



# Herding Strategies at Neolithic Gritille

## The Use of Animal Bone Remains to Reconstruct Ancient Economic Systems

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### Introduction

The Neolithic period, spanning the 9th through early 5th millennia B.C., was a time of two fundamental and far-reaching changes in the Near East: the beginnings of settled village life and the first appearance of food production — the raising of domesticated plants and animals. Much anthropological study of early plant and animal domestication in the ancient Near East has focused on the question of origins; where, when, how, and why man first made the transition from hunting and gathering to food production. Although the problem of Neolithic origins continues to be a major research topic, it is equally important and challenging to study how these Neolithic food producing systems actually functioned once they were established.

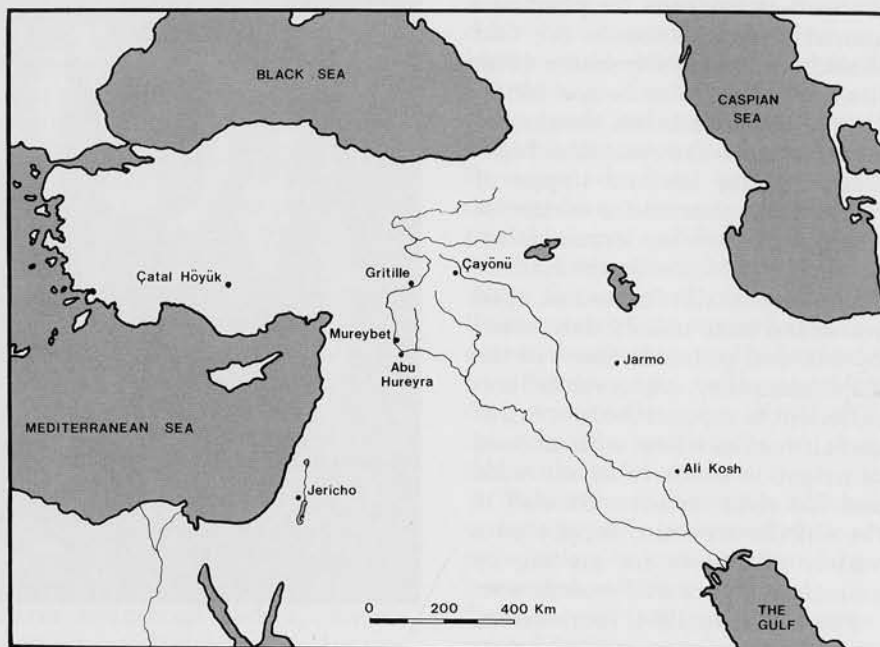
Excavated animal bone remains from the Aceramic Neolithic site of Gritille in southeastern Turkey (Fig. 2) provide one way to investigate the ways in which animal herding or stock raising might have been practiced at this early village community. This discussion will attempt to answer three questions: 1) Which domesticated animals were herded at Gritille in the 7th millennium B.C.? 2) What were the herding

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*Milking sheep at the village of Biriman in the Euphrates river valley of southeastern Turkey. Excavated animal bone remains from Aceramic Neolithic levels at the nearby site of Gritille Höyük indicate that agricultural systems combining herding and farming have flourished in this area for at least eight thousand years.*

strategies employed? In other words, how did the Neolithic villagers of Gritille raise their animals and shape the composition of their herds in order to obtain specific types of animal products? 3) Why did the people of Gritille continue to hunt,

even after they had access to domesticated animals and domesticated crops as reliable sources of food? Examination of these problems provides an example of the ways in which excavated animal bone remains are used to reconstruct



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*Map of the Near East showing the location of Gritille Höyük and other early Neolithic sites.*



3 The east slope of the Gritille mound, viewed from the Euphrates River, shows Neolithic excavation areas in 1984, after four seasons of excavation.

or understand the economic systems of prehistoric societies.

