REASSESSING THE USE OF KELLY'S MOBILITY INDEX IN EXAMINING LATE ARCHAIC ASSEMBLAGE VARIABILITY IN SOUTHERN IDAHO

by

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The following individuals read and discussed the thesis submitted by student Shawn Elizabeth Roberts, and they evaluated her presentation and response to questions during the final oral examination. They found that the student passed the final oral examination.

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DEDICATION

For Dr. Steve and Mama Di. Thank you for giving me the opportunity to take chances. I love you always.

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Shawn Roberts has been an Idahoan for the majority of her life. She received her Bachelor of Arts in Anthropology from Boise State University in May 2013. Following graduation she began her graduate studies working as Coordinator at Boise State University's Archaeology Field School under the advisement of her advisor and PI, Dr. Mark G. Plew. She spent both summers of her graduate studies working with and instructing undergraduate students on proper field archaeology and laboratory techniques.

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ABSTRACT

During the past two decades North American archaeologists have attempted to document levels of prehistoric aboriginal mobility. Robert Kelly has developed a fourteen variable index for assessing mobility based upon the technological organization of chipped stone assemblages. Each variable has a binary outcome of high or low residential mobility reflecting Lewis Binford's expedient versus curated technologies. Kelly's index has been used to individually evaluate levels mobility of a number of Late Holocene age sites in southwestern Idaho. This thesis reanalyzes seven previously assessed sites as well as sixteen additional Late Holocene/Archaic open site assemblages along the Snake River in southern Idaho using Kelly's index of residential mobility.

A primary objective of this thesis is to re-evaluate the use of Kelly's index with respect to whether the inclusion of non-chipped stone materials would significantly alter the usefulness of the index. Additional variables evaluated in this thesis included pottery, groundstone, the presence of fire hearths, and storage features, all of which have been suggested as indicators of mobility. Following the assessment using Kelly's mobility index, 22 of 23 assemblages reflect high levels of residential mobility. Kendall's Tau correlations for the new variables showed that pottery and storage were significantly correlated with pottery, groundstone, the presence of fire hearths, and evidence of storage. A set of linear regression analyses assessing the relationship between

assemblage size and diversity resulted in a low slope which suggests a generalized toolkit for the sampled sites. The analysis suggests Kelly's index alone is not the most efficient means to assess mobility at the level of an individual site. Rather, the index and additional variables should be used as guidelines to assess mobility on a regional scale.

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LIST OF ABBREVIATIONS

BPNC	Birds of Prey National Conservation Area
CCS	Cryptocrystalline silica
KMI	Kelly's Mobility Index (2001)
MNI	Minimum Number of Individuals
OFT	Optimal Foraging Theory
TAR	Thermally Altered Rock

CHAPTER ONE: INTRODUCTION

Understanding the way in which prehistoric peoples moved across the Snake River Plain has been the focus of studies for over 20 years. Gould and Plew (1996, p. 78) conducted a quantitative analysis of seven Late Archaic assemblages along the Snake River in southern Idaho showing a relationship between prey species and tool types. Their analysis found that tool production was highly generalized and often consisted of expediently manufactured tools. In addition, faunal studies implied direct feeding, a strategy most often utilized by foraging groups (Gould & Plew, 1996). Subsequent analyses of Late Archaic archaeological assemblages along the Snake River (Plew, Plager, Jacobs, & Willson, 2006; Plew & Willson, 2007, 2010, 2012; Willson & Plew, 2007) have used Kelly's mobility index (Table 1) to assess assemblage variability and infer short-term occupational site use (Kelly, 2001).

The Late Archaic is distinctive in the Great Basin for a number of reasons. Archaeologically, the Late Archaic in southwestern Idaho has been characterized by the introduction of ceramics and the bow and arrow (Plew, 2008, p. 95). The common occurrence of ceramics in the region occurred approximately 1000 years ago while fire clay technologies have been dated to 6000 years ago. Ceramics from this period are undecorated, utilitarian vessels. The shift from atlatl to bow and arrow is generally associated with a shift towards hunting smaller prey species (Plew, 2008, p. 95). This analysis would expect to see a more common occurrence of fired clay or ceramics in Late Archaic sites along the Snake River.

Faunal remains from Late Archaic sites suggest a diverse diet breadth including "deer, antelope, mountain sheep, and numerous smaller mammals" (Plew, 2008, p. 97). Many resources in the region appear to have been utilized when available and on a seasonal basis. These types of resources included salmon, bison, and camas. While these items were not necessarily primary resources, they do appear throughout the record and were likely utilized when the cost of acquiring and processing outweighed other available resources. Knowing there was a shift in prey species, instances of pottery, and technological preferences speaks to a possible shift in how people moved around the landscape. Previous Snake River Plain mobility analyses have used the forager-collector continuum as a way to characterize assemblages and associate them with differing levels of mobility (Binford, 1980; Kelly, 1988, 1992).

Binford uses ethnographic information and activity area archaeology to outline archaeological expectations of sites for foragers and collectors. In an effort to increase the ways in which archaeological data can be used to infer mobility, Robert Kelly's mobility index (2001) has been utilized in a number of southern Idaho mobility studies (Gould & Plew, 1996; Plew et al., 2006; Plew & Willson, 2010, 2012; Willson & Plew, 2007). Kelly's mobility index (KMI) is a set of variables assessing the lithic component of the archaeological assemblages to infer levels of mobility; it is derived from Binford's (1980) forager-collector continuum. Variables in Kelly's (2001) index (Table 2) include items relating to flake types, bipolar knapping, prevalent raw material types, assemblage size and diversity. Using experimental and ethnographic data, Kelly suggests differences in the archaeological assemblage that correspond with variance in high and low residential mobility.

Figure 1: Overview map of Idaho with study area highlighted, detail in Figure 2.

Kelly's mobility index on the Snake River Plain has been utilized with seven Late Archaic sites to assess mobility for individual sites (Figure 2). These sites fall within an approximately 100 mile stretch of the river between Melba and King Hill, Idaho (Figure 1). The present analyses follow Kelly in examining chipped stone variables. While useful, other artifact types have been shown to be likely indicators of mobility. These include pottery (Bright & Ugan, 1999; Dean, 2005; Eerkens, 2003; Garvin, 2011; Simms, Bright, & Ugan, 1997), groundstone (Buonasera, 2012; Dubreuil & Savage, 2013; Hayden, 1987; Wilke & Quintero, 1996), presence of fire hearths (Kelly, 2001; Panja, 2003), and evidence of storage (Binford, 1979, 1980, 1990; Panja, 2003; Plew, 2003).

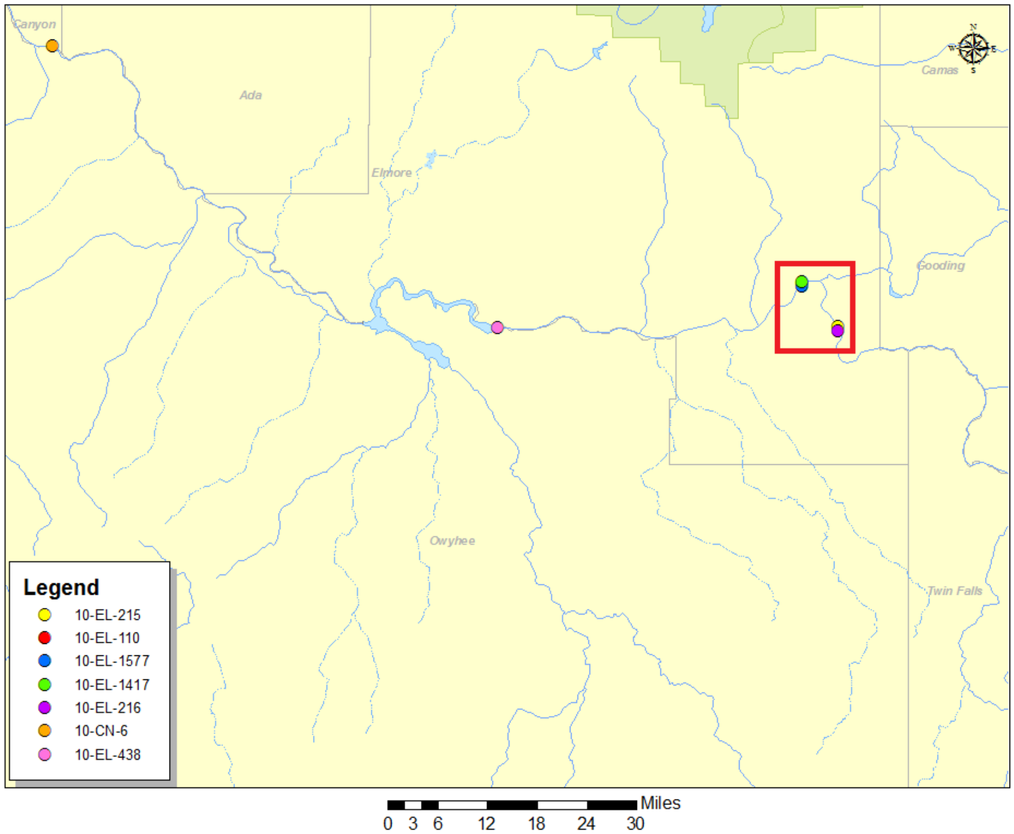

Figure 2: Locations of sites (n=7) that have previously been analyzed using Kelly's mobility index, detail Figure 3.

