CHAPTER X

HAS THE SYSTEM BEEN AT EQUILIBRIUM BETWEEN 1800 AND 1990?

PART 3: ARCHAEOLOGICAL EVIDENCE.

INTRODUCTION

The evidence I have presented on early vegetation conditions and early historical accounts indicates that elk and other ungulates were less abundant in the Yellowstone area during the 19th century than they are today. To further test the hypotheses that elk were or were not abundant in Yellowstone during pre-Columbian times (see Chapter 1 above), I reviewed both published and unpublished archaeological evidence for the entire Intermountain West. I also conferred with university, museum, and government archaeologists who have conducted archaeological research in the West (see Chapter 2 above).

As noted in Table 56, elk presently make up approximately 80% of the total number of ungulates in the Greater Yellowstone Ecosystem, deer 9%, and bighorn sheep 4%. As discussed in Chapter 1 (above), the Park Service believes that the relative abundance of these ungulate species has remained roughly the same for the last several thousand or so years. Thus, the prehistoric ungulate population should have been dominated by elk. If this were true and if it is assumed that Native Americans harvested ungulates in proportion to their abundance, then the ungulate faunal remains from Yellowstone's archaeological sites should be dominated by elk.

ANALYTICAL CONSIDERATIONS

Any analysis of ungulate remains recovered from archaeological sites must consider several possible sources of bias. First, prior to the 1960s and even into the 1970s, most archaeologists "paid little serious attention to vertebrate fauna [remains]" (Falk 1977). Those researchers were primarily interested in aboriginal artifacts or human remains, not prehistoric subsistence patterns. Several early archaeological reports mention large quantities of bone recovered from excavations only to say that they were discarded because they "had no value." More often than not, only simple species lists were prepared and no attention was paid to the species' relative abundance.

During the 1970s this began to change as archaeologists shifted their attention to human subsistence patterns and as they became skilled in identifying faunal remains. Today, detailed faunal reports are an integral part of most archaeological investigations. However, because of this factor, early and later site reports are often difficult to compare.

Second, as interest in faunal remains increased, archaeologists changed their excavation techniques to recover a larger and larger proportion of the total bones or bone fragments at a site. Standard practices changed from hand sorting and retention of only large, readily identifiable bones, to screening all excavated material through 1/4 or 1/8 inch (6.35mm or 3.18mm) mesh and retaining even the smallest bones or bone fragments. This resulted in the recovery of larger numbers of total bones or bone fragments and also dramatically increased the numbers of small mammal bones which were recovered from archaeological sites (Thomas 1969, Payne 1972, Ziegler 1973). Again, this complicates comparison between early and more recent excavations.

Third, most archaeological sites have not been fully excavated, but only a subsample of the sites unearthed (Uerpmann 1973). The proportion of the sites which were excavated and how that sample was selected varied from project to project. Small sites were often completely excavated, while only small portions of larger sites were typically unearthed. It is impossible to determine what biases these procedures introduced into comparison of faunal remains from various site reports.

Fourth, site-specific physical factors affect how well bones have been preserved and, in turn, often determine how much identifiable bone is archaeologically recovered. Preservation is better in dry caves than in open sites and is better in basic soils than in acidic ones. Thus, dry grassland sites with basic soils often yield more recoverable bone than coniferous forest sites with acidic soils.

Fifth, most archaeological sites which have been unearthed in the western United States were excavated to mitigate the adverse impacts of development schemes. Thus, many archaeological sites have been excavated in association with dam or highway projects. Because of this, more archaeological sites have been excavated along rivers or in valleys than in upland areas.

Since it is impossible to quantify, let alone correct, biases that these factors may have introduced into analyses of archaeological faunal remains, I have tried to minimize their influence by making a thorough review of the literature. To the best of my knowledge, I have not overlooked any sites for which faunal remains have been reported, especially in the Greater Yellowstone Ecosystem, western Wyoming, western Montana, eastern Washington, Idaho, and Utah. My review has not been as complete for Nevada, Oregon, or western Washington. I included sites outside the immediate vicinity of Yellowstone to secure as large a sample size as possible and to determine if the patterns observed in Yellowstone were repeated in other areas with similar vegetation, climate, and physiognomy.

Zooarchaeologists use two measures to quantify faunal remains per taxon. These include the minimum number of individuals (MNI) and the number of identified specimens (NISP) (Grayson 1984). "Briefly defined, the minimum number of individuals is that number of individuals which are necessary to account for all of the skeletal elements . . . of a particular species found in the site" (Olson 1983:21). Calculation of MNI depends on the unit used to aggregate the faunal remains. For instance, (1) the entire sample of faunal material from one site can be treated as one large aggregate, (2) the faunal materials can be grouped by natural stratigraphic units, or (3) the faunal materials can first be separated by stratum and then subdivided by units within each stratum (Grayson 1984). The faunal remains can also be separated into an animal's right and left sides, as well as into young and old animals. All of these factors tend to increase MNI. Grayson (1984:37) demonstrated that MNI of 10cm units > MNI per stratum > MNI per site.

The number of identified specimens (NISP) is simply the total number of bones or bone fragments which have been identified for an individual taxon from the total site (Grayson 1984). Grayson (1984:20-26) and Olson (1983:21) listed a total of 11 different criticisms which have been directed toward NISP counts. However, MNI counts also contain several possible biases. Since these problems have been widely discussed in the archaeological literature (Payne 1972; Uerpmann 1973; Grayson 1973, 1978, 1981, 1984; Ziegler 1973; Fieller and Turner 1982; Lyman 1982a; Olson 1983; Allen and Guy 1984; Horton 1984; Klein and Cruz-Uribe 1984; Campbell 1985; Todd and Rapson 1988), I believe it is only necessary to point out the following. (1) As total sample size (NISP) increases (ie., more bones are excavated and identified at a site), the minimum number of individual animals per taxon (MNI) and the number of represented taxa increase (Grayson 1981, 1984; Lyman 1982a). That is to say, MNI has been shown to be a function of NISP. (2) MNI tends to over-represent rare animals.

Grayson (1978, 1981, 1984), Lyman (1982a), and others have noted that "the analyst could calculate and interpret the NISP and the MNI values independently and [then] compare results and interpretations." Because of the biases inherent within MNI and NISP calculations, it may be best to use ordinal scales of relative abundance instead of actual percentages (Lyman 1982a:360). If ordinal scales ranked MNI and NISP species abundances similarly, then that would suggest the pattern was ecologically significant and robust.

Accordingly, in the results and discussion which follow, I have presented both MNI and NISP archaeological faunal calculations when the original site reports contained that information. Since I address only ungulate faunal remains, this eliminates many of the problems commonly associated with MNI or NISP comparisons. For example, small mammals usually have high MNI and NISP values because their bones often were not fragmented by human activity or other site-formation processes. They are more readily identifiable than ungulate bones which usually were intensively broken by humans. As discussed below, 80-90% of the total ungulate bones recovered from most western archaeological sites are less than 2.5cm in length because of fragmentation associated with human food processing. It usually is impossible to identify those fragments to species especially if several ungulate species of similar size, such as deer, antelope, and bighorn sheep, occur together at one site.

RESULTS AND DISCUSSION

Yellowstone Area

Aside from a few surface surveys and reports (Hoffman 1961, Taylor 1964, Shippee 1971), few archaeological sites have been excavated in Yellowstone Park (Lahren 1973; Wright et al. 1978, 1982; Smith 1979b; Marceau 1980; Samuelson 1981). The oldest site in the park for which an age has been reliably determined is the 3100 BP Fishing Bridge burial (48YE1) (Wright et al. 1982) though Cannon (1989) reported a date of 4200 BP for the Chittenden Bridge site (48YE518) and an obsidian hydration date of 4500 BP for the Fishing Bridge site (48YE304). Hoffman (1961) identified 195 archaeological sites in the park while Taylor (1964:51) listed 224. Since that time, at least 50 additional sites have been recorded (Cannon 1989). Though the latest total is not available (Cannon 1989), at least 274 archaeological sites have been located in Yellowstone Park. Wright et al. (1978:48) concluded that "Yellowstone National Park was heavily occupied . . . [and] the area is rich in archaeological remains."

The Yellowstone Library and Museum Association has an aboriginal artifact collection from the park which numbers in the thousands despite the fact that early, illegal collecting probably removed many more artifacts from Yellowstone than were collected by authorized personnel (Hoffman 1961:3-7, Replogle 1956:72). In addition, over 300 archaeological sites have been located to the south in Jackson Hole while more than 1,000 other sites have been reported throughout the rest of the Greater Yellowstone Ecosystem (Arthur 1966, Lahren 1971, Hughes 1977, Wright et al. 1978:49, Cramer 1984, Wright 1984a, Huppe and Howard 1988).

