REPORTS

Plants and Subsistence during the Fluted-Point Period of the Northeast

Nathaniel R. Kitchel and Madeline E. Mackie

The role of plant foods during the fluted-point period (FPP) of North America is contested. Central to this debate is whether the scarcity of FPP macrobotanical materials stems from poor preservation of archaeological features and the macrobotanical remains they might contain or from the limited use of plants during the FPP. Employing summed probability distributions of radiocarbon date frequencies in northeastern North America, we find that FPP hearths are as common as expected, given the small number of well-dated FPP sites in the region. A second comparison shows that northeastern FPP hearths contain macrobotanical remains at a higher frequency than hearths from a region with better preservation and where small seeds formed a part of the diet. The macrobotanical materials so far recovered from FPP hearths in the Northeast show that plant foods contributed to diets during the FPP but that the plant diet breadth was relatively narrow, consistent with a specialized caribou hunting lifeway.

Keywords: fluted-point period, subsistence, plant foods, taphonomy, radiocarbon date distributions, Pleistocene

La importancia de los alimentos vegetales durante el período de las puntas estriadas (FPP) de América del Norte es un tema de debate considerable. Un aspecto central de este debate es si la escasez de materiales macrobotánicos del FPP se debe a la mala conservación de los rasgos arqueológicos y los restos macrobotánicos que podrían contener o al uso limitado de plantas durante el FPP. Empleando distribuciones de probabilidad de frecuencias sumadas de fechados de radiocarbono en el noreste de América del Norte, encontramos que los fogones FPP son tan comunes como se esperaba dado el pequeño número de sitios FPP bien fechados en la región. Una segunda comparación muestra que los fogones FPP del noreste contienen restos macrobotánicos con mayor frecuencia que los fogones de una región con mejor conservación y donde las semillas pequeñas formaron parte de la dieta. Los materiales macrobotánicos recuperados hasta ahora de los fogones del FPP en el noreste muestran que los alimentos vegetales contribuyeron a las dietas durante el FPP, pero que la amplitud de la dieta con respecto a las plantas fue relativamente estrecha, lo cual es consistente con una forma de vida especializada en la caza de caribúes.

Palabres claves: período de las puntas estriadas, subsistencia, alimentos vegetales, tafonomia, distribuciones de probabilidad de frecuencias sumadas de fechados de radiocarbono, Pleistoceno

The importance of plant foods to subsistence during North America's fluted-point period (FPP), ~13,500–12,000 cal BP, is contested. Many FPP sites containing subsistence remains are kill sites, and the era's few recorded camp sites rarely contain hearth features with preserved macrobotanical remains, facts that cloud the role of plants in the FPP diet (e.g., Cannon and Meltzer 2004; Waguespack and Surovell 2003). The near absence of plant remains in FPP sites may be due to poor preservation, but this does not mean that any evidence of plant use in these sites indicates a broad diet (e.g., Gingerich 2011).

This study aims to understand both whether the scarcity of plant remains in FPP sites is attributable to poor preservation of archaeological features and what the few plant remains present in

