Surface Artifact Scatters, Data Collection, and Significance

Case Studies from Australia and the United States

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ABSTRACT

The three authors research surface archaeological records dominated by low-density scatters and isolated artifacts, archaeological phenomena frequently encountered during cultural resource management (CRM) projects in areas of the United States and Australia. We each began researching surface artifact scatters for different reasons but converged on approaches that emphasize the formation of these forms of archaeological deposits. Through a variety of projects, we asked a common set of questions about the processes that both buried and exposed these materials, the methods needed to obtain a chronology in different regions, and the ways we might interpret artifacts found together in different densities. Answering these questions led to the collection and analyses of datasets in innovative ways and the questioning of a number of archaeological categories often thought of as fundamental for archaeological research. Here, we review examples of our respective research and consider the implications for CRM projects dealing with surface lithics.

Keywords: surface archaeology, archaeological significance, lithic technology, Australia, Nebraska, Great Plains

Los tres autores investigan los registros arqueológicos de superficie dominados por la dispersión de artefactos líticos, una clase de datos arqueológicos que se encuentran con frecuencia durante los proyectos de CRM en áreas de Norteamérica y Australia. Cada uno de nosotros comenzó a investigar las dispersiones líticas de superficie por diferentes razones, pero convergimos en un conjunto común de preguntas sobre los procesos que enterraron y expusieron estos registros, los métodos necesarios para obtener una cronología en diferentes regiones, y las formas en que podríamos interpretar los artefactos encontrados juntos en diferentes densidades. La respuesta a estas preguntas nos llevó a recopilar y analizar conjuntos de datos de forma innovadora y a cuestionar una serie de categorías arqueológicas que a menudo se consideran fundamentales para la investigación arqueológica. Aquí revisamos nuestras respectivas investigaciones y consideramos las implicaciones para los proyectos de CRM que tratan con lítica de superficie.

Palabras clave: arqueología de superficie, importancia arqueológica, tecnología lítica, Australia, Nebraska, Grandes Llanuras

Low-density scatters and isolated artifacts present both archaeological challenges and opportunities. A growing academic and compliance literature (e.g., Cain 2012; Dunlop 2018; Ebert et al. 1987; Peacock and Rafferty 2007; Rieth 2008; Wandsnider 1988) promotes greater attention to these types of archaeological occurrence. Whereas scatters and isolates were once deemed of low significance (Peacock et al. 2008) and low information potential (Nolan 2020), archaeologists are now making efforts to consider how best to incorporate them into sampling designs, documentation, and preservation planning. Although strides have been made, many challenges remain.

Archaeological work within nonaggrading and erosional environments provides a vantage onto these issues in that broad visibility—both across surfaces and through the aggregation of multiple smaller areas of exposure—reflects a landscape-scale diversity that includes dense accumulations of debris, diffuse scatters, and isolated artifacts and features. When continuous over large areas, these exposures present a record broken only by changes in density (e.g., Dunnell and Dancey 1983; Ebert 1992; Foley 1981). Understanding the spatial relationships between individual artifacts, features, and densities in these exposures is further complicated by the time-depth of surface deposits (Holdaway and Wandsnider 2006), where artifacts and features found in proximity to one another may be separated by hundreds if not thousands of years (Holdaway et al. 2008a).

Although not unique to the surface record, the diversity in the distribution of artifacts afforded through enhanced surface visibility leads to challenging questions concerning archaeological field documentation protocols and the practice of delineating unit boundaries (e.g., sites). Advances in the application of survey

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technologies (e.g., Hill et al. 2019) mean that archaeologists can record the location and characteristics of ever-increasing numbers of artifacts in scatters distributed across ever-larger areas. Should archaeological databases, therefore, be filled with records of the location of isolates and low-density surface and subsurface scatters, or only the locations of artifact concentrations that achieve some agreed-upon density level—or those that are visible, no matter the density, in some agreed-upon expanse of exposure? Likewise, what would the value of such records—obtained with these different recording scenarios—present to the various stakeholders (Indigenous groups, historic preservation professionals, the public, and land developers)? These questions relate to evaluation criteria used for interpreting archaeological significance and, more generally, the types of information and data archaeologists accumulate and the relationship of these to the construction of archaeological inference.

To help answer these questions, we draw on three case studies from Australia and the United States centered on low-density artifact records consisting of stone artifacts. Although not conducted as cultural resource management (CRM) projects, two concern research on public lands and reflect our approach to these records, whereas the third concerns public outreach focused on the low-density records of nonpublic lands. In each example, analysis of lithic scatters and isolates informs on the extent and nature of landscape use, regardless of whether surface artifacts are found at high or low densities.

Our approach draws inspiration from the experiences of one of the authors when working with local indigenous communities in Australia where Aboriginal traditional landowners expressed a dissatisfaction with the conventional archaeological practice of documenting discrete places used in the past and instead argued for an archaeology tasked with understanding the importance of "being in Country" (see Brown 2008). We have taken this goal to heart and offer our experiences with low-density records in the hope that it may contribute to efforts by CRM archaeologists as they assess best practices for data collection, management, and evaluation.

ARTIFACT SCATTERS, DENSITY, AND ASSEMBLAGE GRAIN

The archaeological discipline has traveled far since Willey (1953) first grappled with surface archaeological materials in the Virú Valley. Nevertheless, how to document and interpret surface materials that vary in density and composition remains an issue. The concept of assemblage grain is useful here, as is recalling the influence of surface geomorphological processes on assemblage visibility.

Assemblage grain (i.e., the minimum resolvable temporal interval) is influenced by behavioral and geomorphic factors. Binford (1980), in introducing the grain concept, explained how patterned variation in hunter-gatherer mobility and settlement shifted according to the spatial and temporal structure of resources. He distinguished "foragers," who employed residential mobility to move consumers between patches of low-abundance resources, from "collectors," whose mobility was tethered to storage facilities and who employed logistical mobility to provision consumers with resources obtained from dispersed and seasonally superabundant patches. Binford's linkage of mobility with the presence or absence of seasonal activities has important implications for the composition of artifact scatters. With greater mobility—and therefore reduced periods of accumulation—the probability of depositing items related to local resource use increased. For groups that spent periods at residential bases, items deposited related to local and distant resources. Where foragers were mobile, grain size was described as "fine," and Binford intuited that there may be greater diversity between assemblages, reflecting individual events. Binford's collectors, with concentrated and nodal patterns of settlement and targeted relocation of resources, created assemblages that were *coarse*-grained; here, assemblage heterogeneity related to how many rare artifacts, associated with rare events, were aggregated. From this, it follows that the most reliable interpretations of short-term stone artifact production and use might be expected from places with only a single tool production, maintenance, or use and discard activities—that is, places where assemblage grain is fine (Andrefsky 2009) and artifact scatter density low.