For many years, historians and the Park Service fostered the belief that Native Americans avoided Yellowstone because of superstition and fear of the area's numerous thermal features and geysers (Dunraven 1967:255; Haines 1977:20, 218; Hoffman 1961:4-5). The archaeological (Arthur 1966:22) and historical evidence (Haines 1977:15, 221; Replogle 1956) does not support this supposition. In fact, Hoffman (1961:4-5) stated that the Native-peoples'-fear-of-Yellowstone myth was fabricated by the park's second superintendent, Norris, specifically to encourage tourism. After the Nez Perce retreat through the park in 1877, tourism declined because of imagined Indian raids (Norris 1877). To alleviate those fears and to encourage park visitation, which ultimately enhanced federal appropriations to the park (Haines 1977), Norris fabricated the myth that Native Americans seldom visited the park (Norris 1877:824, Hoffman 1961:5, Hultkrantz 1979). Furthermore, Norris had all of the resident Shoshone Indians removed from the park to reservations in Idaho or Wyoming (Haines 1977:29; Hultkrantz 1970, 1974; Trenholm and Carley 1964). Replogle (1956, 1959), Hultkrantz (1974), and Janetski (1987) present additional information on Yellowstone's aboriginal inhabitants.

Paleo-Indian artifacts from Mummy Cave located 19 km east of Yellowstone Park on the North Fork of the Shoshone River date to 9000

BP (Wedel et al. 1968). South of the park in Jackson Hole, archaeological sites date to approximately 10,000 BP (Wright 1984a). The Dead Indian Creek site located 4 km east of Yellowstone Park in Sunlight Basin dates to 4200 BP (Frison and Walker 1984), while the Myers-Hindman site 80 km north of the park dates to around 9000 BP (Lahren 1976). Thus, the available evidence indicates that Native Americans inhabited the Greater Yellowstone Ecosystem for the last 10,000 or so years.

Unfortunately, few bones of any species have been recovered or identified from any of the archaeological sites in Yellowstone Park. Only one group of elk bones has ever been recovered from aboriginal habitation sites within the park (Hoffman 1961:20-22), and those were found on the ground surface inside a recent wickiup which probably dates to only 150-100 BP (Hoffman 1961:38). Despain et al. (1986:29, 118) noted that elk bones and an elk skull were found embedded in the travertine deposits at Mammoth Hot Springs "about 100 feet below ground level . . . [and] are at least 250 years old." Lahren (1973) excavated fragmented ungulate bones from 24YE344 along the park's Gardiner River, but that material has never been identified (Wright 1984b).

Hadly (1988, 1989) is in the process of excavating prehistoric materials from Lamar Cave on Yellowstone's northern range. In her available abstracts, she recorded finding elk, bighorn sheep, antelope, and bison bones dating to around 1000 BP, but she provided no data on MNI or NISP. She reported finding no aboriginal artifacts in Lamar Cave and surmised that bones were brought to the cave by predators and scavengers or were washed into the cave by fluvial processes.

Detailed faunal reports have been published for only four sites in the Greater Yellowstone Ecosystem. These include (1) Myers-Hindman, (2) Mummy Cave, (3) Dead Indian Creek, and (4) Bugas-Holding (Tables 57 and 58). Houston (1982:10-11) cited only one archaeological reference, Lahren's (1976) Myers-Hindman site, to support his contention

Table 57. Ungulate remains recovered from archaeological sites in the Greater Yellowstone Ecosystem. Part 1: Minimum number of individuals.

Site	Total number of bones recovered	Number of bones identified to species	Percent of total bones identified to species	Minimum number of individuals (MNI)					
				Elk	Bison	Deer[1]	Antelope	Bighorn	Moose
Dead Indian Creek 48PA551	*	*	*	2	4	50	3	16	0
Mummy Cave (2)	*	*	*	1	1	15	0	88	0
Bugas-Holding 48PA563	*	*	*	2	15	0	1	14	0
Myers-Hindman 24PA504	*	600	*	12	28	27	7	27	0
Totals	*	> 600	*	17	48	92	11	145	0
Percent of Total	-	-	-	5%	15%	29%	4%	46%	0%
Rank	-	-	-	4	3	2	5	1	6
Totals - (Myers-Hindman)[3]	*	*	*	5	20	65	4	118	0
Percent of total	-	-	-	2%	9%	31%	2%	56%	0%
Rank	-	-	-	4	3	2	5	1	6

* Data were not presented in site report.
1. Includes both mule and white-tailed deer.
2. One bone is listed as elk or moose in the site report while an additional bone is listed as elk, moose, or bison.
3. Total minus the Myers-Hindman site.

Table 58. Ungulate remains recovered from archaeological sites in the Greater Yellowstone Ecosystem. Part 2: Number of identified specimens.

Site	Date	Number of identified specimens (NISP)						Reference
		Elk	Bison	Deer[1]	Antelope	Bighorn	Moose	
Dead Indian Creek 48PA551	4500-3800BP	17	43	812	28	311	0	Frison and Walker 1984 Fisher 1984, Scott and Wilson 1984
Mummy Cave (2)	9000-300BP	*	*	*	0	*	0	Harris 1978
Bugas-Holding 48PA563	400BP	24	1,108	0	1	780	0	Rapson and Todd 1989a, 1989b
Myers-Hindman 24PA504	9000-800BP	70	211	105	42	156	0	Larhren 1976
Totals	9000-300BP	111	1,362	917	71	1,247	0	(313/3708)[3]
Percent of Total		3%	37%	25%	2%	34%	0%	
Rank		4	1	3	5	2	6	
Totals - (Myers-Hindman)[4]	9000-300BP	41	1,151	812	29	1,091	0	(212/3,124)[3]
Percent of Total		1%	37%	26%	1%	35%	0%	
Rank		4	1	3	5	2	6	

* Data were not presented in site report.

1. Includes both mule and white-tailed deer.
2. One bone is listed as elk or moose in the site report while an additional bone is listed as elk, moose, or bison.
3. Total MNI/total NISP.
4. Total minus the Myers-Hindman site.

that several thousand elk inhabited Yellowstone Park continuously for the past 9,000 years. However, that site is located approximately 80 km north of Yellowstone at the mountain-plains ecotone and is not characteristic of the park. Myers-Hindman is an open-air site located 8 km southeast of Livingston, Montana, on the floodplain of Dry Creek approximately 3 km from the mountains.

Lahren (1976) identified seven cultural levels and eight settlement units dating from 9000 to 800 BP. He unearthed elk, deer, bighorn sheep, antelope, and bison bones from all eight settlement units. However, based on the total MNI for the site, bighorn sheep and deer were each 2.25 times more common than elk, while bison were 2.33 times more abundant. Only antelope (0.67) were less abundant than elk. Based on NISP for the entire site, bison were 3.01 times more common than elk, while bighorn sheep and deer were 2.23 and 1.50 times, respectively, more abundant than elk. Antelope (0.60) again were less abundant than elk. Elk represent 12% of total MNI and 12% of total NISP. If the 1989 estimated Yellowstone Ecosystem ungulate population (Tables 55 and 56) is used as the expected for a chi-square test, and when only elk, deer, and bighorn sheep are considered, MNI-X^2 = 300.07, $\underline{p}$ <.001 while NISP-X^2 = 1,895.10, $\underline{p}$ <.001. Hence, the proportion of ungulate remains in the Myers-Hindman site do not correspond to today's relative abundance of ungulate species.

Mummy Cave is a large alcove in a south-facing cliff above the North Fork of the Shoshone River approximately 19 km east of Yellowstone Park's east entrance which was excavated during the 1960s (Wedel et al. 1968, Harris 1978, McCracken et al. 1978). "The cave fill . . . consisted of 38 distinct layers with evidence of human occupation contained within 8.5m of detrital sediment" (Wedel et al. 1968:184). The site dates from 9000 to 300 BP and is significant because the "dryness of the cave and its fill . . . [led to] remarkable preservation of bones and perishable cultural materials" (Wedel et al. 1968:184).

Unfortunately, the site report (McCracken et al. 1978) "is regrettably inadequate for the professional archaeologist" (Frison 1981:85). For instance, the faunal remains from the site have never been completely identified (D. Walker, pers. commun. 1989). Harris (1978) only identified and reported on a subsample of bones which were submitted to him (D. Walker, pers. commun. 1989).

