

## The Holocene History of the Red Fox (*Vulpes vulpes*) in Eastern Washington

### Abstract

A modern zoogeography of the red fox (*Vulpes vulpes*) in eastern Washington based on historic data, and a conjectured Quaternary zoogeography of the red fox based on its modern distribution there are evaluated with prehistoric data. Red foxes are indigenous to the Pacific Northwest, and have existed there throughout the last 10,000 years, dispersing northward into deglaciated areas early in the Holocene. Eastern Washington's extant foxes may be hybrid descendants of indigenous and introduced foxes.

### Introduction

In a review of the early 20th century historic zoogeography of red foxes (*Vulpes vulpes*) in the state of Washington, Aubry (1984) concluded: 1) "foxes are infrequently found in [the Columbia Basin during the 20th century, and most of those found are] presumably derived from foxes that escaped from fur farms in the 1930s and 1940s [whereas others found there] probably represent wandering or dispersing individuals" (Aubry 1984:77); 2) the presently extant population of red foxes in northeastern Washington "is descended from introduced animals" (Aubry 1984:77); and 3) a single museum specimen collected in 1923 "constitutes the only evidence that indigenous red foxes occur in southeastern Washington [and probably represents] wandering foxes that were not from an established local population" (Aubry 1984:78).

In his overview of Washington mammals, Dalquest (1948:58, 79) speculated that red foxes in the Cascade Range of Washington took refuge in the southern Cascades during the Wisconsin glacial episode, and that foxes in eastern Washington took refuge in the Blue Mountains of southeastern Washington during the Wisconsin. Both populations dispersed northward, Dalquest conjectured, after glacial retreat (during the Holocene).

The bridge linking Dalquest's speculations and Aubry's conclusions is found in prehistoric remains of red foxes. In this paper I review the Holocene (last 10,000 years) record for red foxes in eastern Washington. That prehistoric record as it is now known indicates that Aubry's (1984) conclusions and Dalquest's (1948) speculations are not incompatible, and largely account for the Holocene record.

### Methods and Materials

All red fox specimens reported were recovered from archaeological sites. Due to the nature of archaeological research in eastern Washington, the specimens may or may not be representative of the abundance or complete distribution of red foxes there during the Holocene (Grayson 1981, 1984; Lyman 1987b).

My own archaeological data (7 sites) and a review of the published and unpublished mammalian faunal data from eastern Washington and vicinity (182 sites) reveal the presence of red fox remains at 16 sites which span the entire Holocene (Table 1, Figure 1). I do not include the remains reported simply as "fox" by Osborne (1957:119), nor the two reported instances of grey fox (*Urocyon cinereoargenteus*) reported by Deaver (1973;

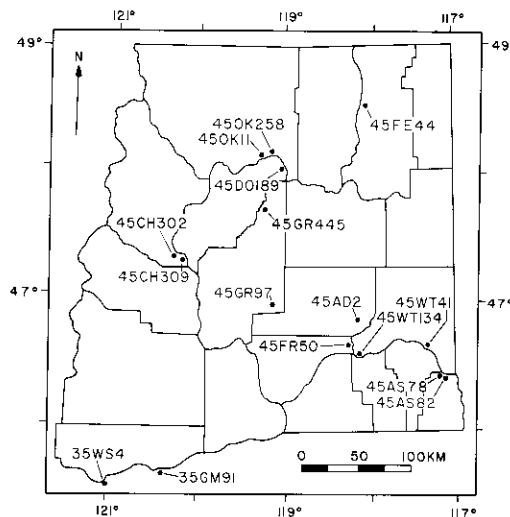


Figure 1. Holocene archaeological sites with remains of red fox (*Vulpes vulpes*) in eastern Washington. County lines shown for reference.

TABLE 1. Summary of Holocene archaeological red fox data in eastern Washington. See Figure 1 for site locations.