Ferring (1986) was among the first to emphasize how the sedimentary environment affects assemblage preservation and grain. With rapid deposition, as in some alluvial environments, fine-grained assemblages may be preserved. In contrast, stable interfluves may see erosion or little sedimentary deposition, resulting in coarse-grained assemblages, even if use of the landscape was the same as in the first example. The depositional envelope and the amount of time it encapsulates is controlled by these geomorphic processes.

In addition to this, scatters differentially become available for documentation owing to a range of processes. In some cases, stable surfaces have accumulated the remnants of human behavior for millennia and are readily available for documentation. At the other extreme, artifacts remain buried until exposed (Schiffer 1987). An assessment of assemblage density (and possibly assemblage integrity) is affected by the in-field assessment of geomorphological factors responsible for visibility.

Given this, how should archaeologists interpret higher-density, likely coarse-grained artifact scatters? Are they owed to single or repeated occupation events, infrequent sedimentary depositional events, complex processes that afford differential visibility, or some combination of all of these? In the following case studies, we provide analyses that directly address the challenges of interpreting coarse-grained, high- and low-density lithic assemblages. In each, the construction of lithic databases involved distinct methods of data acquisition, all of which emphasized landscape-scale parcels as contexts for activity, with activities assessed across disparate spaces, rather than a functional assessment of activities concentrated at one location.

CASE STUDY 1: RUTHERFORDS CREEK, WESTERN NEW SOUTH WALES, AUSTRALIA

In the first case study, stock grazing has increased surface erosion creating "scalds"—unvegetated patches of subsoils where fine sediments are removed by wind and low-energy water (Warren 1965), exposing a lag of larger clasts at the surface, including

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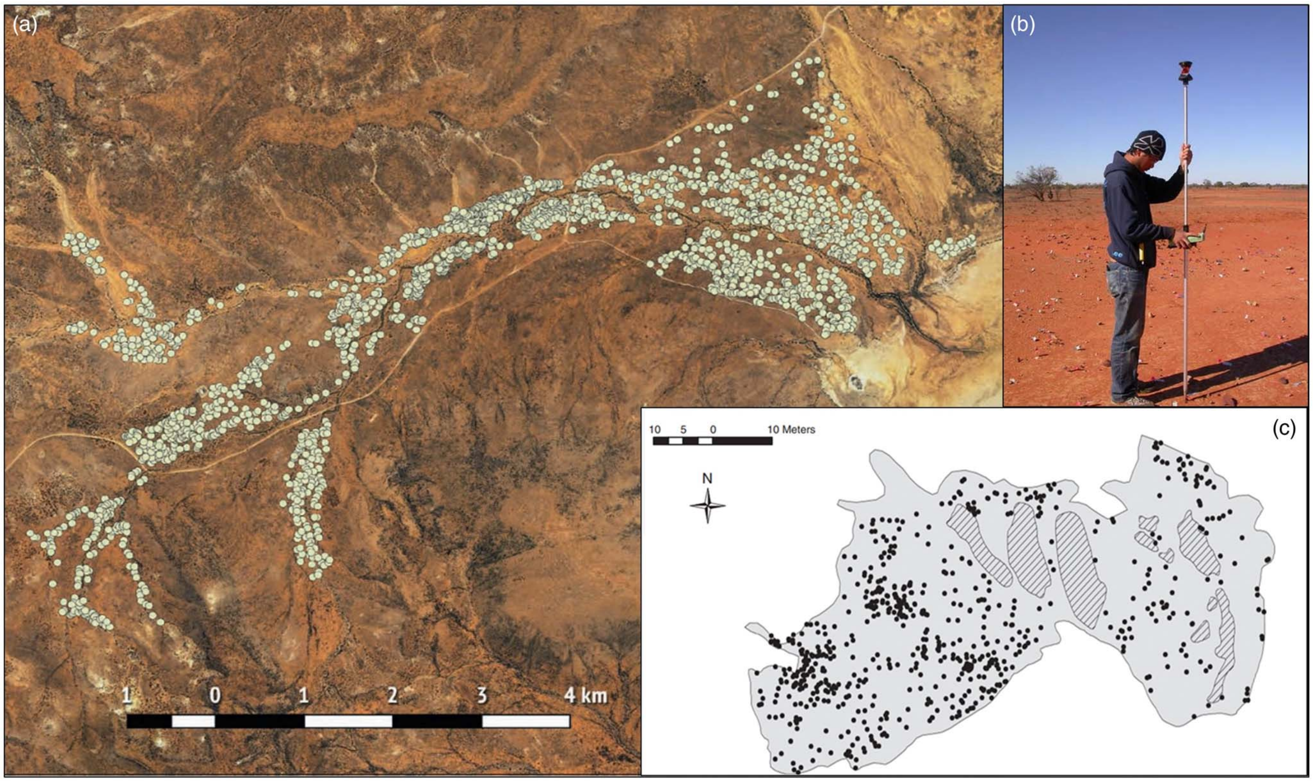

FIGURE 1. Artifact and feature mapping at Rutherfords Creek, NSW, Australia: (a) map of the distribution of scalds over the 13 km drainage; (b) robotic total station mapping of all artifacts 20 mm or greater in sample of 93 scalds (photo by Sam Lin); (c) map of an example scald, showing perimeter, artifacts (black dots), and sediment overburden obscuring visibility (hatched areas).

stone artifacts all largely dating to the late Holocene (Fanning and Holdaway 2001). Archaeological interpretations of artifact scatters from this period equate increased density and diversity of lithics with greater sedentism and intensive occupation linked to the onset of drier, less predictable El Niño–Southern Oscillation (ENSO) conditions (e.g., Smith 1986; Smith and Ross 2008). In this framework, dense artifact concentrations suggest local resource intensification in an increasingly marginal environment (Williams et al. 2015). However, such interpretations assume that dense artifact deposits reflect the concentrated activities of larger groups of people than less dense deposits at any given time. An alternative interpretation suggests that deposits might reflect redundant small group activities, where over time, repeated visitation to the same locations produces higher artifact densities (Holdaway et al. 2008b, 2012, 2016). In this latter scenario, higher-density deposits reflect more frequent visitation and/or greater time-depth over which a record formed.