Notwithstanding this shortcoming, bighorn sheep and deer are the most abundant ungulates unearthed at this site (Tables 57 and 58) and "sheep numbers are consistently equal or greater than deer numbers throughout the cave fill" (Harris 1978:147). Only one individual was identified as either elk or moose while another was identified as either elk, moose, or bison. Today, elk are the predominant ungulate in that same valley (Tables 56 and 59). If the 1989 estimated ungulate population on the North Fork of the Shoshone is used as the expected in a chi-square test, and when only elk, deer, and bighorns are considered, MNI-X^2 = 455.00, $p < .001$. Again the proportions of ungulate remains from Mummy Cave do not match today's relative ungulate abundances.

The Dead Indian Creek site, an open air habitation situated on the bank of Dead Indian Creek in Sunlight Basin and located approximately 34 km east of the Yellowstone Park's northeastern boundary, was excavated by University of Wyoming archaeologists from 1969 to 1972 (Frison and Walker 1984). Obsidian hydration and radiocarbon dates place site occupation between 4500 and 3800 BP. Scott and Wilson (1984) and Fisher (1984) presented a detailed analysis of the faunal remains unearthed at this site. The site was dominated by the remains of mule deer and bighorn sheep, while elk made up only 3% of MNI and 1% of NISP (Tables 57 and 58). Again, if the 1989 estimated ungulate population on the Clark's Fork of the Yellowstone (Tables 56 and 59) is taken as the expected in a chi-square test, and when only elk, deer, and bighorn sheep are considered, MNI-X^2 = 312.82, $p < .001$, while NISP-X^2 = 5203.58, $p < .001$. Again, the proportions of ungulate remains from the Dead

Table 59. Comparison of the relative abundance of ungulates in the Greater Yellowstone Ecosystem during 1989 (from Table 55) with the relative abundance of ungulate remains recovered from that region's archaeological sites (from Table 57).

	Species percentage of total					
Area - Data set	Elk	Bison	Deer	Antelope	Bighorn	Moose
Greater Yellowstone Ecosystem						
1989 population estimates	79	4	9	1	4	4
Archaeological sites (MNI)	5	15	29	4	46	0
Archaeological sites without Myers-Hindman	2	9	31	2	56	0
Clark's Fork of the Yellowstone						
1989 population estimates	72	0	10	0	14	4
Dead Indian Creek site (NISP)	1	4	67	2	26	0
North Fork of Shoshone						
1984 population estimates	65	0	19	0	14	2
Mummy Cave site (MNI)	1	1	14	0	84	0

Indian Creek site do not correspond to ungulate populations in that same area today.

The Bugas-Holding site is also located in Sunlight Basin northeast of Yellowstone Park. This open-air site is situated on the floodplain of Sunlight Creek approximately 13 km west of the Dead Indian Creek site. Bugas-Holding "is a single component, probably single occupation site" dating to 400 BP which was excavated from 1983 to 1986 (Todd and Frison 1987). "In order to meet the interpretative potential of the apparently high level of integrity represented by this deposit, piece-plotting of all material larger than 5mm was combined with fine mesh water screening (1/16 inch)" (Rapson and Todd 1989a). The faunal material from Bugas-Holding has been studied in much greater detail than that of any other archaeological site in the Greater Yellowstone Ecosystem (Todd and Frison 1987; Todd and Rapson 1988; Rapson and Todd 1989a, 1989b).

Unlike the three archaeological sites discussed above, the ungulate faunal remains from Bugas-Holding are dominated by bison and bighorn sheep (Tables 57 and 58). Elk constituted 6% of MNI, but only 1% of NISP. As with the other sites in the Greater Yellowstone Ecosystem, elk were in the minority. Clearly, none of these sites was dominated by elk.

If only elk, deer, and bighorn sheep are considered, Yellowstone's present ungulate population consists of an estimated 86% elk, 10% deer, and 4% bighorn sheep (Table 55). If only elk and deer are considered, elk constitute 90% of total numbers while deer make up only 10% (Table 55). For the four archaeological sites closest to Yellowstone Park (Tables 57-59), elk made up 7% of MNI, deer 36%, and bighorn sheep 57%. Based on NISP, elk accounted for 5%, deer 40%, and bighorns 55%. If only elk and deer are considered, elk constituted 16% of MNI while deer make up 84%. Using NISP, these figures change to 11% elk and 89% deer.

If these calculations are repeated without the data from the

Myers-Hindman site, since that is more a plains than a mountain site, elk contributed 3% of MNI, deer 35%, and bighorn sheep 63%, while elk made up 2% of NISP, deer 42%, and bighorns 56%. If only elk and deer are considered, elk constituted 7% of MNI and deer 93%. With NISP, elk accounted for 5% and deer 95%. Moreover, if the present relative abundance of ungulates throughout the Greater Yellowstone Ecosystem (Table 55) is compared with the observed number of ungulate remains from the four archaeological sites nearest Yellowstone Park (Tables 57-59) in a chi-square test, MNI-X^2 = 1,816.32, $p < .001$, $df = 4$ (moose excluded). However the data are analyzed, the relative abundance of ungulates unearthed in archaeological sites is markedly different from that of the present ungulate populations occupying those same areas. In Yellowstone, archaeological sites are dominated by bighorn sheep, deer, and bison while today's ungulate population is dominated by elk.

In addition to the archaeological excavations reported in Tables 57 and 58, there are a few other sites for which the faunal reports are less complete. These include (1) 48PA852, 48PA853, and 48PA829 are all located along the North Fork of the Shoshone River near Wapiti Campground approximately 3 km east (downstream) of Mummy Cave (Eakin 1986, Eakin et al. 1986). 48PA852 dated to 3300-2600 BP, 48PA853 dated to 2900 BP, and 48PA829 dated to 1500-1100 BP. At 48PA852, 500 bone fragments were recovered, while another 12,000 were unearthed at 48PA853 and 800 more from 48PA829 (Eakin 1986, Eakin et al. 1986). However, the faunal material was highly fragmented and has not yet been completely identified. Most of the bones which have been identified to date are from bighorn sheep or mule deer. A few bison bones have been recovered, but no elk have been identified (Eakin 1986, Eakin et al. 1986).

(2) Archaeologists from the University of Wyoming have identified a series of bighorn sheep hunting sites in the mountains east of Yellowstone Park (Frison 1978, 1983, 1985, 1987, 1988; Frison et al. 1986). They have documented numerous mountain sheep traps, as well as

a 1.5-2m high by 50-65m long net made of juniper (Juniperus spp.) bark cordage dating to 8860 BP which may have also been used to catch bighorn sheep (Frison et al. 1986).

(3) The Lookingbill site (48FR308) located at an elevation of 2,621m and situated above Bear Creek and the Wiggins Fork of the East Fork of the Wind River dates from around 700 BP to the present (Frison 1983). Though the site was excavated in 1977, 1980, and 1981, the faunal remains have yet to be completely identified. Most of the identified ungulate remains are from mule deer with smaller amounts from bighorn sheep, bison, and elk (Frison 1983). "Mule deer dominate the small faunal assemblage in the Archaic levels . . . [and] it is not until the Late Prehistoric Period that elk appear" (Frison 1983:15). Furthermore, five prehistoric bighorn sheep traps are located within a short distance of this site (Frison 1983:14).

(4) Corwin Springs is located approximately 10 km north of Yellowstone Park's Gardiner (north) entrance. There small-scale test excavations have yielded limited faunal materials (L. Davis, pers. commun. 1988). "Only one member of wapiti/moose was identified in . . . [the] 3000-year-old occupation, with bison clearly the dominant." Elk remains have not been positively identified.

Jackson Hole

As discussed in Chapter 2, agency biologists now believe that thousands of elk wintered in Jackson Hole for the last several thousand years (Cole 1969a, National Park Service 1986, Boyce 1989). If this were true, then it would be reasonable to expect that large numbers of elk bones should be found in the many archaeological sites located within Jackson Hole. Such is not the case. In fact, no elk bones have ever been unearthed in any Jackson Hole archaeological site (Wright 1984a, 1984b).

Wright and his associates spent 10 years studying the prehistory of Jackson Hole and they have published numerous accounts of their research (Wright 1978, 1980, 1982, 1983, 1984a; Wright et al. 1978, 1980; Reeve et al. 1979; Reeve 1980, 1983, 1986; Bender 1981, 1983; Wright and Reeve 1981; Bender and Wright 1988, 1989) which Wright (1984a) summarized in his recent book. As previously noted, over 300 archaeological sites have been recorded in Jackson Hole (Frison 1971b, Love 1972, Wright et al. 1978, Wright 1984a:55) of which approximately two dozen were systematically excavated by Wright and his associates.

