Quaternary Research (2026), 1–24
doi:10.1017/qua.2025.10039

Research Article

The Indigenous oral narrative, *Theft of Pine Nuts*, as a proxy for reconstructing historical biogeography in the Great Basin, USA

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Abstract

Our analysis of 61 versions of the Great Basin (GB) Indigenous oral-history narrative, *Theft of Pine Nuts*, provides valuable new paleoecological insights into late Pleistocene (LP) and Holocene biogeography of pinyon pine (*Pinus monophylla*). Pinyon homelands indicated by Indigenous sources were located not only within the current pinyon distribution but also north of the known range, in northern California and Nevada, southern Oregon and Idaho, and western Wyoming. These extramarginal pinyon locations corroborate and expand a Western science hypothesis that proposed LP or Early Holocene refugial populations for pinyon in northern GB that subsequently became extirpated. The narratives also provide new evidence for pre-contact distributions of native mammals in the GB. From analysis of the "ice-barrier" accounts in the Indigenous narratives, we propose parts of this oral-history narrative may have been transmitted since LP times. Whereas most prior efforts have assessed Indigenous oral histories that describe catastrophic geologic events, we document that important ecological dynamics are also embedded in these stories. Our analysis joins other studies in recognizing that oral-history narratives can contain reliable eyewitness observations that are useful for reconstructing paleoenvironmental events and conditions.

Keywords: Indigenous oral-history narratives; *Theft of Pine Nuts*; Great Basin; Pinyon pine; *Pinus monophylla*; Late Pleistocene; Holocene; Climate refugia; Paleoecology; Biogeography

Introduction

Quaternary sciences depend on diverse sources to reconstruct historic conditions. Most often these provide indirect evidence (proxies) that bears only partially on the knowledge sought, and each source has limitations that must be considered in interpretation. To obtain the most accurate understanding, multiple types of data are used together. Introducing new forms of evidence often significantly changes the interpretation of past events.

Indigenous oral histories, stories passed aloud from generation to generation, provide rich sources of information on historic events that can complement and augment Western science proxies (Echo-Hawk, 2000; Mackenthun and Mucher 2021; Angelbeck et al. 2024). Once regarded by Western transcribers as purely mythical and imaginary stories (Lowie, 1915; Dorson, 1963; Mason, 2000), oral-history narratives are now understood to contain elements of past eyewitness accounts that can serve as a valuable new source of paleoenvironmental information (Whiteley, 2002; Hittman, 2013; Stoffle et al., 2024).

Indigenous oral-history narratives abound in cultures around the world (Hulan and Eigenbrod, 2008). In western North America, they have been used successfully in combination with geologic analysis of past catastrophic events, such as volcanic eruptions (Moodie et al., 1992; Budhwa et al., 2021; Angelbeck et al., 2024), megathrust earthquakes and tsunamis (Hutchinson and McMillan, 1997), and massive landslides and floods (McMillan and Hutchinson, 2002; Budhwa et al., 2021). Many Indigenous oral-history narratives involve plants and animals and describe their dietary and cultural values (Sutton, 1989; Berkes et al., 2000). Paleoecological dynamics within the narratives, however, such as plant migration and biogeography, are under-investigated.

Oral tradition has long been recorded in the Great Basin, USA (Lowie, 1909; Kelly, 1938; Fowler and Fowler, 1971). Although most analysts have compared content from the narratives with Western science to validate the former, we move beyond this to examine Indigenous sources for new information useful to Western science. We use Indigenous content to expand and test Western science hypotheses. Our overall goal is to document the power of oral-history narratives in paleoecological analysis through a case study of one Great Basin (GB) narrative, the *Theft of Pine Nuts* (*TPN*). *TPN* is a common story in the opus of GB oral-history narratives, with many variants and well-represented throughout

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[†]Indigenous authors in this study are expressing personal experience and memories, recognizing that other tribal members may have different interpretations. They do not speak for, or attempt to represent, their entire tribes.

Cite this article: Millar, C.I., Thomas, D.H., Benner, M., Cossette, D., Fillmore, H., Teeman, D., Wewa, W., 2026. The Indigenous oral narrative, *Theft of Pine Nuts*, as a proxy for reconstructing historical biogeography in the Great Basin, USA. *Quaternary Research*, 1–24. https://doi.org/10.1017/qua.2025.10039

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the region. At its core, *TPN* is an epic-origins story, describing how pine nuts—an essential element of GB diets—were brought to the People. Our specific objectives are to (1) compile variants of the *TPN* story; (2) evaluate the antiquity of *TPN*; (3) analyze the stories for their ecological and physical content; and (4) use that content to test and expand Western science hypotheses of late Pleistocene–Holocene pinyon pine (*Pinus monophylla*) biogeography and migration.

Oral-history narratives and Indigenous science

Indigenous histories are steeped in social values and interwoven with cultural identity. As such, they comprise a very different category of knowledge than those conventionally used in Quaternary sciences. Drawing upon these stories responsibly requires an explicit respect for the culture from which they come and understanding of Indigenous storytelling traditions (Echo-Hawk, 2000; Whiteley, 2002). Indigenous GB scholars have long argued that tribal input is essential for developing insights into deep history of the GB (Crum, 1994; Brewster, 2003; Blackhawk, 2006; Teeman, 2024). The embedded cultural context of these narratives must be appreciated for the symbolism, latent content, and allegory they contain. The Indigenous partners in this study shared insights into these histories that interpret the traditional lifeways and natural environments reviewed here. In a companion paper, the same authors develop in more detail the nature, history, and survival of GB oral history (Thomas et al., in press); here we focus specifically on ecological and physical insights in these oral histories.

GB Indigenous narratives, by definition, were spoken by Elder storytellers and carry much of the content of Indigenous science. Most of those transcribed over the last 150 years were translated into English, where regrettably much of the original meaning was potentially lost. The stories describe events of fundamental significance (e.g., creation) or represent epic-adventure stories that transmit cultural norms and codify moralities (Liljeblad, 1986). The narratives are not expressed as hypotheses subject to testing or validation; they describe events accepted as real and correct history, "what actually happened" (Hittman, 2013). To survive over generations, the narratives were structured to be entertaining (thus, remembered) as well as instructive, and often contain colorful, playful, or exaggerated elements.

Space (place) and time play out in the oral-history narratives in different ways. Many stories contain recognizable elements of local landscape, such as mountain peaks and plant and animal species. The (English) transcriptions sometimes use modern place-names and common names of known animals or birds. Such descriptions are often sufficient to locate stories and their variants in the current landscape.

Unlike geography, time (including dates, ages, and chronological order) is more difficult to interpret—nor was it important from the narrator's perspective—in the oral-history narratives (Liljeblad, 1986). Events are commonly described as occurring "in time immemorial" or "a long time ago." Time is understood to be nonlinear, and each cycle rests upon collapsing onto the previous. Narratives that we assessed represent a period of time "when Animals were People," considered to be in deep time.

Recognizing vast differences in goals, methods, and intent between Indigenous science and Western science, we provisionally assume that Indigenous oral-history narratives could contain elements that reflect eyewitness observations as well as fictional imagery (Echo-Hawk, 2000; Whiteley, 2002). As with other indirect sources of information in Quaternary sciences, we acknowledge that advantages, disadvantages, and biases likely exist, and temper our interpretations accordingly.

Current understanding of historic pinyon biogeography

Singleleaf pinyon pine and its relatives in genus *Pinus* subsection *Cembroides* have evolutionary origins in what is now southwestern North America dating to the early Paleogene (>60 Ma; Axelrod, 1986; Millar, 1993). The northern pinyons in subsection *Cembroides*, including singleleaf pinyon, diversified in tandem with the emerging geologic landscape of the GB (Axelrod, 1958).

Few records of pinyon pine have been dated to the Early or middle Pleistocene in the GB, likely due to limitations of the record rather than absence of the species (Betancourt, 1986). A pollen core from Owens Lake that extends more than 800,000 years documents abundant *Pinus* pollen (Litwin et al., 1997). Pinyon-type pollen, interpreted as *P. monophylla*, was analyzed from the last 180,000 years of the core (Woolfenden, 2003) and occurred in high-enough abundances to indicate local populations of pinyons. Pinyon pollen percentages showed significant fluctuations that correlated with major cycles of cold (glacial) and warm (interglacial) periods during the last 180,000 years.

We focus on the late Pleistocene (LP; ~22–11.7 ka) and the Holocene (<11.7 ka). Evidence of pinyon's occurrence in the GB during that time comes primarily from macrofossils in ancient packrat (*Neotoma* spp.) middens (Betancourt et al., 1990). Early work on pinyon distribution led to a widely accepted hypothesis that pinyon was absent from most of the GB during the LP and Early Holocene, as climates were too cold for it to survive (Lanner, 1983; Wigand and Nowak, 1992; Lanner and Van Devender, 1998; Grayson, 2011; Cole et al., 2013). Instead, pinyon and its closest relatives retreated southward to areas currently dominated by Mojave Desert ecosystems, where they found conditions favorable for growth (Spaulding, 1990). With warming temperatures of the Holocene, pinyon began to migrate north, mostly after 7–8 ka, into the GB, reaching its modern northern boundary only in the past several hundred years (Lanner and Van Devender, 1998; Figs. 1 and 2).

Using revised radiocarbon dates and adding new sites, Thomas and Millar (2024; also Millar and Thomas 2024a) updated this traditional interpretation, and proposed an alternative scenario (Fig. 3). This retained the LP, southern Mojave refugium, and in addition proposed several high-latitude pinyon refugia. These were suggested as areas where pinyon had advanced during an earlier warm interval, and where, during the last ice age, pinyon survived in very restricted and scattered populations. High-latitude refugia were proposed for the northern White Mountains, CA; Warner Mountain region, CA/NV/OR; the Bonneville region, NV/UT; and the Bear Lake region, UT/ID (Fig. 3). Various lines of evidence were brought forward for these refugia, and tests were employed to compare the hypotheses (Millar and Thomas, 2024a). In the end, both had strengths and weaknesses and were retained for further testing.

Great Basin mammal species

The GB has long been a region of interest for biogeographic study of plants and animals, especially for the "island" nature of its hundreds of mountain ranges separated by broad, low basins (Brown, 1971; Lawlor, 1998; Grayson and Livingston, 1993). Alternating

Figure 1. Current known distribution of singleleaf pinyon pine (*Pinus monophylla*) (dark-brown shading) in the southwestern United States. Gray shading is the hydrologic Great Basin. Source: DataBasin (2024).

climates of the LP and Holocene triggered dramatic shifts in plant and animal ranges (including pinyon pine), leading to contractions and expansions as well as extinctions and local extirpations (Grayson, 2011). Reconstructing the pre-contact occurrences of GB mammalian species has been challenging, given the complex topography, difficult conditions for survey and preservation, and the limited explorations undertaken (Grayson and Livingston, 1993).

Layered on these uncertainties are effects resulting from human activities in the last 15,000 years. Impacts from naturally changing climates, especially on large herbivores, were compounded by stresses of Indigenous hunting (Burney and Flannery, 2005; Hockett, 2015). Putting aside the megafaunal climate versus overkill discussion (Meltzer, 2020), the ranges of some large mammals, at least, appear to have been affected by Indigenous activities, especially as climates were changing (e.g., Garfinkel et al., 2010). The largest anthropogenic effect, however, occurred during the settlement period as a result of over-trapping and overhunting by European-origin pioneers, especially on fur-bearing mesocarnivores and large herbivores (Tappe, 1942; Buechner, 1960; Yoakum, 2004; Shelton and Weckerly, 2007). During that time many species were extirpated from the GB, or their numbers vastly diminished. Attempts to reconstruct prior ranges of these species have been based on historic narratives of explorers and settlers as well as scant fossil evidence, but these have limited scope and uncertain accuracy.

