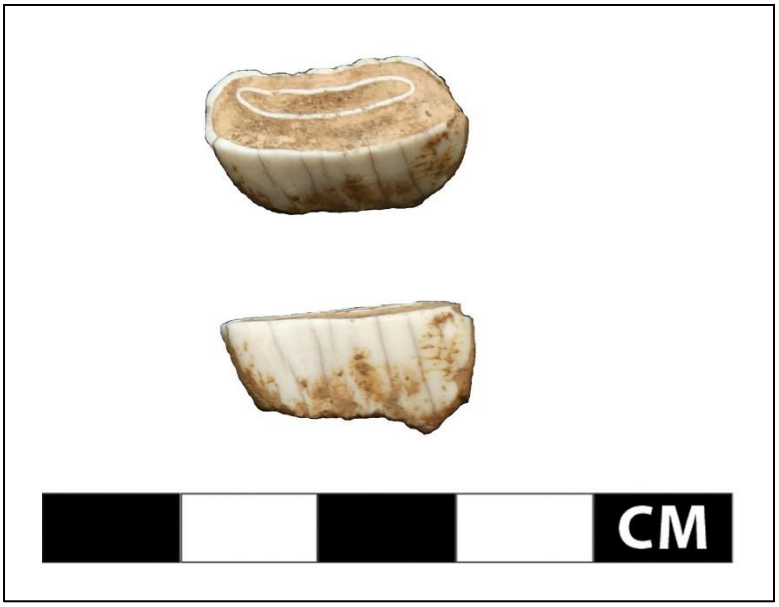
B-23 *Sus scrofa* C^1. From Operation 6, Trench HC6, Locus 70

B-24 *Sus scrofa* first phalanx with abrasion on distal end. From Operation 6, Trench HC6, Locus 80

B-25 *Ovis aries* or *Capra hircus* M_1 or M_2. From Core Sequence 3, Split 9

B-26 *Canis* sp. tibia, proximal. From Core Sequence 1, Split 16

B-27 *Canis* sp. C^1. From Core Sequence 3, Split 13



B-28 *Elephas maximus* molar fragment. From Core Sequence 3, Split 9

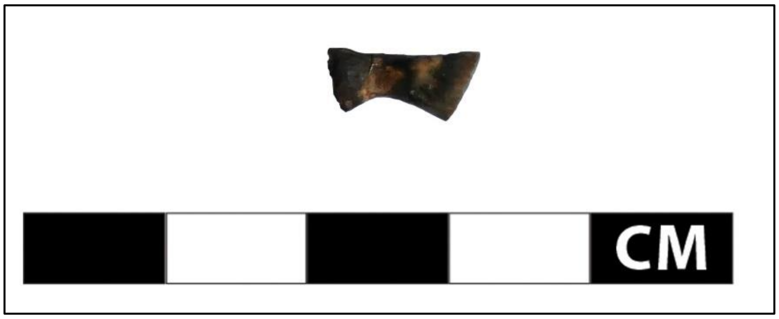
B-29 *Boselaphus tragocamelus* M^3, broken. From Core Sequence 1, Split 11

B-30 ***Cervus unicolor*** **(sambar deer) shed antler with cleanly cut tines and partial polishing on smaller tine. From Core Sequence 1, Split 15**

B-31 Cervinae antler fragments, burnt white. From Operation 6, Trench HC7, Locus 69

B-32 *Antilope cervicapra* (blackbuck) M_1 from Core Sequence 3, Split 13

B-33 Felidae (approx. small *Panthera pardus* size), burnt black with cracking. From Operation 7, Trench J7, Locus 10



B-34 *Lepus* sp. cheek tooth, burnt black, very worn. From Core Sequence 1, Locus 12

B-35 Aves (medium size) proximal ulna (cut mark indicated by red circle) from Core Sequence 1, Split 10

B-36 Aves (medium size) humerus from Core Sequence 1, Split 16

B-37 Aves (*Gallus gallus* size) pelvis from Core Sequence 1, Split 18

B-38 *Pavo cristatus* (peafowl) tarsometatarsus fragment with broken spur, male, from Operation 3, Trench G, Locus 46

B-39 Aves (medium size) ulna from Operation 6, Trench HC6, Locus 58

B-40 Osteichthyes, very large size, neurocranial fragment. From Core Sequence 1, Split 11

B-41 Osteichthyes vertebrae and spines. From Core Sequence 1, Split 16.