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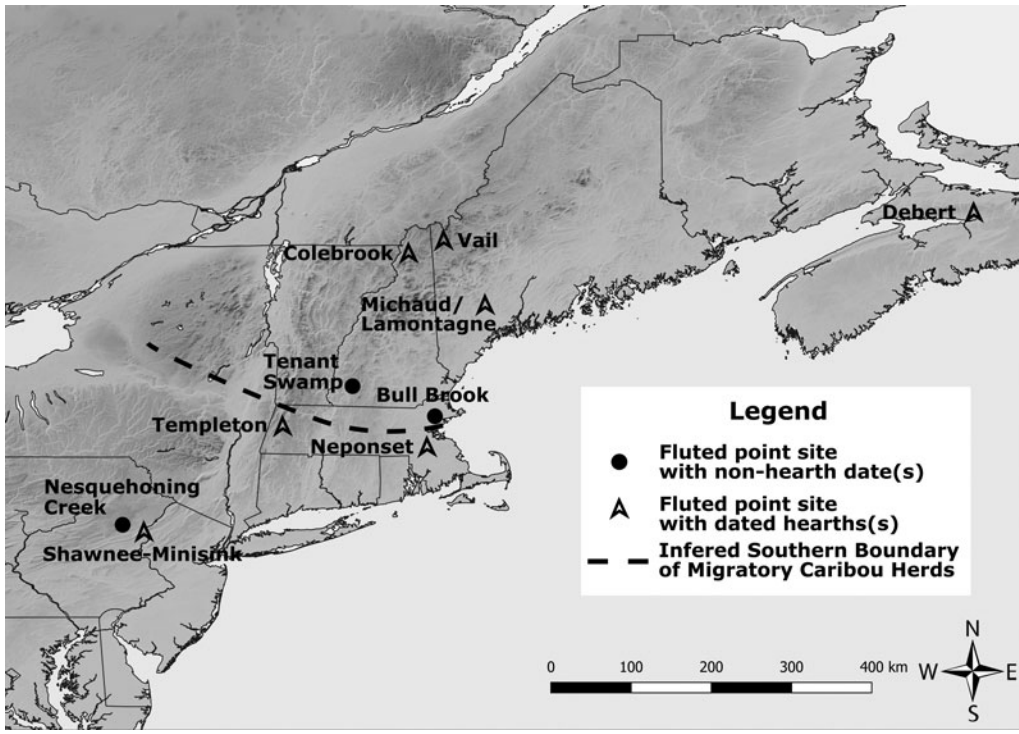

Figure 1. Location of FPP sites with radiocarbon dates from feature and nonfeature contexts included in this study (map by Nathaniel R. Kitchel).

FPP hearths indicate about subsistence activities. In the Northeast (the New England states, New Jersey, New York, and Pennsylvania), there are eight FPP sites containing a total of 11 well-dated features (Figure 1; Table 1), six of which contain carbonized macrobotanical remains recovered via flotation (unfortunately, features from Debert, Neponset, and Vail were not floated and thus are not included in discussions of subsistence activities). Although the sample is small, it is the largest collection of macrobotanical remains associated with fluted-point technology from any comparably sized region in North America.

Through an analysis of feature destruction over time, we show that FPP hearths are as common as expected given the small number of well-dated FPP sites in the Northeast. We also show that they contain macrobotanical remains at a higher frequency than hearths in a region with better preservation and where small seeds probably formed an important part of the diet. These findings indicate that plant remains are relatively common in Northeast FPP hearths and that the record is not biased against the preservation of plant macrobotanical remains. However, the plant remains recovered from Northeast FPP hearths show a preference for fleshy fruits, a pattern most consistent with a relatively narrow plant diet breadth. Although these results indicate that plant foods played a role in the diet during the Northeast FPP, they do not support the frequent use of labor-intensive plant foods like small seeds.

Plant Foods and Subsistence Specialization

The use of plant foods during the FPP intersects with an unresolved debate over whether terminal Pleistocene North American hunter-gatherers were specialized big game hunters (see Cannon and Meltzer 2004:1971; Waguespack and Surovell 2003). Subsistence specialization is rare and occurs in few ecological settings, usually in species-poor environments with an abundance of a single taxon, such as the Arctic tundra

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Table 1. List of Fluted-Point Period Features Indicating the Presence or Absence of Plant Remains.

Site/Feature	Macrobotanical Remains Recovered	Citation
Shawnee Minisink (Feature 35)	None	Dent and Kauffman 1985; Gingerich 2011
Shawnee Minisink (Feature 49)	None	Dent and Kauffman 1985; Gingerich 2011
Shawnee Minisink (Feature 50)	None	Dent and Kauffman 1985; Gingerich 2011
Shawnee Minisink (Feature 54)	None	Dent and Kauffman 1985; Gingerich 2011
Shawnee Minisink (Level 32 Hearth)	Hawthorn (*Crataegus* sp.)	Dent and Kauffman 1985; Gingerich 2011
Shawnee Minisink (Hearth 1)	Hawthorn (*Crataegus* sp.), Hickory (*Carya* sp.),	Gingerich 2011; Gingerich and Kitchel 2015
Shawnee Minisink (Hearth 2)	Hawthorn (*Crataegus* sp.),	Gingerich 2011; Gingerich and Kitchel 2015
Colebrook	Probable Blackberry and other unidentified small seeds	Boisvert and Kitchel 2018
Lamontagne	Smartweed (*Polygonum* sp.)	Hudgel et al. 2017
Templeton	None	Moeller 1980
Michaud	Ericaceae (e.g. Blueberry etc.)	Spiess and Wilson 1987