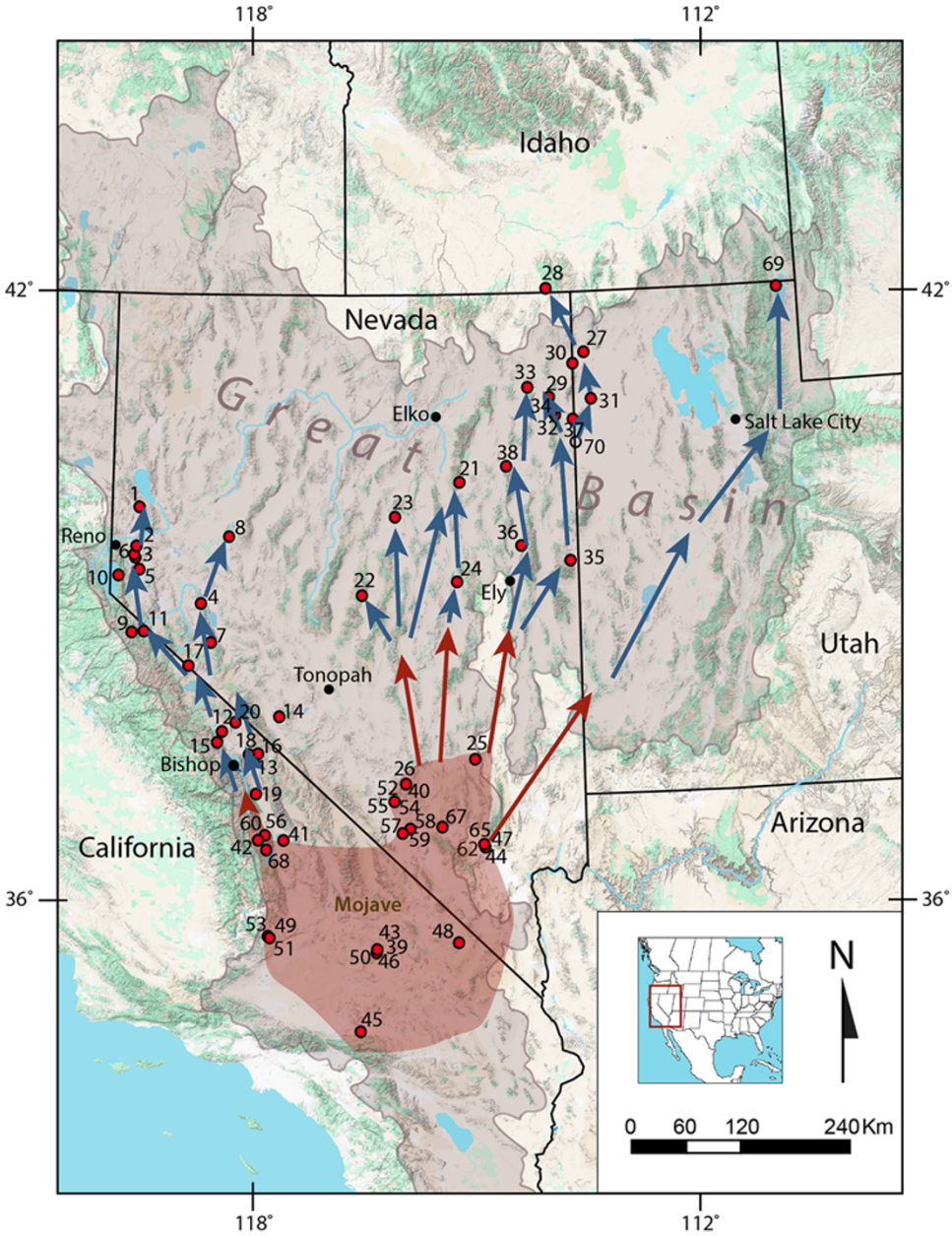

Figure 2. Pinyon hypothesis 1: Migration of pinyon pine from a southern Pleistocene refugium, estimated from midden locations and radiocarbon dates (reprinted from Millar and Thomas, 2024a). The brown polygon denotes the southern late Pleistocene refugium, red arrows show movement out of that refugium during the Early Holocene, and blue arrows show subsequent movement. Gray shading is the hydrologic Great Basin. Numbers represent midden sites used by Millar and Thomas (2024a) to show pinyon migration.

Methods

TPN versions

We searched the published and gray literature (especially ethnographies and historic documents) for transcribed oral-history narratives relating to pine-nut origins. Search titles were *Theft of Pine Nuts, Theft of Fire*, and other phrases involving pine-nut origins. Indigenous participants in this study contributed additional versions and interpreted the role of oral-history narratives in GB culture generally and pine-origin narratives specifically.

Evaluating the antiquity of the TPN narrative

The occurrence and prominence of a massive ice barrier (occurring in other GB oral-history narratives also) is described in such detail that it can be analyzed relative to the historic conditions of ice known for the GB. We assessed glacial periods from the LP through to the present and compared known conditions to descriptions in the oral-history narratives.

Physical and ecological information in the TPN narratives

We evaluated the *TPN* narratives for their natural-history content and compiled lists of mammal, bird, fish, and lizard species. We initially assumed the English names for species in the narratives were correctly translated and referred to known taxa. Indigenous coauthors evaluated these assignments, and we also consulted translation dictionaries. In some cases, we used clues from the description and location of species that were named generically to

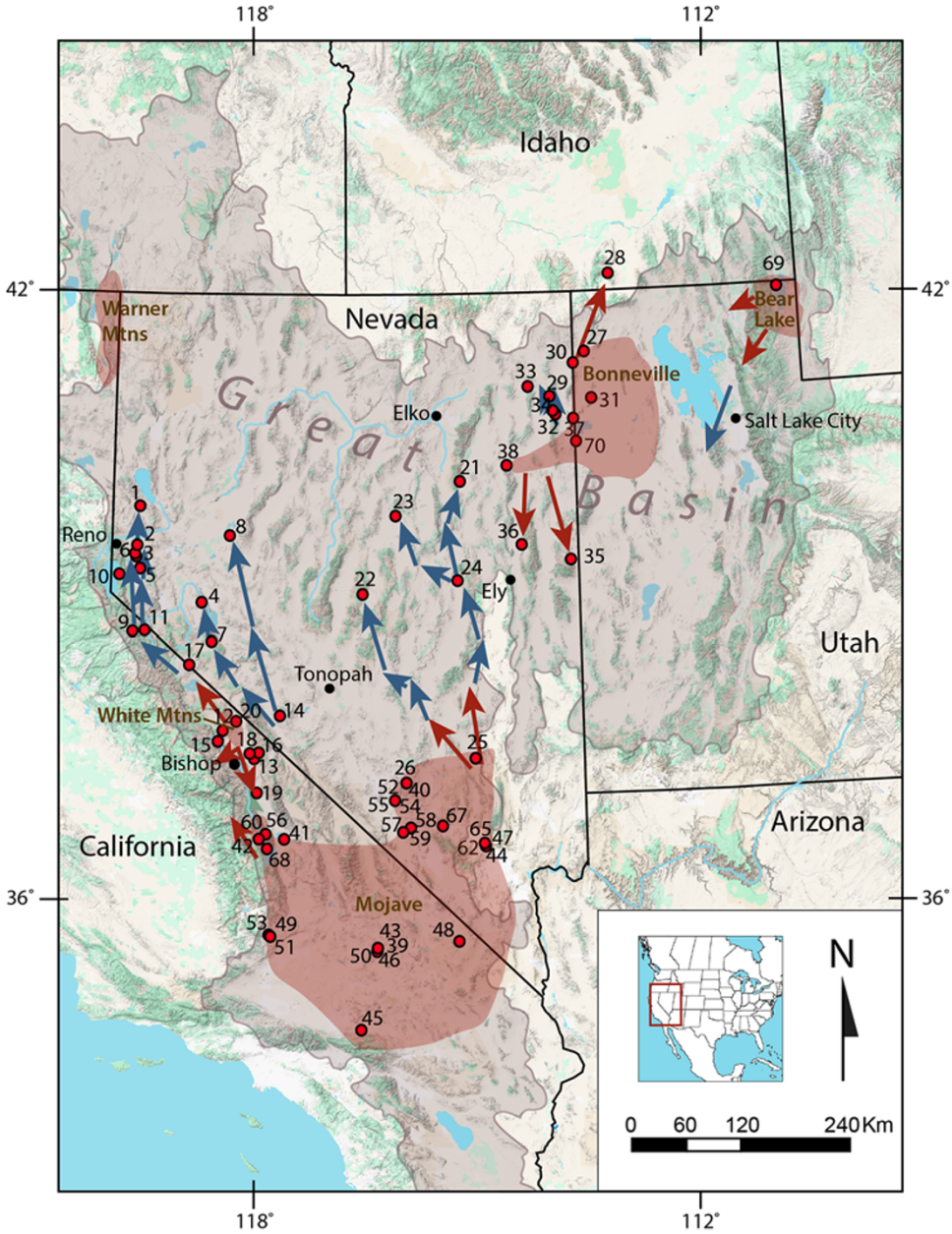

Figure 3. Pinyon hypothesis 2: Northward migration of pinyon pine from the southern Pleistocene refugium and outward from four Pleistocene refugia at higher latitudes in the western and eastern Great Basin (GB), estimated from pollen and midden locations and radiocarbon dates and, for the northeast California refugium, from ethnographic evidence and herbarium records (reprinted from Millar and Thomas, 2024a). Brown polygons denote five late Pleistocene refugia, red arrows show movement out of the refugia during the Early Holocene, and blue arrows show subsequent movement. Gray shading is the hydrologic GB. Numbers represent midden sites used by Millar and Thomas (2024a) to show pinyon migration.

propose likely taxa. Locations were noted for mammal species as provisional descriptions of historic occurrences.

Pine-nut homelands in the TPN narratives

For each of the variants, we attempted to determine the location of the pine-nut homelands. In most versions, this was where the Animal People lived who hoarded the pine nuts. Place-names, topographic features, and indicator bird and animal species were most useful. For the latter, several species have limited distribution in the GB, and provided helpful georeference, recognizing that historic distributions may have differed. We paid special attention to details describing pine-nut homeland locations that are outside the current pinyon distribution range.

Identifying the pine-nut species in the oral-history narratives was critical, in that we sought to understand pinyon pine's biogeography. This was especially important when pine-nut homelands were outside the current pinyon range and within the range of other pine species. We evaluated ethnographic and archaeological references on pine-nut usage. Indigenous coauthors provided information on historic tribal use of pine-nut species.

Results

TPN compiled narratives

We compiled 61 versions of *TPN* and related pine-nut origin narratives (Table 1, Supplementary Material, Supplement 1). In content, they ranged from long, far-reaching epics to a few lines outlining the central plot. Only two versions were written in native languages (with English translations), whereas the rest were transcribed directly into English. The oldest version was recorded by John Wesley Powell in 1873 (Fowler and Fowler, 1971); the most recent include a 2014 Wá•šiw (this spelling is preferred over "Washoe" by tribal members) children's story and *TPN* versions presented here by coauthors Misty Benner and Diane Teeman. Written versions of the narrative, thus, have been known for 152 years. The *TPN* narrative continues to be told; all native coauthors heard the story in their youth.

The 61 versions derived from eight of the nine tribal territories mapped by d'Azevedo, (1986; Fig. 4). We found no versions from Owens Valley Paiute. Northern Paiute territories were most represented and Ute the least.

Stripped to their core, *TPN* narratives relate how pine nuts initially were absent from the narrator's (usually Coyote) land. The narrator and his Animal companions smell pine nuts cooking far off, travel to the distant pine-nut land where they steal the nut, and bring it home. The story is illustrated by a Northern Paiute version (Fowler et al., 1970, p. 135):

> The Old Wolf and the Coyote made a great fandango or dance, and the coyote was a singer. They wanted something good for their guests to eat. The coyote went away up north, many days journey, and smelled four ways, and found pine-nuts. The Old Crane was ruler of that land in the north. He made some pine-nut mush, and filled the coyote's mouth with it, and plastered it all over him. Then the coyote went back to his own land in the south, and the wolf smelled him and said it was good. They all started to go north to the pine-nut country. But the Old Crane hid all the pine-nuts. The little mouse found them, and the yellow woodpecker pulled them out with his bill. All the Crane's sons were asleep, and they slept so soundly that they could not be awakened, though an old woman threw water on them. So they got the nuts, and the wolf's sons ate them all up. Then they all started to go south. But there was a great wall of ice in the way, which they could not pass. All of them tried to break it, but they could not. But at last the little Crow broke it. The coyote tried to pass through where the little crow broke it, but he could not. The Old Crane came upon them and killed all of them except the crow and the chicken-hawk. The chicken-hawk had a stinking leg, and the crane could not catch him. So he escaped and he flew to the top of a great hill (Dayton Hill, near Virginia City), and there he vomited up all the pine-nuts he had eaten in the crane's country. These sprang up and grew and thus pine-nuts were brought to the Paiute land.