B-42 Chondrichthyes vertebra. From Core Sequence 3, Split 10c

B-43 SP Decapoda claw fragment. From Operation 5, Trench PM17, Locus 6

B-44 *Melania* spp. shells. From Operation 3 Rampart Strip, Trench EE, Locus 32

B-45 Mammalia, large size, long bone fragment, worked, cut marks (prob. for tool-making purpose), polished edge. From Core Sequence 3, Split 13a

B-46 Mammalia, large size, worked bone (probable pelvis), polished on both faces and edge, broken, many cut marks on one face. From Core Sequence 3, Split 20

B-47 *Kachuga tecta* (Indian roofed turtle) carapace fragments, worked with a shelf cut into bone and polished. From Operation 3, Trench G, Locus 46.

B-48 *Lamellidens* sp. shell, complete and perforated. From Operation 3 Rampart Strip, Trench EE, Locus 25

B-49 Mollusca, freshwater mussel shell with parallel incised lines. From Operation 6, Trench HC7, Locus 23

B-50 Mammalia, burnt long bone fragments still stuck together with dirt. From Operation 6, Trench HC7, Locus 69.

REFERENCES

Agrawal, Ashvini. 2014. "Asokan and Post-Asokan Inscriptions (up to C. 200 BC)." In *The Texts, Political History and Administration Till c. 200 BC – History of Ancient India Volume III,* edited by Dilip K. Chakrabarti and Makkhan Lal, 413-421. New Delhi: Vivekananda International Foundation.

Ammerman, Steven (in press) "Animal Agents in the Human Environment." In *The Power of Nature: Agency and the Archaeology of Human-Environmental Dynamics*, edited by Monica L. Smith. Boulder: University Press of Colorado.

Aplin, L.M. 2019. "Culture and cultural evolution in birds: a review of the evidence." *Animal Behaviour* 147: 179-187.

Bar-On, Y.M., R. Phillips, and R. Milo. 2018. "The biomass distribution on Earth." *Proceedings of the National Academy of Sciences* 115 (25): 6506-6511.

Barua, Benimadhab. 1929. *Old Brāhmī Inscriptions in the Udayagiri and Khaṇḍagiri Caves*. Calcutta: University Press.

Barua, Maan, and Anindya Sinha. 2022. "Cultivated, feral, wild: the urban as an ecological formation." *Urban Geography*: 1-22.

Basak, Bishnupriya. 2016. "Early Historic Urbanization in South India: A Revaluation." *Pratnatattva* 22: 29-40.

Behera, Pradeep K., and Pranab K. Chattopadhyay. 2013. "Iron Age—early historic period in Eastern India. A study in material culture and technology: evidence from the site of Badmal-Asurgarh, District Sambalpur, Orissa, India." In *The World of Iron*, edited by Jane Humphris and Thilo Rehren, 124-134. London: Archetype Publications.

Berna, Francesco, Paul Goldberg, Liora Kolska Horwitz, James Brink, Sharon Holt, Marion Bamford, and Michael Chazan. 2012. "Microstratigraphic Evidence of *in situ* Fire in the Acheulean Strata of Wonderwerk Cave, Northern Cape Province, South Africa." *Proceedings of the National Academy of Sciences* 107: E1215-1220.

Bhaskar, M.V. 2022. "Indus zoomorphism and its avatars." *Indus Journal of History of Science* 57: 175-194.

Boggs, Carol. 2016. "Human niche construction and the Anthropocene." *RCC Perspectives* 2: 27-32.

Boivin, Nicole L., Melinda A. Zeder, Dorian Q. Fuller, Alison Crowther, Greger Larson, Jon M. Erlandson, Tim Denham, and Michael D. Petraglia. 2016. “Ecological Consequences of Human Niche Construction: Examining Long-Term Anthropogenic Shaping of Global Species Distributions.” *Proceedings of the National Academy of the Sciences* 113 (23): 6388–6396.

Braje, Todd J., and Jon M. Erlandson. 2013. “Looking Forward, Looking Back: Humans, Anthropogenic change, and the Anthropocene.” *Anthropocene* 4: 116-121.

Brazier, R.E., A. Puttock, H.A. Graham, R.E. Auster, K.H. Davies, and C.M. Brown. 2021. “Beaver: Nature's ecosystem engineers.” *Wiley Interdisciplinary Reviews: Water* 8 (1): e1494.

Central Ground Water Board. 2020. *Ground Water Yearbook 2019-2020 South Eastern Region, Bhubaneswar*. Bhubaneswar: Govt. of India Ministry of Jal Shakti Department of Water Resources.

Chakrabarti, Dilip K. 1999. India, An Archaeological History: Paleolithic Beginnings to Early Historic Foundations. New Delhi: Oxford University Press.