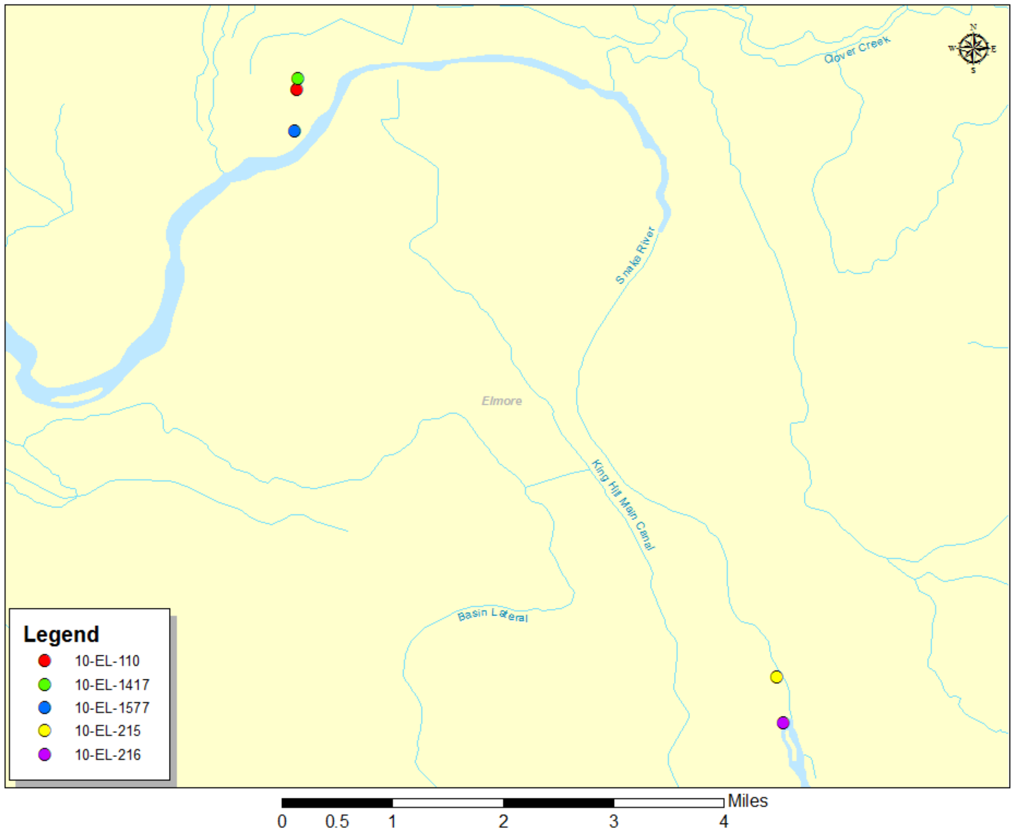

Figure 3. Detail from Figure 2. 5 sites previously assessed using Kelly's mobility index.

Of the previously analyzed sites, 6 of 7 have been designated as having a majority of indices that suggest high residential mobility (Table 1). These sites support hypotheses by Gould and Plew (1996) that Late Holocene/Archaic faunal and artifact assemblages on the Snake River suggest a highly mobile prehistoric lifestyle. This research will increase the sample of sites assessed with Kelly's index in order to evaluate the effectiveness of KMI as a method to assess mobility. The expansion of the sample includes 23 Late Archaic open-site assemblages in the vicinity of the Snake River. The study is restricted temporally to the Late Archaic to limit the variance due to temporal differences in assemblages.

In addition, other indicators of mobility (i.e. pottery, groundstone, fire hearths, and storage features) will be examined in conjunction with KMI to assess whether the current usage of KMI is sufficient for analysis with Late Archaic site excavation archival data.

Table 1. Overview of KMI correlation of criteria according to previous site reports

Sites	Informal Name	Previous KMI Correlation of Criteria	High/Low Mobility
10-EL-215	2012	10/4	High
10-EL-110	King Hill	12/2	High
10-EL-1577	Knox	2/12	Low
10-EL-1417	Swenson	10/4	High
10-EL-216		13/1	High
10-CN-6		12/2	High
10-EL-438		13/1	High

With the expansion of variables and sample size, this thesis addresses the following research questions:

1) What can frequencies of functional tool/debris types tell us about levels of mobility in Late Archaic sites on the Snake River Plain?

2) Does the addition of non-lithic variables to existing mobility indices alter designations of high or low residential mobility for sites along the Snake River, and if so, how and why?

3) What limiting factors are currently embedded in the use of chipped stone variables in mobility analyses?

4) Is the use of Kelly's Mobility Index an appropriate method for assessing the level of mobility from a single site?

Summary of Chapters

Chapter One gives a general overview of the previous research regarding prehistoric mobility on the Snake River Plain as well as the research objectives for this study. Chapter Two outlines the theoretical framework under which this research was conducted as well as outlines the literature supporting the use of technological organization schemes, Kelly's mobility index, and other indices of mobility. Chapter Three includes historic ethnographic data on the region, gives a brief description of each site and assemblages used in this study, and outlines the variables in Kelly's mobility index. Chapter Four is an overview of methods, including the variables and calculations used in this analysis. In addition, a description of the archaeological expectation for each variable is provided. Chapter Five reports the results of all descriptive and statistical analyses. Chapter Six includes a discussion of the analysis provided in chapter five and provides the conclusions of this research.

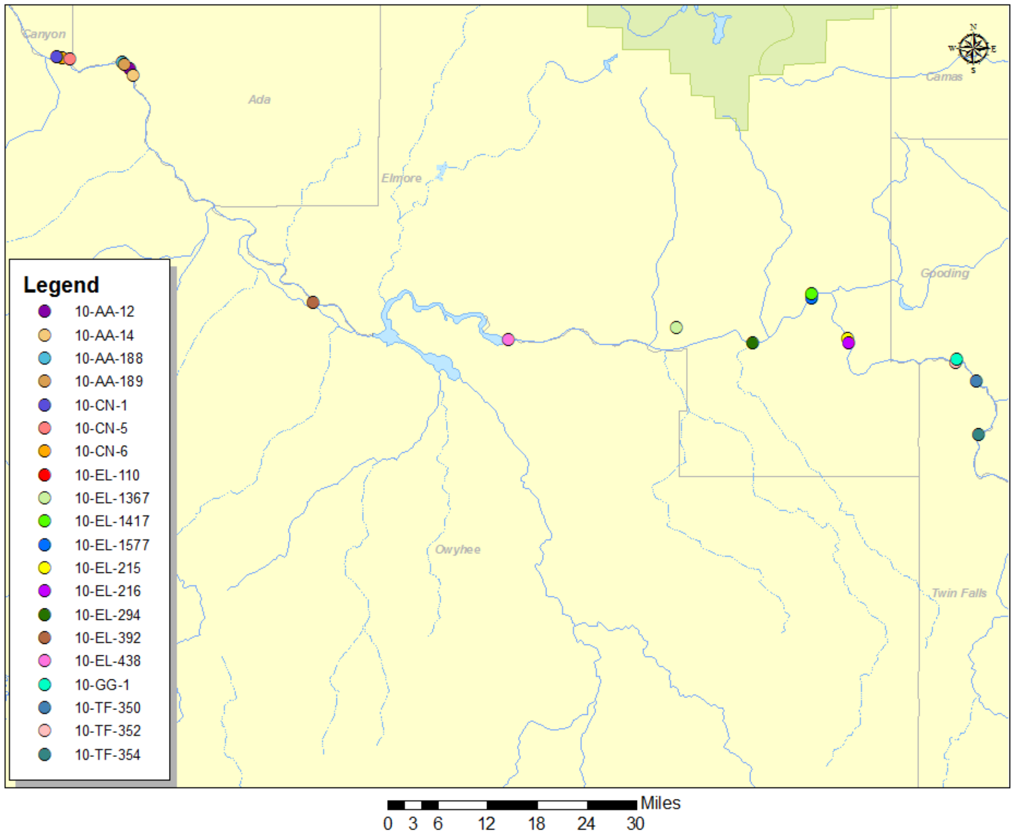

Figure 4: Locations of sites used in this analysis.

CHAPTER TWO: THEORETICAL FRAMEWORK

The forager-collector continuum is the foundation for recent archaeological mobility studies and is a mechanism to compare material culture and the relationship to varying subsistence strategies (Andrefsky, 1991; Bamforth, 1991; Bettinger, 1987; Binford, 1980; Kelly 1983). Binford (1980) uses ethnographic information and activity area archaeology to outline what is expected in the archaeological record for foragers and collectors. A distinct foraging trait is the daily collection of food (Binford, 1980, p. 5). Binford describes foragers as often using a central residential camp to return to nightly after foraging throughout the day. The archaeological remains of foragers generally fall into two categories: the *residential base* and *locations* (Binford, 1980, p. 5). Residential bases are generally the conglomerate of many activity areas and are often tethered to resources such as water. Locations include a wide range of short term activities, generally the procurement, processing, or consumption of an acquired resource. Collectors are characterized by the storage of food and the organization of logistical parties for resource procurement (Binford, 1980, p. 6).

Binford (1980) and Kelly (1992) discuss the formerly limiting mobile and sedentary categorizations of settlement patterns as an organic scale which groups move across based upon environmental constraints, resource abundance, and seasonal variance. The artifacts produced in both foraging and collecting strategies range from curated to expedient (Binford, 1979). Curated items are those produced for a specific purpose in anticipation of a future need. They are maintained, transported, and recycled until they no longer fulfill a need (Bamforth, 1986, p. 2). Expedient tools are often created opportunistically and are not intended to fulfill more than an immediate need.

The contrast between foragers and collectors is discussed in an archaeological context by Robert Kelly (1992) in his elaboration on the correlation between mobility, raw material availability, and technological needs analyzes the "life history" of a biface. The biface is primarily used as an example as it can be used as core material, long use-life tools, or as a by-product of the flaking process (Kelly, 1992, p. 719). He cautions against the use of stage reduction identification alone as a means for assessing site types (i.e. residential base, processing site, etc.) as the biface study shows that a wide array of bifacial reduction strategies (with grossly different outcomes) often have remarkably similar byproducts.