### Gritille Höyük

Gritille Höyük is a small mound, 1.5 hectares in area, located in the Euphrates river valley of southeastern Turkey, in the piedmont zone of the Taurus-Zagros mountain ranges—the area generally believed to have some of the earliest evidence for plant and animal domestication in the Old World (Ucko and Dimbleby 1969; Braidwood and Braidwood 1982). Gritille's location in this transitional zone between the Anatolian highlands and the lowland steppe of North Syria provided a variety of resources to early herders and farmers. In Neolithic times, the Eastern Taurus mountains formed an open woodland zone mainly dominated by oak and pistachio trees. In the Euphrates valley, winter rainfall was sufficient to support the farming of cereals such as wheat without need of irrigation of the relatively wide and flat river terraces. Rainfall in the Gritille area also supported a variety of grasses for grazing by animals, whether wild or domestic.

From 1981 to 1984, four seasons of excavations were carried out at Gritille by an expedition under the direction of Professor Richard S. Ellis (Bryn Mawr College). This

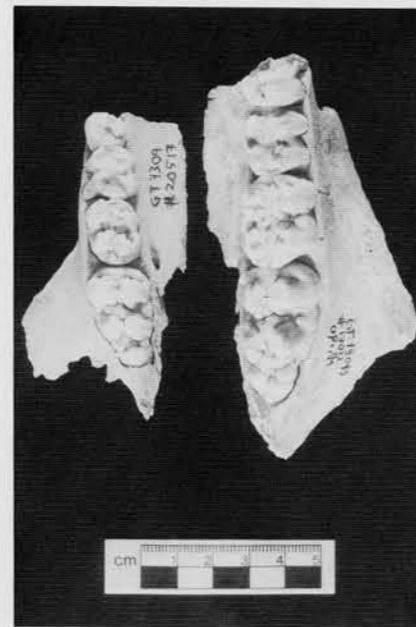
“approximately 80,000 fragments of animal bone were collected from the Neolithic levels”



4 An example of animal bone remains as excavated from Gritille (after cleaning and labeling). Ancient activities at the site, such as burning, cooking, trampling, and gnawing, have damaged the bones to a point where it is often difficult to identify what species they represent.

field work uncovered a 9000-year-long history of settlement at Gritille (Ellis and Voigt 1982; Voigt 1985; Voigt and Ellis 1981). The earliest occupation level at the mound, the focus of this paper, is a 3- to 4-meter-thick deposit of well-preserved houses, open areas, and associated artifacts dating to the 7th millennium B.C. (Fig. 3). This period of early agriculture and animal domestication is often called the Aceramic Neolithic, because it antedates the introduction of pottery in this part of the Near East. This phase at Gritille is thus contemporaneous with sites such as Çayönü in eastern Turkey and Pre-Pottery Neolithic B Jericho, in the Jordan river valley (see Fig. 2).

Excavations at Aceramic Neolithic Gritille have recovered stone tools, bone implements, clay figurines, and other objects that reflect the everyday activities of this early village (see Voigt 1985). In addition, approximately 80,000 fragments of animal bone were collected from the Neolithic levels as part of the Gritille Project's research emphasis on ancient economic systems. Preliminary studies of a small portion of this material (ca. 3500 fragments) have provided valuable information about the economic organization of



5 Comparison of maxillae (upper jaw bones) of domestic pig (at left) and wild pig (right). Reduction in the size of the third molar (the triangular tooth nearest to the centimeter scale in the photograph) provides good evidence for domestication.

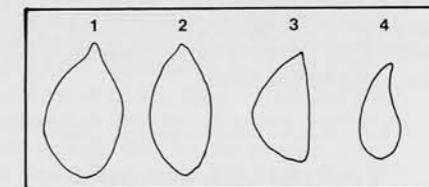
early Neolithic village communities, specifically in relation to the three problems noted earlier.