Chakravarti, Ranabir. 2014. “The Mauryas.” In *History of Ancient India Vol. III --The Texts, Political History and Administration Till c. 200 BC*, edited by Dilip K. Chakrabarti and Makkhan Lal, 231-275. New Delhi: Vivekananda International Foundation.

Childe, V. Gordon. 1950. “The Urban Revolution.” *The Town Planning Review* 21 (1): 3-17.

Clutton-Brock, J. 2014. The walking larder: patterns of domestication, pastoralism, and predation. London: Routledge.

Collins, Steven. 2005. “On the Very Idea of the Pali Canon.” In Buddhism:Critical Concepts in Religious Studies, Vol. 1, Buddhist Origins and the Early History of Buddhism in South and Southeast Asia, edited by Paul Williams, 72-95. New York: Routledge.

Coningham, Robin, and Ruth Young. 2015. *The Archaeology of South Asia: From the Indus to Asoka, c. 6500 BCE-200 CE.* Cambridge: Cambridge University Press.

Cowell, E.B. (Trans.). 1981. *The Jātaka or Stories from the Buddha’s Former Births*. New ed. London: The Pali Text Society. In 5 volumes.

Darwin, Charles, and Alfred Russel Wallace. 1858. “On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection.” *Zoological Journal of the Linnean Society of London* 3: 45-62.

Darwin, Charles. 1859. *On the Origin of Species*. London: John Murray. Project Gutenberg: http://www.gutenberg.org/files/1228/1228-h/1228-h.htm. Accessed 22 April 2017.

Davis, C.E., R.A.E. Coningham, K.P. Archarya, I.A. Simpson, J. Tremblay, R.B. Kunwar, M.J. Manuel, K.C. Krishna Bahadur, and B. Bidari. 2016. "Re-investigating Tilaurakot's Ancient Fortifications: A Preliminary Report of Excavations through the Northern Rampart (Nepal)." *Ancient Nepal* 190: 30-46.

Day, R.L., K.N. Laland, and F.J. Odling-Smee. 2003. "Rethinking adaptation: the niche-construction perspective." *Perspectives in biology and medicine* 46 (1): 80-95.

Demps, K., F. Zorondo-Rodríguez, C. García, and V. Reyes-García. 2012. "Social learning across the life cycle: cultural knowledge acquisition for honey collection among the Jenu Kuruba, India." *Evolution and Human Behavior* 33 (5): 460-470.

Dhammika, Ven. S. 1993. "The Edicts of King Asoka: An English Rendering." *The Wheel Publication* 386/387. Kandy, Sri Lanka: Buddhist Publication Society.

Dhavalikar, M.K. 1999. *Historical Archaeology of India*. New Delhi: Books & Books.

Donkin, A.E., J.A. Sutter, and T. Matney. 2007. "Sisupalgarh, Orissa, India, Final Report on the Archaeo-Geophysical Survey of 2007." Archaeological Geophysics Laboratory, University of Akron, OH. Manuscript on file, University of Akron and University of California, Los Angeles.

Dunne, J., A. Höhn, G. Franke, K. Neumann, P. Breunig, T. Gillard, C. Walton-Doyle, and R.P. Evershed. 2021. "Honey-collecting in prehistoric West Africa from 3500 years ago." *Nature communications* 12 (1): 1-11.

Dyson-Hudson, R. and E.A. Smith. 1978. "Human territoriality: an ecological reassessment." *American Anthropologist* 80 (1): 21-41.

Faith, J. Tyler, and Jessica C. Thompson 2018. "Low-Survival Skeletal Elements Track Attrition, Not Carcass Transport Behavior in Quaternary Large Mammal Assemblages." In *Zooarchaeology in Practice: Case Studies in Methodology and Interpretation in Archaeofaunal Analysis*, edited by Christina M. Giovas and Michelle J. LeFevre, 109-126. Cham, Switzerland: Springer.

Felius, M., M.L. Beerling, D.S. Buchanan, B. Theunissen, P.A. Koolmees, and J.A. Lenstra. 2014. "On the history of cattle genetic resources." *Diversity* 6 (4): 705-750.

Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/faostat/en/#data/QA. Accessed 22 Apr 2017.

Gerbault, P., A. Liebert, Y. Itan, A. Powell, M. Currat, J. Burger, D.M. Swallow, and M.G. Thomas. 2011. "Evolution of lactase persistence: an example of human niche construction." *Philosophical Transactions of the Royal Society B: Biological Sciences* 366 (1566): 863-877.

Ghosh, A. 1989. *An Encyclopedia of Indian Archaeology*. New Delhi: Munshiram Manoharlal Publishers Pvt. Ltd.