To test these alternatives, investigation of a 13 km long drainage, Rutherfords Creek, employed a survey strategy to assess the visible archaeological record, where a random sample of 93 eroded scalds served as units of investigation in order to characterize the distribution of artifacts and features along the drainage system. Each scald was mapped and subjected to close-interval total-coverage survey, resulting in data for more than 20,000 stone artifacts. For each artifact, around 30 attributes were recorded and provenience obtained, with the artifact then returned to its location of discovery (Holdaway and Fanning 2008; Figure 1). Also exposed on the scalds were the remains of heat-retainer hearths (similar to earth ovens in the American Southwest), visible as aggregations of fire-altered rock, sometimes concentrated within caps of baked sediments (Holdaway et al. 2017). The Rutherfords Creek survey recorded more than 1,000 such hearths along the length of the valley, 80 of which were sampled for radiocarbon dating. Hearth ages, along with optically stimulated luminescence dating of sediments upon which hearths and artifact rest, documented the time envelope that the record represented. Artifacts and features reflected a time-averaged surface of accumulation, with a temporal grain of approximately 3,000 years (Davies et al. 2016; Holdaway et al. 2008a, 2010). Data on Rutherfords Creek are therefore organized at the level of individual artifacts and features, where information can be viewed and analyzed at different scales ranging from the level of individual artifacts and features (Davies et al. 2016), to subsets of scalds (Douglass, Holdaway, and Fanning 2017), to individual and aggregated scalds (Davies et al. 2021), and up to the level of the entire basin (Douglass 2010).

The average density of lithics at Rutherfords Creek is 0.58 artifacts/m^2 (Bryant 2013:136), with individual scald lithic densities ranging from 0.03 artifacts/m^2 to more than 12 artifacts/m^2. As noted, artifact accumulation may lead to greater density with age or with greater occupation intensity. To determine which, Davies and Holdaway (2017) compared the ages of dated hearths (ages <3000 BP) on scalds to the density of stone artifacts showing a linear relationship between maximum hearth age and artifact density.

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Concentrated occupation involving the return of resources from distant to central locations leads to coarse-grained, heterogeneous assemblages with a range of artifact types (e.g., Shott 1986), and indeed, there is a linear relationship at Rutherfords Creek between the number of artifact types and log density of artifacts within scalds (Davies and Holdaway 2017:Figure 5). However, although more intensive occupations will include rare artifact types, it is also true that multiple, short-term occupations accumulate such artifacts over time through chance discard (Schlanger 1990), reflecting richness and assemblage size (Jones et al. 1983; Shott 2010a).

To differentiate localized, intensive occupation from repeated, short-term occupations requires a third measure. The cortex ratio is one approach (Dibble et al. 2005; Douglass 2010; Douglass and Holdaway 2011; Douglass et al. 2008, 2021; Lin et al. 2016) that compares the cortical surface area recorded for stone artifacts to that expected, given the number and size of cortical cobbles represented by the number of cores. The ratio provides a proxy measure for movement as artifacts removed or added to an assemblage. At Rutherfords Creek, the mean cortex ratio is 0.53 ± 0.22, indicating a dearth of cortex but with considerable individual scald variability. Plotting the cortex ratio against artifact density shows a negative relationship—but one with little predictive power (Davies and Holdaway 2017:Figure 6). Despite the linear relationship between log stone artifact density and age, there is no trend in the average cortex ratio value with assemblage density—meaning that high- and low-density assemblages do not reflect fundamental differences in artifact production and transport. There is, however, a shift in cortex ratio variance where denser scalds show less dispersal. As noted, density is positively correlated with deposit age—meaning that lower-density scalds are not only more variable but also younger. This suggests that younger scalds reflect shorter-term variance, whereas scalds with greater time depth and therefore greater opportunity for repeated activity see variance reduced as repetition of the trend toward artifact removal iterates over time (Davies and Holdaway 2017; Davies et al. 2018).

As a proxy for artifact movement, the cortex ratio values show that despite local, short-term variability, over time, there are regularities in place use. If attention were focused only on the densest scalds, the low cortex ratio values might be interpreted as specific locations representing "extraction sites," indicating specialized flake removal for use elsewhere with low-density scatters representing other activities—including those at the rare scalds with concentrations of particular tool types (Douglass, Holdaway, and Fanning 2017). But incorporating the low-density scatters shows how flake removal occurs in similar ways at places with both high and low artifact densities along the whole of the drainage line. If intensive, sedentary, late Holocene occupations were the behavioral pattern responsible for the Rutherfords Creek sample, increases in artifact density and artifact type representation should follow population growth and change in environmental productivity. But this did not occur. Instead, the pattern is more consistent with people making a series of small-scale changes to an established settlement pattern involving frequent movement over broad territories and reusing some places more than others depending on local conditions, including potentially the visibility of material remains from previous activity (Davies et al. 2016, 2021; Holdaway et al. 2014). The enduring consistency of this pattern at Rutherford's Creek (as well as a host of similar catchments throughout the region—e.g., Douglass 2010; Holdaway and Fanning 2014) speaks to the overall resilience to long-term land-use strategies geared to widespread fluctuations in an unpredictable climate (Davies et al. 2021; Holdaway et al. 2013).

These conclusions aside, the case study illustrates how older, high-density locations are only understandable if analyzed alongside younger, low-density locations. According to common heritage management guidelines, the eroded nature of the Rutherfords Creek scalds might remove them from consideration for documentation or management (e.g., Cain 2012:209; Nebraska State Historic Preservation Office [NSHPO] 2017:22; Peacock et al. 2008:87). Likewise, low densities in some of the scalds would mean artifacts are registered as isolates, or otherwise left unrecorded—meaning that the pattern and interpretation offered here might not be considered. Translated into the language of CRM significance, we argue that these individually documented deposits become significant in relation to each other (e.g., Dunnell 1984; Nolan 2020; Versaggi and Hohman 2008; Wandsnider 1988).

The second case study considers these issues using a different dataset: bifacial stone points and other artifact forms held in private collections in the United States.

CASE STUDY 2: GREAT PLAINS COLLECTORS

Private artifact collections are a familiar occurrence in rural Great Plains communities. Many farmers, ranchers, and other landowners—here, Collectors (different from Binford's collectors)—have found artifacts and collected them. Consequently, these collections represent a significant archaeological sample. In contrast, professional archaeological research is more limited in scope and geographical distribution. Private property predominates in many American states (e.g., Nebraska, 97%), with compliance work largely limited to federal and state properties, government-funded land development, and roads. Therefore, public knowledge about the location of archaeological remains represents an extensive if underutilized resource. To tap this resource, a USDA Forest Service and University of Nebraska (UNL) partnership was developed to document private collections (Chodoronek et al. 2017; Douglass, Holdaway, and Fanning 2017; Reif and Douglass 2020).

Researchers, Forest Service staff, and UNL students engaged with Collectors during events in areas adjacent to National Grasslands in Nebraska, Wyoming, South Dakota, and Kansas. Program protocols included artifact digitization, remote mapping, and interviews (Hittner and Douglass 2016). Information on artifact provenience was highly variable. Some Collectors knew the location of each find, whereas others could provenience finds only within their own property or within a radius around the home. However, when combined, these collections provided information of an archaeological record analyzable at different scales (e.g., catchment, county, region) largely inaccessible to professional archaeologists.