SITE	YEARS B.P.	SPECIMENS (N)	REFERENCE
35WS4	10,000-4,000	? (5 individuals)	Cressman <i>et al.</i> 1960
35CM91	5,000-150	radius, ulna (2)	Schalk 1987
45GR97	8,700	innominate (1)	Irwin and Moody 1978
45AD2	3,500-150	3 or 4 phalanges, ? (14)	Deaver 1973, Deaver and Greene 1978
45CH309	?	mandible (1)	Lyman, unpub.
45CH302	2,500-500	skull, 3 mandibles, 1 isolated molar, 2 vertebrae, 2 humeri, 2 radii, 4 ulnae, carpal, 4 metacarpals, femur, 2 innominates, tibia (24)	Lyman, unpub.
45OK11	4,000-2,000	phalange (1)	Livingston 1985a
45OK258	4,000-2,000	2 mandibles, 3 isolated molars (5)	Livingston 1985b
45DO189	3,000	humerus (1)	Lyman 1988b
45FE44	9,000-4,400	? (1)	Chance and Chance 1982
45FR50	10,000-8,000	skull (1)	Gustafson 1972
45WT134	4,000-3,500	skull (1)	Lyman, unpub.
45WT41	8,000-6,700	? (1)	Gustafson 1972
45AS78	3,000-100	mandible (1)	Lyman 1976
45AS82	5,000-2,500	mandible, ? (4)	Lyman 1976
45CR445	2,500-2,100	radius, ulna, calcaneum (3)	Lyman, unpub.

Deaver and Greene 1978) and Mead *et al.* (1985). My identifications of bones and teeth as representing *V. vulpes* have been based on the size and morphology of the remains; red foxes tend to be larger, for instance, than other members of the genus. Ingles (1965:339) reports the length of red foxes as 90-100 cm and red fox skulls as 13.7-15.1 cm long. Those same measurements for the kit fox (*V. macrotis*) are 60-84 cm and 10.5-12.2 cm (Ingles 1965:339). The average swift fox (*V. velox*) weighs 2.5-3.5 kg, the average kit fox weighs 2-3 kg, and the average red fox weighs 3-7 kg (Samuel and Nelson 1982).

Because the taphonomic history of a bone assemblage recovered from an archaeological site is difficult to ascertain (Lyman 1987b), the extent to which such assemblages resemble the original fauna from which they were derived cannot be determined (Grayson 1981). It is reasonable to assume, however, that taxa represented in archaeological faunal assemblages lived in the general area of the site of recovery. Typically only bones and teeth of great socio-economic value were transported over great distances by prehistoric peoples (Lyman 1985 and references therein).

Frequencies of red fox remains reported in Table 1 are numbers of identified bones and teeth,

with the exception of the record for 35WS4 which was reported as the minimum number of individual animals represented by an unspecified number of bones and teeth. The written record for red fox remains from eastern Washington archaeological sites does not always include which parts of the skeleton were identified, but I have included such information when available in Table 1. The reported bones and teeth represent most major anatomical regions of the body, indicating that while some of the remains may have been transported significant distances, such as phalanges still attached to a hide used for clothing, that is not regularly the case.

None of the 35 (57.4% of total sample of 61) specimens I have identified displays evidence of human modification, such as butchering marks. Similarly, the two specimens reported by Gustafson (1972), the 14 reported by Deaver and Greene (1978), and the six reported by Livingston (1985a, b) apparently do not display butchery marks (with my 35, 93.4% of total sample of 61). Although such negative evidence does not mean people were not responsible for the deposition of any or all of those remains (Lyman 1987a), there is no evidence to prompt me to argue that any of those remains were deposited by people. The fact that the remains were found in archaeological contexts provides

little clarification of this issue (Lyman 1987b). In the following then, I presume the red fox remains discussed were not transported significant distances (>25 km) by prehistoric human hunters, fully realizing this presumption may be false.