Gillespie, Thomas W., Monica L. Smith, Scott Barron, Kanika Kalra, and Corey Rovzar. 2016. “Predictive modelling for archaeological sites: Ashokan edicts from the Indian subcontinent.” *Current Science* 10: 1916-1921.

Gilliland, K., I.A. Simpson, W.P. Adderley, C.I. Burbidge, A.J. Cresswell, D.C.W. Sanderson, R.A.E. Coningham, M. Manuel, K. Strickland, P. Gunawardhana, and G. Adikari. 2013. “The Dry Tank: Development and Disuse of Water Management Infrastructure in the Anuradhapura Hinterland, Sri Lanka.” *Journal of Archaeological Science* 40: 1012-1028.

Gifford-Gonzalez, Diane. 1989. “Ethnographic Analogues for Interpreting Modified Bones: Some Cases from East Africa.” In *Bone Modification*, edited by R. Bonnichsen and M. Sorg, 179-246. Orono, Maine: University of Maine Center for the Study of the First Americans.

Good, Irene, Jonathan Mark Kenoyer, and Richard Meadow. 2008. “New Evidence for Early Silk in the Indus Civilization.” *Nature Precedings*.

Griffith, Ralph T.H. (Trans.). 1895. *The Hymns of the Atharvaveda*. Benares: E.J. Lazarus & Co.

Gross, J., and D. Bhattacharya. 2010. “Uniting sex and eukaryote origins in an emerging oxygenic world.” *Biology Direct* 5 (1): 1-20.

Harmanşah, Ömür. 2013. “Upright Stones and Building Stories: Architectural Technologies and the Poetics of Urban Space.” In *Cities and the Shaping of Memory in the Ancient Near East*, 153-188. Cambridge: Cambridge University Press.

Hawkes, Jason, and Akira Shimada. 2009. *Buddhist Stupas in South Asia*. New Delhi: Oxford University Press.

Haynes, G. 2006. “Mammoth landscapes: good country for hunter-gatherers.” *Quaternary International* 142: 20-29.

Hollund, H.I., N. Arts, M.M.E. Jans, and H. Kars. 2015. “Are Teeth Better? Histological Characterization of Diagenesis in Archaeological Bone—Tooth Pairs and a Discussion of the Consequences for Archaeometric Sample Selection and Analyses.” *International Journal of Osteoarchaeology* 25: 901-911.

Hooper, Paul L., Hillard S. Kaplan, and James L. Boone. 2010. “A Theory of Leadership in Human Cooperative Groups.” *Journal of Theoretical Biology* 265: 633-646.

Hultzsch, E. 1925. Corpus Inscriptionum Indicarum. Vol 1. Inscriptions of Asoka. Oxford: Clarendon Press.

Huxley, Julian. 1942. *Evolution: The Modern Synthesis*. London: Allen and Unwin.

International Union for Conservation of Nature (IUCN). 2016-3. The IUCN Red List of Threatened Species. http://www.iucnredlist.org/. Accessed 4 May 2017.

Jamison, Stephanie W., and Joel P. Brereton (Trans.). 2014. *The Rigveda: the earliest religious poetry of India*. Oxford: Oxford University Press.

Jesmer, B.R., J.A. Merkle, J.R. Goheen, E.O. Aikens, J.L. Beck, A.B. Courtemanch, M.A. Hurley, D.E. McWhirter, H.M. Miyasaki, K.L. Monteith, and M.J. Kauffman. 2018. "Is ungulate migration culturally transmitted? Evidence of social learning from translocated animals." *Science* 361 (6406): 1023-1025.

Kant, Shashi. 1971. The Hāthīgumphā Inscription of Khāravela and the Bhabru Edict of Aśoka—A Critical Study. Delhi: Prints India.

Keil, P.G. 2020. "On the Trails of Free-Roaming Elephants: Human-Elephant Mobility and History across the Indo-Myanmar Highlands." *Transfers* 10 (2-3): 1-21.

Kendall, Cristopher, Anne Marie Høier Eriksen, Ioannis Kontopoulos, Matthew J. Collins, and Gordon Turner-Walker. 2018. "Diagenesis of Archaeological Bone and Tooth." *Palaeogeography, Palaeoclimatology, Palaeoecology* 491: 21-37.

Lal, B.B. 1949. "Sisupalgarh 1948: An Early Historical Fort in Eastern India." *Ancient India* 5: 62-105.

Lal, B.B. 1991. "Planned Cooperation between Archaeologists and Scholars of Ancient Literature – A Crying Need." *Man and Environment* 16 (1): 5-21.