### Identification of Animal Domestication in the Archaeological Record

Determining which domesticated animals were present at Neolithic Gritille poses a basic but difficult problem. The first step is to identify the animals from their bones, and then determine whether these were wild or domesticated forms of sheep, goat, cattle, pig, or dog. Identification of many fragments is often difficult or impossible because the animal bones recovered in excavation are frequently small fragments crushed under millennia of later buildings, burnt, cooked, trampled, or gnawed beyond recognition by dogs in the ancient settlement (Fig. 4). The species present at an archaeological site can be identified by comparing the excavated bone fragments with the skeletons of modern animals of known species. Analysis of this sort, using comparative faunal collections



6 Skull of a modern domesticated goat. The helically (“corkscrew shaped”) twisted horn is characteristic of domesticated goats in the Near East.



7 Schematic cross sections through goat horn cores showing the change in shape from wild (1), through early domesticated (2,3), to fully domesticated forms (4). Cross section number 4 represents the medially concave, helically twisted horn core of the type shown in Figure 6. (From Hole, Flannery, and Neely 1969:fig. 115)

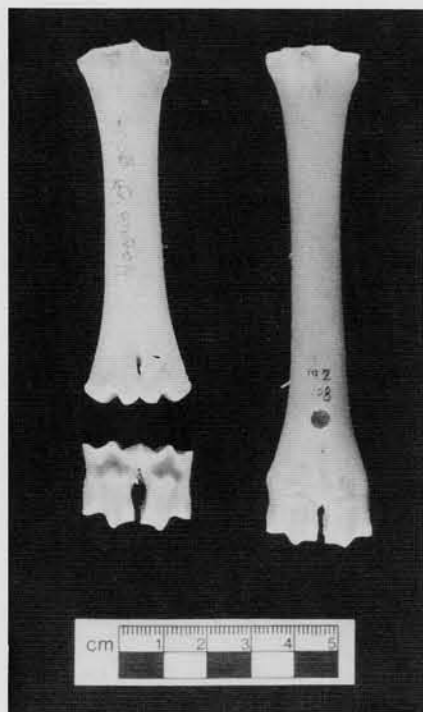
at MASCA (the Museum Applied Science Center for Archaeology) and the University of Pennsylvania Anthropology Department, revealed that sheep and goats as a group were the most common animals at Neolithic Gritille, comprising approximately 80 percent all identifiable bone fragments examined to date. At both Gritille and the nearby contemporaneous site of Çayönü, sheep outnumbered goats by more than 2:1. Pigs were second in importance, and cattle third. Deer, gazelle, hares, hedgehogs, and (apparently domesticated) dogs were also present in small numbers. Although Gritille is located on the banks of the Euphrates river, the Neolithic

inhabitants of the site appear to have relied far more heavily on land mammals than on aquatic resources (e.g., fish or mussels).

After identifying what animals were present at Gritille, the next step consists of determining whether the potential food animals—sheep, goats, pigs, and cattle—from this site were wild or domesticated. Domestication can be thought of as a process of increasing human control over animals so that they are kept captive, bred, and exploited for their products, such as meat, dairy goods, hides, or wool. After a certain amount of time, controlled breeding, feeding, and selective culling of animals resulted in changes of size, shape, and behavior of the newly domesticated livestock. In short, the early effects of domestication can be characterized as the eventual emergence of selectively bred sheep, goats, cattle, and pigs that were smaller, more docile, and considerably less intelligent than their wild counterparts.

Three types of changes in a faunal sample provide important clues as to whether or not an animal has been domesticated:

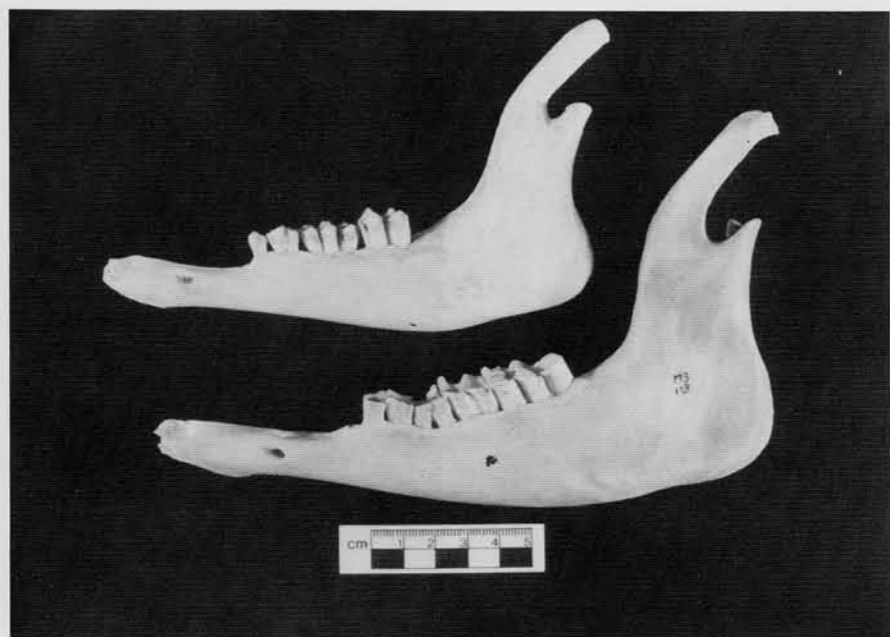
1) *Reduction in size*: Early domesticated animals are often smaller than their wild ancestors (Fig. 5). This domestication-related size reduction appears in some teeth and



8 Unfused (left) and fused (right) goat and sheep metacarpals (bones of the lower forelimb). In young animals, the shaft (diaphysis) and the ends (epiphyses) of the bone are held together by cartilage. In adult animals, the cartilage is replaced by bone, fusing the shaft and ends into a single element.

bones more clearly than in others. Thus, for example, in cattle, measurements of the third molar, astragalus, distal humerus, distal metacarpal, first phalanx, and third phalanx can all be used to determine whether the animal was wild or domestic. Similarly, measurements of the second and third molars of pigs can often provide good distinctions between wild and domestic swine. In attempting to determine whether an animal is wild or domesticated, ideally measurements from a large sample of bones or teeth should be used (since animals can vary considerably in size, even within the same population). Unfortunately, in the faunal sample analyzed so far from Neolithic Gritille, only a few of the most useful bones and teeth were preserved well enough to be measurable.

The metric evidence suggests that both wild and domestic cattle were present at Neolithic Gritille. A nearly complete third phalanx (hoof) from Gritille is 56.26 millimeters long,



9 Mandibles (jaw bones) of a juvenile sheep (top) and a fully mature adult (bottom). In the juvenile, the milk teeth (deciduous premolars) are still present, and only the first molar has erupted (on the right side of the top mandible in the photograph). In the adult mandible, the milk teeth have been replaced by permanent premolars, while all three molars have erupted and show very heavy wear.