## Results

There are no known Wisconsinan-aged red fox remains from eastern Washington, but that may be due to the fact that only three faunal assemblages of that age are known from this area (Lyman 1986a). That red foxes were in eastern Washington during the early Holocene (10,000 to 7,000 B.P.) is indicated by remains from four sites. Fox remains from 45FR50 may date as early as 10,000 years ago, remains from 45WT41 as early as 8,000 years ago, and remains from 45FE44 as early as 9,000 years ago. The fact that 45FR50 and 45WT41 are in southeastern Washington and 45FE44 is in northeastern Washington provides support for Dalquest's (1948) conjecture that red foxes occupied mountainous regions in eastern Washington during the last glacial period, then dispersed northward during the Holocene. An early Holocene dispersal might account for the 8,700-year-old remains from 45GR97.

The 10,000-year-old fox remains from 35WS4 suggest that foxes may have taken refuge in the southern Cascades of Washington during the Wisconsinan, just as Dalquest conjectured. These data also suggest a possible early or middle (7,000 to 3,500 B.P.) Holocene dispersal by foxes into the northern Cascade Mountains of Washington, which might also account for the middle Holocene remains from 45OK11 and 45OK258. In addition, the middle Holocene record from 45WT134, plus the possible middle Holocene records from 35GM91, 45OK11, 45OK258, and 45AS82 suggest that red foxes were present in eastern Washington during this relatively warm and dry climatic period (Barnosky *et al.* 1987), even though red foxes tend to avoid hot, dry habitats (see Samuel and Nelson 1982 for a general account).

During the late Holocene (last 3,500 years), red fox remains were deposited at 45AD2, 45CH302, 45DO189, 45AS78, and 45GR445, and possibly at 45GM91, 45OK11, 45OK258, and 45AS82. It is unclear if this apparent increase in frequency of site records over the middle Holocene is due to greater abundances of foxes at this time, or the fact that more late Holocene

archaeological remains have been recovered and studied (Lyman 1986a, 1987b).

It is difficult to ascertain whether the Holocene red fox remains described here represent "established local populations" or "wandering" (Aubry 1984) individuals. All remains I have examined represent skeletally mature individuals rather than newborns or juveniles. Recovery of the remains of newborns might be taken as evidence of locally reproducing established populations. Given the low probability for preservation of the remains of newborns of any mammalian taxon in the archaeological record (Lyman 1984), the absence of newborn red fox remains in eastern Washington archaeological sites does not necessarily mean that resident local populations did not exist there.

Aubry (1984) concludes on the basis of historic data that most twentieth century red foxes in eastern Washington are derived from introduced fur farm escapees. The 16 Holocene records reported in Table 1 suggest that modern populations in eastern Washington may also include individuals descended from red foxes that occurred in this region during the Holocene. Whether those indigenous foxes were resident to eastern Washington or resident to contiguous areas, such as the Idaho panhandle and occasionally wandered through eastern Washington, cannot be determined from the available data.

## Discussion

The Holocene zoogeography of mammals in Washington has been dynamic (Livingston 1987, Lyman 1986a, 1986b, 1988a, Lyman and Livingston 1983, McCorquodale 1985, Van Vuren 1987). Significant additions to our understanding of that history can be found by careful evaluation of historic records, as Aubry (1984) has shown. But the prehistoric record is also an important source of information, as Fichter and Williams (1967) have shown for red foxes in Idaho. The prehistoric record provides a unique source of information that temporally extends historic data, occasionally prompting conclusions different from those suggested solely by historic data (e.g., Lyman 1988a).

The faunal record as reflected by archaeological data suggests that red foxes were widespread in eastern Washington throughout the Holocene. Those data also are readily subsumed within Dalquest's (1948) conjectured late Quaternary

zoogeography of red foxes. Perhaps the apparently low historic population of indigenous red foxes implied by Aubry's (1984) analysis resulted from the impacts of Euroamerican settlement, particularly given early historical perceptions of them as harmful predators (see Buechner 1953 for other examples). Importantly, it seems clear that modern red fox populations in eastern Washington might not simply be the result of historic introductions.

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