Lal, B.B., Rabindra Kumar Mohanty, and Monica L. Smith. 2014. "Sisupalgarh." In *History of Ancient India Vol. III --The Texts, Political History and Administration Till c. 200 BC*, edited by Dilip K. Chakrabarti and Makkhan Lal, 617-628. New Delhi: Vivekananda International Foundation.

Lal, Makkhan. 2014. "Early Historical Urbanism and State Formations." In *History of Ancient India Vol. III --The Texts, Political History and Administration Till c. 200 BC*, edited by Dilip K. Chakrabarti and Makkhan Lal, 435-500. New Delhi: Vivekananda International Foundation.

Laland, Kevin N., and Michael J. O'Brien. 2010. "Niche Construction Theory and Archaeology." *Journal of Archaeological Method and Theory* 17: 303–322.

Laland, Kevin N., John Odling-Smee, and Marcus W. Feldman. 2000. "Niche Construction, Biological Evolution, and Cultural Change." *Behavioral and Brain Sciences* 23: 131–175.

Larson, Greger, and Dorian Q. Fuller. 2014. "The Evolution of Animal Domestication." *Annual Review of Ecology, Evolution and Systematics* 45: 115-36.

Lewontin, R.C. 1983. "Gene, Organism, and Environment." In *Evolution from Molecules to Men*, edited by D.S. Bendall, 273–285. Cambridge: Cambridge University Press.

Lyman, R. Lee. 1994. *Vertebrate Taphonomy*. Cambridge: Cambridge University Press.

Marom, Nimrod, and Guy Bar-Oz. 2013. "The Prey Pathway: A Regional History of Cattle (*Bos Taurus*) and Pig (*Sus scrofa*) Domestication in the Northern Jordan Valley, Israel." *PLoS ONE* 8 (2): 1-13.

Magee, Peter. 2010. "Revisiting Indian Rouletted Ware and the impact of Indian Ocean trade in Early Historic south Asia." *Antiquity* 84: 1043-1054.

Majerus, Michael E.N., 2009. "Industrial Melanism in the Peppered Moth, *Biston beularia*: An Excellent Teaching Example of Darwinian Evolution in Action." *Evolution: Education and Outreach* 2: 63-74.

McMahon, Augusta, Arkadiusz Sołtysiak, and Jill Weber. 2013. "Late Chalcolithic mass graves at Tell Brak, Syria, and violent conflict during the growth of early city-states." *Journal of Field Archaeology* 36 (3): 201-220.

Mishra, Umakant. 2013. "Multiple Gods, Goddesses and Buddhas Locating Buddhism in the Religious Dynamics of Early Medieval Orissa." In *Imaging Odisha*, edited by Hermann Kulke, 194-209. Orissa: Prafulla Pathagar.

Mitra, Debala. 1975. *Udayagiri and Khandagiri.* New Delhi: Archaeological Survey of India.

Mohanty, R.K., and M.L. Smith. 2005. "Sisupalgarh Excavations 2005 Field Report." 39 pp. On file, Archaeological Survey of India, New Delhi, and Department of Anthropology, University of California, Los Angeles.

Mohanty, R.K., and M.L. Smith. 2006. "Sisupalgarh Excavations 2006 Field Report." 48 pp. On file, Archaeological Survey of India, New Delhi, and Department of Anthropology, University of California, Los Angeles.

Mohanty, R.K., and M.L. Smith. 2007. "Sisupalgarh Excavations 2007 Field Report." 50 pp. On file, Archaeological Survey of India, New Delhi, and Department of Anthropology, University of California, Los Angeles.

Mohanty, R.K., and M.L. Smith. 2008. "Sisupalgarh Excavations 2008 Field Report." 47 pp. On file, Archaeological Survey of India, New Delhi, and Department of Anthropology, University of California, Los Angeles.

Mohanty, R.K., and M.L. Smith. 2009. “Sisupalgarh Excavations 2009 Field Report.” On file, Archaeological Survey of India, New Delhi, and Department of Anthropology, University of California, Los Angeles.

Mohanty, R.K., M.L. Smith, and T. Matney. 2007. “A Preliminary Report of the Archaeological Investigations at Sisupalgarh 2006.” *Man and Environment* 32 (1): 57-66.

Nicol, C. 2006. “How animals learn from each other.” *Applied Animal Behaviour Science* 100 (1-2): 58-63.

O’Bryan, C.J., J.R. Allan, M. Holden, C. Sanderson, O. Venter, M. Di Marco, E. McDonald-Madden, and J.E. Watson. 2020. “Intense human pressure is widespread across terrestrial vertebrate ranges.” *Global Ecology and Conservation* 21: e00882.