In an effort to increase the way in which archaeological data can be used to infer mobility, Robert Kelly's mobility index (2001) has been utilized in a number of southern Idaho mobility studies (Gould & Plew, 1996; Plew et al., 2006; Plew & Willson, 2010, 2012; Willson & Plew, 2007). The index utilizes the chipped stone used to interpret archaeological site use duration. Kelly's mobility index (KMI) is a set of variables relating to the lithic component of the archaeological assemblage. Using experimental and ethnographic data, Kelly suggests differences in the archaeological assemblage which would be discernible between sites of high or low residential mobility.

Other models relevant to archaeological mobility studies include optimal foraging theory (Alvard, 1993; Hill, Kaplan, Hawkes, & Hurtado, 1987; Sahlins, 1968), central place foraging (Bettinger, Malhi, & McCarthy, 1997; Bird & Bliege Bird, 1997; Kaplan

& Hill, 1992; Zeanah, 2004), and patch choice analyses (MacArthur & Pianka, 1966; Sosis, 2002).

The goals of optimal foraging modeling (OFT) are to explain variation in hunter-gatherer resource acquisition and to develop general models for understanding these decision-making opportunities. OFT is based upon the foundation that organisms will act according to fitness maximizing behaviors (Kaplan & Hill, 1992). In economic terms, the best strategy is one whose benefits most greatly outweighs the costs. Optimal foraging is a fundamental concept for those studying the mobility continuum as the costs of moving a group can vary based upon group composition, season, and possible fitness costs with substantial residential movement. Another utilization of OFT in archaeology is through the analyses of faunal assemblages. Gould and Plew (1996) analyzed collections along the Snake River with interest in highlighting the importance of fish in prehistoric contexts. Of the study sites, Gould and Plew were able to demonstrate a distinctive relationship between tool frequencies and types of prey represented in the record and illustrated the stability of avoiding bulk fish exploitation in the Late Archaic. The faunal data here suggests more of a foraging subsistence strategy. This is potentially useful with Kelly's (2001) identification of chipped stone indices. By identifying the faunal material as reflecting foraging effort, Kelly's index could be applied to the corresponding lithic assemblages to assess whether the lithic components also reflect expedient strategies or foraging effort.

Central place foraging models are based on the premise that human foragers often use a central point with a limited foraging radius when hunting or gathering to maximize efficiency. This method may reduce search times when the foragers know where specific resource patches are in relation to their camp location as well as limiting the energy expenditure used by constantly relocating to follow available resources. Kaplan and Hill (1992) make the distinction between specific pursuit central place foraging models and random search and pursuit central place foraging models. Specific pursuit is the knowledge of either a specific patch or prey item and energy expenditure involved in the acquisition of those resources. Conversely, random pursuits are forays where any species falling in the diet breadth are targeted and pursued. This relates to the use of Kelly's index as central place foraging models show that different activities are spread across the landscape. Different activities, whether it's the creation of expedient or curated technologies, would result in identifiably distinct activity areas and assemblages. When an area where central place foraging was used has been identified there should be the 'central place' where activities reflecting lower degrees of mobility occur. Conversely, on the outskirts where forays and logistical trips occur archaeologically the expectation would be supported in the occurrence of assemblages reflecting high residential mobility.

The reality of central place foraging practices most likely fall somewhere between the two models (Kaplan & Hill, 1992). Archaeologically, there have been many interesting tests on the applicability of central place foraging models in prehistoric settlement site distributions. The testing often includes the calculation of acquisition costs between archaeological sites and the radius within which foragers would be able to travel to keep cost-benefit in a profitable range (Hildebrandt & Ruby, 2006; Metcalf & Duncan, 1992). Once a profitable radius is calculated sites within this area can be studied in a larger context than was previously possible.

Morgan (2008) uses central place modeling and geographic information systems (GIS) to illustrate this concept. This study uses GIS to reconstruct prehistoric foraging radii or the distance a forager will travel in a single day to acquire resources. Morgan identified settlements in the southern Sierra Nevada, California area and evidence of acorn caching. Morgan used Binford's (2014, p. 20) coarse versus fine grain assemblage categorization to identify sites in the study area (see also Plew, M. G., Ames, K. M., & Fuhrman, C. K., 1984). Coarse grained assemblages are those which include items accumulated over a substantial period of time while fine-grained assemblages reflect very few cultural site formation events. The analysis of least cost path between caches and residential bases resulted in a foraging radii of 9 km. The use of GIS, known caching, and residential bases has the potential to greatly expand the way in which we can discuss prehistoric foraging radii and practices.

Metcalfe and Duncan (1992) generated hypotheses using central place and time allocation models to determine the relationship between processing in-field or after a resource has been brought back to the central place residential hub. In-field processing was defined simply as the deconstruction of a resource into smaller units near where the resource was procured (Metcalf & Duncan, 1992, p. 353). With faunal remains the comparison of cost-benefit for in-field processing and only transporting the most resource dense items to the residential hub can inform which aspects were important to prehistoric diet.

The definition of resource also allows archaeologists to use this type of lithic sources using X-ray fluorescence (XRF) technology. XRF identifies unique mineral characteristics of volcanic glasses. Each obsidian source has a unique mineral composition which can be sourced and compared to artifacts made of the same material. By knowing the distance between the artifact and the source material archaeologists are more apt to discuss the acquisition costs of materials in relation to the distance of the source. A case study of obsidian sources in the Great Basin suggested an expansive cyclical territory following artifact distribution and proximity from the original volcanic glass source (Jones, Beck, Jones, & Hughes, 2003). The study correlated the drying between terminal Pleistocene to the early Holocene to the usage of where artifacts generally remained within 200-300 km of the source (Jones et al., 2003, p. 31). This 200-300 km radius was used to imply the limitation of mobility within those zones for the transition from Pleistocene to early Holocene. This premise has since been critiqued for failing to regard other agents of artifact movement (i.e. recycling by other individuals, natural movement of stone by water and wind from sources, etc.) (Willson, 2007). These studies show that foraging radii can be calculated with sensitivity to the complexity of how items move across the landscape.

Technological Organization

With the rise of lithic studies in 1960s and 70s, many researchers began to look at the way in which organization of the artifact assemblage reflects specific strategies and levels of mobility. The primary means of distinguishing investment in a tool is expediency versus curation (Binford, 1979; Nelson, 1991; Kelly, 1988, 1992; Torrence, 1983, 1989). Mobility studies and the assessment of technological organization of artifact assemblages reflect the variance in tool investment.

Ammerman and Feldman (1974) researched a quantitative approach to assess mobility through assemblage organization. They focused on “(1) the set of activities performed by a group during the course of a year; (2) the relative frequency with which each activity is performed during the year; (3) the set of tool types used by the group; (4) the "mapping" relations between tool types and activities; and (5) the dropping or abandonment rates of stone tools" (p. 610). Shott (1986) continued with this type of analysis, testing the validity of the assumption that as mobility increases the number of tools carried decreases. He demonstrated that overall quantity is limited by mobility, but high levels of diversity among an individual tool kit can be maintained by decreasing the number of tools per category.

Winter's Technological Organization Scheme

Winter's 1969 assessment of the Riverton culture uses an artifact classification scheme of discrete functional categories. The description of the Riverton artifact assemblage focused on the need to not only discuss form, but also artifact function. Winter's focused on the common problem of providing solely artifact measurements with no discussion of the function. Even when form was described it was done without the care for similar forms with completely different functions (Winter, 1969, p. 30).

The assessment of the Riverton assemblage contained a combination of traditional description and functional analysis. Winter established a ten categorical system including: "weapons, general utility tools, domestic implements, fabricating and processing tools, woodworking tools, agricultural or digging implements, ornaments, ceremonial equipment, recreational equipment, and fire-making equipment" (Winter, 1969, p. 30). Winter acknowledges even within these categories there is likely misidentification or misinterpretation of functional uses for artifacts, but the use of functional categories provides a foothold for future researchers to continue analysis with the recorded data.

This scheme was taken by Thomas (1983) and condensed into categories relevant to protohistoric Great Basin Shoshoneans. Thomas includes general utility tools, weapons, harvesting equipment, domestic, fabricating, ceremonial, and recreational equipment (1983). Harvesting equipment, a variable not specifically included in Winter's scheme, includes "any implement designed primarily to facilitate the untimely demise of some member of the floral community" (Thomas, 1983, p. 72). Thomas goes on to use these categories to correlate with different types of archaeological sites in the Great Basin taking the utility of these functional categories even further. Much of the discussion comes back to the seasonal variability of the region with noted activities and their association with tool types. Thomas goes a step beyond Winter's creation of a technological organization scheme and applies it toward identifying activity areas by tool function in the Great Basin.

Thomas' (1983) condensed scheme was used by Gould and Plew (2001) in their analysis of faunal remains and tool types for sites on the Snake River (Gould & Plew, 2001, p. 39). The difference between the modern functional analyses and the former practice of reporting of artifact dimensions gives the future researcher a clearer insight as to the overall function of the site assemblage.

In contrast, Binford (1980) conducted a case study with a group of Nunamiut Eskimo to record the way in which the archaeological context is created. Binford recorded activities for several logistical and residential moves. In this Binford found that "locations preferred for residential camps can be expected to yield a most complex mix of archaeological remains since they were commonly also utilized logistically when the residential camps were elsewhere" (Binford, 1980, p. 15). Binford does caution the user of assemblage-based systematics to remember that patterns yielded from archaeological remains are informing on the organizational function of cultural systems, not the culture themselves (Binford, 1980, p. 28). Robert Kelly, a student in the Lewis Binford school, has created such an method of organizational function analysis with the index of residential mobility (Kelly, 2001).

Kelly's Mobility Index

With the use of functional analyses, mobility studies have begun to explore specific aspects of the archaeological assemblage and how trends in function can reflect levels of mobility. Kelly's Mobility Index (KMI) uses fourteen variables related to the chipped-stone aspect of the archaeological assemblage to assess levels of prehistoric humans' residential mobility. Each variable has a dichotomous outcome of high or low mobility based upon experimental and case study data. Kelly establishes the theory behind the index as a reflection of expected behaviors.