Although the versions are highly consistent, the central plot is modified and embellished in several ways among the narratives. We recognize nine themes as well as additions and deletions (Table 2, Supplementary Material, Supplemental Table 1). In a few versions, the pine-nut theft story is embedded within the widespread *Theft of Fire* story, which has a narrative similar to *TPN* but focuses on fire. In other versions the storyline is quite different but nonetheless describes how pine nuts were first brought to the People.

Antiquity of the elements in the TPN narratives: role of the ice barrier

Perhaps the most astonishing element in the *TPN* tales is the occurrence of an ice barrier: 22 of the 61 variants include this (5 from the NW; 15 from the WC; 1 from the NC; and 1 from the NUT; for codes, see Fig. 5, Supplementary Material, Supplemental Table 1). The ice barrier is portrayed as a towering wall of ice that impedes the Animal people from proceeding toward the pine-nut land and/or in returning home after stealing the pine nuts. The ice barrier is described as formidable ("They travelled until they came to an ice blockade. It stood from sky to earth." no. 4 (here and throughout "no." refers to version number in Table 1); in another version, "You'll never believe what I [Grizzly Bear] found. I went up there to the north and there was a *big* mountain of ice. Because it was so huge I could not go around the mountain … In awe, they [Coyote's People] looked up into the sky, and the ice mountain went up into the clouds." no. 40); and seemingly uncrossable ("They found a blockade of ice just like these mountains; it was all ice … They all stopped there; they couldn't go across." no. 2). The Animal People eventually cross the ice barrier, usually with the help of corvid birds that fractured the ice. Importantly, the narratives make clear that this was an ice wall, not winter snow ("All the animals packed up and went to see the mountain of ice. When they were approaching from a distance they could see white, and somebody said, 'It's snowing! That's all it is, it's just snowing.' And the Grizzly Bear told them, 'We still have many more days to go.' So they went on for many days, until they finally got to the wall of ice. And they looked up and it was true!" no. 40).

Descriptions of enormous ice barriers appear to indicate glaciers or large permanent ice fields. How did people living in the GB learn about towering ice barriers and write of them in *TPN* narratives? We consider candidate glacial periods for these descriptions.

Currently (post-1920 CE) ice glaciers in the GB occur only in the Sierra Nevada, CA (Fig. 6A). Many GB mountain ranges support small rock glaciers (ice-embedded features covered with thick rocky mantles) high in cirques (Millar and Westfall, 2019). Persistent ice on the headwalls of two GB rock glaciers has been considered glacial (Osborn and Bevis 2001), but one in the Wasatch Range, UT, fully melted in the twentieth century (Fig. 6D), and the other, in the Snake Range, NV, melts in warm years and reforms only as a small ice field. The remaining non-glacial ice patches in GB ranges are very small (mean area excluding the Sierra Nevada < 1 ha; Millar and Westfall, 2019) and are plastered as thin veneers against their cirque headwalls—they are unimposing, hard to see, and present no barrier to passage over or around mountains.

During the Little Ice Age (LIA; 1450–1920 CE; Grove, 2019) small glaciers advanced in three GB ranges (Sierra Nevada, CA/NV; Wasatch Mountains, UT; Steens Mountain, OR; Osborn and Bevis, 2001). All LIA glaciers were small, high in cirques ($>$3100 m), and did not extend far from the headwalls (Clark et al., 1994; Clark, 1995; Millar and Westfall, 2019; Fig. 6A). These might have been seen by hunters traveling to the alpine zones, but no LIA glacier in the GB would come near descriptions in *TPN* narratives. The next older, Early Neoglacial, advances (3800–1400 cal yr BP) were almost entirely expressed as rock glaciers in the GB, some of which doubtlessly had thin ice fields adhering to cirque headwalls (Millar and Thomas, 2024b). These also would not have produced ice barriers fitting the *TPN* descriptions. No earlier glacial periods are known in the Holocene GB.

We are left considering LP glaciers as models for the *TPN* ice barrier. The final advances of Pleistocene glaciations in the GB were two brief but distinct glacial intervals: the Recess Peak in the Sierra Nevada (Gillespie and Clark, 2011; Fig. 6A) and the Younger Dryas in a few of the high interior ranges (Osborn and Bevis, 2001; ~13–11.7 ka). Ice glaciers of these ages would have been apparent

Table 1. Compiled list of 61 versions of *Theft of Pine Nut* oral-history narrative analyzed in this study.

Version no.	Storyteller and tribal origin	Year transcribed	Reference
1	Unspecified storyteller (Northern Shoshone, Lemhi, ID)	1906	Lowie (1909, pp. 246–247)
2	Billy Steve (Northern Paiute, Pyramid Lake)	1930	Kelly (1938, pp. 364, 395–398)
3	Daisy (Limpy) Brown (Northern Paiute, Groundhog Eaters)	1930	Kelly (1938, pp. 364, 398–399)
4	Piudy (Northern Paiute, Groundhog Eaters)	1930	Kelly (1938, pp. 364, 399–401)
5	Nina Naneo (Northern Paiute, Beatty, OR)	1930	Kelly (1938, pp. 364, 401)
6	Big Archie (Northern Paiute, Groundhog Eaters)	1930	Kelly (1938, pp. 401–402)
7	JJohnny Dick (Western Shoshone, Owyhee, NV)	1939	Smith (1993, pp. 84–86)
8	Charlie Thacker (Northern Paiute, Winnemucca, NV)	1935	Steward (1943, p. 260)
9	Jim Tybo (Western Shoshone, Battle Mountain, NV)	1939	Smith (1993, pp. 146–147)
10	Minnie Leach (Western Shoshone, Battle Mountain, NV)	1939	Smith (1993, pp. 152–153)
11	Naches (Northern Paiute, Lovelock, NV)	1873	Fowler and Fowler (1971, pp. 247–248)
12	Tom Horn (Western Shoshone, Smith Valley, NV)	1935	Steward (1943, pp. 257–258)
13	Bob Gibson (Western Shoshone, Elko, NV)	1935	Steward (1943, pp. 258–260)
14	Arthur Johnson (Western Shoshone, Gosiute, NV)	1939	Smith (1993, p. 44)
15	Bridgeport Tom (Paiute, Mono Lake, CA)	1927-1928	Steward (1936, pp. 431–433)
16	Gilbert Naches (Northern Paiute, Lovelock, NV)	1940	Riesenberg (1940)
17	Patsie Wilson (Shoshone, Saline Valley, CA)	1935	Steward (1943, pp. 256–257)
18	Johnnie Shoshone and Andy Shoshone (Kawaiisu)	1937-1938	Zigmond (1980, pp. 225–227)
19	Humboldt Joe (Northern Paiute, Lovelock, NV)	1914	Lowie (1924, pp. 217–220)
20	Humboldt Joe (Northern Paiute, Fallon, NV)	1914	Lowie (1924, p. 221)
21	Misty Benner from Frank and Hazel Quinn, (Walker Lake Paiute, Yerington, NV)	2000	Presented here by Misty Benner (January 8, 2024)
22	Irwin Weiser (Northern Paiute, Beatty, OR)	1995	Thornes (2020, pp. S42–S49)
23	Wuzzie George (Northern Paiute, Fallon, NV)	∼1949	Wheat (1967:31)
24	Santos Phillips (Kawaiisu)	1929	McCown in Zigmond (1980, p. 45; story A)
25	Emma Williams (Kawaiisu)	1929	McCown in Zigmond (1980, p. 45; story B)
26	Emma Williams (Kawaiisu)	1936–1940	Zigmond (1980, p. 45; story C)
27	Likely Emma Williams (Kawaiisu)	1947–1949	Cappanari in Zigmond (1980, p. 46; story D)
28	Captain Louey Crook (Northern Paiute, Burns, OR)	1890–1905	Heizer and Hester (1972, pp. 43–44)
29	Unspecified storyteller (Southern Paiute Shivwits Band, UT)	1873?	Fowler and Fowler (1971, pp. 85–86)
30	Unspecified storyteller (Southern Paiute Shivwits Band, UT)	1873?	Fowler and Fowler (1971, p. 86)
31	Naches (Northern Paiute, Lovelock, NV)	1873	Fowler and Fowler (1971, p. 219)
32	Unspecified storyteller (Northern Paiute)	1880	Fowler and Fowler (1971, pp. 247–248)
33	Wilson Wewa (Northern Paiute, Warm Springs, OR)	∼2015	Wewa and Gardner (2017, pp. 25–26)
34	Unspecified storyteller (Ute)	?	Kaelin (2017, pp. 91–99)
35	Harry Simpson (Northern Paiute, Pyramid Lake/Dayton, NV)	1933	Park (n.d.); tale 40)
36	Rosie Plummer (Northern Paiute, Pyramid Lake, Walker River, NV)	1933	Park (n.d.); tale 45)
37	Jigger Bob (Northern Paiute, Pyramid Lake, NV)	1933	Park (n.d.); tale 50)
38	Billy Frazier (Northern Paiute, Pyramid Lake, NV)	1933	Park (n.d.); tale 53)

(*Continued*)

Table 1. (*Continued.*)

Version no.	Storyteller and tribal origin	Year transcribed	Reference
39	Unspecified storyteller (Northern Paiute)	1950's	Stone (1991, pp. 40–49)
40	Wilson Wewa (Northern Paiute, Warm Springs, OR)	~2015	Wewa and Gardner (2017, pp. 19–24)
41	Unspecified storyteller (Northern Paiute, Dayton Hill/Virginia City, NV)	1875	Fowler et al. (1970, p. 135)
42	Saggie Williams (Northern Paiute, Battle Mountain, NV)	?	Lanner (1981, p. 82)
43	Unspecified storyteller (Washoe)	1970	Gehm (1970, pp. 1–3)
44	Unspecified storyteller (Wind River Shoshone)	?	Trehero and Hultkranz (2009, pp. 47–50)
45	Unspecified storyteller (Northern Rockies, Lemhi, ID)	?	Clark (1966, pp. 177–179)
46	Billy Steve (Northern Paiute, Pyramid Lake, NV)	1930	Kelly (1938, pp. 364, 403–404)
47	Unspecified storyteller (Northern Shoshone)	1906	Lowie (1909, pp. 244–246)
48	Raymond George (Shoshoni, Lemhi and Fort Hall, ID)	1967	Lorin Gaarder/Jerome Hinckley, University of Utah Library, 1969, pp.1–2
49	Unspecified storyteller (Washoe)	?	Lanner (1981: 83)
50	Lydia Summerfield or Howard Smith (Paiute/Washoe)	?	Harold's Club (1951)
51	Lydia Summerfield or Howard Smith (Paiute)	?	Harold's Club (1951)
52	Lisa Enos and Melba Rakow (Washoe)	2014	Enos et al. (2014)
53	Jim Jones (Northern Paiute, Pyramid Lake, NV)	1914	Lowie (1924, pp. 213–217)
54	Unspecified storyteller (Southern Paiute Shivwits Band, UT)	1915	Lowie (1924, pp. 183–184)
55	Unspecified storyteller (Southern Paiute Shivwits Band, UT)	1915	Lowie (1924, pp. 160–161)
56	Lillian Frank Maynard (Northern Paiute, Burns, OR)	1980s	Transcribed by Diane Teeman (2024)
57	Bill Cornbread (Washoe, Coleville, NV)	1926	Lowie (1939, pp. 338–339)
58	Dave Cheney (Washoe, Minden, NV)	1926	Lowie (1939, pp. 339–340)
59	June Ton (Western Shoshone, West Fork Valley, NV)	pre-1968	Crum (1994, pp. 5–6)
60	Unspecified storyteller (Southern Paiute, Pahrump, NV)	pre-2016	McCracken (2016)
61	Unspecified storyteller (Northern Paiute)	1931	Boulden (1931)

to human observers, as the largest ones extended ~5 km down-valley, and conceivably could have impeded travel, although ice depths were shallow, moraines low, and canyons narrow. Cross-mountain and trans-canyon mountain travel would have been readily possible despite these glaciers, and they seem unlikely to have made an impression on people as massive or imposing barriers.