Odling-Smee, F. John, Kevin N. Laland, and Marcus W. Feldman. 2003. *Niche Construction – The Neglected Process of Evolution (Monographs in Population Biology 37)*. Princeton: Princeton University Press.

Oliver, W., and K. Leus. 2008. *Sus scofra*. The IUCN Red List of Threatened Species 2008: e.T41775A10559847. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T41775A10559847.en. Accessed 4 May 2017.

Olivelle, Patrick (Trans.). 2013. *King, Governance, and Law in Ancient India: Kauṭilya’s Arthaśāstra*. Oxford: Oxford University Press.

Olsen, Sandra. 2006. “Early Horse Domestication of the Eurasian Steppe.” In *Documenting Domestication – New Genetic and Archaeological Paradigms*, edited by Melinda A. Zeder, Daniel G. Bradley, Eve Emshwiller, and Bruce D. Smith, 245-269. Berkeley: University of California Press.

Ortner, Sherry B. 1995. “The Case of the Disappearing Shamans, or No Individualism, No Relationalism.” *Ethos* 23 (3): 355-90.

Ota, S.B. 2007. “Evidence of a Stupa at Sisupalgarh, Orissa: Re-interpreting Earlier Excavation Data.” *Man and Environment* 32 (1): 67-73.

Pal, J.N. 2014. “Kausambi.” In *The Texts, Political History and Administration Till c. 200 BC – History of Ancient India Volume III*, edited by Dilip K. Chakrabarti and Makkhan Lal, 551-565. New Delhi: Vivekananda International Foundation.

Paranavitana, S. 1950. “Sīgiri, the Abode of a God-king.” The Journal of the Ceylon Branch of the Royal Asiatic Society of Great Britain and Ireland 1: 129-183.

Patel, Ajita K., and Richard H. Meadow. 2017. "South Asian contributions to animal domestication and pastoralism: bones, genes, and archaeology." In *The Oxford Handbook of Zooarchaeology*, edited by Umberto Albarella, Mauro Rizzetto, Hannah Russ, Kim Vickers, and Sarah Viner-Daniels, 280-303. Oxford: Oxford University Press.

Patnaik, Sunil Kumar. 2016. "Excavations at Aragarh (2014-2016): An Early Historic Buddhist Site." *Puratattva* 46: 223-32.

Patnaik, Sunil Kumar. 2019. "Buddhist Monuments of Odisha: A Study of Forms and Patronage." *International Review of Social Research* 9 (1): 38-48.

Patra, Benudhar. 2015. "Urbanisation and Urban Centres in Early Coastal Odisha: Archaeology and Identification." *Proceedings of the Indian History Congress* 76: 57-65.

Pattanayak, S., B.S. Rath, S. Pasupalak, A. Baliarsingh, A.K.B. Mohapatra, A. Nanda, and G.S. Panigrahi. 2018. "Spatial and temporal variability of rainfall in Khordha district of Odisha." *The Pharma Innovation Journal* 7 (10): 716-722.

Pendergast IV, T.H., S.M. Hanlon, Z.M. Long, A.A. Royo, and W.P. Carson. 2016. "The legacy of deer overabundance: long-term delays in herbaceous understory recovery." *Canadian Journal of Forest Research* 46 (3): 362-369.

Powers, S.T., and L. Lehmann. 2014. "An Evolutionary Model Explaining the Neolithic Transition from Egalitarianism to Leadership and Despotism." *Proceedings of the Royal Society* 281: 1-9.

Price, Edward O. 2002. *Animal Domestication and Behavior*. Wallingford, UK: CAB International Publishing.

Price, M., and Hongo, H. 2020. "The archaeology of pig domestication in Eurasia." *Journal of Archaeological Research* 28 (4): 557-615.

Qu, Tongli, Chen Youcheng, Ofer Bar-Yosef, and Wang Youping. 2018. "Late Middle Palaeolithic Subsistence in the Central Plain of China: A Zooarchaeological View from the Laonainaimiao Site, Henan Province." *Asian Perspectives* 57 (2): 210-221.

Ramachandran, T.N. 1951. "Find of Tempera Painting in Sītābhiñji, District Keoñjhār, Orissa." *Artibus Asiae* 14 (1/2): 4-25.

Rainsford, Clare, and Terry O'Conner. 2018. "Bone Taphonomy in Deep Urban Stratigraphy: Case Studies from York, United Kingdom." In *Zooarchaeology in Practice: Case Studies in Methodology and Interpretation in Archaeofaunal Analysis*, edited by Christina M. Giovas and Michelle J. LeFevre, 93-107. Cham, Switzerland: Springer.

