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## Human Occupation in the Beringian "Mammoth Steppe": Starved for Fuel, or Dung-Burner's Paradise?

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Several researchers suggest that western Beringia went unoccupied before and during the Full Glacial because of a lack of woody fuel (Elias 2002; Goebel 1999; Guthrie 1990; Hoffecker and Elias 2003; Hoffecker et al. 1993), limiting when people could enter the Americas. If abundant large herbivores grazed this "mammoth steppe," (Guthrie 1990; MacPhee et al. 2002), dung should have been plentiful. People rely on dung for fuel in many high-latitude and high-altitude grassland and tundra environments where wood is scarce or absent (e.g., Winterhalder et al. 1974; Wright 1992). Herbivores transform grass and browse into concentrated lignins and other undigested residue that is easily collected, dried, stored, and burned. Understanding the availability and burning properties of herbivore dung and the energetics of collecting and processing is necessary to evaluate the proposition that human occupation prior to ca. 14,000 yr B.P. in Beringia was fuel-limited.

The Tibetan Plateau of central Asia is an appropriate analog to the western Beringian subarctic, since it is similarly devoid of woody plants and temperature and precipitation regimes are similar. Modern Tibetan pastoralists burn *argols* (Mongolian for animal droppings) for nearly all heating and cooking needs (Goldstein and Beall 1990). Dung from different herbivores varies in fuel properties (see Huc 1852:104-5 for an interesting early account of Tibetan "argology"); yak dung is preferred for its sustained even, moderate heat. Dried yak dung yields about 3306 kcal/kg or 893 kcal/liter of gross energy, similar to cattle and bison dung. We initiated an ethnoarchaeological evaluation of dung use in the northern Tibetan Plateau, Qinghai Province, China in 2001, and preliminary observations suggest that a single family, living in a 10-m<sup>2</sup> canvas or hair tent with an earthen firebox, requires about 100-150

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liters of dung chips per day in summer and about double that in winter, amounting to roughly 70,000–80,000 liters of dung consumed annually.

Collecting and processing dung is a significant part of a woman's daily routine. Men and children also collect, often on special foraging trips. One group of dung foragers that we observed had collected 1000 liters per person in 4 hours in a pasture where yak patties were spaced 3–4 paces apart. Dung for a year's needs thus requires about 320 person-hours (less than an hour a day) for collecting and additional time to dry it. Collecting time is not limited here unless previous collecting has scoured the landscape, but drying and processing might limit daily fuel production in the wet season (Goldstein and Beall 1990).

The upper-Paleolithic peopling of the Tibetan Plateau (Brantingham et al. 2001; Brantingham et al. 2003) undoubtedly depended for fuel on dung from wild rather than domesticated herds. Nineteenth-century explorers in Tibet reported astonishing numbers of large herbivores (Schaller 1998). For example, Rockhill (1894:199–205, 381) writes,

We saw a great many antelopes (ling yang and huang yang) near the foot of the pass, and on the way up I noticed six yaks feeding on the side-hills. The ground was everywhere covered with their dung, so I fancy they are quite numerous in these hills. . . . Bunches of yaks were on every hill, and that readily accounted for the shortness of the grass in the neighborhood. It is wonderful what huge quantities of grass these animals eat, a herd of a hundred would, I believe, find barely enough on a good, rich meadow three miles square. Fortunately their droppings supplied us with an abundance of much needed fuel . . . [the grasslands were] alive with game of every description, and the ground was so thickly covered with yak and wild ass dropping that it looked like a vast barnyard.

But Rockhill also mentions dismal camps where dung was either lacking or too wet to burn. Patchiness of dung distribution is an important factor, along with the time needed to dry it and the ability of foragers to transport dung or store it, that figures into whether sustained occupation of Tibet was fuel-limited. The distribution and density of ruminants may also be a factor, given the apparent human preference for their dung.

Our initial results suggest that dung of large herbivores was a suitable and available fuel source in glacial-age western Beringia, and that lack of fuel was likely not a hindrance to the human occupation of the region. We will continue to pursue this issue by investigating modern-day dung availability, collection, and use from both domestic and wild stocks and developing archaeological signatures of dung fuel use in the colonization of the Tibetan Plateau, and hopefully Beringia as well.

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## Early Cave Occupations on San Miguel Island, California

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Caves and rockshelters around the world have been important for the study of early humans (Bonsall and Tolen-Smith 1997). On California's Channel Islands, which contain some of the earliest evidence of coastal occupation in North America, a number of rockshelters and caves have yielded early cultural deposits. Our recent work on San Miguel Island has documented as many as 15 shell middens dated between about 11,800 and 8000 CALYBP. Three of these are located in caves or rockshelters, which provide shelter from the island's pervasive winds and winter storms.

The most recent addition to the inventory of early cave occupations on San Miguel Island is a small rockshelter (Seal Cave) located near the tip of Harris

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