During the last glacial maximum (LGM; ~21–18 ka) massive glaciers formed that filled long U-shaped valleys and left towering moraines in the GB (Fig. 6B and C). In the eastern Sierra Nevada, LGM glaciers extended more than 25 km from summit to terminus (Wahrhaftig et al., 2019a) and had depths to 300 m. In the interior, LGM glaciers extended 10 km, often far beyond the mountain range fronts, and had ice depths $>$ 85 m (Munroe and Laabs, 2011). Some GB ranges had extensive ice caps that covered the summit plateaus and high slopes of the mountains and fed ice into massive valley glaciers. Ice caps and their derivative valley glaciers are a candidate source for the eyewitness descriptions of ice walls in many of the *TPN* narratives due to their size, height, and difficulty to cross. If so, these LGM descriptions would have been added to later *TPN* oral-history narratives.

Biodiversity in the TPN narratives

The animals in the *TPN* narratives are important characters, playing roles that relate to their natural ecology as well as characteristic, stylized personalities. Coyote, for instance, is commonly present in the pine-nut narratives, reflecting the widespread distribution of coyotes (*Canis latrans*) across the GB. Coyote is also a trickster, often one who makes mistakes but who, in the end, regularly plays a heroic role that helps other Animal People or restores moral balance (Danberg, 1968).

From the *TPN* versions we compiled 24 mammal taxa, 17 birds, 6 reptiles/amphibia, and 1 fish (Table 3, Supplementary Material, Supplemental Table 1). *TPN* versions had different numbers and diversities of animals, reflecting the ecology of the narratives' geographic homelands and the importance of the animals to the plot of the story. The characters Coyote, Wolf, and Mouse had the greatest representation among mammals, occurring in 48, 34, and 32 versions, respectively (Table 3). The remaining mammals occurred in eight or fewer versions, with seven occurring in only one. The latter included taxa likely rarer in Middle–Late Holocene GB landscapes than at present (cougar, *Puma concolor*), species that became extinct in the GB (grizzly bear, *Ursus arctos horribilis*), and also common species (gopher, *Thomomys* spp.; weasel, *Mustela*

Figure 4. Tribal territories in the Great Basin and border regions. Modified from d'Azevedo (1986; permission from National Anthropological Archives, Smithsonian Institution).

spp.) or marginal (moose, *Alces alces shirasi*). Notable omissions from the narratives were pronghorn (*Antilocapra americana*) and marmot (*Marmota flaviventris*). No extinct LP or Holocene species appear to inhabit the narratives.

Among the geographic indicator species, grizzly bear ranged historically into small regions of southeast Oregon, far northwest Nevada, and central Utah (Mattson and Merrill, 2002; Supplementary Material, Supplemental Fig. 1A). Similarly, although black bears (*Ursus americanus*) occur at present only around the margins of the GB, their historic range is estimated to include some high mountain ranges of central Nevada (Lackey et al., 2013; Supplementary Material, Supplemental Fig. 1B).

Crows, woodpeckers, and cranes are the most common of 17 bird taxa mentioned in the *TPN* narratives (Table 3). Eleven specified Yellowhammer (woodpeckers) and eight described Pinyon Jay (*Gymnorhinus cyanocephalus*) and Red Woodpeckers. The

Table 2. Variant themes and add-ons of the *Theft of Pine Nuts* and related pinyon origin stories (refer to Supplementary Material, Supplement Table 1).

Variant themes	
I.	Core pine-nut theft. The narrator's People do not have pine nuts. They go to a distant land where pine nut trees grow (smelling them there or finding them otherwise); they distract the Pine Nut People by playing the Hand Game. One of the narrator's people (often Mouse) finds the pine nut. It is relayed home, passing on from one to the next Animal. The Pine Nut People pursue, killing each as they go. Wolf spits the seeds to plant pines; Coyote swallows and plants only junipers.
II.	Pine nuts present initially in the narrator's land and extirpated; reseeded in situ (no "other" land). Fire and drought extirpate pinyons (Coyote's wrath); Wolf replants and dwarfs trees to make them easier for People to reach.
III.	Pine nuts present initially in the narrator's land but stolen/extirpated by People in other land; "reverse theft story." Pine nuts were present in the narrator's land but people from elsewhere kept stealing them until pine nuts no longer remained, and the narrator's people went to retrieve them (and steal them back).
IV.	Pine nuts created wherever Wolf chooses.
V.	Pine nuts present initially in narrator's story, then extirpated; otherwise similar to Base Story (I.)
VI.	Coyote steals pine nuts from sister; only one location, no other People or other land.
VII.	An Animal Person goes away (no mention of theft), gets the pine nut, and returns.
VIII.	A Giant emerges from a mountain and creates pine-nut trees with his arrows and then goes back to a silvery cave.
IX.	Pine nuts obtained and planted by a benevolent large bird, not stolen.
Add-ons to Basic Story	
i.	Ice barriers impeded either going to the Pine-Nut Land or returning to the narrator's land.
ii.	The pine nut is hidden in a leg of an Animal (often Hawk), which gets home safely. The leg is cast over the hills and pine nuts are planted.
iii.	Same as ii, but the leg (or some part of Animal) is rotten or there are sores somewhere where the pine nut is hidden.
iv.	Pines do not remain in the Pine Nut People's ("Other People") land after theft, or the trees remain but seeds are not good, or only very small trees remain.
v.	Pine-nut theft is part of *Theft of Fire* story—i.e., embedded within *Theft of Fire* theme.
vi.	Coyote steals pine nuts but all the other characteristic Animal People come from the pine-nut land and pursue Coyote. Coyote has no "People."

remaining taxa are mentioned in six or fewer versions; Golden Eagle (*Aquila chrysaetos*) and Goose (*Branta* spp.) each are mentioned in only one. Notably, members of the crow family (Corvidae) make up one-third of all bird occurrences. Given the focus on corvids, it is unusual that Clark's Nutcrackers (*Nucifraga columbiana*), common in the pinyon woodlands and a primary pinyon-nut disperser, do not appear in any *TPN* narratives. The hero character in a Wá•šiw story (no. 52) who brings the pine nut to the People was a "large black and white bird that walked but did not fly." Clark's Nutcrackers are black and white and disperse pine nuts, but fly. No extinct birds known from the GB meet this description (Grayson, D.K., personal communication, 2024).

As with mammals, several of the bird taxa are geographic indicators. Crane (Greater Sandhill Crane, *Antigone canadensis*) is especially useful, because its breeding ranges dip into the GB only in the far northwest corner (Warner Mountains region, CA/OR/NV), the Owyhee region of north-central Nevada, south-central Idaho, and far NE Utah and E Idaho (BirdLife DataZone, 2024–2025; Supplementary Material, Supplemental Fig. 1F). In that the breeding ranges of cranes appear to be similar in the Holocene GB as today (Drewien and Bizeau, 1974), we used these regions to locate pine-nut homelands in the oral narratives. Yellowhammer is also a useful geographic indicator. This most likely refers to Williamson's Sapsucker (*Sphyrapicus thyroideus*), as it is the only woodpecker in the region that has yellow plumage. In the GB, Williamson's Sapsucker occurs year-round along the eastern Sierra Nevada (CA/NV) north to the Warner Mountains, and has only a few breeding locations in NW Nevada and central Utah (BirdLife DataZone, 2024–2025; Supplementary Material, Supplemental Fig. 1G). Canada Jay (*Perisoreus canadensis*) dips into the GB in a few spots in eastern Utah and the NW GB (BirdLife DataZone, 2024–2025; Supplementary Material, Supplemental Fig.1H).

Ecological/physical features in the TPN narratives

Topographic features

The most recognizable and useful elements for georeference in the *TPN* narratives are named topographic features. We assume the place-names given by the translators are generally the same features as those told in the native languages (Supplementary Material, Supplemental Table 1). These include named local hills (e.g., "Chinese Hat, buttes near Owyhee," no. 7); prominent mountains ("Yamsi Mountain and Gearhart Mountain," no. 5); lakes ("Pyramid Lake," told in many versions), hot springs ("From Austin they went on their way north and camped by the hot spring at Beowawe." no. 9); and rivers ("He chased him north and Lizard jumped in the Reese River." no. 36).

Although mountain ranges are commonly mentioned, there is almost never definite indication for the location. One exception is narrative no. 39, where the range is clearly identified ("Wolf stood on the Stillwater mountain range"), otherwise, identification to a specific mountain range can only be interpreted by the general region of the narrative. Some topographic features are given that are generic names in the Indigenous language and do not refer to specific (English) place-names, while some names refer to many

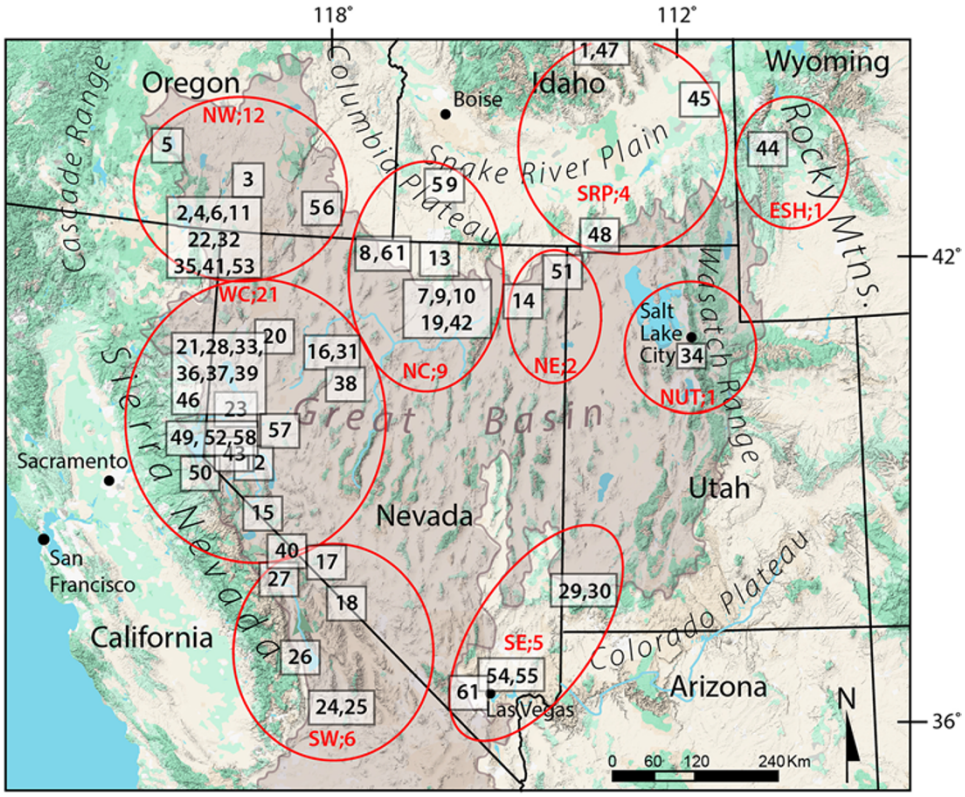

Figure 5. Geographic subregions of the Great Basin (GB; gray shading) with locations of pine-nut homelands (position of boxes) as inferred from the *Theft of Pine Nut* (*TPN*) variant narratives. Numbers in boxes refer to the *TPN* versions (Table 1). Regions: NW, northwest; WC, west-central; SW, southwest; NC, north-central; NE, northeast; SRP, Snake River Plains; SE, southeast; NUT, northern Utah; ESH, Eastern Shoshone.