A short-term residential/ logistical model would produce bifaces for long-term use prior to groups entering the Carson Desert. The amount of naturally occurring toolstone is extremely limited to outskirts of the region. The available stones in the region include cryptocrystalline stone and glassy volcanics. Kelly suggests the use of quality lithic materials would be limited and a higher degree of precision would be exerted to minimize waste. This would result in more complete flakes and less angular debris. Bifaces would likely serve dual purpose as tool and source material (Kelly, 2001, p. 73-74).

For a long-term residential model Kelly suggests that as material shortages occur more often in an environment without readily available toolstone bipolar reduction of exhausted cores or fragments would increasingly occur. Bipolar manufacture would become more common with extension of occupation especially when groups stay in an area longer than anticipated. However, bipolar flaking would be less prevalent in sites where the acquisition of toolstone coincides with other activities. Kelly assumes there should be sufficient evidence of bifacial tool manufacture in the study area since they were commonly used throughout the Great Basin and are known to be maintained in residential locations (Kelly, 2001, p. 74).

Table 2. Kelly's Mobility Index (2001) is a tool to compare components of the archaeological assemblage to expectations of varying mobility patterns.

Kelly’s Mobility Index (2001)		
	High Residential/ Logistical Mobility	**Low Residential Mobility or Sedentism**
Lithic Raw Material	Cryptocrystalline	Siltstone, Tuff, Rhyolite
Evidence of bifaces as Cores	Common	Rare
Evidence of bifaces as by products	Rare	Common
Bipolar knapping/scavenging	Rare	Common
Flake Tools	Rare to Medium	Common
Fire-cracked Rock	Rare	Common
Site size/density	Small/low	Large/high
Tool/debitage ratio	High	Low
Biface/ flake tool ratio	High	Low
Compete flakes	Rare	Common
Distal Flake Fragments	Common	Rare
Proximal Flake Fragment	Common	Rare
Angular debris	Rare	Common
Assemblage size/diversity	Low slope	High slope

Based upon these expectations, Kelly created an index modified from Raven and Elston (1988) for assessment of a single site’s mobility. It includes thirteen variables related to the chipped stone component of an archaeological assemblage with a dichotomous outcome for high or low residential mobility.

Additional Archaeological Indices of Mobility

Pottery

Pottery has been discussed as an artifact which reflects a higher level of investment, often associated with collectors (Eerkens 2003; Eerkens, Neff, & Glascock, 2002). Eerkens (2003) studied the presence and densities of pottery in lower-elevations of the southwestern Great Basin. His analyses suggested that the use of fired clay technologies was not necessarily limited by residential mobility. While the presence of pottery was not limited to sites associated with lower levels of mobility he did note the comparative investment, or quality of the pottery, was notably discernible in foraging versus collecting associated sites (Eerkens, 2003).

Simms, Bright, and Ugan (1997) provided an analysis of variation in ceramics for the Great Basin. The stylistic characteristics, as a proxy for investment, were used to infer levels of residential mobility. Pottery in the Great Basin is generally utilitarian. There is little evidence of decoration aside from the occasional incised or painted sherd. Simms et al.'s argument is an economic hypothesis connecting the level of investment with the return rate from pottery identified as stylistically distinct. They suggest that as the use-life and utility of a pot increases, the more apt it is to be connected to a strategy of lower residential mobility or sites with multiple occupations. In their study, each sherd was examined for temper particle size and sherd thickness. Temper particle size is relevant as the "finer temper increases resistance to crack initiation as a result of thermal and mechanical stress. It also permits the production of vessels with thinner walls, which not only reduces weight but also increases thermal conductivity and thermal shock resistance" (Simms et al., 1997, p. 783).

Theoretically, thinner walls increase the heating efficiency, lower weight, and increase heat conductivity. As the thickness of the sherd decreases, the implied investment increases. Therefore, thinner walls would suggest lower levels of mobility. The case study involved the examination of 5,345 sherds from 40 archaeological sites throughout the Great Basin. After examining 120 samples for variation in temper and clay composition, their research supported their hypothesis that "greater investment in the quality of ceramic manufacture with increasing residential stability, occupational redundancy, implying caching of ceramics with long use-life and/or the presence of a logistic system moving high quality ceramics to short-term camps" (Simms et al., 1997, p. 789). Bright and Ugan (1999) found a similar conclusion in their assessment of Great Salt Lake pottery. Their research suggested that pottery that indicated the highest degrees of investment was found in areas with the lowest seasonal variability in resources. Areas with higher degrees of resource seasonality had less prevalent occurrence of pottery.

Ceramics in the region studied by Simms et al. (1997) are rarely decorated and often differ simply in vessel shape and thickness. Simms et al. (1997) discussed the usage of X-ray Fluorescence (XRF) analysis to identify pottery made in different regions when stylistic characteristics are not viable. They examined an admittedly small sample of typologically distinct pieces--specifically Snake Valley Red-on-Buff, which is thought to be exotic to the area--and found that samples from the area had markedly similar chemical composition to sherds common in the Great Salt Lake area. This suggests the

Snake Valley Red-on-Buff variation is not necessarily exotic to the area, but could be local variation in technique rather than representative of different culture groups.

Eerkens (2003) compares his analyses which suggest increased investment with increased mobility to Simms et al. (1997) and finds a distinction in their study areas. Eerkens notes “restrictions imposed by a mobile lifestyle in the western Great Basin may also account for the low variation” seen in the Simms et al. (1997) study. Eerkens (2003) also makes a distinction between his findings and Simms et al. (1997) by asserting that most sedentary prehistoric populations created pottery readily due to the time and resource investment in making quality pots. However, once foraging or highly mobile groups adapted fire clay technology to create expedient, possibly lower quality pottery for specific purposes, the presence of pottery can not necessarily be associated with mobility. Rather, the quality of pottery is more likely reflective of levels of mobility. (Eerkens, 2003; Eerkens et al., 2002).

Pottery recovered on the Snake River is most often undecorated greyware and other than variation in thickness, form, and mineralogy, sherds are not usually distinctive by stylistic differences. Dean (2005) addresses the use of pottery variation and residential mobility in a case study conducted in Idaho. The study focused on residential mobility determined from surface sites by first categorizing sites by environmental classes. The pottery was split into thick and thin categories and was correlated with the environmental classes. Dean found that there was no specific correlation between either thick or thin pottery with specific environmental conditions. Rather the research concluded that lower degrees of residential mobility are identifiable by the presence or absence of both thick and thin pottery sherds (Dean, 2005, p.27).

Temper is another distinctive characteristic used to identify variance in pottery. Common materials include sand, crushed shell, or finely-crushed crushed pottery sherds. The way in which pot makers chose temper has also been of recent interest. Garvin (2011) assessed the variability in selected eastern Snake River Plain pottery with emphasis on the sources and preferential tempers used. His macro- and microscopic analysis of 36 sherds suggested that most of the inspected sherds could have been produced in the vicinity of the collection. In addition, it appears that late-period potters preferentially chose certain rock tempers based upon local availability and aesthetic characteristics (Garvin, 2011). The variation in temper is a practical categorization technique in the Snake River context, as stylistic variation is more subtle.

One important caveat with the use of pottery is the extreme variation of sherd size. Often pieces as small as 1 square centimeter are recovered during excavation and cataloged. This speaks to the problem of using pottery sherd counts as comparable data, one sherd could be half of a pot and recorded as a single artifact or it could be a tiny fragment. This is a limitation to note, but does not deter from a comparison of the absence and presence of pottery in archaeological sites.

Groundstone

Groundstone is an artifact with potential as a mobility indicator. Much like pottery, it exhibits variation in its presence among archaeological sites. It occurs in sites that have been designated as both short- and long-term use sites. Groundstone modification is often associated with sedentism or tethered mobility, due to the general lack of portability, but there is a growing body of literature demonstrating the potential for hunter-gatherers to modify and increase the utility of groundstone in limited amounts of time (Buonasera, 2012; Dubreuil & Savage, 2013; Hayden, 1987; Wilke & Quintero, 1996).

The Great Basin provides insight into the complexity of groundstone as an indicator of site investment. A discussion of this is seen in the analysis of site 10-EL-215 (Plew & Willson, 2012). This site has been categorized as reflecting high residential mobility and produced considerable amounts of groundstone. This instance may point to the use of groundstone as site furniture, items left behind and revisited over extended time periods (Binford, 1979). There is debate as to whether these artifacts may have been produced over a period of time with repeated visits or if their production is less intensive than previously suggested (Buonasera, 2012; Dubreuil & Savage, 2013).

Fire Hearths

Fire hearths also have potential as indicators of residential mobility. Fire cracked rock is uniquely identifiable as an indicator of human processing and occurs when cobbles are heated and rapidly cooled when submerged in water. This rapidly cools the cobbles and heats the water, often resulting in macro- and micro- cracked rock. These fire cracked rocks are used to identify fire hearths in archaeological settings. Kelly's index includes a "fire-cracked rock" category wherein highly mobile settings it is deemed "rare" (2001, p.73). While it is not impossible for a highly mobile individual to produce a fire, the expectation is that these activities would be conducted in the central residential location, not on logistical forays. This connects with another issue in identifying fire hearths that are less formally distinguishable. Often fires are created with little to no formal change to the physical landscape (i.e. they do not rock line an area or dig out a pit). This leads to less formidable archaeological evidence, often only identifiable in distinguishable color differences seen in the profile of an excavated unit wall.

Thoms (2008) outlines the relationship between fire cracked rock and increased nutritional return rates for various roots. Several types of fire hearths and earth ovens exist, with the common trait of fire-heated rocks lining a pit where food is processed. Thoms (2008) found the remnants of these fire pits or ovens were often just fire cracked rock lined pits. These pits were found at sites dated thousands of years old. Thoms (2007) also illustrated the stability of fire cracked rock in the archaeological record as an indicator of site integrity.