Ray, Himanshu P. 1988. "Early Buddhist Caves of the Western Deccan." *Expedition Magazine* 30: 3-9.

Ray, Himanshu P. 2008. “Providing for the Buddha: Monastic Centres in Eastern India.” *Arts asiatiques* 63: 119-138.

Ruddiman, William F. 2010. *Plows, Plagues, and Petroleum: how humans took control of climate*.” Princeton: Princeton Science Library.

Sahu, Nabin Kumar. 1984. “Appendix 1: Hâthígumphâ Inscription.” In *Khâravela: A Golden Jubilee Publication*, edited by Nabin Kumar Sahu, 311-346. Odisha: Orissa State Museum.

Sarao, K.T.S. 2014. “Janapadas, Mahajanapadas, Kingdoms, and Republics.” In *History of Ancient India Vol. III --The Texts, Political History and Administration Till c. 200 BC*, edited by Dilip K. Chakrabarti and Makkhan Lal, 183-204. New Delhi: Vivekananda International Foundation.

Sarao, K.T.S., and Anita Sharma. 2014. “The Buddhist and Jaina Texts.” In *History of Ancient India Vol. III --The Texts, Political History and Administration Till c. 200 BC*, edited by Dilip K. Chakrabarti and Makkhan Lal, 127-182. New Delhi: Vivekananda International Foundation.

Sawant, Reshma, and Gurudas Shete. 2016. “A Review of Early Historic Urbanization in India.” In *A Companion to South Asia in the Past*, 1st Edition, edited by Gwen Robbins Schug and Subhash R. Walimbe, 319-331. Chichester, UK: John Wiley& Sons.

Schiffer, Michael B. 1987. *Formation Processes of the Archaeological Record*. Salt Lake City: University of Utah Press.

Schenk, Heidrun. 2006. “The Dating and Historical Value of Rouletted Ware.” *Zeitschrift für Archäologie Außereuropäischer Kulturen* 1: 123-152.

Schopf, J.W. 2014. “Geological evidence of oxygenic photosynthesis and the biotic response to the 2400-2200 Ma ‘Great oxidation event’.” *Biochemistry (Moscow)* 79 (3): 165-177.

Schwartz, Amy L.W., Harry F. Williams, Elizabeth Chadwick, Robert J. Thomas, and Sarah E. Perkins. 2018. “Roadkill scavenging behaviour in an urban environment.” *Journal of Urban Ecology* 4 (1): 1-7.

Sharma, G. R. 1960. *The Excavations at Kaushambi (1957-59)*. Allahabad: Department of Ancient History, Culture and Archaeology, University of Allahabad.

Shaw, Julia. 2013. “Archaeologies of Buddhist propagation in ancient India: ‘ritual’ and ‘practical’ models of religious change.” *World Archaeology* 45 (1): 83-108.

Sherratt, A. 1981. "Plough and Pastoralism: Aspects of the Secondary Products Revolution." In *Pattern of the Past: Studies in Honour of David Clark*, edited by Glynn L. Isaac and Norman Hammond, 155-199. Cambridge: Cambridge University Press.

Shipman, Pat. 2010. "The Animal Connection and Human Evolution." *Current Anthropology* 51 (4): 519-538.

Shipman, Pat, Giraud Foster, and Margaret Schoeninger. 1984. "Burnt Bones and Teeth: an Experimental Study of Color, Morphology, Crystal Structure and Shrinkage." *Journal of Archaeological Science* 11: 307-325.

Singh, Upinder. 2009. *A History of Ancient and Early Medieval India: From the Stone Age to the 12th century*. New Delhi: Pearson Education India.

Singh, Upinder. 2012. "Governing the State and the Self: Political Philosophy and Practice in the Edicts of Aśoka." *South Asian Studies* 28 (2): 131-45.

Skilling, Peter. 2011. "Stūpas, Aśoka and Buddhist Nuns: Early Buddhism in Ujjain and Malwa." *Bulletin of the Asia Institute* New Series 25: 157-173.

Smith, Bruce D. 2007. "Niche Construction and the Behavioral Context of Plant and Animal Domestication." *Evolutionary Anthropology* 16: 188–199.

Smith, Bruce D. 2011. "A Cultural Niche Construction Theory of Initial Domestication." *Biological Theory* 6: 260–271.

Smith, Monica L. 2002. "The Role of Local Trade Networks in the Indian Subcontinent during the Early Historic Period." *Man and Environment* XXVII (1).