Note: At Shawnee-Minisink Gingerich (2011) has argued that only hawthorn (*Crataegus* sp.) and possibly blackberries (*Rubus* sp.) were consumed by the inhabitants of the site and that other plant remains were the product of accidental carbonization. At Shawnee-Minisink only hawthorn and hickory (*Carya* sp.) were recovered from secure feature contexts, whereas other small seeds were recovered from matrix samples (Gingerich 2011:136) and are not included in this analysis.

(Meltzer and Smith 1986:8–9). Paleoenvironmental reconstructions show that the terminal Pleistocene environment of northeastern North America was similar (though not identical) to those of modern high latitudes (Adovasio and Carr 2009; Shuman et al. 2009) supporting populations of caribou (*Rangifer* sp.) that were hunted during the FPP (Robinson 2012). Although the applicability of ethnographic models derived from contemporary caribou hunters to these problems is contested (e.g., Levine 1997), caribou hunting remains the most parsimonious explanation for many behaviors inferred from the FPP's archaeology (Ellis 2011). If any groups employing fluted-point technology are to be taken as specialized big game hunters, it is those of the Northeast. The role of plant foods among these groups is therefore important to the continental debate over the interpretation of plant remains from FPP hearths.

FPP Feature Taphonomy

It is not clear whether the pattern of plant remains from FPP hearths results from behavioral practices or taphonomic bias. Securely associating plant remains with human activities requires that a hearth must be (1) visible during excavation and (2) sampled via flotation. At FPP sites in the Northeast, macrobotanical recovery procedures varied considerably and are sometimes unreported. We thus restrict our analysis to presence/absence data. Other methods to identify plant remains at archaeological sites (e.g., phytoliths) have rarely been used at FPP sites and are not discussed here.

For charred macrobotanical remains to be securely associated with subsistence activities, they must be recovered from discernible cultural features (e.g., Spiess and Mosher 1992). Hearths are the primary source of macrobotanical remains, because other potential features, such as storage pits, have not been identified at Northeast FPP sites. Although macrobotanical remains from hearths can be non-anthropogenic (Gramly and Funk 1990), if any plant remains are evidence of FPP subsistence practices, it is those found carbonized in hearths.

Features, like all archaeological remains, are subject to taphonomic bias: older materials are less common than younger materials, even if originally produced in equal numbers (Bluhm and

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Surovell 2019). If features are rendered visually indiscernible from the surrounding soil more rapidly than nonfeature charcoal, there should be a greater disparity between radiocarbon date frequencies from nonfeature contexts compared to those from features as sites get older. Note that we are concerned here with the characteristics that make features visually discernible, not only the carbon contained therein. If a feature is unidentifiable during excavation, then charred plant remains may be unattributable to subsistence. Alternatively, if taphonomic processes affect feature visibility and nonfeature carbon in a similar manner, then we should expect similar radiocarbon date frequencies from each context through time.

Are Dated Features Unexpectedly Rare during the FPP?

We used radiocarbon dates from the Northeast to compare the frequency of dates from feature and nonfeature contexts. We gathered dates from all time periods and contexts from the Canadian Archaeological Radiocarbon Database (Martindale et al. 2016) and from a compilation project overseen by Robert Kelly. Before analysis we "cleaned" the database to remove spurious dates and assigned dates as "feature" or nonfeature dates from context information (Supplemental Text 1; Supplemental Table 1). Of 3,311 total dates, more than half ($n = 1{,}864$) came from features (Figure 2). The presence of more feature than nonfeature dates is expected because carbon from features is preferable for dating. Furthermore, our cleaning criteria removed some decades-old dates on dispersed carbon.