The location of fire hearths or fire cracked rock in relation to other site elements can also be used as an indicator of site function. Panja (2003) discussed the relationship between structures and fire hearths, hypothesized scenarios which would imply varying degrees of mobility. For example, large fire-pits in silos could be indicative of nondomestic or community utilized fire pits. The absence of fire pits in structures could suggest the structures were not for permanent occupation, but logistical or short-term use (Panja, 2003). The limited number of structures on the Snake River, with little to no evidence of fire hearths in the structures themselves, Panja's (2003) hypotheses would be testable as a means to use the association of fire cracked rock and structures with varying levels of mobility.

Formal Archaeological Features: Indicators of Storage

One of the key components of identifying archaeological evidence of a collecting strategy is the discovery of caches, field camps, and repeatedly visited locations (Binford, 1980). While these locale types vary in their manifestation in the archaeological record, the most common component is storage or structures. Collectors differentiate themselves from foragers by choosing to invest in technologies and strategies which involve the storage of goods and tools (Binford, 1980). The variability of structures has been suggested to indicate different levels of mobility with an implied inverse relationship between mobility and investment in housing (Binford, 1990). Binford uses ethnographic data to correlate structure shape, roofing materials, and portability with varying degrees of mobility (Binford, 1990).

On the Snake River, storage has been viewed as primarily associated with storage for winter months (Plew, 2003, p. 271). Storage on the Snake River has been defined as including "food caches, storage pits, or features containing food or traces of foodstuffs, lined/unlined pits, and stone/rock features lining excavated features or delimiting them" (Plew, 2003, p.272). For this study, these parameters were used for designating storage features from report data. Plew (2003), however, sampled 77 sites on the Snake River and found that only nine sites had evidence of storage. The nine sites are limited temporally to the Middle and Late Archaic (see also Morgan, 2012).

This study (Plew, 2003) suggests that the lack of evidence for storage may be related to the nature of resources being stored and the environment of the region. One of the few examples of seasonal storage is Baker Cave III located in eastern Idaho (Plew & Sundell, 2000). The remains of seventeen bison were recovered, the majority of which were adult females associated with fetal remains. This suggests a winter butchering and seasonal storage and processing of bison (Plew & Sundell, p. 128, 2000).

Relating to the storage of plant materials in the region, Dunn (1995) conducted experiments concerning seed storage and found that over a period of three months, 96%

of stored seeds were found to have fungal contamination. In fact, he notes that fungal contamination began almost immediately after storage with both green and prepared seeds. This suggests that storage of seeds and other resources in the region may have been limited to short-term caching to avoid deterioration. The lack of extended use of storage facilities relates to Panja's (2003) articulation of storage and sedentism. He discusses a disconnect between structures, storage, and sedentism with the illustration of protohistoric Missouri Valley Hidatsa who live seasonally in permanent structures. It is likely that prehistoric storage on the Snake River followed a similar pattern of short-term seasonal usage.

According to Binford's (1980) forager-collector continuum, storage is a primary indicator of a collecting strategy. Storage is readily identifiable and archaeologically discernable, thus making it a clear variable to use in conjunction with Kelly's index of residential mobility. Especially considering the ethnographic account by Steward (1938) and Murphy and Murphy (1960) in the next section, the identification of storage would prove a reliable indicator of low residential mobility.

CHAPTER THREE: SOUTHWESTERN IDAHO PREHISTORIC BACKGROUND & ARCHAEOLOGICAL ASSEMBLAGE OVERVIEWS

In an effort to understand the prehistory of the region, this research uses the ethnographic information of the Snake River in conjunction with archaeological data. The ethnographic and historic information on the Snake River Plain is generally sourced from two main sources, Julian Steward's *Basin-Plateau Aboriginal Sociopolitical Groups* (1938) and Murphy and Murphy's *Shoshone-Bannock Subsistence and Society* (1960). Steward gives a description of western Idaho as groups who inhabit the area around streams with abundant salmon, a resource which he assumes is a primary subsistence strategy. He attributes small group numbers to the lack of the horse (1938, p. 165). Steward discusses seasonal variation in settlement with winter encampments near Twin Falls (1938, p. 166). The description centers on family groups tethered to the river and salmon caches.

Steward attributes the lack of horses to "the very small amount of good pasturage along the lower Snake River" and the small size of groups to the inability for the landscape to provide resources for densely populated groups (Steward, 1938, p. 166). Steward consistently discusses "villages" in the Snake River region and disregards the use of communal hunting effort including drives and corrals. The description of subsistence effort relies heavily on seasonal salmon runs, camas, seed and root gathering.

Murphy and Murphy (1960) discuss the inhabitants of the middle Snake River as Shoshone who

> relied heavily on the salmon runs for food and fished during spring, summer, and fall… Glenn's Ferry was one of the better fishing sites… root gathering and festivities [occur] every summer on Camas Prairie. During the fall, deer were taken on Camas Prairie and in the country immediately south of the Snake River. (p. 316-329)

Records indicate only one group being encountered in the middle Snake River near Goose Creek. The inhabitants of the nearby mountains were believed to have returned to the river and valley environments from the winter.

These early historic and ethnographic depictions of the Snake River region suggest that groups inhabited the area along the river in multi-family villages, primarily to acquire salmon (Steward, 1938). Later in the 20th century, Murphy and Murphy (1960) collected historic information, often from singular informants, which suggested a more isolated scattering of groups throughout the valley. Similar to Steward (1938), Murphy and Murphy (1960) emphasize the indigenous groups' reliance on fishing as a primary subsistence activities.

The ethnographic accounts of a heavy reliance on fishing have been tested along the Snake River. Pavesic and Meatte (1980, p. 21) state that "the mechanism forcing population shifts and determining village size were the anadromous fish runs, the highest yielding protein resource available" (see Gould & Plew, 1996, p. 65). This has since been refuted through experimental data showing the importance of other resources

(Gould & Plew, 1996, 2001) and interannual variability in salmon migrations (Plew & Guinn, 2015). Three Island Crossing has the highest concentration of fish remains of any site in the region, but only would have supported a group of 25 for 20 days (Eastman, 2011, p. 107). There has also been a noted absence of the expected fishing gear which may be attributed to the organic nature of many fishing implements (Yu & Cook, 2014, p. 16).

Overall, research in western Idaho has shown a disconnect between Steward's description of a collector/village strategy and the archaeological record. In an attempt to understand the range of activities along the Snake River sites being excavated have included everything from large, multi-component sites, such as Three Island Crossing (Eastman, 2011; Gould & Plew, 2001), to surface lithic scatters across the Birds of Prey National Conservation Area (Sayer, Plager, & Plew, 1996). Twenty-three assemblages from twenty-one sites have been chosen for the comparative analysis of Kelly's Mobility Index and additional assessment of indicators of mobility. The sites were chosen based upon their vicinity to the Snake River, categorization as an open site, and availability of written records. Prior to this analysis, seven assemblages have been examined using KMI (Figure 2). These sites were included in the analysis so they may be examined with the addition of pottery, groundstone, fire hearths, and storage as mobility indices. Each of the variables, how they are assessed, and why they are theoretically relevant, are explained below.

Archaeological Site Overviews and Parameters

Previously, the use of Kelly's index of residential mobility has been limited to Late Archaic open-sites along the Snake River. Late Archaic sites are characterized as having material culture including the bow and arrow and ceramics. In this region, Late Archaic sites generally date within the last 2,000 years (Plew, 2008, p. 79). To keep the sample homogenous and limit the number of factors which could potentially contribute to the preservation or nature of sites being assessed, the following criteria were established for inclusion in the data set. Sites were required to: be in the direct vicinity to the Snake River; be designated as an open site; have components designated as Late Archaic; include an inventory of artifacts and ecofacts; and include a detailed description allowing calculation of cubic meters. These parameters stem from the original research done using Kelly's mobility index in southwestern Idaho (Plew et al., 2006; Plew & Willson, 2007; 2010, 2011, 2012; Willson & Plew, 2007).

One modification from the previous use of Kelly's residential mobility index is a wider range of assemblage sizes and extent of excavation conducted. Previously, KMI was used on sites with sizable assemblages, both artifact and non-artifactual. The sample includes a wide range of assemblage sizes including non-artifactual assemblages ranging from 47 to over 100,000 items and artifact assemblages from 0 to 1,403. The intention of increasing the range of assemblage sizes is to assess whether or not KMI is suitable for analyzing sites with less robust assemblages or less excavation conducted. This type of site is common in the region and are integral for understanding the range of activities occurring on the Snake River.

<u>10-CN-1</u>

10-CN-1 is located outside of the Celebration Park Recreation Area in Canyon County, Idaho on BLM property. The area has been highly disturbed by vandals, but still shows a long temporal history through the two plus meter cultural depth. Two possible hearths were featured, but indeterminate due to the level of disturbance. Winter's (1969) categorization shows a majority of weapons and general utility tools. The non-artifactual assemblage from 10-CN-1 suggest a use of deer and salmon among other small mammals, however the minimum number of individuals (MNI) are a conservative five and eighteen respectively (Sayer, Plew, Plager, & Miller, 1997).

<u>10-CN-5</u>

10-CN-5 is located in Celebration Park Recreation Area south of Melba, Idaho. Excavated over two field seasons, 2007 and 2008. The site is located on the northern bank of the Snake River and has a time depth which possibly extends into the early Middle Archaic. The artifact and lithic assemblage suggest the recycling and retooling of curated cores and artifacts. The majority of faunal remains recovered from the site are charred and include species from deer to small rodents. (Huter, Kennedy, Plager, Plew, & Webb, 2000). The multi-component site seems to have been occupied multiple times over the last 3,000-4,000 years. (Huter et al., 2000). Winter's (1969) categorization suggests hunting, processing, and lithic tool upkeep. This site was not previously analyzed with KMI.