Wright (1984a) found that Native Americans inhabited the valley for the last 10,000 or so years and he located several large archaeological sites. Those sites, as well as almost all of the other archaeological sites in the valley, are situated near sources of vegetative foods, especially fields of blue camas (Camassia quamash). Historically bulbs of blue camas were an important food for many Native peoples throughout the Intermountain West (Statham 1975). Wright (1984a) unearthed only a few bones of bison and mule deer in the lower valley plus some bighorn sheep remains at hunting sites in alpine areas but not a single elk bone. Frison (1971b) reported finding "mostly buffalo [bison], with smaller numbers of mule deer and at least one bear" at an archaeological site on the National Elk Refuge.

Wright (1984a) believed that Native Americans who summered in Jackson Hole subsisted mainly on vegetal foods and that during winter, when plant foods were not available, those people had to rely more heavily on ungulates. However, Wright (1984a) found no evidence that Native Americans ever wintered in Jackson Hole. Wright (1984a) hypothesized that Native Americans had to migrate out of Jackson Hole southeast to either the Green River - Red Desert region or west into Pierres Hole because very few ungulates wintered in Jackson Hole. Wright (1984a) found no evidence that large numbers of elk summered or wintered in Jackson Hole prior to the 1830s.

Wright (1984b) noted:

First, what are the actual data to support that 15,000 to 35,000 elk wintered in Jackson Hole prior to 1880? We have excavated more than two dozen sites in Jackson Hole with absolute dates ranging from 140 B.P. to 5195 B.P. We have not recovered a single elk bone from any of them (nor any moose for that matter). If such a large number of animals were present, why are they totally absent from our archaeological sites? Since other animals are present, the answer to our failure to recover elk (and moose) cannot be one of preservation.

As discussed in Chapter 9, 2,000-4,000 elk now summer on the valley floor in Grand Teton National Park. According to Wright (1984b):

... The entirety of the summer range encompasses about 50 square miles. An intensive surface survey of this range recorded not a single archeological site (only a couple of quartzite cores lying on the surface). Hence, not only have we recovered no elk bones, but the entire summer range of the elk was completely unoccupied and unutilized by the prehistoric Native Americans in the region.

Wright (1984b) added:

The situation concerning elk is comparable in Yellowstone Park. We have excavated several deep stratified sites: e.g. at Chittenden Bridge with C-14 dates from 4880 B.P. to 615 B.P.; and at Fishing Bridge with dates from 4570 B.P. to 680 B.P. There are plenty of elk (and moose) around these two sites today, but no elk (or moose) from the excavations. It is not preservation for certain at Fishing Bridge because we have a human burial in good condition from Fishing Bridge dating to ca. 3100 B.P. ... Farther north we have a long sequence back to 7100 B.P. at a site below the Gardner High Bridge, but no elk or moose (there may be a preservation problem here). However, we have recovered animal bone in Swan Lake Flat above Mammoth. It is mule deer and associated with a date of 2965 B.P. Swan Lake Flat and Willow Park just to the south [support] substantial elk and moose populations [today].

Where are these 1000s of prehistoric elk?

In addition, though hundreds of moose now summer and winter in Jackson Hole (Houston 1968, Boyce 1989, Table 55), no moose bones have been unearthed in any of that area's archaeological sites. Wright (1984a:27) noted:

"We have excavated several archaeological sites in northern Jackson Hole that are within prime moose habitat at present, and have been routed from more than one of them by an angry cow moose. Yet neither [moose] bones, teeth, nor antlers have been recovered on any of these sites."

During the 1980s, the Bureau of Reclamation lowered the level of Jackson Lake so that they could repair the Jackson Lake Dam. "The lowered reservoir levels which occurred during the repair of Jackson Lake Dam offered an opportunity to mitigate the damage to the archaeological resources impacted [when] the reservoir [was built]" (Connor 1988:87). Thus, the National Park Service through its Midwest Archaeological Center, undertook a 5-year study of the archaeological sites exposed by the falling lake level. During that project "109 archaeological sites were recorded. This is the highest density of sites in any area in the Grand Teton-Yellowstone area" (Connor 1988:87). Approximately half these sites had not been previously recorded.

"The dominant feature of any of the Jackson Lake sites are concentrations of fired rock" (Connor 1986:2) or fire-cracked rock which Wright (1984a) and his associates identified as plant-processing roasting pits. Literally hundreds of roasting pits and tons of fire-cracked rock have been found. The Lawrence site, the largest documented site, covers an area of over 1 km^2 and contains at least 200 hearths or roasting features (Connor 1986:32). At least 11 other sites over 10,000m^2 in size were inventoried (Connor 1986:32).

Despite the nearly complete absence of bones at any of these sites, Park Service archaeologists have attempted to redefine these associations of fire-cracked rock as primarily bone-grease processing sites, not plant-processing structures (Connor 1986, 1987, 1988, 1989). Park Service archaeologists argue that if they were actually plant-processing sites, plant pollen, and especially blue camas pollen, should be present. Since little camas pollen has been found in these features, the agency has concluded that they could not have been primarily plant-processing sites.

While a determination of these structures is beyond my expertise, Drs. George Frison, Alston Thoms, and Frank Leonhardy who have all viewed these sites at the invitation of the Park Service, informed me that in their opinions, the features in question are primarily plant-processing sites, not sites of bone-grease manufacture. Their opinions are based upon two factors. First, native people usually harvested blue camas after it had completed flowering because that was when the bulbs contained the maximum concentration of nutrients. Thus, camas pollen is rarely found in camas roasting ovens. Second, the virtual absence of bone fragments despite adequate preservation conditions. Bone-grease processing sites usually contain large quantities of bone fragments. In the fifth and final year of the Jackson Lake archaeological project, "the first extensive collection of bison bone in the history of the project" was discovered (Connor 1988:88). Yet these bones were not associated with roasting-pit features (G. Frison, pers. commun. 1989).

In his recent book on the Jackson Hole elk herd, Boyce (1989:212-213) presented a short review of faunal remains found in archaeological sites as support for his contention that thousands of elk inhabited that area for the last 8,000 or so years. He cited the Dead Indian Creek site as evidence that elk remains date to 4000 BP. However, a review of the site report (Frison and Walker 1984) shows that site is located nearly 200 airline km from Jackson Hole. Moreover, as discussed above, the ungulate faunal remains from that site are dominated by mule deer and bighorn sheep, not elk (Tables 57 and 58). This is the exact opposite of the present situation in Jackson Hole where elk constitute more than 80% of total ungulate numbers (Table 56). More importantly, Boyce (1989) failed to mention any of the archaeological work done in Jackson Hole by Wright and his associates.

Why would biologists overlook recent archaeological investigations in Jackson Hole? Commenting on this point, Wright (1984b) said

> ... keep in mind that I have battling [sic] wild life biologists from Grand Teton and Yellowstone Parks for some years. One told me after a seminar that I gave at the Jackson Hole Biological Research Station on the faunal resources of the region, "even if you demonstrate that no elk were here, we will still continue to argue for them because our management policies require a herd of at least 10,000 by the end of Pinedale (glaciation - about 10,000

years ago)."

Wyoming

In the account of ungulate remains unearthed in Wyoming and other western states which follows, I tabulated the archaeological data in the following manner. (1) Only sites which contained complete site reports and significant quantities of identified ungulate remains (MNI or NISP) were included in the state tables. (2) MNI and NISP data are presented in separate tables by state. (3) In the tables which contain MNI data, I also included data on the total number of bones recovered at the site, the number of bones identified to species, and the percent of the total bones identified to species. (4) In the tables which contain NISP data, I also included information on the age of the site, as well as the reference to the site report. (5) Because of the length of these state archaeological tables, they are found in appendix D. (6) Sites which contained insufficient quantities of identified ungulate remains to be listed in the state tables are discussed in the text.

The archaeological faunal remains reported in Tables 68 and 69 (in Appendix D) do not include any of the sites from the Greater Yellowstone area found in Tables 57 and 58. Instead, those sites are from Wyoming's Green River Basin, the Bighorn Mountains, and southwestern Wyoming. Most of those sites are located in foothill or intermountain basins. I did not include any of the bison procurement or processing sites which have been excavated in Wyoming since those are primarily Plains sites.

Nevertheless, some bison procurement sites do contain small quantities of non-bison ungulate remains (MNI/NISP) such as (1) Vore Bison Jump -- antelope (1/1), mule deer (1/1) (Walker 1975b); (2) Horner site -- antelope (2/8), mule deer (4/17) (Frison and Todd 1987); (3) 48AB301 -- deer, antelope, elk (Zeimens 1975); (4) Glenrock Buffalo Jump -- antelope (*/3) (* = data not presented in site report) (Frison 1970); (5) Big Goose Creek site -- elk (*/4), white-tailed deer (*/35), bighorn sheep (*/8) (Frison et al. 1978); and (6) Wardell Buffalo Trap -- antelope (*/8) (Frison 1973a). Though elk were recovered at two of these archaeological sites, deer and antelope occurred more commonly.