To determine whether features were preferentially destroyed, we used two methods employing summed probability distributions (SPD). The first identifies significant divergences of feature dates by comparing the feature SPD to a null model created by iteratively reshuffling feature and nonfeature ages while accounting for sample size (e.g., Bevan et al. 2017; Crema et al. 2016). This permutation-based method tests whether the feature and nonfeature dates are from the same statistical population (*permTest* in rcarbon v1.4.1; Crema and Bevan 2021; Crema et al. 2016). The second method compares the feature and nonfeature SPDs themselves, accounting for taphonomic processes (Bluhm and Surovell 2019).

The feature SPD and the null model track each other, converging more frequently with age (Figure 3a). Nonetheless, although the feature SPD has statistically similar growth rates to the null model (rate of change $p = 0.092$; Supplemental Figure 1), it is significantly distinct overall (global $p = 0.0002$; Figure 3a). This difference is driven by divergences between the SPD and null model at ~250–990 cal BP, 1220–1340 cal BP, 2650–2920 cal BP, 3240–5030 cal BP, and 5930–5940 cal BP. Prior to 5030 cal BP we see convergence of feature and null model dates until ~9700 cal BP, before which feature dates are intermittently less frequent than expected at four brief time periods. The underrepresentation of feature dates during these oldest periods likely results from the small sample size of dates from features and nonfeature contexts during this time (Figure 2). Feature dates and null model dates do not differ significantly during the FPP.

The taphonomically corrected SPDs show a similar distribution (Figure 3b), with the differences between the feature dates and nonfeature dates during the Archaic (~3200–5000 cal BP) being particularly pronounced. We interpret the overall similarity of the feature and nonfeature dates as indicating that features are not preferentially destroyed compared to carbonized material within archaeological strata, although this initial test would benefit from higher resolution datasets (e.g., Edinborough et al. 2017). This analysis indicates that the small number of features (pre-6000 cal BP) in the record is not a reflection of feature-specific taphonomic bias. Therefore, we expect the record of plant materials from hearths during the FPP to be as representative of subsistence as any other archaeological materials from the same period.

Comparison to More Plant-Intensive Subsistence Systems

Although the sample of Northeast FPP hearths is small, it is no smaller than expected given the low number of dated sites in the region (Figure 1; Tables 1 and 2). These data suggest that the number of FPP hearths will always remain low, underscoring the need to draw conclusions

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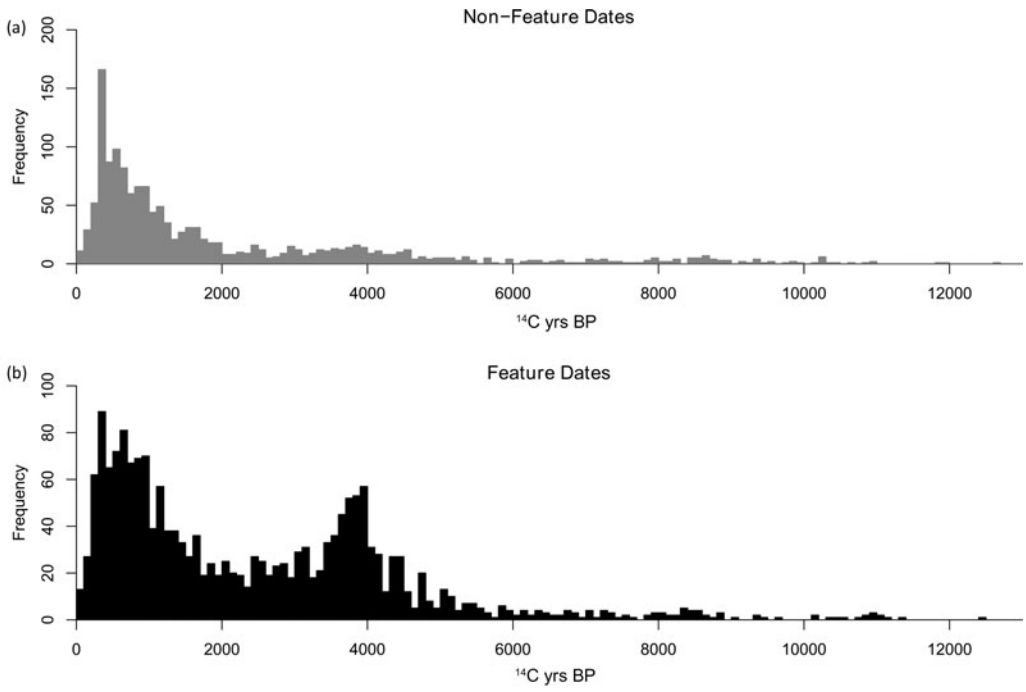