### “The third form of evidence for domestication is a change in the ages of the animals killed.”

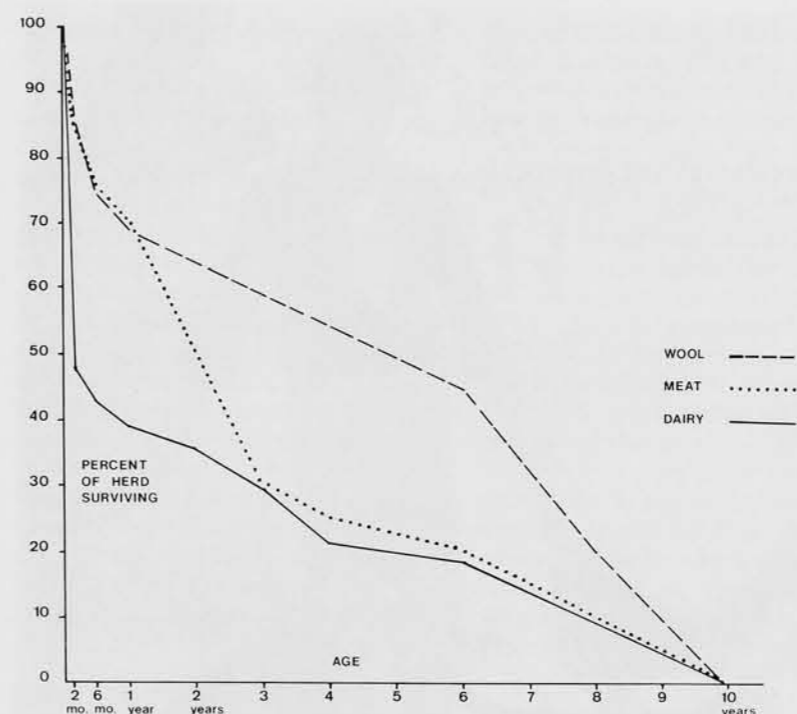
falling well below the 81-109 millimeter size range for wild cattle (Hole, Flannery, and Neely 1969:307). Similarly, a fragmentary cattle first phalanx (toe bone) from Gritille has a proximal width of 24.08 millimeters, within the expected size range for a domesticated individual (see Hole, Flannery, and Neely 1969:306, fig. 127). Measurements of other phalanges suggest that wild cattle continued to be hunted in addition to the herding of domesticated cattle.

Measurements of pig teeth seem to indicate that swine at Neolithic Gritille were at a very early stage of domestication (if they were domesticated at all). H. Stampfli's analysis of the pig remains from Çayönü suggested a series of tooth sizes that characterize domesticated versus wild pigs (Lawrence 1980:307). By

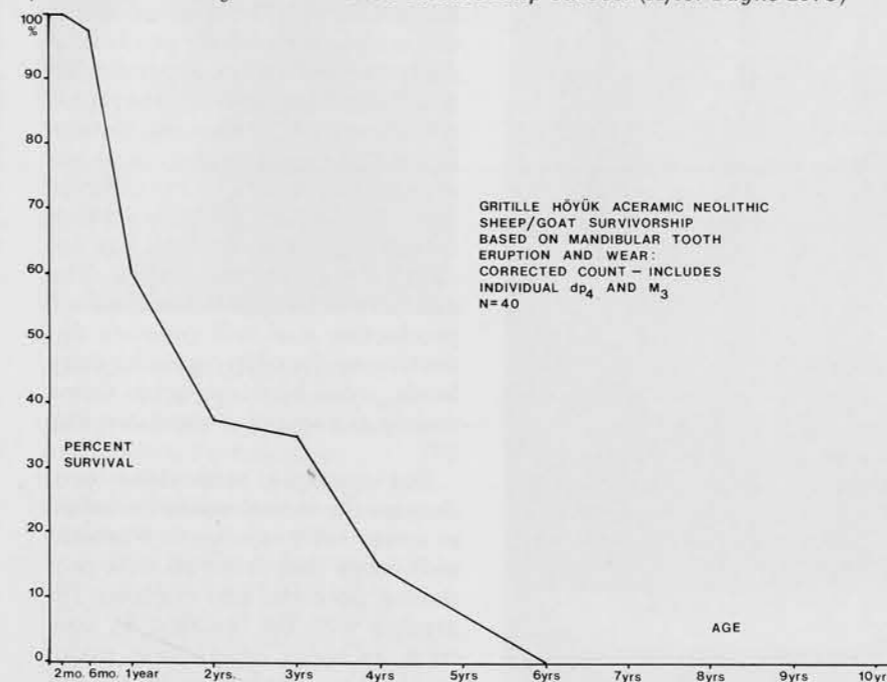
these criteria, the five measurable second and third molars from Gritille fall just within the expected range for domesticated pigs; however, the measurements given in another study of pig domestication in the Near East (Flannery 1983:table 3) suggest that the Gritille Neolithic teeth fall within the range of the smallest wild pigs in the area. This ambiguity might be explained by suggesting that the pigs at Neolithic Gritille were in a very early stage of domestication. Clearly, we need a much larger sample of measurable teeth from Gritille in order to determine whether the pigs at this site were domesticated, transitional, or wild.