In addition to the archaeological excavations reported in Tables 68 and 69, there are eight sites for which the faunal reports are less complete. These include: (1) Leigh Cave -- deer, bighorn sheep (Frison 1968a); (2) 48SW2302 -- bison (*/2), antelope (*/2), deer (*/1) (Tucker 1985); (3) Schiffer Cave -- antelope (*/2), bighorn sheep (*/3), mule deer (1/3) (Frison 1973b); (4) Daugherty Cave -- antelope (*/1), bison (*/3), elk (*/2), mule deer (*/2), bighorn sheep (*/3) (Frison 1968b); (5) Birdshead Cave -- antelope, bighorn sheep, deer (Bliss 1950); (6) Bentzen - Little Bald Mountain site -- elk, bighorn sheep, bison (Bentzen 1963); (7) 48SU867 -- bison (*/2), deer (*/1) (Creasman and Thompson 1985); and (8) Little Canyon Creek Cave -- mule deer (6/*), antelope (6/*), bighorn sheep (10/*) (Latady 1978). Again, though elk have been recovered from a few sites, deer, bighorn sheep, and antelope are more common.

For the archaeological excavations reported in Tables 68 and 69, antelope and bison dominate the basin sites while deer and bighorn sheep are the most common ungulates from foothill or mountain sites. Of the 21 sites reported in Tables 69 and 68, elk have been recovered from only 3 sites, bison at 14, deer 9, antelope 17, bighorn sheep 6, and moose none. Elk make up only 1% of the total ungulate remains recovered from these sites. If only elk, deer, and bighorn sheep are considered, elk account for 9% of MNI, deer 56%, and bighorn sheep 36%. With NISP, elk account for 2%, deer 22%, and bighorn sheep 76%. If only elk and deer are considered, elk make up 14% of MNI while deer make up 86%. With NISP, elk 10% and deer 90%. No matter how these data are analyzed, elk are exceedingly rare. Frison (1978), Frison et al. (1978), and Walker (1987) all noted that elk are rare in all Wyoming archaeological sites and that elk are usually found only in Late Prehistoric Period (500 BP -

present) deposits. Elk are absent from most earlier deposits (Frison 1978, Walker 1987).

The Joe Miller (48AB18) site is the only archaeological excavation in Wyoming where elk are the most common ungulate (Creasman et al. 1982). That site is located at an elevation of 2,384m in the foothills at the north end of the Medicine Bow Mountain Range in south-central Wyoming. Creasman et al. (1982:78-79) concluded that the upper component of this site "represents an elk processing locale, a site type seldom documented on the high plains."

At all of these Wyoming archaeological sites, 80-90% of the recovered bone are fragments less than 3 cm long (Smith and Creasman 1988). Nearly all of the bones were broken or fractured by humans, not by other site-formation processes. At most sites, only 4-16% of the recovered bones were identified to species due to the high degree of fragmentation which had occurred.

Montana

Relatively few archaeological sites have been excavated in the mountainous portions of Montana (Tables 70 and 71, in Appendix D). Even where sites have been investigated, relatively low numbers of ungulate remains have been identified due to the highly fragmented nature of the faunal material and poor preservation conditions. Thoms and Burtchard (1987:449) noted that approximately 90% of the bone they uncovered in site 24LN1054 measured "less than two centimeters in maximum dimension." At other sites, Thoms (1984:232) found 75% of the faunal remains were "less than 2 cm in size." Notwithstanding these difficulties, archaeological sites in the Bighorn Mountains and northwest Montana are dominated by deer. Based on NISP, deer make up 97% of the identified ungulate remains while elk account for only 2%.

I made no attempt to systematically evaluate all of the bison procurement sites on the plains of eastern Montana. However, during the course of this study, I obtained reports on six bison procurement sites which contain small quantities of non-bison ungulate remains. These include (1) Drake Site (24YL51) -- elk, antelope, deer (Aaberg 1975); (2) Ellison's Rock (24RB1019) -- antelope (*/6) (Herbort and Munson 1984); (3) Sun River (24CA74) -- antelope (*/299), deer (*/15), bison (*/13) (Greiser et al. 1985); (4) Boarding School Bison Drive -- elk (*/1) (Kehoe 1967); (5) Hagen Site -- mule deer (1/*) (Mulloy 1942); and (6) Bootlegger Trail Site (24TL1237) -- elk (1/*), deer (3/*); antelope (7/*) (Roll and Deaver 1980). Though elk were recovered at three sites, deer and antelope occurred more commonly.

Besides the archaeological excavations reported above, there are four additional Montana sites for which the faunal reports are less complete. These include (1) Black Canyon (24BH215) -- bison, elk, deer (Brown 1969); (2) Dry Head Site (24CB203) -- bison, elk, deer (Brown 1969); (3) Libby Reservoir -- mostly deer, some elk (Taylor 1973); and (4) Pilgrim (24BW675) -- deer most abundant, some bison and antelope (Aaberg 1983, Davis 1983). In addition, Rasmussen (1974) reported that he found mule deer, bighorn sheep, bison, elk, and antelope bones in a woodrat (Neotoma cinerea) nest along the Clark Fork River. Again, though elk were recorded at three out of four sites, deer were more common.

Recently the Institute for Quaternary Studies, University of Maine at Orono, excavated several archaeological sites and natural trap caves in Montana's Pryor Mountains as part of a research project to investigate that region's prehistory. Bonnichsen and Oliver (1980) reported that of the bones (n = 2,101) recovered from the 2000 BP archaeological site in Crystalsin Cave (24CB85), 99% of the identifiable ungulate material was from bighorn sheep while only one or two bones, each, were from bison or deer. They also reported that the 4000-2000 BP Big Lip Rockshelter (24CB75) contained faunal remains of bison, bighorn sheep, and deer. Much of the bone they recovered was less than

1 cm in length and all was highly fractured. They noted (p. 51) that "most of the ungulate remains occur as tiny fragments, suggesting extensive butchering for marrow extraction."

At the 7000-2000 BP False Cougar Cave (24CB84) in the Pryor Mountains, bones of the following ungulates (NISP) were recovered; bighorn sheep (9), deer (7), and bison (5) (Bonnichsen 1979, Bonnichsen and Oliver 1980, Bonnichsen et al. 1986). Using hair samples found in False Cougar Cave, Bonnichsen and Bolen (1985) identified mule deer, elk, bison, and bighorn sheep. Shield Trap is a small, natural trap cave located approximately 300m west of False Cougar Cave (Bonnichsen and Oliver 1980, Bonnichsen et al. 1986). Bighorn sheep and bison bones have been recovered from that site but "the overwhelming majority of bones recovered [are] bison."

Idaho

The archaeological sites reported in Tables 72 and 73 (see Appendix D) can be grouped according to geographic location. Ungulate faunal remains from sites on the eastern Snake River Plains are generally dominated by bison while archaeological excavations in mountainous areas or in the western Snake River Valley are dominated by bighorn sheep or deer. Of the 15 sites reported in Table 72 and 73, elk were recovered from only 5 while bison were found at 9, deer 11, antelope 8, bighorn sheep 9, and moose 1. Elk account for only 1% of the total ungulate remains recovered from these sites. If only elk, deer, and bighorn sheep are considered, elk account for 4% of MNI, deer 20%, and bighorn sheep 77%. Elk account for 3%, deer 48%, and bighorn sheep 50% of NISP. If only elk and deer are considered, elk make up 15% of MNI while deer make up 85%; with NISP, elk make up 6% and deer 94%. However these data are analyzed, elk remains are exceedingly rare.