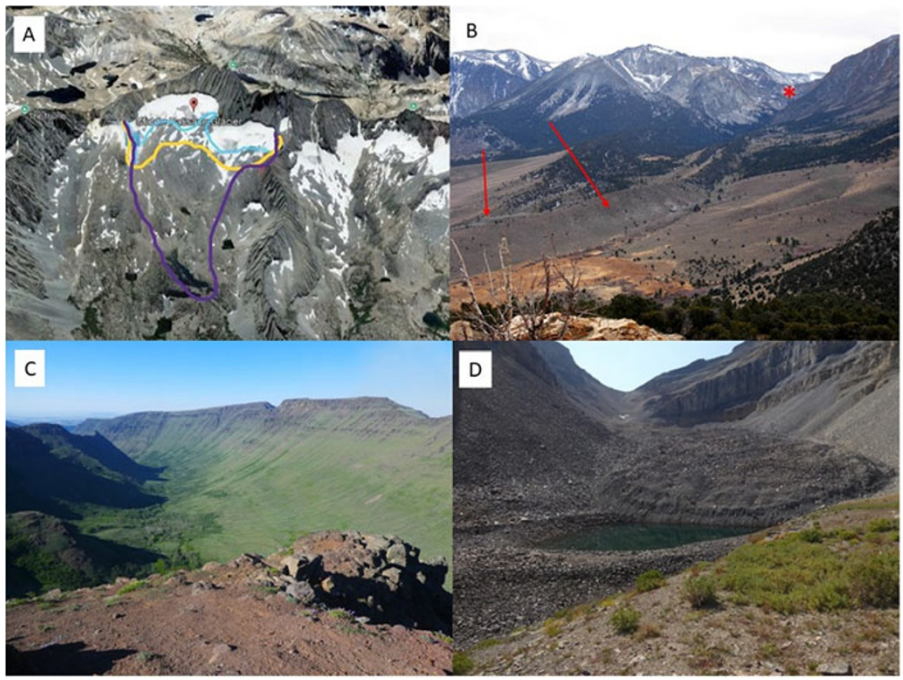

Figure 6. Glaciers of the Great Basin (GB), last glacial maximum (LGM) to present. Ice glaciers exist in the GB currently only as small features in the Sierra Nevada; small ice-embedded rock glaciers also occur currently in several GB ranges. (**A**) Middle Palisade glacier, Sierra Nevada, CA. Blue line shows extent of the modern glacier, one of the largest in the range. Yellow line shows the extent of the Little Ice Age glacier. Purple line shows the extent of the Recess Peak (late Pleistocene) glacier. (**B**) Bloody Canyon, Sierra Nevada, CA. The LGM glacier filled the canyon marked by the red asterisk, and extended significantly beyond the range front (red arrows show moraines). (**C**) Giger Gorge, Steens Mountain, OR. A massive LGM glacier filled the canyon, and an ice cap covered the summit plateau. (**D**) Timpanogos rock glacier, Wasatch Mountains, UT, typical of features that dominated GB ranges through cold periods of the Holocene. Embedded ice is buried under a thick rock mantle.

places with the same modern name, such as the use of "pine nut" for a mountain ("They lived in the eastern Pine-Nut Range." no. 19; "He made them on the side of Pinenut Mountain." no. 21; "And this is the origin of piñon trees around *Tiva Kaiv*, Piñon Nut Mountain." no. 34). These are useful for georeferencing only when other nearby locations can be identified.

Table 3. Compilation of mammals, birds, and reptiles in the *Theft of Pine Nuts* (*TPN*) oral-history narratives.

				Regions of the Great Basin: Region, no. of versions[c]									
Animal/bird/reptile-amphibian person[a]	Indigenous name	Western common name[b]	Latin name	Total #	NW #	WC #	SW #	NC #	NE #	SE #	SRP #	NUT #	ESH #
1. Mammals													
Coyote	It-sa', yahowitz	Coyote***	*Canis latrans*	48	8	23	2	6	1	2	4	1	1
Wolf	Ica', sunawiv	Gray wolf***	*Canis lupis*	34	7	20		2		3		1	1
Mouse	puiia.zi, pomtcaruv	Mouse*	*Peromyscus* spp.	32	6	16	1	6		2		1	
Deer		Mule deer***	*Odocoileus hemionus*	8	2	6							
Rat	kangwiisi gweak	Packrat*	*Neotoma* spp.	7		4					3		
Rabbit		Cottontails, Hares*	*Sylvilagus* spp., *Lepus* spp.	6		2		1			2		1
Chipmunk		Chipmunk*	*Tamias* spp	4	1	1	1	1					
Fox		Fox**	*Vulpes* spp	4	1	2				1			
Mountain Sheep		Bighorn sheep***	*Ovis canadensis*	4		4							
Squirrel		Squirrel*	Several genera	4	1	2					1		
Bat			Many species	2		2							
Bear		Black bear**	*Ursus americanus*	2		1	1						
Bison (buffalo)		American bison***	*Bison bison*	2		1						1	
Elk		Elk***	*Cervus canadensis*	2		1							1
Porcupine		Porcupine***	*Erethizon dorsatum*	2							1		1
Rock Squirrel		Rock squirrel**	*Otospermophilus variegatus*	2							2		
Skunk		Skunk**	*Mephitis* spp.	2				2					
Badger		American badger***	*Taxidea taxus*	1	1								
Beaver	hangisha	American beaver***	*Castor canadensis*	1		1							

(*Continued*)

Table 3. (*Continued.*)

Animal/bird/reptile-amphibian person[a]	Indigenous name	Western common name[b]	Latin name	Regions of the Great Basin: Region, no. of versions[c]									
				Total	NW	WC	SW	NC	NE	SE	SRP	NUT	ESH
				#	#	#	#	#	#	#	#	#	#
Cougar		Mountain lion***	*Puma concolor*	1	1								
Gopher		Pocket gopher*	*Thomomys* sp.	1	1								
Grizzly Bear		Grizzly bear**	*Ursus arctos horribilis*	1	1								
Moose		Moose, Elk*	*Alces alces shirasi* or *Cervus canadensis*	1		1							
Weasel (White)		Ermine*	*Mustela erminea*	1		1							
Notable omissions		Pronghorn	*Antilocapra americana*	0									
		Marmot	*Marmota flaviventris*	0									
		Pleistocene–Holocene extinct/extirpated species		0									
2.Birds													
Crow	Hai, wiada, atakuz	American Crow***	*Corvus brachyrhynchos*	19	3	7	2	4		1	2		
Woodpecker		Many species		19	2	9	1	3			2	1	1
Crane		Sandhill Crane***	*Antigone canadensis*	16		6		4		1	3	1	1
Yellow-hammer	Oha atsab; õa ad'(z/l)aban Kitcakuz	Williamson's Sapsucker**	*Sphyrapicus thyroideus*	11	3	6	2						
Pinyon Jay	Sana' kee, Chai-ok, sanaki	Pinyon Jay, Maximillian Jay**	*Gymnorhinus cyanocephalus*	8	1	4		2		1			
Red Woodpecker	ádzabá na	Northern Flicker*	*Colaptes auratus*	8	3	3	1	1					
Chickenhawk	Chickenhawk Sai.bazo, saibas, sy'badz au	Red-tailed Hawk*	*Buteo jamaicensis*	6		5		1					
Eagle		Bald Eagle or Golden Eagle**	*Haliaeetus leucocephalus or Aquila chrysaetos*	5	1	4							
Hawk	Saipazo'o	Many species		5	2	2		1					
Magpie		Black-billed Magpie***	*Pica hudsonia*	4	1	1		1			1		

(*Continued*)

Table 3. (*Continued.*)

Animal/bird/reptile-amphibian person[a]	Indigenous name	Western common name[b]	Latin name	Regions of the Great Basin: Region, no. of versions[c]									
				Total	NW	WC	SW	NC	NE	SE	SRP	NUT	ESH
				#	#	#	#	#	#	#	#	#	#
Owl		Many species		4		3	1						
Raven		Common Raven***	*Corvus corax*	4	1	1		1					1
Canada Jay	Ong, Onga	Canada/Gray Jay/Rocky Mountain Jay***	*Perisoreus canadensis*	3					1	2			
Mudswallow		American Cliff Swallow**	*Petrochelidon pyrrhonota*	2	1	1							
Hummingbird	sofi.oi'	Many species		2		2							
Golden Eagle		Golden Eagle***	*Aquila chrysaetos*	1	1								
Goose		Western Canada Goose**	*Branta canadensis ssp. moffitti*	1			1						
Notable omissions		Clark's Nutcracker	*Nucifraga columbiana*	0									
		Stellar's Jay	*Cyanocitta stelleri*	0									
3. Reptiles–Amphibia													
Spotted Lizard	tubudza	Great Basin collared lizard*	*Crotaphytus bicinctores*	4	2	2							
Rattlesnake		Western rattlesnake*	*Crotalus oreganus*	3	1		1	1					
Frog		Many species		2	1			1					
Snake		Many species		2	1			1					
Bullfrog		Many species		1	1								
Fish/minnows		Many species		1		1							

[a]"Animal Person," Bird Person," and "Reptile–Amphibian Person" refer to characters in the *TPN* versions.
[b]Asterisks indicate level of confidence in species-level identification: *low; ***high.
[c]NW, Northwest; WC, West Central; SW, Southwest; NC, North Central; NE, North East; SE, South East; SRP, Snake River Plain; NUT, Northern UT; ESH, Eastern Shoshone-Wind River. See Fig. 5 and Supplementary Material, Supplemental Table 1.

Fire and smoke

Fire and smoke commonly occur in *TPN*, mostly in reference to detecting pine nuts, either before the theft occurs, giving a clue to where the pine nut trees are located, or after the nuts are brought back, indicating that the theft was successful and pine-nut trees were established. These explicitly or implicitly refer to pine-nut processing over a fire, which was the primary method for preparing pinyon cones and seeds for consumption (Madsen, 1986). Fifteen variants reference smelling pine nuts or fires as they are prepared (Supplementary Material, Supplemental Table 1). These derive from the NC, WC, SW, NW, and ESH subregions. An additional category that may refer to smoke occurs in seven variants, including the NW, SW, NC, ESH, and 4CR subregions (for codes, see Fig. 5). Those involve initial detection of pine nuts by Coyote, who chokes, spits, bleeds, or otherwise is distressed on detecting pine nuts at a distance.

Role of the rotten, stinking, or sore leg

Thirty-two versions, from all GB subregions except the ESH (Fig. 5), include the theme of a bird, usually hawk (rarely Coyote), carrying the pine nut after the theft in a rotten, sore, or stinking leg. The leg is cast off upon reaching the thieves' homeland, thus planting pine-nut trees. We interpret the role of the rotting leg to suggest mulching of pine nuts, which hastens their germination, as when pine nuts are planted by birds in autumn.

Pine-nut homelands

Cardinal directions of the pine homelands relative to the narrator's lands are valuable in determining the location of pinyon origins. This information is given in 41 versions; 27 indicate pine homelands north of the narrator's land, 7 indicate east, 4 indicate west, and 3 indicate south (Table 4). Using all clues available, we propose that 23 versions describe locations where both the pine homelands and the narrators' or thieves' locations are within current pinyon distribution ranges (Table 4, Figs. 1 and 5). Twenty-four do the opposite: the pine homelands and the narrator's land are outside the current pinyon pine ranges. In the remaining 14 variants, there is a mixed condition: the pine homelands or narrator's land is outside the current pinyon range. Of most interest are the 38 versions that locate the pine-nut homeland outside the current pinyon distribution. These cluster, with exceptions, in three regions: greater Warner Mountains region (11 versions), Owyhee (7 versions), and Pyramid Lake (7 versions). Other pine-nut origin locations beyond the current pinyon range include Lemhi/central Idaho/W Wyoming (four versions), Humboldt Sink/Humboldt Range (three versions), and Santa Rosa Range (two variants). Versions from southern Oregon, Wasatch Range, southern Idaho, and Goose Creek Mountains had one version each. We discuss these further in the following sections.