2) *Morphological Changes*: The second clue to domestication is a change in the shape of certain bodyparts. For example, in one of the characteristic genetic changes associated with domestication, the shape of goat horn cores shifts from a straight “scimitar” shape to a helically twisted or “corkscrew” shape (Figs. 6, 7; Hole, Flannery, and Neely 1969:270-278).

3) *Culling Patterns*: The third form of evidence for domestication is a change in the ages of the animals



10 Survivorship curves for sheep and goats under different herding strategies. The vertical axis shows the percentage of the herd surviving; the horizontal axis shows the age of the animal. At birth (age 0 months on the left), 100 percent of the herd is alive. As the animals grow older, they are culled from the herd so that virtually none survive beyond an age of ten years (reflected by a survivorship of 0 percent at the bottom right side of the graph). The ages at which the animals are culled will depend on what products the herders are emphasizing. As a result, meat, dairy, and wool (or fiber) production each yield distinctive survivorship curves. (After Payne 1973)



11 Survivorship curves for sheep and goats at Neolithic Gritille, based on tooth eruption and wear. The very high percentage of young animals suggests that these were domesticated animals herded mainly as a source of meat (compare the Neolithic data from Gritille with the idealized survivorship curve for meat production shown in Fig. 10).

killed. Herds of wild sheep and goats consist of mostly adult animals, with a relatively small percentage of young lambs or kids (due to the extremely high natural mortality rate from disease, predation, and adverse weather conditions in the wild). Since hunters would in any case want to bring home as much meat as possible, it would make sense for them to kill mostly full-grown adults. For these two reasons, if an archaeologist finds large numbers of adult sheep and goat remains, it is likely that these animals were hunted (see, e.g., Hesse 1982).

If the sheep and goats were domesticated, we would expect to find mostly young animals. One major reason for this is that the Neolithic herders would have been selectively killing off or culling the young male sheep and goats so that they would not compete for grazing and fodder with the more productive and valuable females. In addition, one would expect natural deaths from disease to affect young animals more severely than adults. In short, if a village had domesticated animals, the effects of natural mortality combined with the deliberate killing-off of young males would result in a situation where the bones of young animals are very common in archaeological deposits at that site.

Thus, the presence of many adult animals suggests the hunting of wild sheep and goats, while the predominance of young animals (two years old or less) suggests the herding of domesticated animals. The age at which an animal was killed can be determined by examining either the fusion of bones (Fig. 8) or the eruption and wear of teeth (Fig. 9). The ages at which different bones fuse are known from studies of modern animals. Similarly, teeth erupt at specific ages and wear down at a more or less consistent rate. As a result, by examining the mandible (jaw bone) of a sheep or goat from Neolithic Gritille, we can give a relatively precise determination of the age at which it was killed. A study of the sheep and goat mandibles from Gritille showed that more than 60 percent were young animals killed before they reached an age of two years. This strongly suggests that most of the sheep and goats of Gritille were domesticated



12 Goat butchering in the village of Cümçüme, Euphrates valley, southeastern Turkey. Animal bone remains from Gritille and other Neolithic sites in the Near East suggest that the earliest herding strategies focused on meat production rather than dairy or wool.

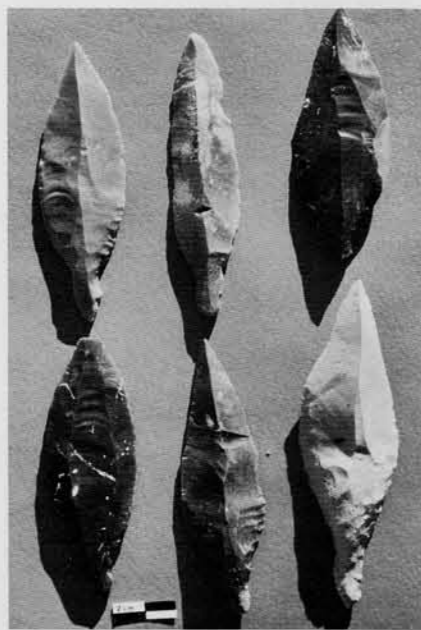
in Aceramic Neolithic times.