Figure 2. Uncalibrated radiocarbon dates used in this analysis from (a) nonfeature (n = 1,447) and (b) feature (n = 1,864) contexts.

from the extant sample of FPP hearths. As noted, 6 of 11 (55%) Northeast FPP features sampled via flotation contain carbonized plant remains, even though many (e.g., berries) may be accidental introductions (Walker et al. 2001:174). To contextualize this information, however, it is instructive to compare them to a sample of hunter-gatherer hearths with good preservation and where small seeds are expected.

Although several early Holocene sites with multiple features, such as Barton Gulch (Armstrong 1993) or Dust Cave (Walker et al. 2001), do exist, a sample drawn from single sites is subject to bias by location-specific tasks, seasonal activities, or exceptional preservation. A larger sample prevents a single site from substantially biasing seed presence/absence information. Therefore, for the comparative sample we compiled a database of floated hearths from southwest Wyoming (Supplemental Table 2), a region that offers a searchable compliance database, the known use of seeds for subsistence, and good preservation due to aridity. The dataset includes the presence/absence of carbonized seeds from floated hearths found at sites containing metates from Lincoln, Sweetwater, and Uinta Counties (for methods, see Supplemental Text 1). We assume seeds were not processed by fire at these sites but were accidentally carbonized.

Of the 206 floated hearths sampled, 86 (37%) contained charred seeds, and only 11 (13%) contained more than five seeds each. These data suggest that, even where preservation is good and plants were an important part of diet, hearths often do not contain abundant macrobotanical materials. The results show that the sample of floated FPP hearths in the Northeast contain macrobotanical remains at a *higher rate* than those from Wyoming. This was surprising given that Wyoming hearths were expected to contain macrobotanical materials in greater abundance and more frequently than in Northeast FPP hearths. These results suggest that plant macroremains in Northeast FPP hearths are quite common.

Conclusion

Although feature dates are scarce during the FPP, they are no less common than expected given the

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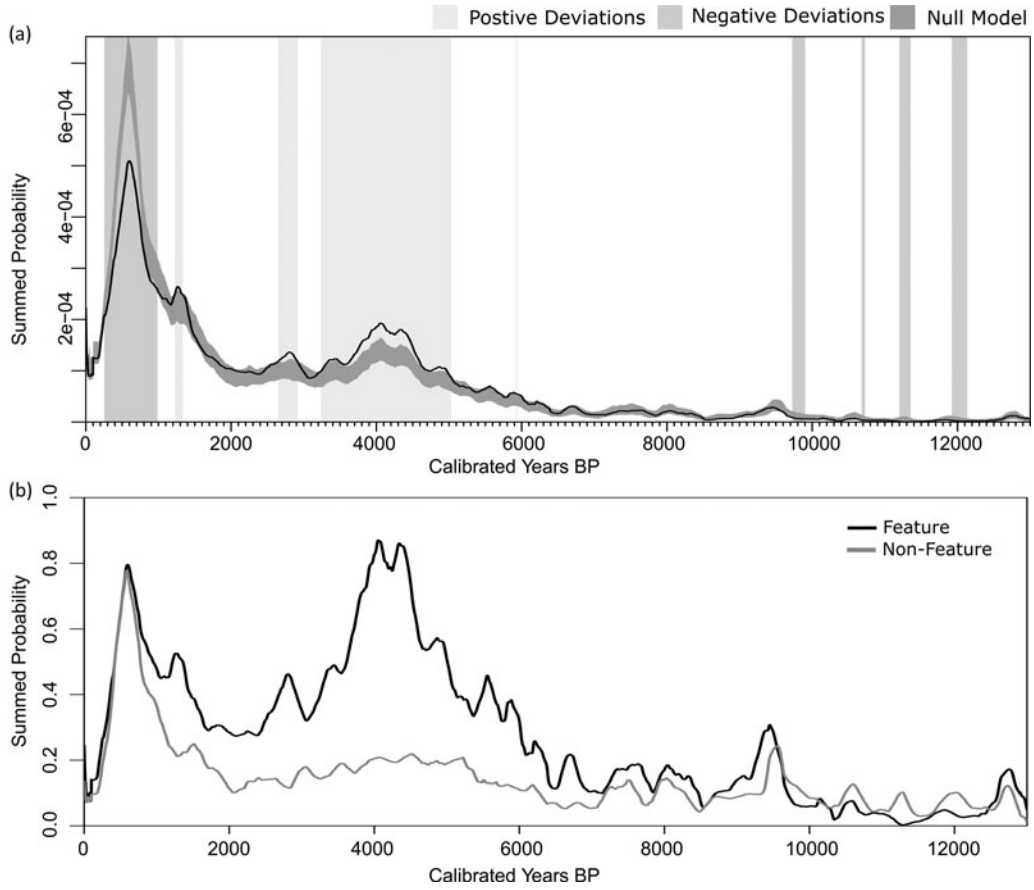