Smith, Monica L. 2003. "Early Walled Cities of the Indian Subcontinent as 'Small Worlds'." In *The Social Construction of Ancient Cities*, edited by Monica L. Smith, 269-289. Washington, DC: Smithsonian Books.

Smith, M.L. 2005. "Archaeological Research in Sisupalgarh, an Early Historic City in Eastern India." In *South Asian Archaeology 2003*, edited by Ute Franke-Vogt and Hans-Joachim Weisshaar, 297-306. Aachen: Kommission für Auβereuropäischer Kulturen.

Smith, Monica L. 2006. "The Archaeology of South Asian Cities." *Journal of Archaeological Research* 14: 97-142.

Smith, Monica L. 2016. "Urban Infrastructure as Materialized Consensus." *World Archaeology* 45 (1): 164-178.

Smith, Monica L. 2018. "Texts and Archaeology: Fulfilling a Collaborative Need." In *Felicitating a Legendary Archaeologist: B.B. Lal*, edited by B.R. Mani, Rajesh Lal, Neera Misra, and Vinay Kumar, vol III, 671-685. Delhi: B.R. Publishing.

Smith, Monica L. 2019. *Cities: The first 6,000 years*. New York: Viking.

Smith, Monica L., and Rabindra Kumar Mohanty. 2016. "Archaeology at Sisupalgarh: The Chronology of an Early Historic Urban Centre in Eastern India." In *South Asian Archaeology and Art 2012 Proceedings of the Twenty-First Conference of the European Association for South Asian Archaeology and Art (Paris, 2-6 July 2012), Vol. 2,* edited by Vincent Lefèvre, Aurore Didier, and Benjamin Mutin, 683-695. Turhaut, Belgium: Brepols.

Sugandhi, Namita. 2013. "Conquest of Dharma: Network Models and the Study of Ancient Polities." *Archeological Papers of the American Anthropological Association* 22 (1): 145-163.

Thapar, Romila. 2012[1973]. "Preword: Aśoka, A Retrospective." In *Aśoka and the Decline of the Mauryas*, Romila Thapar. Oxford: Oxford University Press.

Trautmann, Thomas. 1971. Kauṭilya and the Arthaśāstra: A Statistical Investigation of the Authorship and Evolution of the Text. Leiden, Netherlands: Brill.

Tripati, Sila, Girish Prabhu, Sunil Kumar Patnaik, Subrata Kumar Acharya, Uma Kanta Mishra, Rudra P. Behera, Gopal Charan Pradhan, Baba Mishra, Dibishanda Garnayak, Anam Behera, Saumya Ranjan Sahoo, and Sachin Vidydhar Joshi. 2019. "A Preliminary Study of Knobbed Ware from Odisha." *Man and Environment* XLIV (1): 82-89.

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

Watts, D.P. 2008. "Tool use by chimpanzees at ngogo, kibale national park, Uganda." *International Journal of Primatology* 29 (1): 83-94.

Winterhalder, Bruce, and Eric Alden Smith. 2000. "Analyzing Adaptive Strategies: Human Behavioral Ecology at Twenty-Five." *Evolutionary Anthropology* 9: 51-72.

World Bank. 2022. Urban population (% of total population). https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS, Accessed March 18, 2022.

Yoffee, Norman, and Nicola Terrenato. 2015. "Introduction: a history of the study of early cities." In *The Cambridge World History: Volume III: Early Cities in Comparative Perspective, 4000 BCE-1200 CE,* edited by Norman Yoffee, 1-24. Cambridge: Cambridge University Press.

Yule, Paul. 2006. *Early Historic Sites in Orissa*. New Delhi: Pragun Publications.

Zalasiewicz, J., C.N. Waters, E.C. Ellis, M.J. Head, D. Vidas, W. Steffen, J.A. Thomas, E. Horn, C.P. Summerhayes, R. Leinfelder, and J.R. McNeill. 2021. “The Anthropocene: comparing its meaning in geology (chronostratigraphy) with conceptual approaches arising in other disciplines.” *Earth's Future* 9(3): e2020EF001896.

Zeder, Melinda A. 2012a. “The Broad Spectrum Revolution at 40: Resource Diversity, Intensification, and an Alternative to Optimal Foraging Explanations.” *Journal of Anthropological Archaeology* 31: 241-264.

Zeder, Melinda. 2012b. “Pathways to Animal Domestication.” In *Biodiversity in Agriculture: Domestication, Evolution, and Sustainability*, edited by Paul Gepts, Thomas R. Famula, Robert L. Bettinger, Stephen B. Brush, Ardeshir B. Damania, Patrick E. McGuire, and Calvin O. Qualset, 227-59. Cambridge: Cambridge University Press.