Roadshow data, like other private collections (e.g., Nolan et al. 2022; Shott and Pitblado 2015; Wright 2022), provide a window into archaeological occurrences on private land. Where public land is limited, professional documentation is unrepresentative of

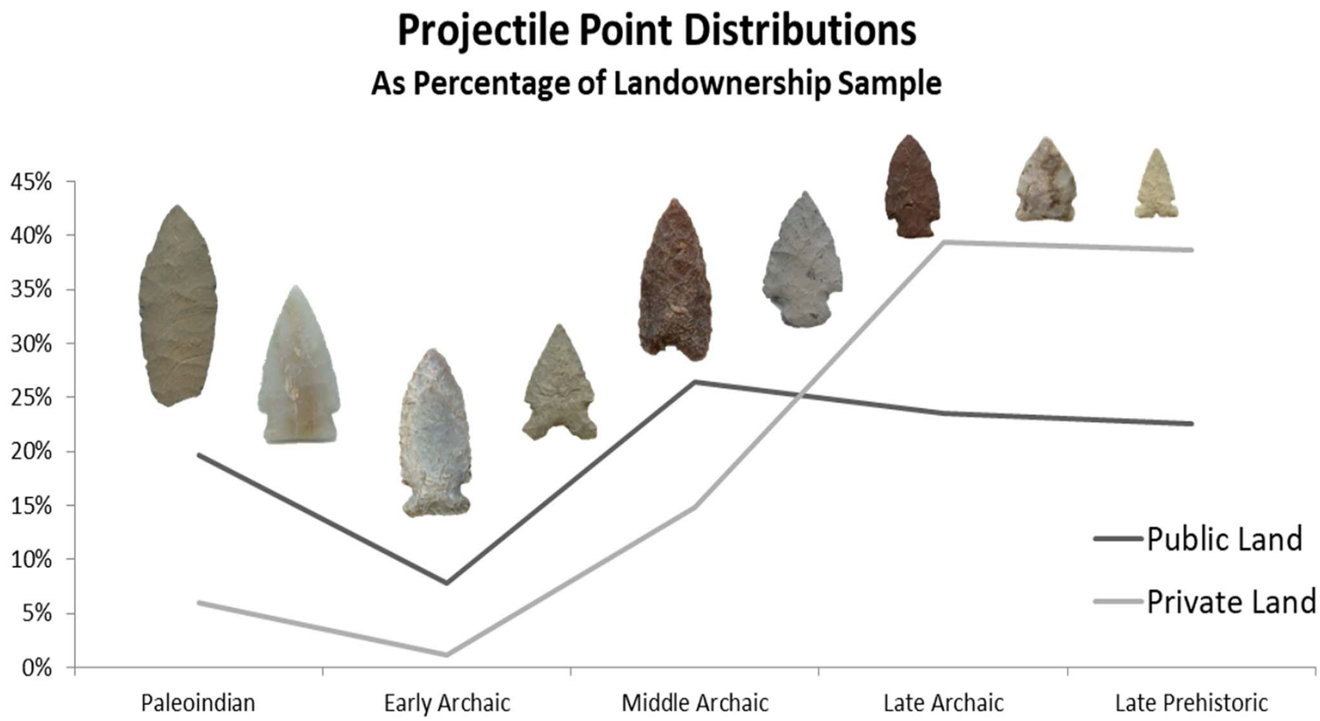

FIGURE 2. Projectile-point distribution between public and private land for Cook County, Wyoming. Reproduced with permission from Rowe (2019).

archaeology across the state. In Nebraska, for instance, the distribution in state site files mirrors major public works (e.g., the I-80 corridor) and, until 2018, there were entire counties without a single site record. In states with abundant public land, differences between private land collections and public CRM records are also significant (Rowe 2019; Figure 2). Likewise, in areas with poor documentation or limited public access, reinvestigations of sites are common, whereas new information derived from compliance work remains rare. Working with Collectors, archaeologists stand to gain a much more spatially representative sample of the total extant record.

The Roadshow project also demonstrated differences in recording practice. CRM typically documents "sites" with isolates often either not recorded or not afforded consideration beyond basic recording (e.g., Alvey 2019; Dunlop 2018; Morton 2015; Peacock and Rafferty 2007). Various degrees of site salience (Tainter and Bagley 2005) derive from observations of density, internal stratification, types of artifacts and features, and, importantly, perceptions of "integrity" (Mathers et al. 2005; Miller 2008). The practice of compliance archaeology therefore structures archaeological recording through perceived information potential (Nolan 2020), the costs of mitigation, and theoretical perspectives situated in functionalist anthropology rather than geomorphology. In contrast, Collectors lack this disciplinary history. Rather than searching for "sites," "camps," or "activity areas," Collectors overwhelmingly target erosion (e.g., blowouts, animal trails, two tracks, sand bars, and areas of deflation, much like the scalds in Australia; LaBelle et al. 2022). In these areas, they focus on the location of isolates and indeed return to exposures over time to collect newly unearthed finds. Theirs is therefore a practice based on geomorphology—a form of geoarchaeology—rather than one derived from anthropological models of past land use.

Interviewers asked if Collectors only targeted points or whether they collected other artifacts as well. Results indicate that Collectors initially offered to show projectile points because they knew these had typological and chronological significance. However, whereas some Collectors only targeted points, the majority collected everything they found. Such collection practices contrast with professional archaeological practice, where collected finds from surface occurrences are commonly though not exclusively dominated by points and other chronologically meaningful types. Indeed, the "Collector sampling strategy" parallels the total-coverage sampling approach used in scalds.

As Case Study 1 illustrated, older, high-artifact-density locations are only interpretable when analyzed alongside younger, low-density locations. Seen from this perspective, the Great Plains Artifact Collector data might be analyzed in similar ways. Moreover, interviews frequently provide the means to determine locations where collecting occurred. The completeness of collection, also often discoverable, provides the potential for data recording equivalent to the Australian case. Collectors targeted areas of visibility, with a focus on individual artifacts; therefore, they collected both high- and low-density locations rather than emphasizing dense and diverse "sites" for focused data recovery, which is the professional tendency. Understood from this perspective, the Collector data, involving descriptions of the artifacts but also the gathering of contextual information, provides an important and spatially extensive dataset without substantial recovery costs.

TABLE 1. Artifact Numbers and Density for Each Area Surveyed in ONG.

Study Location	N	Survey Area (m^2)	Artifact Density (m^2)
Pete Smith Hill (PSH)	236	20.0	11.8000
Sand Creek (SC)	287	239,914.1	0.0012
North of Roundtop (NRTP)	215	456.1	0.4714
Northwest of Hudson Meng (NWHM)	46	385.3	0.1194
Toadstool (TS)	116	5,473.0	0.0212
Whitehead Creek Survey (WHCS)	590	7,195,598.8	0.0001

In the third case study, we consider results of analyses of data derived from artifact exposures with a range of densities in a Great Plains study region.