Warner Mountains region

The Warner Mountains, reaching summits above 3000 m, extend north-to-south for 150 km in NE California and S Oregon. The range is bordered by Warner and Surprise Valleys on the east, and Goose Lake Valley on the west, all of which contain wetlands that are key Sandhill Crane habitat. In the surrounding region are Yamsay and Gearhart Mountains, 95 km and 55 km, respectively, west of the Warner Mountains, and the Hart Mountains, 35 km to the northeast. The nearest pinyon population currently known is ≥200 km south, in the Reno, NV, area.

We determined these locations from direct descriptions, that is, place-names, and from indirect clues. The most important of the latter was the direction the pine-nut smell was coming from relative to the narrator's homeland and the presence of indicator species, Sandhill Cranes ("Crane People") and/or Williamson's Sapsucker ("Yellowhammer") in the pine-nut homelands (Supplementary Material, Supplemental Table 1, Supplemental Fig. 1F and G).

Owyhee region

The Owyhee region comprises rolling desert plains in north-central Nevada and SW Idaho that are cut by tributaries of the Owyhee River and form a vast canyon/plateau landscape. Much of this region lies in the Snake River basin, outside the hydrologic GB. We determined this area from direct place-names, as well as direction of the pine-nut smell, and reference to Crane People. Greater Sandhill Cranes breed in the Owyhee region (Supplementary Material, Supplemental Fig. 1F). The nearest known pinyon pine population is >145 km south.

Pyramid Lake region

Pine-nut homelands are directly named as Pyramid Lake in six *TPN* narratives and implied in one other. Lying within the rain shadow of the Sierra Nevada, the region has a very dry climate, and low elevations induce high summer temperatures. The ranges around the lake are either treeless or dotted with juniper (Charlet, 1996). The northernmost occurrence of pinyon's primary distribution is in the Virginia Range, >50 km south of Pyramid Lake. A few isolated modern occurrences nearer to Pyramid Lake (University of Nevada, Reno Herbarium voucher) appear to be recent colonists.

Other regions outside the current pinyon range

Several *TPN* narratives describe pine-nut homelands in other locations outside the current known pinyon distribution. In three *TPN* narratives (nos. 20, 16, 3) we infer the homelands to be the area of the Humboldt Sink and Humboldt Range, NV. The nearest pinyon population is currently in the Stillwater Range, 55 km east. Two versions (nos. 8, 61) locate the homeland in the Santa Rosa Range. The nearest known population is 150 km south. *TPN* narrative no. 51 describes both the narrator's home and the pine-nut homelands as the Goose Creek Range, NV/UT/ID. While pinyon currently grows in the neighboring Grouse Creek and Raft River Mountains, UT, it has not been found in the Goose Creek Range (Charlet, D.A., personal communication, 2011). The nearest pinyon stand is ∼10 km east. One version (no. 34) indicates the pine-nut homeland near Salt Lake City; currently pinyon grows ∼60 km distant. Four *TPN* variants (nos. 1, 44, 45, 47) refer pine-nut homelands to locations north and northeast of the GB, two in the Snake River Plains, likely around Lemhi, ID, and two (nos. 44, 45) from the northern Rockies, WY (Fig. 5). The closest pinyon stands currently occur 250 km south of the Idaho locations and 235 km southwest of the western Wyoming location. A single version (no. 48) locates the pine homeland in southern Idaho, ∼40 km north of the Albion Mountains' current populations.

Pinyon pine homelands within the current pinyon range

The remaining versions place pine-nut origins within the current known pinyon distribution range (Table 4, Supplementary Material, Supplemental Fig. 1).

Table 4. Pine-nut origins (homelands) in the *Theft of Pine Nuts* oral-history narratives and direction to pine-nut homeland.

	Direction to pine-nut homeland from narrator's land			
Pine-nut homelands relative to current pinyon range	**North**	**South**	**West**	**East**
1. Theft variants within the current pinyon pine range (pine homeland and narrator-thieves land within range)				
23 Versions: nos. 12, 14, 15, 17, 18, 23, 24, 25, 26, 27, 29, 30, 31, 40, 43, 49, 50, 52, 54, 55, 57, 58, 60 Pine homeland locations: Pine Grove Hills, Sierra Nevada, Bodie Mtns, Lida, CA, N Death Valley, Virginia Mtns, Lone Pine, CA, Bishop, CA, White Mtns, Pine Nut Mtns, Wind River Range, Job's Pk (Carson Range)	7	1	2	4
2. Theft variants outside the current pinyon pine range (pine homeland and narrator-thieves land outside range)				
24 Versions: nos. 1, 2, 3, 4, 5, 6, 8, 11, 13, 16, 19, 22, 33, 34, 35, 42, 44, 45, 46, 47, 48, 51, 53, 56 Pine homeland locations: Lemhi, ID, Hart Mtns, Yamsay Mtn, Gearhart Mtn, Warner Mtns, Santa Rosa Range, Owyhee region, E Idaho, NE Nevada, Goose Creek Mtns, SE Oregon, Wasatch Range	12	1	1	2
3. Theft variants with mixed conditions				
14 Versions: nos. 7, 9, 10, 20, 21, 28, 32, 36, 37, 38, 39, 41 Pine homeland locations: Warner Mtns, Owyhee region, Humbolt Range, Pyramid Lake, Stillwater Range, Santa Rosa Range	8	1	1	1

Discussion

Assumptions and biases

As with all paleoecological proxies, Indigenous oral-history narratives have biases in how accurately they reflect histories of interest to Quaternary sciences and in assumptions that underlie their use. We outline key biases and assumptions in our study, recognizing that future work in the fields of pinyon paleoecology, GB archaeology, and Indigenous oral narratives will help to clarify these issues.

Ice barriers

In our analyses of the ice-barrier motif in the *TPN* narratives, we have assumed the reference is to permanent—glacial—ice, not seasonal snow. As we documented, seasonal snow, although certainly difficult to walk through when deep, is discounted directly in several versions and in other versions the descriptions indicate "ice" that is not possible to cross, high walls and barriers, and descriptions of "formidable" character, which we assume are unlikely to reference seasonal snowpacks.

Indigenous migration into and across the GB

We assume the core plot of the *TPN* and related narratives (theft/arrival of pine nuts) is ancient, potentially originating at the time when pine nuts first became important to people in the GB (early Middle Holocene; e.g., Rhode and Madsen 1998), and that the narrative moved throughout the GB as people migrated. This begs a question about localization of the narrative: Did people accommodate the story to their geography faithfully to where pine nuts grew in their region, or did they adopt local geography to the story randomly with no reference to pine-nuts? While this remains an open question, we assume the former, as outlined below.

Current understanding of people migrating into the GB indicates a genetically unified and geographically coherent path across Beringia and southward into North America and the GB (Moreno-Mayar et al., 2018; Willerslev and Meltzer, 2021; Thomas et al., 2025). This discredits former hypotheses of immigration into the continent from the west (South Pacific) via the Pacific Ocean or overland from the east (western Europe) via Greenland. The most accepted timeline for entry into the GB is via the northwest part of the region after 15,000 years ago (as outlined in "Antiquity of *TPN* Narratives"). GB Paleoindians (pre-9000 cal yr BP) settled along marshlands that fringed GB pluvial lakes, where they exploited large game as well as lower-ranking resources that were abundant in the wetlands (Thomas and Millar, 2024). Desiccating wetlands toward the end of the Early Holocene triggered transition to new subsistence systems, initially focusing on remaining marsh resources as lakes dried (Madsen, 2002, 2007; Zeanah, 2004). Paleoindian sites in volcanic uplands also were used at this time, indicating fanning-out movements that included forays into the uplands (Smith and Barker, 2017; Puckett, 2023). Thomas and Millar (2024) outline the subsequent dispersal of post-Paleoindians through the central, western, and eastern GB. They document that the concomitant migration of pinyon pine in the GB facilitated these movements as people shifted to strong dependence on pine nuts. Thus, the peopling of the GB is a story of movement through the LP and into the Middle Holocene and related to pinyon pine. Increasing stability occurred as groups settled in local areas, becoming the geographically associated communities recognized today.

Given this history, why do we accept the assumption that the *TPN* narratives faithfully identify pine-nut geographies of their local regions rather than localities unrelated to pines? First and importantly, we base this on the authority of oral-history scholars reflecting the role of geography in oral narratives generally. The Indigenous priority on space and place helps to explain why Indigenous oral history is so closely tied to ancient landscapes, reflecting place-bound interactions with spirits, ancestors, and one another (Deloria, 1973; Van Dyke, 2008; Fixico, 2024). The conviction that "wisdom sits in places" (Basso, 1996) runs deep in North American oral history, because "place-making involves multiple

acts of remembering and imagining … place-names describe what was seen by those who named the places, and are useful indicators of how the environment of a place has changed over time" (Zedeño et al., 2021, p. 311).

Also critical is the strong dependence that Indigenous people had on pine nuts once they inhabited pinyon pinelands (Steward, 1933, 1938; Madsen, 1986; Rhode and Madsen, 1998; Thomas and Millar, 2024). Locally, people would have known their pine regions very well, and they would have traveled some distances to procure them. Local names, described in the tribal languages, are indicated in the *TPN* narratives as well as being translated into English, modern place-names.

More generally, Indigenous oral narratives that have been interpreted as eyewitness accounts, such as catastrophic physical events, are told only within the region of the specific event (eruption, tsunami, megaflood) and do not proliferate outside the region (Budhwa, et al., 2021). This is true even where volcanic eruptions, for instance, occurred in other regions nearby. Considering the Mazama eruption and the Indigenous oral history describing it, a reasonable assumption might be that people in adjacent regions would adopt a "Mazama story" to their local volcanic eruptions. To the contrary, however, Holocene eruptions occurred in the GB (e.g., Mono-Inyo craters, Modoc volcanic field), yet no Mazama-like narratives were adopted to those local geographies.

Further argument is the persistence of eyewitness-account oral narratives locally long after they occurred. The Mazama eruption, Cascadia megathrust earthquake/tsunami, and Columbia River superflood oral narratives are still told in their local regions despite the fact that they refer to millennia-old events (Budhwa et al., 2021). Similarly, we document that many *TPN* narratives are told outside the region of current pinyon pine occurrence, and argue that, as in the Mazama–Cascadia–Columbia cases, the people have deep memory of their local situation (i.e., when pinyon grew there) embedded by stories told in situ. People whose ancestry had no experience with pinyon (e.g., outside the GB) would have no touchstone for surreptitiously adopting *TPN* stories, and, thus, we find no pine-nut stories in those regions.

Species of pine nuts in the TPN narratives

The presumed species of conifer in the *TPN* narratives is single-leaf pinyon pine, due to the geographic locality of the narratives. Pinyon produces cones with large, nutritious nuts that were—and remain—singularly important in Indigenous diets (Steward, 1933, 1938; Madsen, 1986). The priority of pinyon nuts over other species is widely recognized: the Wá•šiw people assert the value of pinyon pine in linguistic terms. The word for "my pine-nut lands," referring to pinyon pine, is similar to the word for "my face," an intentional association according to Wá•šiw Elders (Fillmore, 2017). Ethnographer Margaret Wheat wrote, when referring to pinyon pine, "These nuts [were] virtually the only nuts used by Indians of Western Nevada" (Wheat, 1967, p. 30), and GB pioneering ethnologist and archaeologist Julian Steward concluded that pinyon pines were "the most important single food species wherever it occurs" (Steward, 1938, p. 27). In an analysis of 556 GB oral-history narratives, Sutton (1989) found pinyon pine to be the most common species of 46 food plant taxa mentioned, and concluded that among pines, "only pinyon was identified as food" (p. 244). The pinyon species satisfy, if not prove, the identity of pine-nut species in the *TPN* narratives for variants that derive within the modern range of pinyon pines. The question becomes more challenging for narratives outside the current distribution of pinyon. We consider the possibility that pine nuts referred to species other than pinyons next.