<u>10-CN-6</u>

10-CN-6 is located within Celebration Park, north of the Snake River, in Canyon County some 40 miles south of Boise. The site has been the subject of numerous resurvey projects and excavations (Hauer & Hughes, 1996; Keeler & Koko, 1971; Murphey, 1977; Plew et al., 2006). The site is characterized as a Late Archaic with several fire hearths and mussel concentrations. The 375 artifacts recovered included both prehistoric and historic items. The site was originally assessed with KMI and was established as a high residential mobility site having 12 of 14 high characteristics.

<u>10-AA-12</u>

This site is located on the Birds of Prey National Conservation Area (BPNC) in southwestern Idaho (Sayer et al., 1996). The excavation was limited to two one-meter square units and 18 shovel test pits. The testing recovered a small non-artifact assemblage including 294 pieces of shell, 225 lithic flakes, and 11 unidentifiable fauna remains. The artifact assemblage was extremely small including only five formal artifacts.

<u>10-AA-14</u>

This site is located within the BPNC in southwestern Idaho (Sayer et al., 1996). Five artifacts were recovered as well as over 500 lithic flakes. The debitage is overwhelmingly obsidian and the predominantly small size of the recovered flakes suggests retooling rather than manufacture at this site. The non-artifactual assemblage consisted of 785 pieces of shell, 514 lithic flakes, and 22 unidentifiable faunal remains. Five projectile points were recovered and comprised the entire artifact assemblage.

<u>10-AA-188</u>

This site is located within the BPNC in southwestern Idaho (Sayer et al., 1996). Eleven artifacts as well as 800 lithic flakes, 79% of which were obsidian, were recovered during excavation. The size and lack of cortical material present suggests late stage reduction and retooling as the dominant lithic activity at this site. Of the four sites located on the BPNC, 10-AA-188 had the highest concentrations of TAR, possibly representing hearths or cooking areas.

10-AA-189

This site is located on the BPNC in southwestern Idaho (Sayer et al., 1996). Within the site boundary, six square meter units were excavated and six additional units were opened outside of the boundary. A dense concentration of shell on the surface guided the area for excavation. No formal artifacts were recovered, but there was a small lithic assemblage of 48 flakes, 83% of which were obsidian (Sayer et al., 1996).

10-EL-438

Fifteen miles south of Mountain Home, Idaho site 10-EL-438 was excavated to assess the depth of the suspected cultural deposit from a reported lithic scatter. The area has been highly disturbed by plowing and the disturbance has revealed a substantial amount of mollusk and thermally altered rock. The excavation resulted in the recovery of 97 prehistoric artifacts, including Middle and Late archaic points, a MNI of 5 fish remains, 2,000 lithic flakes, as well as thermally altered rock suggesting limited, isolated use of fire and stone heating. The site was analyzed with KMI and was assessed as having 13 of 14 high mobility criteria (Plew & Willson, 2010).

10-EL-215

10-EL-215 is an open site located on the western edge of Hagerman Valley near King Hill, Idaho. The terrace slopes steeply upward to the open terrace with the site area approximately 200 meters west of the Snake River. The site was discovered in 1981 (Plew, 1981) during the survey for the Wiley Dam project and excavated over three field seasons: 1987, 2011, and 2012 (Plew, 1981; Plew & Willson, 2012). A total of 18.8 cubic meters were excavated, resulting in the discovery of more than 240 artifacts and 60,000 non-artifactual items. The artifact assemblage was characterized as having Late and Middle Archaic components. Several organic stains and rock clusters were featured, during excavation, but no formal fire hearths or storage features were designated (Plew & Willson, 2012).

10-EL-216

10-EL-216 is located east of site 10-EL-215 and is separated by approximately 500 meters. The excavation conducted in 2011 by the Boise State Archaeology Field School (Plew & Willson, 2010), was reassessing a depression proposed to be a house structure (Butler & Murphey, 1982). The proposed Fremont feature was radiocarbon dated and found to be within the historic era (70 +/- 40BP). The site was assessed and matched 13 of 14 KMI criteria. This suggested high residential mobility.

10-EL-392

10-EL-392 is located on the Birds of Prey Natural Conservation Area, north of the Snake River and west of C.J. Strike Reservoir. The faunal assemblage suggested a narrow diet breadth and a small assemblage with limited variation. The site produced a medium non-artifactual assemblage including 3,915 lithic flakes, 1,252 pieces of shell, and 852 faunal remains. The artifact assemblage included 49 items with highest occurrences of weapons, domestic, and general utility items. The site was not previously analyzed using KMI (Plew & Sayer, 1995).

Medbury (10-EL-1367)

The Medbury site is located in Hammett, Idaho on the northern bank of the Snake River. The property is privately owned and currently being used as an organic alfalfa field. The site was excavated over two seasons (Plew & Willson, 2005) and is notable for a large percentage of thermally altered rock and pottery sherds. The artifact and non-artifactual assemblage is limited and suggests a short-term use with the utilization of open fires. The site was not previously analyzed with KMI (Plew & Willson, 2005).

Three Island Crossing (10-EL-294)

Three Island Crossing is located just outside of Glenn's Ferry, Idaho on the north side of the Snake River. The site is known historically as the location where pioneers crossed the Snake River while traveling the Oregon Trail. The site was excavated over four field seasons, 1986, 1987, 2010, and 2013, to thoroughly understand the extent of the site area (Eastman, 2011; Gould & Plew, 2001). One of the few prehistoric structures is located in this site. The site also includes two possible storage pits. Over 1,000 pottery sherds and a total of 1,730 artifacts were recovered during excavation; however, the overall diversity of the assemblage is limited. This site was not previously analyzed using KMI (Eastman, 2011; Gould & Plew, 2001).

Three Island Crossing is among the few sites with any type of formal storage, noted in the presence of a structure and storage pits. This site has also been excavated over four field seasons to understand the range of the site boundary. Even with the most substantial assemblages of fish remains in Idaho, the caloric value suggests that fish alone would have supported a group of 25 for up to 20 days (Eastman, 2011, p. 107). The faunal assemblage was identified as having three different radiocarbon dates which shows repeated use of the site calling into further question the seemingly vast assemblage.

King Hill Creek (10-EL-110)

10-EL-110 is located on River Ranch west of King Hill, Idaho. The site is situated on the north bank of the Snake River and King Hill Creek is directly southwest. The site function has been characterized as a multi-occupation "hunting, fishing, following, and the exploitation of invertebrates and locally available plant foods. A primary focus of the site's activates over time is extensive basalt core reduction and tool manufacture" (Willson & Plew, 2007). 10-EL-110 was previously assessed using KMI with 12 of 14 criteria correlating with high residential mobility (Willson & Plew, 2007).

Knox (10-EL-1577)

The Knox site is one of three sites located on River Ranch and is located on the northern bank of the Snake River, ¼ mile west of King Hill, Idaho. The site included what appears to be a storage pit and a possible fire hearth. Typologically, and based upon hydration analysis, the site consists of Late Archaic and Middle Archaic components. The artifact assemblage represents a wide range of activities, but suggests a focus on tool production. This site was analyzed using KMI and was established as having 12 of 14 characteristics for low residential mobility (Plew, Huter, & Benedict, 2002).

Swenson (10-EL-1417)

The Swenson site is located near King Hill, Idaho within range of the Bell Mare basalt quarry (Plew & Willson, 2007). The site is on the northern terrace of the Snake River and is one of three sites on River Ranch, a privately owned property. The Union

Pacific railroad is directly north of the site area. The use appears to be a reoccurring hunting, fishing, and likely the gathering of available vegetation use during the Late Archaic. The site was used for fairly intensive basalt core reduction and lithic tool production. The Swenson site was analyzed as having 10 of 14 high residential mobility characteristics on KMI.

Bliss (10-GG-1)

The “Bliss” site (10-GG-1) is located approximately ½ a mile from Bliss, Idaho along the northern bank of the Snake River. The multi-component site includes prehistoric and historic elements. The artifact assemblage includes a large proportion of pottery and projectile points. Few formal features were recorded and with extensive natural disturbance due to the Ventura effect in the canyon this is not necessarily a surprise. The few fire hearths described were without stone rings or formal construction (Plew, 1981). One possible storage pit was also noted (Plew, 2003).

10-TF-352

This site is located directly across the Snake River from 10-GG-1, the Bliss site. The site was determined to have two separate components: one containing “a Humboldt component contained in two culture bearing levels... approximately 60-70 cm bpd… [and] a Rose Spring-Eastgate component containing pottery” (Plew, 1981, p. 91). The non-artifactual assemblage was medium-sized including 3,109 lithic flakes, 3,106 faunal remains, and 29 pieces of shell. The artifact assemblage was mainly comprised of general utility tools, followed by domestic items and weapons.

10-TF-354

This site is located near Salmon Falls Dam outside of Bliss, Idaho on the southern side of the canyon. The site includes minimal cultural material, including nine artifacts, 241 pieces of lithic debitage, and three faunal remains. The excavation of this site failed to identify any formal features (Plew, 1981).

10-TF-350

10-TF-350 is located southeast of 10-GG-1 on the southern side of the Snake River. This site was identified by lithic scatter and appears to be mainly a surface site. Almost all units were culturally sterile, with a total of 37 flakes and 10 faunal remains recovered with no evidence of formal artifacts or features. The site appears to have been a short-term use area for lithic reduction (Plew, 1981).