CASE STUDY 3: OGLALA NATIONAL GRASSLAND (ONG)

The ONG comprises a 38,234 ha (94,480-acre) United States Forest Service–administered land parcel in northwestern Nebraska. The region ranges from flat and low rolling prairies to eroded badlands and steep-sided stream valleys. The modern environment is semiarid, with seasonal changes reflecting a continental climate. The landscape is predominately short-grass prairie, but as in the rest of the Great Plains, the so-called "sea of grass" (Allen 1993) is broken by erosion and deflation, and altered through fire. These features provide windows into an archaeological record otherwise obscured from view.

Several field seasons on the ONG followed the methodologies of the Australian case study. Areas of erosion and deflation were mapped, followed by total coverage survey, with data recorded in the field using a variety of standard measurements (Douglass et al. 2008, 2018; Fanning and Holdaway 2001; Holdaway et al. 2015), along with photography of each object.

Study locations surveyed included erosional exposures along a drainage system (Sand Creek); a sample of the deflated Chadron gravel cobble fields (Pete Smith Hill); a sample of an expansive erosional area (Toadstool); and because of recent prairie fire, survey of deflated hills with exposed surface records (North of Roundtop; Northwest of Hudson Meng). Finally, analysis included collections from a 1970s survey (Whitehead Creek), using a survey methodology similar to the current study's approach (Agenbroad 1979). These areas demonstrate a lagged surface record marked by isolates and low-density scatters. Temporal grain is coarse, as indicated by projectile point typology, where points within individual study locations are separated by thousands of years with larger data records covering Folsom to metal trade points. The majority of artifacts were observed near the interface of erosion and intact prairie and at the base of isolated patches of prairie, termed "sod tables" (Burkhart et al. 2008). Revisitation over multiple years reveals new artifacts exposed and lagged as erosion continues. Table 1 provides summary information on artifact samples for each location, including total area surveyed and artifact density. Survey and data recording followed the scald-based sampling protocols utilized in Australia, where every artifact within investigation units (e.g., extant of erosion/deflation) was mapped and attribute recording was completed in the field, which allowed analysis from the level of individual artifacts and aggregations thereof.

Lithic artifacts are composed of local stone sources in the north of the study area (e.g., Pete Smith Hill) and nonlocal sources dispersed throughout the Great Plains (Douglass, Kuhnel, et al. 2017; Figure 3). Local materials come from gravels associated with the Chamberlain Pass formation, otherwise known as the Chadron Gravels (Terry et al. 1995), which includes quartz, silicified sandstones, fine-grained cherts, and agates.

Data records for all artifacts from a sample from 20 m^2 units distributed within a 400 m^2 area of the Pete Smith Hills study location provided a basis for assessing the initiation of local stone out-flow over the ONG landscape using two different methods. The first used generalized linear mixed models (Braun 2007; Douglass 2010; Douglass et al. 2018) to predict the average reduction intensity of cores based on cortex proportion and flake scar number and complexity. Reduction intensity at Pete Smith is low (31%), with modeled mean cobble size before reduction at 288.9 g. The distribution of core reduction values plotted using a survivorship curve (Figure 3a) indicates little effort expended to preserve cores, and short of some early discard, the trend line resembles random discard (Shott 2002, 2010b), in which only a handful of flakes were produced on average per cobble.

The second method is the cortex ratio used in the Australian example. Using the estimated mean cobble size mentioned earlier, cortex ratio values at Pete Smith are 0.96, close to that expected if all products of reduction remained on site. Because of low reduction intensity, much of the cortex creating the 0.96 assemblage cortex ratio value is therefore "locked up" as unworked material (Douglass et al. 2016; Holdaway and Douglass 2015). Flakes, in contrast, have a cortex ratio of 0.92, a value lower than expected from a sample of cortical flakes produced via light core reduction. This value suggests that although core reduction was slight, selection involved bigger, earlier-stage flakes and was completed so that the remaining flake products have less cortex than the cores from which they were struck. Preforms and bifacial flaking associated with transforming flakes to preforms is lacking at Pete Smith, indicating that the flake blanks removed were most often unretouched or lightly retouched cortical pieces.

Movement of artifacts away from locations with raw material sources (such as Pete Smith) is reflected in the other study location samples. Table 2 gives artifact frequencies for both local and nonlocal material, average artifact mass, and the raw cortex ratios for sampling units from each study location. Cortex ratios calculated for Chamberlain Pass raw materials at the other study locations indicate considerable diversity: one area has values that are low, one has a value above one, and others are somewhere in between. These results are similar to Rutherfords Creek, where low-density scalds also showed high variability in ratio values.

Lin and colleagues (2015) examined the effect of sample sizes on the cortex ratio. Using resampling techniques and experimental data, they developed a formula for calculating the null 95% confidence interval (CI) of cortex ratios—that is, the range of ratio

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TABLE 2. Summary Information on Artifacts from ONG Study Locations.

Study Area	*N* (local)	*N* (nonlocal)	Mass (local) g	Mass (nonlocal) g	Cortical: Noncortical Platform Ratio	Cortex Ratio (local)	Cortex Ratio for Flakes (local)
Whitehead Creek Survey (WHCS)	115	451	1,985	5,368	0.081	0.77	0.67
North of Roundtop (NRTP)	75	140	75	94	0.190	0.89	0.89
Northwest of Hudson Meng (NWHM)	21	19	57	29	0.053	0.25	0.25
Sand Creek (SC)	166	61	4,007	468	0.630	1.00	1.16
Toadstool (TS)	79	8	1,841	50	0.300	0.76	0.78
Pete Smith Hill (PSH)	236	0	12,488	0	0.650	0.96	0.92