Limber pine (*Pinus flexilis*; Madsen, 1986; Rhode and Rhode, 2015) is the most likely candidate as a food item. It currently grows at subalpine elevations in many GB ranges, including several north of the current pinyon range limit (DataBasin, 2024) in areas of a few *TPN* versions. Limber pine nuts are not as large, have different nutritional value from the pinyon pine species, and are more difficult to procure than pinyon nuts (USDA, 2024). Cones open at maturity, and most often cones are chewed apart on the tree before maturity by Clark's Nutcrackers or taken by tree squirrels. Although limber pine nuts clearly were used, pinyon was favored when present (Rhode and Madsen, 1998).

Several other pine taxa are mentioned in diets of Indigenous people of the GB. Sugar pine (*Pinus lambertiana*) has large and nutritious seeds (Farris, 1982) that are contained in very large cones and have been documented to have been collected. Sugar pines do not, however, start producing seed cones until trees are ~150 years old (USDA, 2024), and cones are borne high in the crowns of very tall trees (often >60 m tall), making them difficult to access. Sugar pine grows only in two small areas that overlap some *TPN* versions, the Wá•šiw territory of the Tahoe Basin/eastern Carson Range and the far northwest margin of the hydrologic GB (DataBasin, 2024). Sugar pines occur in very low frequency within mixed-conifer forests and would have been unlikely to provide a significant proportion of Indigenous diet.

Whitebark pine (*Pinus albicaulis*) is another candidate species for pine nuts in some *TPN* versions. Growing at high elevations, whitebark pine ranges along the western fringe of the GB, in the eastern Sierra Nevada, Carson Range, Warner Mountains, Yamsay Mountain, and Gearhart Mountain, where it forms the upper tree line. It also occurs sporadically across the northern tier of GB mountains in Nevada, including the Pine Forest Range, Bruneau Mountains/Jarbidge Range/Copper Mountains, Ruby Mountains, and East Humboldt Range, and also in the Wind River Range, WY, outside the GB (DataBasin, 2024). All but the Ruby and East Humboldt are beyond the known range of pinyon pine.

Whitebark pine is unlikely to have been widely used in the Indigenous GB. Unlike other local pine species, cones of whitebark pines have thick scales in which seeds are embedded. The cones do not fall intact to the ground; rather the scales are disarticulated on the tree by their obligate seed disperser, Clark's Nutcracker, which pecks the seeds out from the pitch-covered cones high in the crowns (Fig. 7). What remains on the ground after the birds have retrieved the nuts are the nut-less scales and naked cone axes. By the time cones are ripe, birds or tree squirrels have retrieved all or nearly all nuts from cones on the tree (Ward et al., 2006); successful collecting by humans requires obtaining the cones before birds do. This requires climbing the trees, as the cones are high in the crown and not readily knocked out, and postprocessing cones to obtain mature seed. Modern nursery practices attest to the difficulty of collecting and processing whitebark pine seeds (Supplementary Material, Supplement 2).

Ethnographic evidence for whitebark pine is sparse in the GB. Steward (1938, p. 28) noted consultants describing whitebark pine seeds as "too small and too greasy and trees too difficult to climb to make them profitable." Paiute and Wá•šiw coauthors do not recognize the species as a food source. Outside the GB, in the region of one of our outlying *TPN* versions (Eastern Shoshone, no. 45), a complex of high-elevation alpine villages known as High Rise Village occurs at upper tree line in the Wind River Range (Adams, 2010). It was long assumed that the people harvested local

Figure 7. Whitebark pine cones and seeds. (**A**) Mature seed cone on tree. (**B**) Mature seed cones high in tree crowns. All cones have been completely chewed while on the tree by Clark's Nutcrackers, the obligate seed disperser for whitebark pine seeds. (**C**) Cone axes and disarticulated scales remain on the ground after Clark's Nutcrackers have taken seeds while cones are in the crowns. (**D**) Comparison of seed sizes between pinyon pine (left) and whitebark pine (right).

whitebark pine nuts. A thorough analysis, however, of lipids from grinding stones and ceramic artifacts (Stirn et al., 2023) revealed many dietary plants but no evidence for whitebark pine.

Ponderosa pine (*Pinus ponderosa*) is the final candidate we consider for pine nuts north of the current pinyon range. The species occurs at low- to mid-montane elevation along the far western and northwestern margins of the GB. Small, isolated populations exist in the south-central GB (DataBasin, 2024) that might have been more extensive in the Early Holocene. Cones are produced high in tall trees and open to allow small, winged seeds to disperse. Although ponderosa seeds were used (Couture et al., 1986; Kennedy 2018), their small size and the difficulty of obtaining cones would make ponderosa seeds a lower-value resource (Yanovsky, 1936; Farris, 1982).

Importantly, of the 38 *TPN* versions whose pine-nut homelands we interpreted to lie north of the current pinyon range, 18 are in areas where none of the alternative species now grows (Supplementary Material, Supplemental Table 2). Given this and the absence of alternative nut species in many versions within the current pinyon range, we provisionally conclude that, even in regions where pinyon pines do not now grow, the *TPN* narratives likely refer to pinyon pines.

Antiquity of TPN narratives

Our review of glaciations in the GB from the present to the LP suggests that only during the LP would the amount of ice and glacial distribution approach the descriptions of ice barriers included in many *TPN* narratives. One pinyon-origin narrative includes an additional clue. A Wá•šiw story (no. 52) describes the hero bird that brought pine nuts to the People, and begins as follows, "They [the large black-and-white bird, and his companions] were walking along the tops of the mountains, following the ice. It was melting, and they liked it cold, so that's why they were following the ice." Assuming the location to be the high mountains around Lake Tahoe (core of the Wá•šiw homeland), this reference suggests conditions of the LP, given that the Animals were following ice along the tops of mountains. The large Sierra Nevada LGM ice cap extended to the Tahoe Basin area (and northward) west of the hydrologic divide (Gillespie and Clark, 2011; Fig. 8). Animal People walking along "mountain tops" following ice could refer to the ice cap margin at the hydrologic divide. Recess Peak glaciers also may have created ice rims along the range crest. Reference to "melting" may indicate deglaciation phases of either glacial interval.

To consider LGM glaciers as reference for the ice barriers requires that we review dates for the first peopling of the Americas, in particular the GB. Two date ranges are currently debated. Abundant evidence exists for Paleoindians living in the GB by 12–15 ka (reviews in Moreno-Mayar et al., 2018; Willerslev and Meltzer, 2021). A secure ag of 14.1 secure date ka on an anthropogenic locust cache is the oldest for the western GB (Pellegrini et al., 2022) in the region of many of our *TPN* versions. But given that LGM deglaciation was complete by 15 ka in GB ranges (Laabs et al., 2013; Munroe, 2018; Wahrhaftig et al., 2019b), people would not have seen glaciers as they arrived. An earlier arrival of people in North and South America, before and during the LGM, is gaining some acceptance (>20 ka; Becerra-Valdivia and Higham, 2020; Bennett et al., 2021; Gruhn, 2023; Pansani et al., 2023; Pigati et al., 2023; Stoffle et al., 2024). While the ages remain debated for many of these sites, if people had been in the GB before ~17 ka—or recalled massive ice elsewhere (Arctic)—this oral history could have been passed to storytellers relating the *TPN* narratives.

We tentatively propose that the ice-wall descriptions appearing in many of the *TPN* narratives derived from eyewitness observations in the LP and persisted through oral transmission more than 17,000 years. Is there precedence for this antiquity in the GB? One of us (HF) knows a GB Wá•šiw Creation story notable for its apparent LP age. The story relates a great tsunami in ancestral Lake Tahoe that destroyed villages on its east shore and brought water high on the Carson Range, Tahoe's eastern flank (Danberg, 1968;

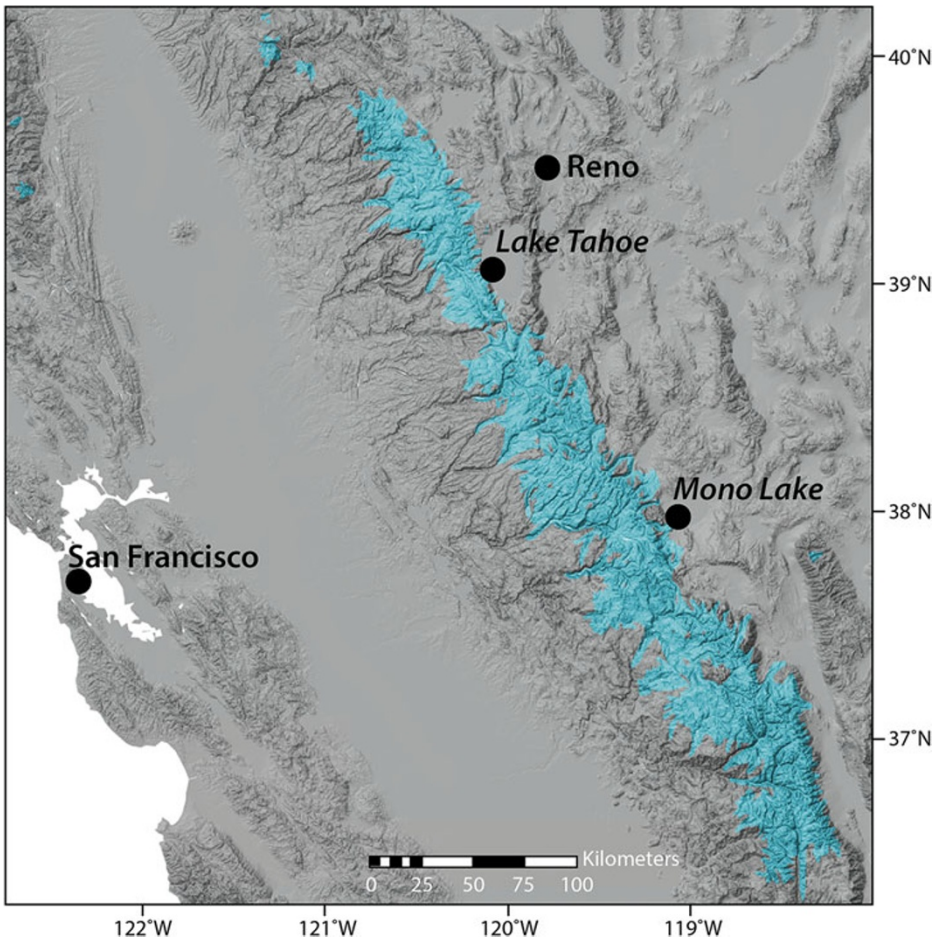

Figure 8. Extent of last glacial maximum ice cap, Sierra Nevada, CA/NV. Modified from Gillespie and Clark (2011, p. 448; with permission from Elsevier).

Fillmore, 2017). This tsunami is known from geologic analysis to have resulted after earthquakes along the range-front faults of Tahoe's west side released a massive landslide (Moore et al., 2014). This gouged away a section of landscape, creating McKinney Bay, and sent 12 km^3 of debris into the lake (compare with ~2.8 km^3 for the 1980 Mt. St. Helen's eruption in Washington State). The tsunami displaced 33% of the volume of Lake Tahoe and sent water 100 m up the east shore (Moore et al., 2014). The tsunami has a minimum age of 12 ka, derived from lake-bottom piston cores that passed Mazama ash but did not hit landslide debris, and a maximum age of 21 ka from the LGM moraine that the landslide broke through (Moore et al., 2014). Delta terraces created by the tsunami at Cave Rock were dated at 19.2 ± 1.8 ka (Dingler et al., 2009), which falls within the minimum/maximum date range.

Others have suggested that Indigenous oral traditions have deep antiquity. One of the first narratives recognized to have high fidelity with Western science was the oral-history narrative detailing the Mt. Mazama eruption, ~7700 years ago (Budhwa et al., 2021). Late Pleistocene examples also exist. Fiedel (2007) elaborated details of what he interpreted as human travel through LP Beringia, suggesting that ice barriers of GB oral-history narratives derived from observations of those times. Stoffle et al. (2024) compiled oral-history narratives and ethnographic interviews with Elders in the Death Valley, CA, region and compared conditions from these with well-dated geologic events that suggest human occupation in the region 40,000 years ago. Angelbeck et al (2024) document traditional oral-history narratives extending back to the "Time of Transformation" in the Gulf of Alaska region, events that date to the LP. Ruuska (2026) investigated ice barrier stories from many GB oral-history narratives in addition to *TPN* and correlated them with various ages of deglaciation in LP Arctic. Hittman (2013) considered the walls of ice described in the GB "Ice Barrier" story as being a "historic allusion to the last ice age" (pp. 210–211).