In short, the three types of evidence for domestication—size, morphological changes, and changes in age structure—give good evidence that sheep, goat, cattle, and possibly pigs were domesticated at Gritille in the late 7th millennium B.C. But the evidence also shows that there was at least some hunting of deer, gazelle, wild cattle, and possibly wild goat at this time.

### Herding Strategies

Given that domesticated sheep, goats, cattle, and (possibly) pigs were present at Gritille, we can now look at the second question posed at the beginning of this discussion: How did the Neolithic villagers of Gritille raise their animals and shape the composition of their herds in order to obtain specific types of animal products? In other words, what type of herding strategies did they employ?

Sheep and goats can yield a variety of different products, such as dairy



13 Flint projectile points from Neolithic Gritille. The large number of projectile points, combined with the animal bone data, suggest that hunting continued to play a role in the Neolithic subsistence economy even after the domestication of sheep, goat, cattle, and pigs.

goods, meat, or fiber (wool or goat hair). The ideal herd composition differs for each of these production goals. For this reason, depending on whether the herder wants to emphasize dairy, meat, or fiber production, he would shape the age and sex composition of his flock in a different way. Graphs that plot the number of animals culled at each age are called survivorship curves. The different culling patterns for each production goal will generate distinctive survivorship curves for dairy herds, wool herds, or herds raised mainly as a source of meat (see Fig. 10).

For example, with dairy production the males would be culled at a very early age (up to 6 months old), since they have no milk producing potential and compete for grazing with the females. By contrast, in meat production males would be culled later in life (at about 18 to 24 months old) when they begin to reach optimum meat weight. In wool production, males would be castrated and retained in the herd, resulting in a completely

different survivorship curve (see Payne 1973).

By examining the bone and teeth from an archaeological site, we can determine the ages at death of the animals and reconstruct a survivorship curve for that herd. By comparing the archaeological survivorship curve with the survivorship curves for known products, we can make an educated guess at whether the ancient villagers were raising their animals to provide curds, kebab, or kilims (woolen textiles). Figure 11 shows the reconstructed survivorship curve for Neolithic Gritille. The ages of the sheep and goats fit very closely with the kind of culling or kill-off pattern we would expect if these animals were being raised mainly for their meat (Fig. 12). As yet, the analyzed



14 Red deer (*Cervus elaphus*). Although red deer, roe deer, and fallow deer are no longer found in southeastern Turkey, they apparently thrived in the open oak-pistachio parklands of the Taurus piedmont zone in Neolithic times. Ecological studies in Europe have shown that red deer (and other varieties of deer as well) follow a seasonal migration pattern in which they spend summers in the uplands and winters in the lowlands. The Neolithic villagers of Gritille probably hunted deer at the winter end of their seasonal movement. (From Raymond Chaplin, *Deer* [Poole (Dorset): Blandford Press, 1977])

sample of cattle remains from Neolithic Gritille is still too small to allow for any reconstruction of the herding strategies followed.

### Hunting by Herders

Having examined domesticated herds, we can now turn to the third question: Why did the people of Gritille continue to hunt, even after they had domesticated animals and crops as reliable sources of food? In trying to answer this question, it helps to look at two very different sets of schedules: 1) the seasonal cycle of agriculture and herding, and 2) the seasonal cycle by which wild animals such as deer or mountain goats migrate from summer to winter grazing areas. Briefly, these sched-

“the seasonal cycle of wild animals . . . would have provided a valuable added resource to the Neolithic villagers of Gritille”



15 LANDSAT satellite image of the Euphrates river valley in the Gritille area (the arrow indicates the general location of Gritille). This image, taken in February 1975, shows the concentration of heavy snows in the mountains (the white area at the top of the image), while the river valley itself (at bottom) remains mostly snow free.

ules suggest that the villagers hunted in the winter and relied much more on domesticated crops and animals for the rest of the year (Fig. 13).