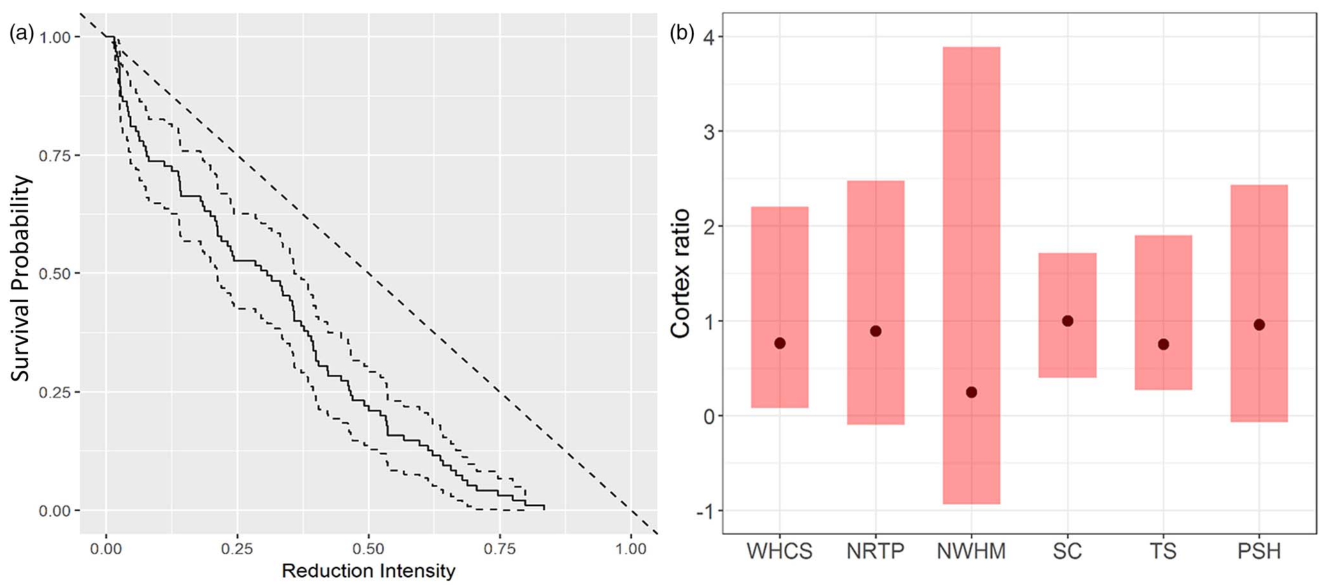

FIGURE 3. Local stone outflow on the Oglala National Grasslands: (a) reduction intensity for cores sampled at the Pete Smith Hill study location; (b) resampled cortex ratio values (black dots) and 95% confidence intervals for the study locations (Whitehead Creek Survey, North of Roundtop, Northwest of Hudson Meng, Sand Creek, Toadstool, Pete Smith Hill).

values producible by sampling a complete assemblage at a given sample size. By comparing archaeological cortex ratios to their corresponding null CIs, it is possible to interpret the archaeological cortex ratio with statistical confidence. The black dots in Figure 3b show the cortex ratios of the six assemblages located away from Pete Smith, whereas red bars represent their respective null 95% CIs following Lin et alia (2015). The null cortex ratio CIs have a wide spread, reflecting the small sample size of the assemblages. As a result, all of the archaeological cortex ratios fall within their respective null distributions, which means that it is difficult to determine whether the calculated ratios signal an imbalance in assemblage cortex versus volume or not.

These results indicate that small sample size has an impact on the certainty of the empirical cortex ratio values. Some areas seemingly received an abundance of cortical flakes (e.g., Sand Creek), whereas others received more noncortical artifacts. Some locations received many primary flakes discarded with little modification (Sand Creek, again), whereas other places received material from continued maintenance of transported cores and the retouching of transported blanks (e.g., White Head Creek). The wide CI ranges are similar to the variability seen in the cortex ratio values for low-density Rutherfords Creek scalds. Taken in isolation, the low-density assemblages distant from Pete Smith are too small to show statistical significance. To obtain larger samples at individual locations would require much time to pass to allow for further erosion or more expansive survey of erosion within the study area. But if aggregated, the assemblages suggest that cortical flakes and some cores were moving away from local material sources and discarded through the grasslands.

There are other ways to explore how the outflow and inflow of stone affected the formation of assemblages. Local stone captures material moving out from sources, whereas nonlocal materials show a flow of stone moving through the grasslands that originated somewhere else. One way to observe this is to look at the size (mass) for artifacts made from local and nonlocal sources as well as variability in relative proportions of local and nonlocal stone. Because samples are small, we bootstrap (1,000 iterations) the assemblages to derive the 95% CIs for overall weight

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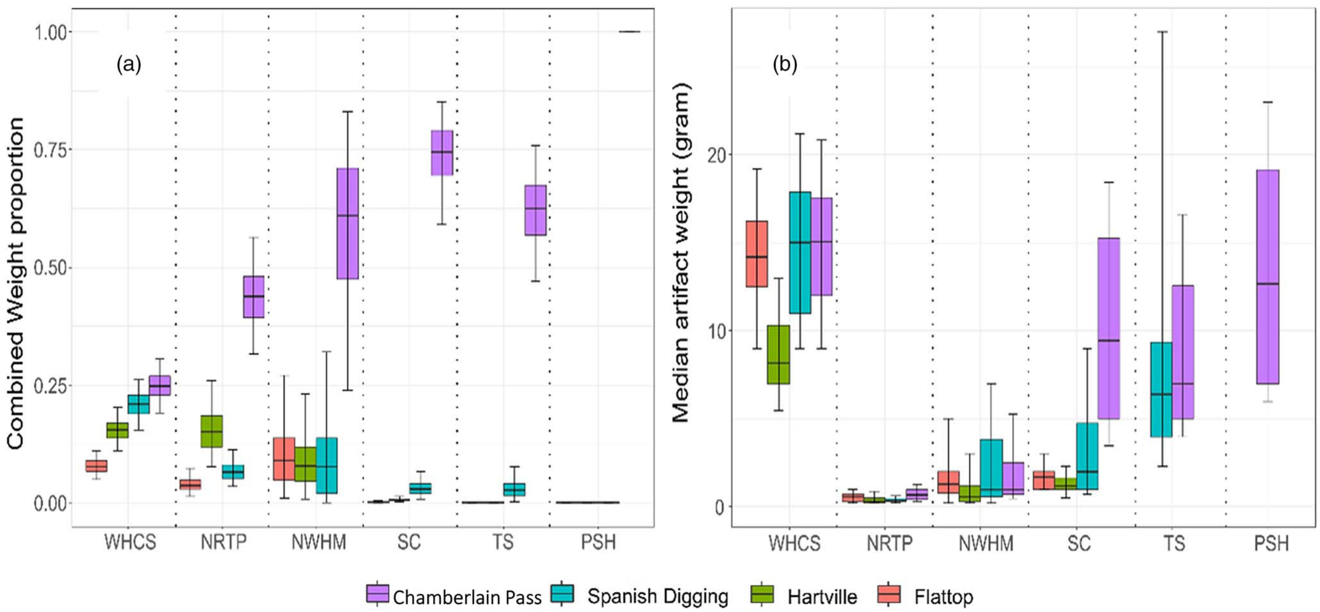

FIGURE 4. Artifact weight by raw material type for the study locations (Whitehead Creek Survey, North of Roundtop, Northwest of Hudson Meng, Sand Creek, Toadstool, Pete Smith Hill): (a) combined proportions by material type for all detached pieces (i.e., not cores); (b) median artifact weight by raw material type for all detached pieces for the study locations.

proportion (Figure 4a) and median artifact weight (Figure 4b) of detached pieces by raw material sources, including the local Chamberlain Pass source and three other nonlocal sources (Spanish Diggings or Cloverly Quartzite, sourced to the Laramide range in eastern Wyoming; Hartville chert, with a similar source; and Flattop chert, a White River Group silicate outcropping throughout the western Plains). Figure 5a plots 95% CIs of local and the nonlocal artifact frequency across the study locations. Results indicate larger sizes for flakes manufactured from local material compared to those manufactured from nonlocal materials, variability in relative proportions of local versus nonlocal material, and considerable variability in artifact size.