Figure 3. Summed probability distributions of feature and nonfeature dates from the Northeast with 200-year smoothing and binned by site in 100-year intervals (feature n_{dates} = 1,864, n_{sites} = 565, n_{bins} = 1,307; nonfeature n_{dates} = 1,447, n_{sites} = 493, n_{bins} = 1,017). (a) SPD of feature dates compared to a 95% confidence interval of nonfeature dates; produced with 5,000 simulations of *permTest* function. (b) SPDs of feature and nonfeature dates taphonomically corrected (Bluhm and Surovell 2019). All dates were calibrated and summed in the rcarbon package v.1.4.1 (Crema and Bevan 2021) using the IntCal20 calibration curve (Reimer et al. 2020) in R v.4.0.2 (R Core Team 2020).

Table 2. List of Fluted-Point Sites with Dates from Nonfeature Contexts.

Site	Material Dated	Context	Citation
Bull Brook	Calcined Bone	Burned bone concentration associated with FPP materials; some bone fragments identified as caribou	Robinson et al. 2009
Nesquehoning Creek	Charcoal	Stratigraphic level with fluted points	Stewart et al. 2018
Tenant Swamp	Calcined Bone	Scattered calcined bone in association with diagnostic FPP materials	Goodby et al. 2014

small number of dates from this period. Additionally, the frequency of carbonized seeds in Northeastern FPP hearths is higher than at a time and place where preservation was better and where small seeds were important to the diet. In other words, although small, our sample of FPP macrobotanical remains is not substantially biased by taphonomic processes.

Although this finding might indicate that plants were fundamental to the diet during the Northeast FPP, the repeated presence of berries at these sites indicates that plant gathering was

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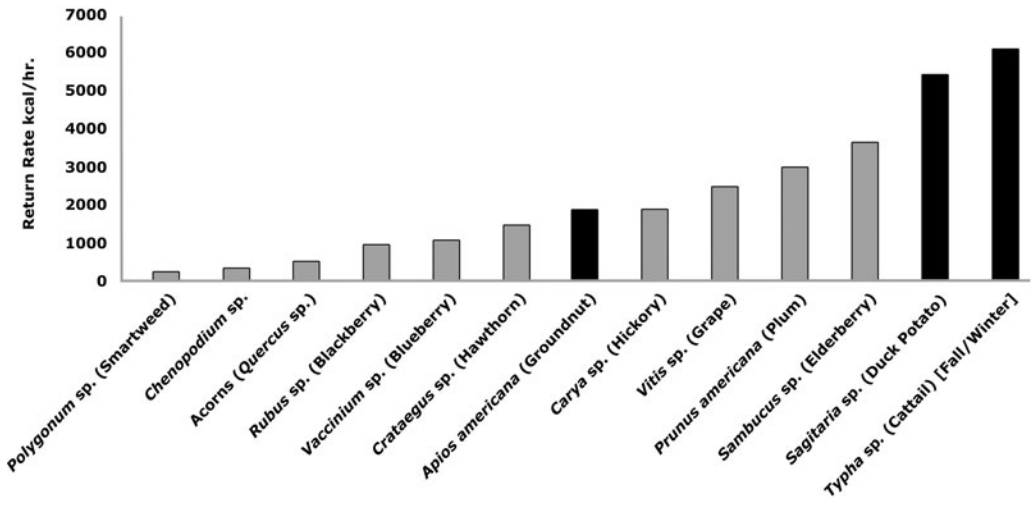