Besides the archaeological excavations reported in Tables 72 and 73, there are 11 additional Idaho sites for which the faunal reports are less complete. These include (1) Challis Bison Jump (10CR196) -- 20 to 30 bison were killed in a single event (Butler 1971b); (2) Quill Cave (10CR197) -- bison (11/359) (MNI/NISP), bighorn sheep (Butler 1971a); (3) Jaguar Cave -- elk, deer, antelope, bison, bighorn sheep (Kurten and Anderson 1972); (4) Smith Gulch (10IH175) -- deer/bighorn sheep (Henrikson 1988); (5) Bernard Creek Rockshelter (10IH483) -- ungulates were reported as being present or absent in 88 excavation units. Elk were present in 12 of 88, deer in 75 of 88, and bighorn sheep in 81 of 88. Some 12,748 total bones were recovered but only 6% were identifiable (Randolph and Dahlstrom 1977); (6) Malad Hill (10OA1 and 10OA2) -- bison, elk, deer, antelope, bighorn sheep (Swanson and Dayley 1968); (7) Givens Hot Springs (10OE1689) -- 17,220 items of bone recovered, 7400-2000 BP. A total of 98% of the identified bone was deer and no other ungulates were recovered (Gillette 1981, Green 1982); (8) Five Fingers Buffalo Jump (10OE229, 10OE232) -- bison (Agenbroad 1976; Plew 1987, 1989; Cassells 1989); (9) Wasden or Owl Cave (10BV30) -- elk (1/*), bison (60/*) (Butler 1971a, Butler et al. 1971, Miller 1980); (10) Cooper's Ferry site (10IH73) -- mostly macerated deer bone (Butler 1962); and (11) Bobcat Cave -- bison (*/34), elk (*/134) (R. Holmer, pers. commun. 1988). The bison remains were recovered at the mouth of the Bobcat Cave while 134 elk antler tines were all recovered approximately 500m underground in an ice cave. The elk antler tines were apparently used as chisels along with hammer stones to excavate holes in the ice which then may have been used to store perishable foods (R. Holmer, pers. commun. 1988). Though elk were recorded at five of the 11 sites, other ungulates were more common.

Leonhardy (1985) excavated site 10VY31 along Big Creek near the Middle Fork of the Salmon River within the River of No Return Wilderness. That site consists of a series of 33 depressions presumed to be housepits and dated to 2500-900 BP. The assemblage of faunal remains consisted of 13,101 bone fragments of which "only 411 (3.14%)

could be identified to genus or species level" (Leonhardy 1985:51). The fauna list includes 32 (MNI) bighorn sheep and 10 (MNI) mule deer. Bighorn sheep "is by far the most common species. In terms of NISP sheep is eleven times more frequent than the next most common species, deer . . . Virtually all the large mammal remains recovered . . . were heavily processed by breaking them into fingernail size pieces" (Leonhardy 1985:51-52).

Hornocker (1970), who studied mountain lions in this same area, reported that during the late 1960s approximately 1,000-1,400 elk, 1,800-2,600 mule deer, and 500-800 bighorn sheep wintered in the Big Creek drainage. Hackenberger (1984, 1988) reported that during the 1970s and early 1980s, elk comprised approximately 29% of the total number of ungulates wintering in Big Creek, mule deer 52%, and bighorn sheep 19%. Sport hunters are permitted to harvest only a limited number of trophy bighorn rams while elk and mule deer are subjected to more intensive hunting. Hornocker (1970) reported that in 1966, hunters killed 242 elk and 260 mule deer in the Big Creek drainage.

While elk presently account for almost 30% of total ungulate numbers within Big Creek, no elk bones have been recovered from archaeological sites in that valley (F. Leonhardy, pers. commun. 1988). Moreover, mule deer which are the most common ungulate in that area today, are only 1/10 to 1/3 as common as bighorn sheep in the archaeological record. Bighorn sheep dominate the archaeological faunal remains, yet they are the least abundant ungulate today even though they now receive less hunting pressure than deer or elk. Clearly, either elk and mule deer were less common in the past than they are today, or for some reason their bones are underrepresented in archaeological sites. As discussed in Chapter 11 (below), there is no evidence to support the latter supposition.

At all Idaho archaeological sites, most of the recovered bones have been broken or fractured by humans, not by other site-formation processes. The vast majority of recovered bones are less than 1-3 cm long (Holmer and Ross 1985, Leonhardy 1985). At all sites, less than 5% of the total recovered bones were identified to genus or species due to the degree of fragmentation which had occurred.

Utah

Besides the archaeological excavations reported in Tables 74 and 75 (see Appendix D), there are 15 additional Utah sites for which the faunal reports are less complete. These include (1) Taylor Ranch near Utah Lake -- mostly bison, but also deer and antelope. An elk tooth pendant was also recovered (Beeley 1946); (2) Spencer Site (42UT4771) -- bison, deer, and an elk tooth pendant (Janetski 1986); (3) Sparrow Hawk Site (42TO261) -- mostly bighorn sheep and a few deer (Janetski 1986); (4) Kaiparowits Plateau (42KA368) -- deer, bighorn sheep (Fowler and Aikens 1963); (5) Bull Creek sites -- bighorn sheep, deer, antelope (Jennings and Sammons-Lohse 1981); (6) Felter Hill (42DC2) -- deer (Shields 1967); (7) Whiterocks Village (42UN170) -- deer, elk (Shields 1967); (8) Lamb's Knoll Caves (42WS202 and 42WS203) -- one elk bone (Aikens 1965); (9) Parunuweap Knoll (42WS200) -- deer, bighorn sheep, elk (Aikens 1965); (10) Bear River Levee site (42BO107) and Knoll site (42BO109) -- primarily bison with some deer and bighorn sheep (Fry and Dalley 1979); (11) Old Woman site (42SV6) -- deer and elk antler fragments. "An absence of elk bone suggests that the occupants found antlers elsewhere and carried them onto the site" (Taylor 1957); (12) Poplar Knob (42SV21) -- bighorn sheep were most abundant, followed by deer and elk, most of latter were antler fragments (Taylor 1957); (13) Turner-Look site -- deer, bighorn sheep, bison, and elk (Wormington 1955); (14) the Sitterud bundle recovered at 42SA119Y contained, among other items, a large elk antler baton and the bundle was covered with a large, tanned elk hide (Benson 1980); and (15) Nawthis Village -- mule deer 74%, antelope 17%, and bighorn sheep 9% (Sharp 1988). Though elk were recorded at nine of the 15 sites, deer and bighorn sheep were more common.

Utah's archaeological sites presented in Tables 71 and 72 can be subdivided into two groups based on geographic location, physiographic setting, and vegetation type. Four sites (Bear River No. 1, 2, and 3, and Woodruff) in northern Utah are situated in large grassland-dominated valleys. Based on NISP, bison account for 90% of the ungulate remains recovered at those sites while elk comprise 5%, mule deer 4%, and bighorn sheep 0.4%. As discussed above, bison are also abundant at other sites in Utah and Salt Lake Valleys. This is the only part of the state where bison remains are common and where more than an occasional elk bone has been unearthed in archaeological contexts.

At 42 archaeological excavations over the rest of the state (Tables 74 and 75), elk were found at only five sites and account for only 0.5% of total MNI and 0.1% of total NISP. If only elk, mule deer, and bighorn sheep are considered, elk account for 1% of MNI, mule deer 54%, and bighorn sheep 45%. Based on NISP, elk make up only 0.1%, mule deer 78%, and bighorn sheep 22%. When only elk and mule deer are considered, elk accounted for 1% of MNI and mule deer 99%. With NISP, elk make up only 0.1% and mule deer 99.9%. However the archaeological data are analyzed, elk are extremely rare. These 42 sites are dominated by either mule deer or bighorn sheep. At only two sites are antelope the most abundant ungulate.

These results are similar to other summary reports. Marwitt (1970) tabulated ungulate faunal remains from 13 archaeological sites (not including Bear River sites 1, 2, and 3) and reported NISP values of 3,929 for mule deer, bighorn sheep 1,386, antelope 126, bison 19, and elk 5. Later, Marwitt (1980) summarized the faunal remains from 26 Utah archaeological sites. He reported mule deer were recovered from 25, bighorn sheep 15, antelope 12, bison 15 (again mostly from Utah and Salt Lake Valleys), and elk from 9. Marwitt (1980) ranked the abundance of ungulates found in Utah archaeological sites as either rare, present, or common. He reported that mule deer were common at 12 sites, present at 10, and rare at 3; bighorn sheep - 5 common, 8 present, 2 rare; antelope - 3 common, 8 present, 3 rare; bison-6 common, 6 present, 3 rare; and elk - 2 common, 2 present, 5 rare.

As with other archaeological sites throughout the northern Rockies, most of the faunal remains recovered from Utah sites are highly fragmented. "An extremely high degree of bone fragmentation, probably the result of marrow extraction and tool manufacture, characterizes the bone remains analyzed" (Jennings et al. 1980:166). However, a larger percentage of the faunal remains recovered from Utah archaeological sites have been identified to genus or species than has been reported from surrounding states. This is because many of Utah's sites were excavated during the 1940s - 1960s and were not screened through 6.4mm mesh (1/4 inch) as is common today. Thus, the only bones which were saved from most early excavations were large pieces which could be easily retrieved by hand sorting. As Sharp (1988:7) stated, "the harder you look, the more you get." Thus, unscreened sites will, on average, produce lower total bone counts, but a larger proportion of that bone can be identified to genus or species.