Taken together, we entertain the possibility of eyewitness accounts of LP events being passed through Indigenous oral history. The inclusion of ice walls in the *TPN* oral-history narratives, importantly, does not imply dates for either pinyon origins or mammal species' locations.

Implications for high-latitude LP pinyon refugia and Holocene expansions

The *TPN* narratives provide new evidence that pinyon pine may have grown north of its current known range limit in the LP or Holocene, as proposed by Millar and Thomas (2024a). The oral-history narratives corroborate potential high-latitude refugia or expansions by their consistent indications of northern origins for pine-nut homelands and by specific locations, including Yamsay Mountain, Gearhart Mountain, Hart Mountain; Warner Mountains; Santa Rosa Range; Pyramid Lake, Owyhee region;

Goose Creek Range; central Idaho; and western Wyoming. These pine-nut homelands are above 41.5°N and north of the current pinyon distribution range.

Of the northern pine-nut homelands in *TPN*, the greater Warner Mountains region has several lines of evidence from Western science suggesting that pinyon may have been present historically and may still occur (Millar and Thomas, 2024a). Although the nearest known native pinyon is >200 km south, botanical observations, ethnographic references, and several unconfirmed twentieth-century observations refer to pinyon (Millar and Thomas, 2024a). In particular, a 1948 herbarium voucher of two old-growth *Pinus monophylla* specimens was recorded by a prominent botanist from the west slope of the north Warner Mountains (USO Herbarium no. 16444); private landowner constraints have limited recent attempts for us to search for these. Ethnographic references report pine nuts and pine-nut collecting and processing on Bidwell Mountain in the north Warner Mountains (Kelly, 1932). Another ethnographic reference was reported for the west slope of Saddleback Mountain (Eagle Peak, 3016 m) in the south Warner Mountains (1977; Ike Leaf, Hammawi, via Richard Hughes, unpublished report). There are several references in Leaf's report, the most explicit being the following:

> In November they went up to the west side of Saddleback to gather pine nuts. 10-15 people involved in pine nut gathering, with a little hunting at this time; men might help in gathering but women knew how to prepare the pine nuts. Pine nuts taken out of cone by roasting in fire; area about 10-12 ft. across (but no pit), used pine nut tree fire wood, manzanita wood to get hot fire for hot coals. Fine cones stirred with stick until cones pop open (stick of chokecherry wood), then taken out of fire and swept onto a tule mat rug. Chokecherry sticks brought up to the site from the village. Fired cones scraped, by hand or *with* a small stick, and nuts dropped out and put into a deerskin bag. Pine nut operation may have taken about two weeks from start to finish. After the middle of November they stored and organized; small, shallow (ca. 6" deep) storage pit dug into floor of house covered with tule mats to keep dry. The storage pit was about 4 ft. long, about 1 to 1½ ft wide and about 6-8" deep.

Several other northern regions from the *TPN* stories suggest reasonable historic pinyon occurrence. Pyramid Lake at present lies ~50 km north of pinyon's primary distribution. Four isolated pinyon colonists occur at the southwestern margin of Pyramid Lake (two young trees are likely progeny of the adjacent adult) and a small stand (~10 ha) exists near the very southwestern edge of the lake, suggesting other trees may exist or have existed in the area. Two versions of *TPN* locate the pine-nut homeland in the greater Bonneville region, UT, a region also proposed as a northern refugium based on old ages of pinyon in middens (Millar and Thomas, 2024a; Fig. 3). Millar and Thomas (2024a) consider that in addition to LP northern refugia, pinyon may have advanced north of its current range during favorable Holocene conditions and subsequently been extirpated as conditions deteriorated (see also Betancourt, 1986; Neilson, 1986). Taken together, high-latitude areas identified as northern pinyon homelands in the *TPN* narratives corroborate and expand Western science hypotheses occurrences of pinyon north of its current distribution. These areas warrant further attention for evidence of prior pinyon occurrence, including field surveys for as-yet-undiscovered northern pinyon stands, new midden analyses, reanalyses of existing pollen data for pinyon-type pollen, and starch analyses on grinding stones for evidence of pinyon.

Implications for pre-contact mammal species distribution ranges

The *TPN* narratives provide insight into past distributions of several mammal species in the GB. Grizzly Bear was an important character in a *TPN* story from the Walker Lake area. This location for grizzly bears in west-central Nevada places them outside their reconstructed historic range (Mattson and Merrill, 2002; Supplementary Material, Supplemental Fig. 1A)

The *TPN* narratives also corroborate and extend reconstructions of the pre-contact distribution of black bear in the GB. One version (no. 38) involves black bear in the Pyramid Lake–Nixon, NV, area. This area is outside historic bear habitat considered by Hall (1946) but within Lackey et al.'s (2013) revision of the historic distribution. Another (no. 18) describes black bear in the Panamint Range (Death Valley area), outside both Hall's (1946) and Lackey et al.'s (2013) estimates.

Wolves, a key character in many of the *TPN* narratives, were widespread historically across North America but hunted to near extinction in vast portions of their former range (Shelton and Weckerly, 2007). Shelton and Weckerly canvassed reports of historic wolf observations and produced a map showing areas of increasing confidence for occurrence (Supplementary Material, Supplemental Fig. 1C). The locations of wolves interpreted from the *TPN* narratives provide new evidence for regions that had low or moderate confidence in Shelton and Weckerly's (2007) evaluations, including Pyramid Lake, Hart Mountain, Warner Mountains, Walker Lake, Bodie Mountains, Lovelock, Stillwater Range, Pine Nut Mountains, Carson Range, Owyhee region, northern Utah, and Wind River Range.

Bighorn sheep were widely distributed in GB mountains but were extirpated throughout their range by overhunting and disease during the contact/settlement era (Buechner, 1960; Supplementary Material, Supplemental Fig. 1D). Archaeological evidence for Indigenous bighorn hunting is ubiquitous across high mountain ranges of the GB in the form of hunting blinds, corrals and wing traps, butchered bones, and associated projectile points (Hockett et al., 2013; Thomas et al., 2020). Although we might expect that bighorn sheep would be common in the *TPN* narratives, only four versions, all from the west-central GB, mention the species. Those provide new information on the former range of bighorn sheep for the Bridgeport, CA, region, and mountains to the east, likely the Bodie Mountains, as well as the Warner Mountains.

American beavers were widely extirpated throughout their North American range by over-trapping in the settlement period (Baker and Hill, 2003; Gibson and Olden, 2014). Now found sporadically in streams of the GB, most of those are assumed to derive from intentional or accidental introduction. Controversy remains over beavers' pre-contact native range in the GB, with most accounts describing it as limited, although some suggest extensive distribution (Lanman et al., 2012). Beaver occurs in one *TPN* story, which takes place in the Pyramid Lake–northern Sierra Nevada region, adding evidence for beavers as native to that area.

Although elk have been introduced into many GB ranges and cougars have expanded populations throughout the modern GB, both were rare pre-contact (Grayson, 2011). Elk occur in two (maybe three) *TPN* narratives, one outside the GB (Wind River Range, WY), where elk are historically native, and one to two in west-central GB. Elk have long been considered absent from the Sierra Nevada region, but recent evidence suggests they may have been native through the Late Holocene into historic times (Lanman et al., 2024). The *TPN* narratives corroborate this,

and also indirectly validate the rarity of elk elsewhere in the GB. Similarly, only one *TPN* narrative, in the west-central GB, describes cougar, again indirectly corroborating their pre-contact rarity.

Conclusions

While Indigenous oral-history narratives were never intended to chronicle historical detail, and include aspects beyond the scope of Western science, our assessment of 61 versions of the *Theft of Pine Nut* narratives, told over 152 years and across the GB, leads us to conclude that many elements represent eyewitness observations of value to Quaternary sciences. High consistency among the versions across the breadth of the GB gives us confidence to interpret paleoenvironmental conditions, to compare these with Western science hypotheses, and to propose ages of longevity for these orally transmitted narratives. We outline new information in the narratives on pinyon pine biogeography, with focus on pine-nut homelands interpreted north of the current pinyon range. Several of these co-occur in regions identified by Millar and Thomas (2024a) as LP refugia or Holocene expansions with subsequent extirpation. Collectively they corroborate alternative hypotheses of pinyon's former occurrence north of its current range.

The *TPN* narratives also add useful content about pre-contact distributions of mammals in the GB. Additional evidence is provided, and new locations indicated, for historic occurrences of grizzly bear, black bear, gray wolf, bighorn sheep, beaver, elk, and cougar.

Our assessment of the *TPN* narratives is, to our knowledge, unique for assessing ecological dynamics. Previous analyses have assumed that singular and catastrophic geologic events such as megathrust earthquakes, eruptions, and tsunamis were the only events significant enough to be retained in oral tradition. We demonstrated that ecological dynamics ensuing over centuries and millennia are also encoded in the narratives, especially when they relate to a subject, such as pine nuts, that has high survival and cultural value.

Whereas dates and age are difficult to assess in oral-history narratives, we propose that the common appearance of a massive ice barrier in the *TPN* narratives reflects eyewitness accounts of LP (LGM) glaciers and ice caps. Given the current accepted understanding that people did not arrive in the GB until after 15 ka, LGM deglaciation was complete by that time. Although latest Pleistocene advances (~13–11.7 ka) might have produced adequate ice reference in the narratives, we think it more likely that inclusion of ice barriers in the *TPN* narratives resulted from observations in the Arctic or elsewhere before 15 ka and were transmitted through oral tradition as people moved south.

Although we do not argue that the age of glacier observations directly implies ages for pine-nut origins or mammal ranges, we do propose that the *TPN* narratives have deep antiquity. This is suggested by the large number of variants, general consistency among versions, and their widespread representation among tribal groups. (Budhwa et al., 2021).

In this study, we sought reliable content in the *TPN* oral-history narratives as a new type of evidence for reconstructing Quaternary history. Previous work has focused on corroborating Indigenous knowledge using Western science as a "control," (e.g., Franks et al., 2024) rather than considering that new information might be brought to Western science. We share the perspective with an increasing number of environmental scientists that oral-history narratives can introduce reliable new data useful for testing Western scientific hypotheses and for expanding knowledge broadly. In so doing, the narratives provide new avenues for future paleoecological and archaeological research. For pinyon, this includes searching for field, midden, and pollen evidence of historic pinyon pines at high GB latitudes and reassessing pre-contact mammal ranges in the GB. We have already begun field surveys, and encourage other archaeologists and ecologists to do the same.

Acknowledgments. We thank David Charlet (College of Southern Nevada), Robin Tausch (U.S. Forest Service), and Robert Westfall (U.S. Forest Service) for reviews of the draft manuscript. We are indebted to Scotty Strachan (University of Nevada) and Geoffrey Smith (University of Nevada, Reno) for critical comments as journal reviewers. Authors Millar and Thomas thank our Indigenous coauthors who spent many hours explaining natural history and cultural perspectives on oral-history narratives. We thank Catherine Fowler for her input on Indigenous oral history and for generously providing previously unpublished versions of *Theft of Pine Nuts*. Thanks to Zeese Papanikolas for providing several new versions of *TPN*, Richard Hughes for sharing unpublished ethnography from the Warner Mountains, Diana Roberson for archival work, and Jenn Steffey for rendering the maps.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/qua.2025.10039.

Data availability statement. Twenty-four complete versions of the *Theft of Pine Nuts* narrative are included in Supplement 1 in the Supplementary Material. Transcripts of all 61 versions of the *TPN* oral-history narrative that support the findings of this study are available on request from the corresponding author (CIM).

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