Figure 5b presents the bootstrapped proportions of artifacts with different platform types using the same CI. Three platform types are illustrated: cortical, single platform, and other (incorporating bifacial, ground, multifaceted, and crushed varieties). Patterns among the locations are similar to observations about artifact size and cortex proportions. Locations with the highest cortex ratio values tend to have the most cortical platforms, which is not surprising given that early reduction flakes are more prevalent driving up cortex proportions. Locations with smaller artifacts and/or larger proportions of nonlocal material have lower percentages of cortical platforms and high percentages of other platform types reflecting greater reduction intensity.

In summary, even though samples are small, there is a marked degree of variability among locations. But much of the observed patterning relates to the relative proportion of local versus nonlocal raw material that drives trends in artifact size, cortex proportion, and platform characteristics. Consequently, different locations in the ONG are variably sensitive to the two-way processes of raw material moving out from a local source and coming to rest over the broader landscape, and of materials brought in from other more distant sources working their way into the study area. Ultimately, such movement provides the basis for understanding changing settlement systems and place use through time. The challenge for archaeologists is that to document such change requires repeated observations at locations that include low density, low diversity, lithic scatters, and isolates like those recorded in the Australian study.

DISCUSSION AND CONCLUSION

The three case studies add to a growing body of research that illustrates the value of low-density lithic artifact scatters. In Australia, analyzing both low- and high-density artifact exposures using the cortex ratio allows inferences about the regularity of movement of artifacts, with results suggesting that locations with both high- and low-density assemblages represent similar outcomes. Both suggest repeated use of places by small groups of people rather than a distinction where higher-density deposits are indicative of intensive resource extraction often by larger/more concentrated groups. The American cases studies, both Collector assemblages and those from ONG, indicate the potential for similar types of analyses. Some Collectors accumulate lithic artifact assemblages over lifetimes from known locations. Analyses conducted in the ONG indicate that without repeated visits to sample eroding assemblages, it is difficult to obtain sufficient artifact numbers to demonstrate movement away from raw material rich areas into places lacking tool stone. However, despite these limits, results are sufficient to suggest differences in the history of landscape use across wide areas driven by movement reflected in the use of local versus distant raw materials. All three case studies help to further show the value of analyzing the spatial distribution of lithic artifacts rather than concentrating efforts on high-density locations or those containing unique concentrations of retouched

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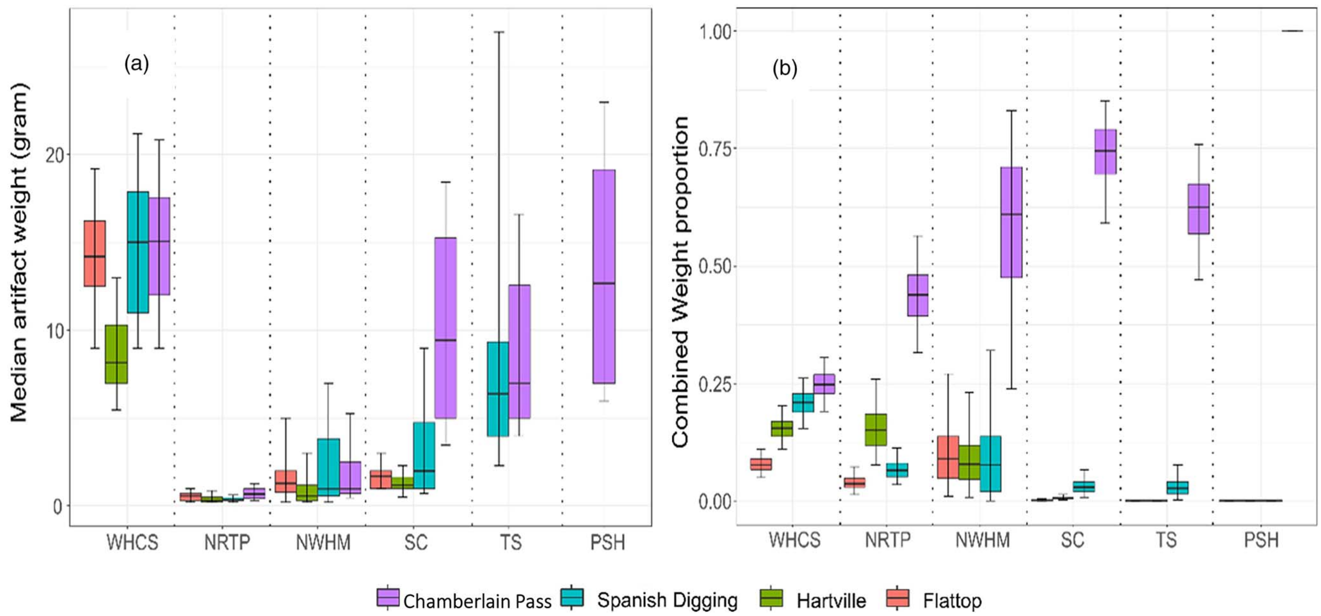

FIGURE 5. Study location assemblage variability (Whitehead Creek Survey, North of Roundtop, Northwest of Hudson Meng, Sand Creek, Toadstool, Pete Smith Hill): (a) proportions of artifacts with different platform types between the study locations; (b) local and nonlocal lithic source proportions across the study locations.

tool forms. This suggests that analytically, low-density surface scatters hold the same research potential as high-density deposits. Indeed, one is not interpretable without the other (Sullivan 1996; Wandsnider 1988).

Nebraska State Historical Society (NSHS) Section 106 guidelines specify requirements for eligibility in the National Register of Historic Places. Site identification requires the delimitation of a spatial boundary; however, isolated finds have the added stipulation that those subject to postdepositional processes are ineligible for site status (NSHPO 2017:22). Eligibility assessment further requires archaeologists to consider the site's physical condition, the depth of deposit, density of artifacts, feature integrity, research potential, and uniqueness.

Tainter and Bagley (2005) critique current practice in the United States, arguing that it implicitly confers protection on sites that are exceptionally deep, old, well preserved, or rich in variety. In contrast, archaeological occurrences generated by high-frequency (e.g., daily) production activities often result in a sparse archaeological record with little saliency. Such low-saliency sites, they contend, are likely more representative of past behaviors than are the high-saliency sites but are rarely considered "significant." Their point is that current practice, without reflection, shapes or biases the archaeological record preserved and bequeathed to future generations. Lipe (1974) advocated for the long-term preservation of a representative sample of sites. However, if *high-saliency* sites remain the focus, and low-saliency sites are overlooked or ignored, there is no way to preserve a representative sample, let alone accurately interpret the sites given analytical and protective priority (Nolan 2020).