Nevada

Besides the archaeological excavations reported in Table 76 and 77 (see Appendix D), there are six additional Nevada sites for which the faunal reports are less complete. These include (1) Smith Creek Cave (26WP46) -- mostly bighorn sheep but also elk, deer, antelope, and bison (Tuohy and Rendall 1979); (2) Kachina Cave (26WP69) -- mostly bighorn sheep but also antelope and bison (Tuohy and Rendall 1979); (3) Council Hall Cave (26WP229) -- bighorn sheep, antelope, deer (Tuohy and Rendall 1979); (4) Alta Toquima Village -- mostly bighorn sheep (Thomas 1981); (5) 26PE67 -- antelope and mule deer (Cowan and Clewlow 1968); and (6)

Thomas Shelter (26EK698) -- bighorn sheep (1/53) (MNI/NISP) (Dalley 1976). Elk were recorded at only one of six sites; bighorn sheep were the most common ungulate.

The ungulate faunal remains recovered from archaeological sites in Nevada are predominately bighorn sheep (Tables 76 and 77). Pippin (1977) listed 49 archaeological sites in the Great Basin (Nevada, Utah, Idaho, California, and Oregon) where bighorn sheep had been identified. Elk have been recovered from 4 of the 21 archaeological sites listed in Tables 76 and 77. If only elk, deer, and bighorn sheep are considered, elk account for only 1% of NISP, deer 7%, and bighorn sheep 92%. When only elk and deer are considered, elk make up 13% of NISP while deer constitute 87%. Even though elk are unknown historically from Nevada, a few elk bones have been recovered from archaeological sites over the last 6,000 or so years (Grayson 1988).

Mule deer are relatively rare in all of Nevada's archaeological sites, and according to Thomas (1970) and Grayson (1982), most deer remains date to only the last 1,000 or so years. Prior to that time, very few deer bones have been recovered from any Nevada archaeological site. However, since the early 1900s, mule deer populations in Nevada have irrupted to high levels (Gruell 1986), and today, mule deer greatly outnumber bighorn sheep which have declined in most areas (Pippin 1977, Thomas 1983). In recent years, Nevada has issued approximately 150 bighorn sheep hunting permits per year while the state issued over 31,000 deer licenses in 1990.

The vast majority of ungulate bones recovered from all archaeological sites in Nevada are less than 3 cm in length because of human induced fragmentation (Dansie and Ringcob 1979). However, unlike Wyoming, Montana, and Idaho, most archaeological sites excavated in Nevada have been dry caves or rockshelters where preservation of small-mammal bone is excellent. Thus, the percent of total bones identified to genus or species ranges from 5 to 18% in Nevada which, on average, is two to three times greater than in the states mentioned above.

Oregon

The archaeological sites presented in Tables 78 and 79 (see Appendix D) can be separated into two groups based on their geographic location. Faunal remains recovered at excavations on the Pacific coast and at sites throughout the rest of Oregon, contain different proportions of ungulate species. Archaeological sites on the coast are dominated by only two species, deer and elk, which are represented in about equal proportions. At the sites denoted in Table 78 and 79, elk outnumber deer 52% to 48%. To the best of my knowledge, at sites on the Pacific coast (see Washington below) elk make up a larger percentage of the identified ungulate remains than at other archaeological sites throughout North America where a similar quantity of faunal remains have been recovered.

Throughout the rest of Oregon, elk bones were recovered from 17 of 29 archaeological sites, but there they accounted for only 3% of NISP and 6% of MNI (Tables 78 and 79). Instead, these sites were dominated by deer and bighorn sheep. If only elk, deer, and bighorn sheep are considered, elk accounted for 4% of NISP, deer 79%, and bighorn sheep 17%. When only elk and deer are considered, elk make up 4% of NISP and deer 96%. In Oregon's Elk Creek basin, Pettigrew and Lebow (1987:D34) reported that deer were present in archaeological sites over the last 3,000 years while elk were present for only the last 1,000 years.

In northeast Oregon, Reid (1988:19) noted that:

> . . . at Stockhoff (35UM52) and Ladd Canyon (35UM74), deer were the only ungulates represented in faunal samples, while at Marsh Meadow (35UM95) bighorn sheep, pronghorn (antelope), and bison were present but deer was absent. Elk, so abundant in the area today, were absent at all three (archaeological) sites.

Reid and Caulk (1986:13) added that "one wonders why elk remains are relatively scarce in the area's archaeological faunas, given their rapid rebound over the past 75 years."

According to Reid (1988:107-108)

> . . . the Downey Gulch [Tables 78 and 79 -- in northeast Oregon] faunal samples display interesting patterns. Thus, bighorn sheep and pronghorn antelope represent 80 percent of the identifiable elements at 35WA616 [while] a similar pattern [also] seems to hold at 35WA615 . . . If elk were present in prehistoric Downey Gulch as abundantly as they are today, the site faunas should contain more elk remains than they do.

Reid (1988:103) recalled where he "counted a column of 36 elk as they descended from the summit of Hill 5230 to water in the pools of Downey Lake" near the Downey Gulch archaeological sites. Reid (1988:28) added that "elk are extremely abundant in the study area today."

Most of the faunal remains recovered from Oregon archaeological sites are highly fragmented. Minor and Toppel (1984:45) noted that 77% of the bone recovered from Lava Island Rockshelter (Tables 78 and 79) was less than 2 cm in length. Schmitt (1986:87) added that:

> the condition of the faunal assemblage [only 0.4% could be identified to genus or species due to extremely small fragment size] indicates maximizing of acquired animal resources by human inhabitants of 35JA42 ... ethnographic and archaeological data indicate that the processing of bone for soup/grease [often called bone grease processing] was the major factor resulting in the highly fragmented condition of the [bone] assemblage.

Washington

In addition to the archaeological excavations reported in Tables 80 and 81 (see Appendix D), there are three other sites in Washington for which the faunal reports are less complete. These include (1) Ash Cave (45WW61) -- "a sample of 40-50 pounds of macerated deer bone . . . was recovered . . . virtually every bit of bone, including the phalanges, had been smashed or cracked, presumably for the extraction of bone marrow and grease" (Butler 1962:71-72). Antelope horn core fragments were also recovered from this site (Miss and Cochran 1982). (2) Wenas Creek -- deer were "by far the most numerous", bighorn sheep, and elk were also present (Warren 1968); and (3) Bateman Island (45BN161) -- 65% antelope, 10% deer, 10% bison, 10% elk, and bighorn sheep were present (Harkins 1980).

Most of the archaeological sites presented in Tables 80 and 81 are located in Washington's Columbia Basin where elk were found in 38 of 58 sites. However, those sites are dominated by deer which comprise 76% of the identified ungulate faunal remains. Bighorn sheep account for 9%, antelope 7%, and elk 5%. If only elk, deer, and bighorn sheep are considered, elk account for 9% of MNI, deer 76%, and bighorn sheep 15%. With NISP, elk make up 5% of the total, deer 84%, and bighorn sheep 11%. If only elk and deer are considered, elk accounted for 10% of MNI while deer make up 90%. Based on NISP, elk make up only 6% of the total while deer account for 94%. At only one site (Riparia-45WT1), are elk the most abundant ungulate.

In contrast to the pattern in eastern and central Washington, elk outnumber deer 63% to 37% at a coastal site in western Washington. This is similar to the pattern observed in Oregon (see above) where elk were more abundant than deer in coastal sites but not throughout the rest of the state. In their journey of discovery through the West during 1804-1806, Lewis and Clark (1893) reported seeing and killing more elk in the coastal forests of Washington than at any other point in their travels.

Osborne (1953) was the first to discuss the archaeological occurrence of ungulates (antelope and bison) in Washington's Columbia Basin. Since then, others have used archaeological data to address the prehistoric biogeography of various ungulate species in eastern Washington and Oregon. Schroedl (1973) reported that bison remains had been uncovered at 32 archaeological sites while Harkins (1980) listed 37 sites where bison had been found. Galm and Masten (1985:268) listed total bison and antelope NISP from Columbia Basin sites by 500-year intervals back to 10,000 BP. They reported that antelope bones had been recovered during each of the twenty 500-year periods while bison bones were absent from only 3; 8000-8500 BP, 9000-9500 BP, and 9500-10,000 BP. They (p. 313) also mapped the distribution of bison, antelope, and bighorn sheep remains recovered from Columbia Basin archaeological sites dating to 3000 BP.

Lyman and Livingston (1983) used archaeological faunal remains to discuss the late Quaternary zoogeography of elk, bighorn sheep, and antelope in eastern Washington. McCorquodale (1985) presented archaeological evidence of elk in the Columbia Basin while Brown (1977) reported on the archaeological occurrence of antelope. Livingston (1987) used discriminant analysis to distinguish between white-tailed and mule deer mandibles from 24 archaeological sites in Washington and Oregon. She reported that white-tailed deer were found in 13 of 24 sites (54%) while mule deer were recovered from 21 of 24 sites (88%). Of the 94 deer jaws she examined 46 (49%) were from white-tailed deer while 48 (51%) were from mule deer. This suggests that white-tailed deer make up a substantial proportion of the deer MNI and NISP listed in Tables 78-81.