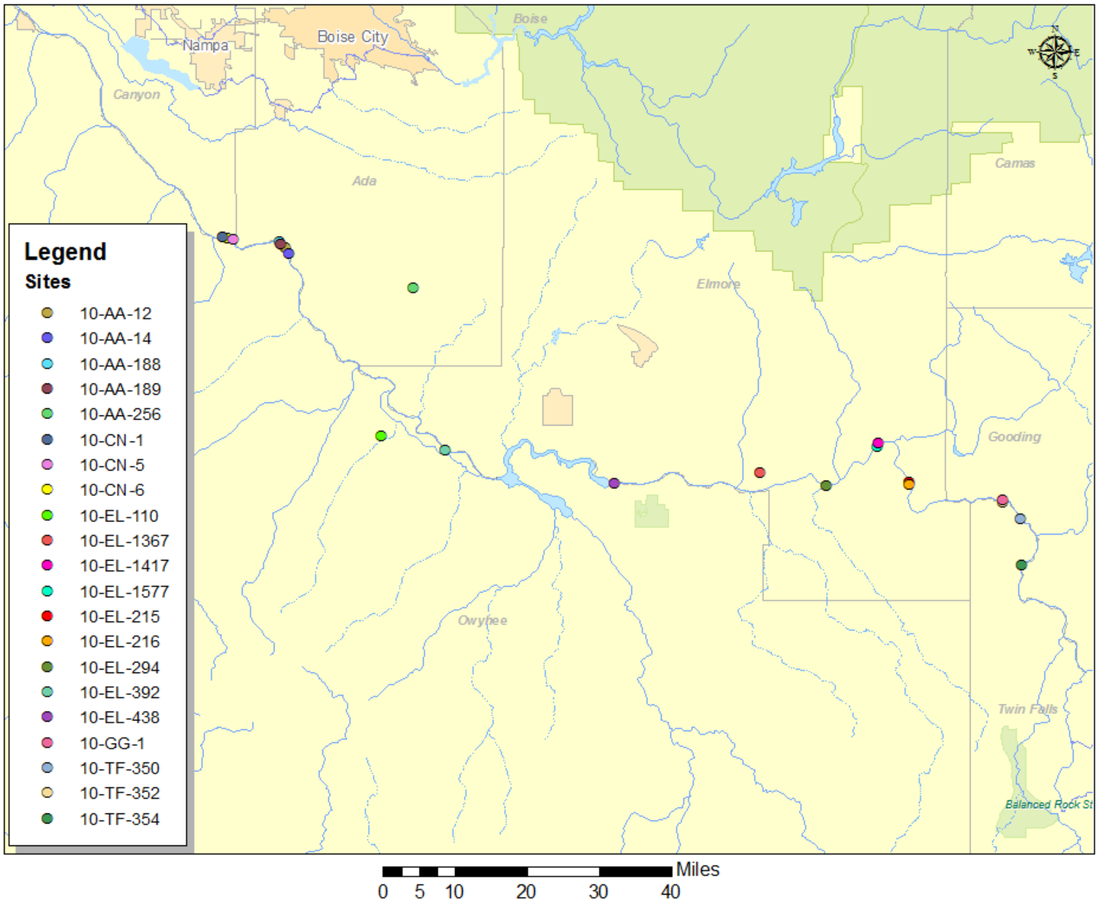

Figure 5: **Sites analyzed using Kelly's Mobility Index along the Snake River.**

CHAPTER FOUR: METHODS

Previously, the use of Kelly's index of residential mobility has been limited to Late Archaic open-sites along the Snake River. Late Archaic sites are characterized as having material culture including the bow and arrow and ceramics. In this region, Late Archaic sites generally date within the last 2,000 years (Plew, 2008, p. 79). To keep the sample homogenous and limit the number of factors which could potentially contribute to the preservation or nature of sites being assessed the following criteria were established for inclusion in the data set. Sites were required to: be in the direct vicinity to the Snake River; be designated as an open site; have components designated as Late Archaic; include an inventory of artifacts and ecofacts; and include a detailed description allowing meters cubed excavated to be calculated. These parameters stem from the original research done using Kelly's mobility index in southwestern Idaho (Plew, Huter, & Benedict, 2002; Plew et al., 2006; Plew & Willson, 2007, 2010, 2011, 2012; Willson & Plew, 2007).

The reports of the twenty-three assemblages meeting these requirements were acquired from the Center for Applied Archaeological Science repository. Seven of the sites sampled have already been assessed using KMI, but were cataloged again in the same manner as new assemblages and reassessed using standardized measurements outlined above. From each assemblage the following information was recorded:

- Lithic raw material(s)

- Breakdown of the inventory by artifact type
- Debitage, faunal, shell, botanical, and TAR counts
- Volume of excavation (meters cubed)
- Number of fire hearts
- Number of storage features

From this information each of Kelly's variables were calculated as follows.

Elements of Kelly's Mobility Index

Lithic Raw Material:

Raw material is categorized as reflecting high or low residential mobility generally based upon the local availability of toolstone materials. In the Carson Desert, located in Nevada and the focus of Kelly's case study, there was no naturally occurring knapping material in the valley. The closest materials were basalts, siltstones, silicified tuffs, and rhyolites from the southeastern range of the desert (Kelly, 2001, p. 73). Kelly outlines the expected use of CCS, or silicified rhyolites, in a short-term residential/logistical model as they were the closest, most expedient material source on the southeastern range of the desert.

Jones et al. (2003) apply a similar analysis to a larger portion of the Great Basin to identify settlement patterns. Using XRF Jones et al. (2003) identify spatial relationships between artifacts and source materials and find that artifacts do not generally leave a 300km radius from the source.

<u>Evidence of Bifaces as Core</u>

As noted, Raven and Elston's study (1988) focused on the dichotomy of lithic assemblages in which sites appear to have either bifaces being used as a versatile tool or a flake source. When entering an environment like the Carson Desert where raw materials are relatively unavailable, individuals must think out about their foray. Unforeseen incidents may arise during mobile periods. Having bifaces which can be used as either a tool or source material minimizes the risk when the possibility of not acquiring toolstone exists during a foray.

Short-term use of sites would be identified by bifaces "as both tools and cores. Tool consumption and generation of lithic debris should be low at short duration sites . . . the extent tools are present assemblages should contain relatively large numbers of flake tools made on bifaces thinning flakes" (Raven & Elston, 1988, p. 159).

<u>Evidence of Bifaces as Byproducts</u>

In opposition to the previous variable, "evidence of bifaces as by-products" would indicate that the location of the bifaces was used for the initial creation of the biface. If more time and effort was invested for creation of a long-term use tool, this suggests a less intense need for conserving toolstone. If a more sedentary location/strategy is being employed we assume that toolstone is either being procured or stored for future use; therefore, the need to use existing bifaces as cores would be unnecessary. We would expect to find more exhausted cores and debitage flakes in a situation where bifaces are byproducts.

Bipolar Knapping/Scavenging

Bipolar knapping is “a technique of resting a core, or lithic implement, on anvil and striking the core with a precursor” (Crabtree, p. 42, 1972). Kelly suggest bipolar knapping would be common in situations of low residential mobility and it is a conservation method used when raw materials are scarce. As far as scavenging, the archaeological testing of this concept is precarious, particularly when dealing with strictly archaeological reports.

Flake (Non-biface Reduction) Tools

Flake tools include scrapers and worked or modified flakes. These tools are often created for expedient use and are not intended to have a long use life. They can be created quickly, modified as the functional need arises, and be used for lithic supply or as a tool. A high flake to tool ratio was any site that exceeded 1:1 ratio.

Fire-cracked Rock

Fire cracked rock (thermally altered rock or TAR) has been established as rare if it comprises less than 20% of the total non-artifactual assemblage (Plew & Willson, 2012). Prior to Plew and Willson’s (2012) quantitative definition of TAR rarity analyses using KMI were limited to qualitative and relative measures. The significance of fire cracked rock in the determination of mobility level speaks to both the site function and activity area use of a given locale. Rock takes on TAR attributes when it is heated in fires and dropped into water to bring the liquid to a boil. Notably, TAR varies greatly in sizes collected and is often only noted as being absent or present. When archaeological reports do report quantity there is still little control over how large or how much fire cracked rock was actually collected.

Site Size/Density

As designated in Plew and Willson (2012) artifact assemblages are small when the assemblage is less than 200 items, medium when ranging from 200 to 500, and large when the assemblage exceeds 500 items. Density is calculated by the total of the artifactual and non-artifactual materials divided by cubic meters. Non-artifactual assemblages are considered small if fewer than 5,000 items, medium from 5,000 to 20,000 and large when exceeding 20,000 items. These designations are important especially in instances where assemblages are being compared that vary greatly in size and the extent of excavation that was conducted. By standardizing and calculating site size and density, there is a measure by which small and large assemblages and sites can be compared.

Tool/Debitage Ratio

As defined in Plew and Willson (2012), the tool to debitage ratio is calculated with the following variables: number of tools, number of lithic flakes, and meters cubed excavated. The tools per cubic meter are divided by the debitage per meters cubed excavated. Based upon Kelly's scheme, you would expect a high tool to debitage ratio in instances of high residential or logistical mobility (Kelly, 2001). Based upon open sites in the Great Basin, a high ratio was defined as any ratio exceeding .05. This measure can only be relevant if tool/debitage ratios for a known region have been calculated.

Previously, the use of Kelly's index has been problematic since there is no set context for which the index has been applied that can be compared to other regions.

Complete Flakes

Complete flakes are defined as those which have: a discernible single interior surface, a point of applied force, and intact margins (Sullivan & Rozen, 1985; Kuijit et al., 1995). Complete flake fragments are considered indicative of more deliberate knapping and increased time investment (Kelly, 2001, p.73).

Proximal Flake Fragments

Proximal flakes are defined as those which have a discernible single interior surface, a point of applied force, without sheared axis of flaking, and the margins are not intact (Kujit, Prentiss, & Pokotylo, 1995). Proximal flake fragments are partial flake fragments indicative of less control during the knapping progress. Higher proportions of partial flakes suggest more expedient knapping methods (Kelly, 2001, p. 73).