The production of domesticated crops and animals in the Near East follows a consistent seasonal round. In southeastern Turkey, cereals are planted in October or early November, and harvested in June or July. In the herding cycle, sheep and goats are born in the winter, usually in the period from January to March. For both the agricultural and herding cycles, winter is the time of greatest uncertainty. The villagers do not know how the crops will survive, or how long they will have to live off their stocks of stored grain. For the herds, the winter birthing season is a particularly risky period because it is a time when the newly born lambs and kids are particularly susceptible to disease and relatively harsh weather conditions.

In short, winter is a time when farmers and herders are extremely reluctant to consume their stored crops or animals because they do not yet know how well the next harvest will turn out or how well their herds will survive the winter birthing season. The seasonal cycle of wild animals, however, would have provided a valuable added

resource to the Neolithic villagers of Gritille at just the time when it could provide the greatest benefit—in winter. Animals such as red deer, fallow deer, wild goats, and wild sheep have a fairly predictable seasonal migration in which they spend summer in the uplands and winter in the lowlands (Fig. 14).

Gritille is located along the Euphrates in the largely snow-free flood plain, while the neighboring mountains and plateau are snow-covered in winter (Fig. 15). In a situation like this, deer, wild goats, and probably wild cattle, as well, would have come out of the hills into the Euphrates river valley as a prime winter grazing area. In other words, every winter these wild animals would have been coming straight towards Gritille at precisely the time when the villagers were most reluctant to consume their domesticated animals or stored crops. If this suggestion is correct, then hunting emerges as an important part of the Neolithic economy — it would have provided an easily available and fairly reliable source of food that could be used each winter until the villagers had a better idea of how well their crops and herds would survive and produce that year.

## Conclusion

The animal bone remains from Gritille suggest that the Neolithic villagers there herded domesticated sheep, goat, cattle, and (possibly domesticated) pigs as a source of meat for the spring, summer, and autumn. In winter, however, they may well have depended much more on hunting the deer, wild cattle, and wild sheep or goats that migrated down from the highlands into the Euphrates river valley.

When we consider the Neolithic economy at Gritille as a carefully scheduled combination of cropping, herding, and hunting, the picture that emerges depicts a seasonal cycle of alternating bounty and scarcity, conservatism and willingness to consume. In this view, the Aceramic Neolithic villagers of Gritille were people who knew their environment and exploited it in a variety of ways with great ingenuity. 2



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## Acknowledgments

This article is a revised version of "Herding Strategies at Neolithic Gritille," originally presented at the symposium "Prehistoric Pioneers—Nomads to Farmers," organized by Elin Danien and held at The University Museum, Philadelphia, March 16, 1985. The excavations at Gritille Höyük were sponsored by Bryn Mawr College with the cooperation of the University of North Carolina and with the participation of The University Museum, University of Pennsylvania. Analysis of the Gritille faunal remains was funded by a Fulbright-IIIE grant in 1982-83, and by a MASCA Research Fellowship in 1983-84, as part of a long-term research program at MASCA under the directorship of Dr. Stuart Fleming. Dr. Pamela Crabtree (MASCA) supplied large amounts of encouragement and practical advice on problems in the identification of the Neolithic fauna. I am grateful to Dr. Richard S. Ellis (Bryn Mawr College) for providing photographs from the Gritille Project archives, and to Kay Clahassey, for advice on bone photography and for use of studio facilities at the University of Michigan Museum of Anthropology. Dr. Richard S. Ellis, Dr. Mary Voigt, and Patricia Wattenmaker gave valuable comments and criticisms of earlier drafts of this paper. Final responsibility for content rests with the author.