As with the other states I surveyed, most of the faunal remains recovered from archaeological sites in Washington are highly fragmented. Olson (1983:41) noted that only 1.4% of the medium and large mammals bones recovered were intact or complete. She (p. 98) added:

> . . . the medium and large mammal remains [were] highly fractured. The inhabitants of the site were making maximal use of the animal resources. Every bone that contained marrow was being processed -- even those that were labor intensive for the amount of marrow yielded (i.e., mandible and phalanges). Among the Nunamiut, those two skeletal elements were processed for marrow only in times of food scarcity.

Schalk and Mierendorf (1983:625-629) concluded that:

> . . . the extent of bone breakage and fragmentation in these assemblages argues for intensive processing of medium and large size artiodactyles . . . intensive bone grease or juice manufacturing is indicated in all three assemblages. Long bone fragments smaller than 2.5 cm comprise 80% of the 45CH254 sample, 77% of the fragments from component I at 45DO407 and 89% of the long bones from 45DO407 component II.

Schalk and Mierendorf (1983:626) added:

> The marrow extraction data also suggest intensive processing of medium and large size mammals. . . . In the

> three assemblages (45CH254 and 45DO407 component I and II), phalanges and mandibles as well as long bones appear to have been broken to facilitate marrow extraction. Binford (1978:26-32) has determined bone marrow quantitative indices for sheep and caribou. Because of index similarities between the two ungulates, he argues that indices can be used for other ungulates within this size range. Those data indicate that long bones such as the tibia, metatarsal, metacarpal and femur have a high marrow index (this reflects the high concentration of desirable low-melting-point fats). Phalanges and mandibles exhibit a low marrow index (Binford 1978:27). His study also indicates a strong bias against using phalanges and mandibles as a source of marrow. Nunamiut informants reported that these elements were used in the past during times of food scarcity (Binford 1978:31-32). He suggests that ". . . the number of broken mandibles is a fair measure of the food security of the group in question. If many are broken, then little animal food is regularly available and the people are utilizing morsels of very limited utility" (Binford 1978:15).

Thus, this evidence for intensive processing of bones for marrow and grease suggests that Native peoples may have been experiencing a period of nutritional stress when they occupied this and other sites in Washington, Oregon, Idaho, Montana, Wyoming, Utah, and Nevada because they often collected small amounts of nutrients which were relatively expensive to extract.

SUMMARY AND CONCLUSIONS

The ungulate faunal remains unearthed at 202 archaeological sites in the northwest United States are summarized by state or geographic area in Table 60. A total of 3,345 MNI and 52,624 NISP are represented. Based on these data, the relative abundances of ungulates are ranked as follows (1) deer (includes both mule and white-tailed), (2) bighorn sheep, (3) antelope, (4) bison, (5) elk, and (6) moose. This ranking is the same for both MNI and NISP which suggests that this pattern is ecologically significant and robust (Lyman 1982a, Grayson 1984).

If only elk, deer, and bighorn sheep are considered, elk account for 5% of MNI, deer 55%, and bighorn sheep 40%. With NISP, elk make up 3% of the identified specimens, deer 70%, and bighorn sheep 27%. On the other hand, if only elk and deer are considered, elk constituted 9% of

Table 60. Summary of ungulate remains recovered from 210 archaeological sites in the northwestern United States.

State	Number of sites	MNI: Elk	MNI: Bison	MNI: Deer[1]	MNI: Antelope	MNI: Bighorn	MNI: Moose	NISP: Elk	NISP: Bison	NISP: Deer[1]	NISP: Antelope	NISP: Bighorn	NISP: Moose
		Minimum number of individuals (MNI)						Number of identified specimens (NISP)					
Yellowstone	4	17	48	92	11	145	0	111	1,194	917	71	1,247	0
Washington (2)	58	74	33	650	98	129	0	1,115	544	17,058	1,674	2,137	0
Oregon (3)	28	9	4	101	26	22	0	132	187	2,918	82	635	0
Idaho	14	19	199	105	35	413	1	49	1,972	841	139	879	1
Montana	10	4	0	25	0	3	0	24	18	1,550	0	6	0
Wyoming	21	4	42	25	273	16	0	19	377	178	2,418	628	0
Nevada	21	*	1	8	1	73	0	54	49	359	135	5,108	0
Utah (4)	46	3	37	247	138	203	0	7	21	5,764	346	1,661	0
Total (5)	202	130	364	1,253	582	1,004	1	1,511	4,362	29,585	4,865	12,301	1
Percent of Total	-	4%	11%	37%	17%	30%	0.03%	3%	8%	56%	9%	23%	0.002%
Rank	-	5	4	1	3	2	6	5	4	1	3	2	6
		Percent of total MNI by state or area						Percent of total NISP by state or area					
Yellowstone	4	5%	15%	29%	4%	46%	0%	3%	34%	26%	2%	35%	0%
Washington (2)	58	8%	3%	66%	10%	13%	0%	5%	2%	76%	7%	9%	0%
Oregon (3)	28	6%	2%	62%	16%	14%	0%	3%	5%	74%	2%	16%	0%
Idaho	14	2%	26%	14%	5%	53%	0.1%	1%	51%	22%	4%	23%	0.03%
Montana	10	13%	0%	78%	0%	9%	0%	2%	1%	97%	0%	0.4%	0%
Wyoming	21	1%	12%	7%	76%	4%	0%	1%	10%	5%	67%	17%	0%
Nevada	21	*	1%	10%	1%	88%	0%	1%	1%	6%	2%	90%	0%
Utah (4)	46	0.5%	6%	39%	22%	32%	0%	0.1%	0.3%	74%	4%	21%	0%
Pacific Coast (6)	4	*	0%	*	0%	0%	0%	56%	0%	44%	0%	0%	0%
Utah-prairie (7)	4	*	*	*	*	*	*	5%	90%	4%	0.4%	0.4%	0%

* Data not included in site reports.
1. Includes both mule and white-tailed deer.
2. Not including the Pacific coast site.
3. Not including the four Pacific coast sites.
4. Not including Bear River No. 1, 2, and 3 or Woodruff Bison Kill.
5. Total MIN = 3,345, Total NISP = 52,624.
6. Includes four sites in Oregon and one in Washington.
7. Includes Bear River No. 1, 2, and 3 and Woodruff Bison Kill.

7. In general, and at most archaeological sites where bison and elk occur together, bison remains are more abundant than elk. For total MNI, bison outnumbered elk 2.8 to 1, while for total NISP, bison were 2.9 times more numerous than elk.

8. Intact ungulate bones are infrequently recovered from Intermountain archaeological sites. Most of the ungulate remains are highly fragmented and are less than 2.5 cm in length because of human-related food-processing activities. Aboriginal peoples throughout this region utilized ungulates to the maximum possible extent including bone grease processing.

MNI and deer 91%. Based on NISP, elk make up 5% of the total while deer contribute 95%.

At five other sites on the Pacific coasts of Oregon and Washington, deer and elk were the only identified ungulates, and there elk make up 56% of NISP while deer account for 44% (Table 60). At an additional four sites located in Utah's northern valleys, bison contributed 90% of NISP, elk 5%, deer 4%, antelope 0.4%, and bighorn sheep 0.4%. Except for the sites on the Pacific coast, in prehistoric times elk were one of the least abundant ungulates in archaeological faunal remains.

In my opinion, these archaeological data support the following conclusions.

1. Elk have rarely been found in archaeological sites throughout the greater Yellowstone Ecosystem. Unlike Yellowstone's current ungulate population which is dominated by elk, archaeological ungulate faunal remains are dominated by bighorn sheep and mule deer.

2. This pattern of high elk numbers today coupled with a low representation in the archaeological record is not unique to the Greater Yellowstone Ecosystem, but has been identified in at least two other regions of Idaho and Oregon.

3. Elk are rare in most Intermountain archaeological sites and, except for moose, are the lowest ranked ungulate.

4. Ungulate remains unearthed from those sites are dominated primarily by deer and/or bighorn sheep.

5. Only archaeological sites on the Pacific coasts of Oregon and Washington contain a significant proportion of elk, as well as large numbers of elk remains.

6. Moose have been recorded at only one of the more than 300 archaeological sites reviewed in this study. Moose have not been positively identified from any of the archaeological sites in the Greater Yellowstone Ecosystem though they are common in that area today.