The assessment system for inclusion of sites into the Aboriginal Heritage Information Management System (AHIMS) in New South Wales (NSW), Australia, is broadly similar to that in Nebraska. Criteria for assessing archaeological significance cover research potential, rarity, and representativeness. Research potential relates to the ability to inform on past behavior, rarity to the "importance in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practiced, in danger of being lost, or of exceptional interest" (Aboriginal Heritage Division 1997) and representativeness of site types (e.g., rock shelters, open sites) in a variety of environments (Byrne 1997:6–10). The NSW National Parks and Wildlife (NSWP&W) Act 1974 and the NSW Environmental Planning and Assessment Act 1979 regulate the heritage and environmental impact assessment processes in New South Wales (Bryant 2013). In 2010, amendments to the NSWP&W Act added a Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW that proscribed assessment processes. However, despite criteria in these processes asking practitioners to include social and spiritual values alongside those related to science and archaeology, Brown (2008) discusses the failure of the archaeological community to integrate scientific values with other value systems. This led to the adoption of a site-based discourse by Aboriginal communities, with the archaeological objects themselves given spiritual and social values. In other words, despite a separation of assessment criteria dating from the 1980s—one Indigenous and the other archaeological (Lilley and Williams 2005)—archaeological (i.e., scientific) assessment prevailed but was adopted by Aboriginal communities for their own purposes. As a result, there is an emphasis placed on physical heritage items by Aboriginal communities reflecting the language used in heritage legislation but not necessarily the strictly archaeological interpretative potential of these objects (Byrne 2013). The result, Brown (2008) contends, is a heritage system where the descriptions of objects become an end in themselves, with archaeological impact assessment reduced to an aspiration to conserve, rather than assessments of archaeological research potential.

Brown (2019) contrasts the site-based Australian heritage legislation with the Aboriginal concept of "Caring for Country." The phrase refers to people, nonhuman species, and supernatural beings as part of a landscape where significance comes from the whole rather than the parts (Rose 1996). As Brown (2019) notes, there is a tension in heritage work between archaeological site definition and Aboriginal community aspirations to protect Country, regardless of the presence of heritage objects.

In Nebraska, NSHS Guidelines interpret site integrity as the physical condition of the site with information requested concerning the past, current, and future threats. However, in both Nebraska and western NSW, site integrity as a criterion highlights a "Catch-22" situation (Wandsnider 1988; Wandsnider et al. 2008). In both the ONG of Nebraska and the Great Plains collecting communities, it is mostly through erosion and other geomorphological processes that archaeologists and Collectors are able to document artifact occurrence. Without the aid of erosion, the Great Plains' "sea of grass" would provide little opportunity for assessing artifact distribution and therefore archaeological site definition. Although subsurface testing is employed to evaluate surface finds, densities are often too low to economically and accurately document low-density distributions such as those reported for the ONG study above. Instead, some sort of disturbance—slope erosion, deflation, etc.—is required. The same is true in semiarid western NSW, where erosion creates surfaces on which artifacts appear as a lag—that is, visibility attributable to these processes acts to both enhance and detract from the research potential of particular locations.

The Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW, Australia, is not predicated on determining disturbance but does require the construction of a predictive model for Aboriginal land use. This model includes the potential for accumulation and preservation of objects, predictions of landscape use, the location of resources, and foci for activities and settlement, together with the distribution of material traces of Aboriginal land use (Department of Environment Climate Change and Water 2010:8). The obvious difficulty in constructing such a model is to assess both the visibility and distribution of archaeological materials and therefore to develop an understanding of the full variability of the archaeological record, without extensive fieldwork (Smith 1996). Any inaccuracies in models raise the possibility of removing sections of the landscape from consideration.

Issues of the relationship between disturbance and significance come to a head when considering records such as Rutherfords Creek, the ONG, and those documented by Collectors. Describing the record as it appears at one time and place may have little long-term significance. As many CRM professionals appreciate, upon return to the same location in the future, erosion may well have not only removed the archaeological materials originally recorded but also exposed others previously unseen. At the same time, as in both the Rutherfords Creek and ONG case studies, assessing archaeological significance requires extensive surface erosion. Seen in this context, the actions of some Collectors have produced archaeological samples of sufficient magnitude to provide for archaeological analysis unobtainable through conventional archaeological investigation. Collectors, therefore, rather than archaeologists, have fulfilled the criterion for determining research significance where this includes a requirement for artifact abundance.

A heritage system where the description of objects becomes an end in itself—but where the exposure of the archaeological record, and therefore its visibility, is a continually changing process—poses challenges for the heritage management community. How do we recommend the preservation of significant sites in the face of development when exposure, and therefore site definition, is transitory? Perhaps the results of the Rutherfords Creek and ONG analyses provide a way forward. Brown (2019) notes the tension between aspirations to conserve Country and the legislative basis for heritage when notions of Country may include intangible criteria that value parts of landscapes without the presence of conventional heritage materials (in the United States, Traditional Cultural Properties [TCPs]; King 2003; Parker and King 1998). The patterns identified in Rutherfords Creek are emergent in the sense that they take time to develop. The loss of variance with the cortex ratio can only be observed if both short-term and long-term deposits are compared as well as those with both high- and low-density records. Similar results are suggested by the comparison of low-density lithic assemblages in the ONG to locations with dense records, such as Pete Smith. As noted in the introduction, a source of inspiration for the work presented above can be traced to advice from Aboriginal communities. As a senior Aboriginal man remarked to one of us (SJH) many years ago, "It's not about place, Simon. It's about Country." As it turns out, archaeological analysis tailored to thinking about low-saliency artifact distributions across landscapes rather than the significance of single places—that is, high-saliency archaeological sites—shows that such advice is extremely useful. To understand the archaeological manifestations of such fundamental archaeological concepts as forager and collector needs a concept like Country or TCPs rather than place (in the sense that place equates to site).

Of course, this brings the Australian experience of the adoption of scientific archaeological criteria by Aboriginal communities full circle. Archaeologists just need to see that through this adoption, Aboriginal people have provided the methodological inspiration to allow reliable analyses of the archaeological record without the need to impose arbitrary significance criteria that prejudge the importance of levels of disturbance and artifact abundance. The results from the ONG study and the analytical potential of Collector assemblages suggest that the same may be true in the United States. With this realization may come the opportunity for archaeologists (both Indigenous and otherwise) to combine forces to rework heritage practice to better reflect the material existence of the archaeological record.

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Data Availability Statement

Portions of this article are based on previously published data. Image data from collector collections are available at www.unl.edu/plains/artifact-roadshow-digital-archive. Inquiries regarding data from Australia may be directed to Simon Holdaway. Inquiries regarding data from the Oglala National Grassland may be directed to Matthew Douglass.

Competing Interests

The authors declare none.

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