Figure 4. Post-encounter return rates for select plant foods found in the Northeast. Black bars indicate geophytes. Some species, particularly hickory, were likely absent from the northern portion of the region during the Pleistocene (adapted from Gingerich and Kitchel 2015).

incidental to other concerns (Spiess et al. 1998:224). The scarcity of small seeds and the absence of grinding stones indicate that low-return-rate, high-processing-cost plant foods were *not* substantial components of the Northeast FPP diet (Gingerich and Kitchel 2015). Rather, Northeast FPP groups focused on plant foods requiring no substantial technological investment (sensu Bettinger et al. 2006) and providing essential nutrients (like vitamin C), such as berries.

Although plant foods augmented hunted foods (Gingerich and Kitchel 2015), the evidence does not support intensive exploitation of technologically expensive, low-return-rate plant foods (see also Gingerich 2011:139–140; Hofman and Todd 2001:204–205). This finding fits well with an interpretation of Northeast FPP groups as highly mobile hunter-gatherers (e.g., Ellis 2011), who offset local resource depression through mobility rather than dietary expansion and accompanying technological intensification. Ultimately, the plant foods most likely to have been exploited during the FPP are nutritionally important fleshy fruits, hickory nuts, and geophytes such as cattail (*Typha* sp.) rhizomes with high-caloric return rates (Figure 4; Gingerich and Kitchel 2015). Although parenchymatous tissues are infrequently preserved in open-air hearths, efforts to identify the use of geophytes at FPP sites offers an additional test of this hypothesis.

The use of high-return-rate, low-processing-cost plant foods during this period does not mean these groups were unfamiliar with the utility of other plant resources for food or other purposes, but that those higher-cost resources were not regularly or intensively used under most circumstances. It is not necessary to invoke the habitual use of low-return-rate resources as a risk mitigation mechanism when maintenance of environmental knowledge fulfills this role (see Hofman and Todd 2001:201).

The overall caloric contributions of plants, particularly fleshy fruits during the FPP, were likely far smaller than that of meat, given a post-encounter return rate of caribou (*Rangifer tarandus*) that is nearly 4 times (25,370 kcal/hr; Smith 1991) that of the most calorically dense plant food, winter cattail (7,000 kcal/hr; Madsen et al. 1997), and 18 times that of the hawthorn fruits found at Shawnee-Minisink (1,415 kcal/hr; Reidhead 1981). Plant foods were likely periodically important to the FPP diet when meat was scarce and as a source of essential nutrients such as vitamin C. Still, our sample, though small, does not point to the systematic and intensive use of low-return-rate plant foods during the

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Northeast FPP. Instead, caribou hunting was most central and most likely structured many aspects of life at this time (Ellis 2011).

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Data Availability Statement. The radiocarbon database is included as Supplemental Table 1 and is available through the Canadian Archaeological Radiocarbon Database. The Wyoming data are available in published sources or from the Wyoming State Historic Preservation Office.

Supplemental Material. For supplemental material accompanying this article, visit https://doi.org/10.1017/aaq.2021.125.

Supplemental Text 1. Explanation of Methods for Radiocarbon and Comparative Hearth Analysis.

Supplemental Table 1. Cleaned Northeast Radiocarbon Database Used for Feature and Nonfeature Analysis.

Supplemental Table 2. Floated Features from Archaeological Sites in Wyoming Used in this Analysis.

Supplemental Figure 1. Rate of change analysis for feature permutation test using the same dataset and methods detailed in Figure 3.

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