Distal Flake Fragments

Distal flake fragments are defined as flakes with discernible single interior surface without a point of applied force (Kujit et al., 1995). Distal flake fragments are partial flakes suggesting more expedient flaking and less control over the knapping process. (Kelly, 2001, p. 74).

Angular Debris:

Angular shatter is "multifaceted, angular toolstone fragments with no flake-like characteristics. Cortex is often present" (Raven & Elston, 1988, p.186). When expedient knapping occurs “less control [is] exerted in the knapping process, resulting in a high frequency of flake fragments to whole flakes, with perhaps high frequencies of angular debris” (Kelly, 2001, p. 74).

Assemblage Size/Diversity

Assemblage size is generally correlated as increasing with extended periods of occupation. Conversely, it could also be an indicator of repeated short-term occupational use and should be considered in context with the entirety of the index. To control for the range of excavation conducted at each site, the variables in KMI were analyzed per meters cubed.

Of the original thirteen variables in KMI, only seven are viable for use without the availability of physical collections. Excluded variables include: bifaces as cores, bifaces as by-products, bipolar knapping/scavenging, complete flakes, proximal flake fragments, distal flake fragments, and angular debris. A discussion of the exclusion of these variables can be found in Chapter Six.

CHAPTER FIVE: RESULTS

The assessment with KMI for 23 assemblages on the Snake River found that lithic raw material, flake tools, and biface/flake tool ratios were categorized as characteristic of high residential mobility for all 23 assemblages (Table 6). Fire-cracked rock had two assemblages with rates of low residential mobility. Site size to density resulted in seventeen assemblages being categorized as high (Figure 6).

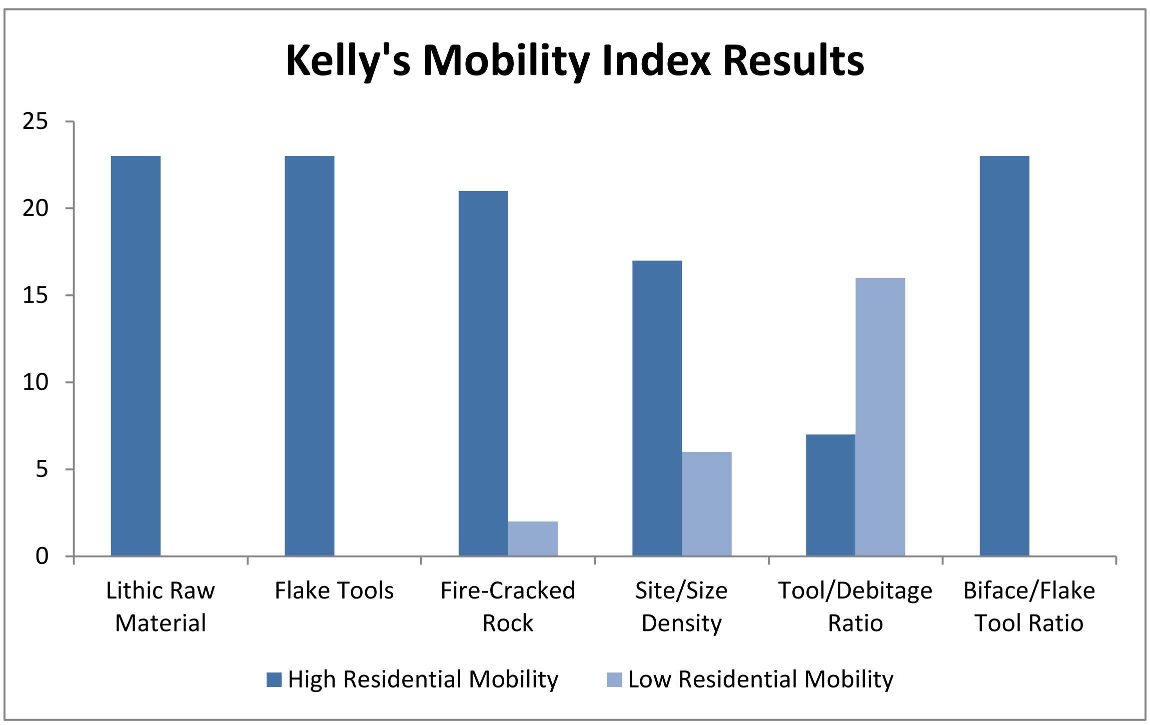

Figure 6: Bar chart showing the designation for six variables from Kelly's Mobility Index for 23 sites along the Snake River.

Overall, three sites had exclusively high mobility traits, thirteen had five, six had four, and one had three (Figure 8). Site size and density resulted in inconclusive designations for four assemblages. The first assemblage was from 10-GG-1, the Bliss site. While it was characterized as having a large site size, it was designated low density due to the massive amount of excavation compared to the number artifacts recovered. The three excavations at Three Island Crossing also experienced similar results having extensive excavation and comparatively low artifact counts resulted in a large/low designation for all three assemblages from the site.

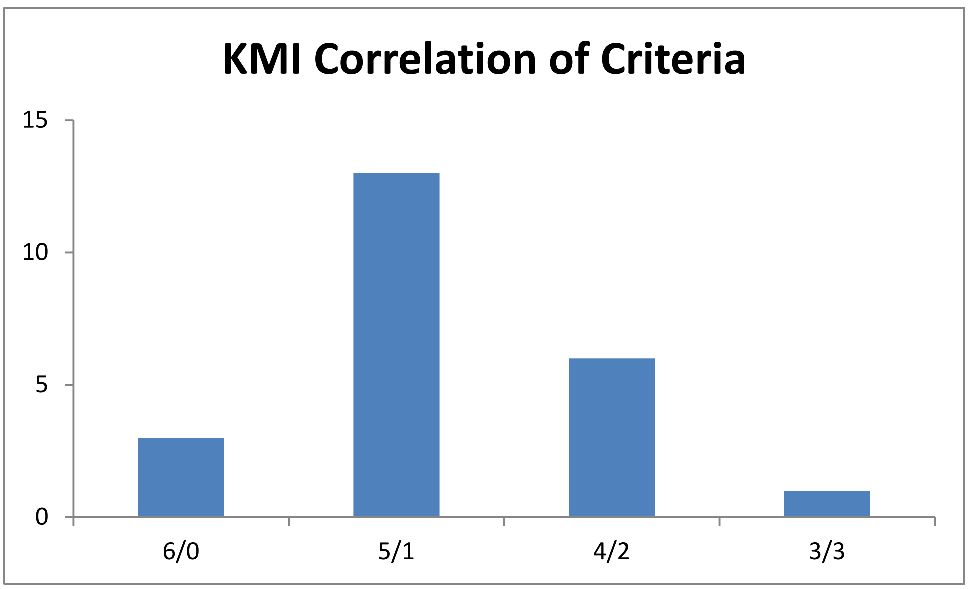

Figure 7: Correlation of criteria for KMI for 23 assemblages on the Snake River Plain.

As 22 of the 23 assemblages assessed were identified as having a majority of KMI variables reflecting high residential mobility, I tested the four additional indices of mobility to see whether they correlated with one another. The assemblages were initially assessed for distribution normality. For the 23 assemblages examined, a Shapiro-Wilk test was used to determine that artifact assemblages were non-normally distributed between small, medium, and large categories, D(3)= .750, p<.001, and non-normally distributed for non-artifactual assemblages D(3)= .750, p<.001. The sample of sites contained a disproportionate amount of small artifact assemblages, 15 of 23, skewing the data and causing the non-normal distribution (Figure 8).

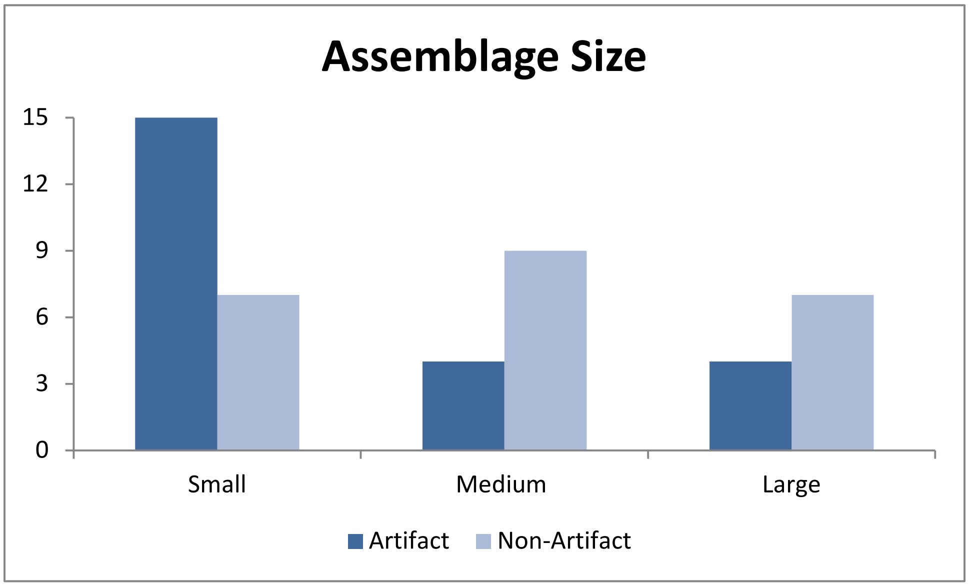

Figure 8: Bar chart showing the variation in artifact and non-artifact assemblage size for 23 assemblages along the Snake River.

Inventory counts of pottery, fire hearths, groundstone, and storage were examined as indicators of mobility. The distribution of pottery D (23) = .372, fire hearths D (23) = .430, groundstone D (23) =.288, and storage D (23) =.539 were all significantly non-normal (p<.001). The distribution of the presence of pottery D (23) = .401, fire hearths D (23) =.422, groundstone D (23) =.464, and storage D (23) = .533, were all significantly non-normal (p<.001) (Figure 9).

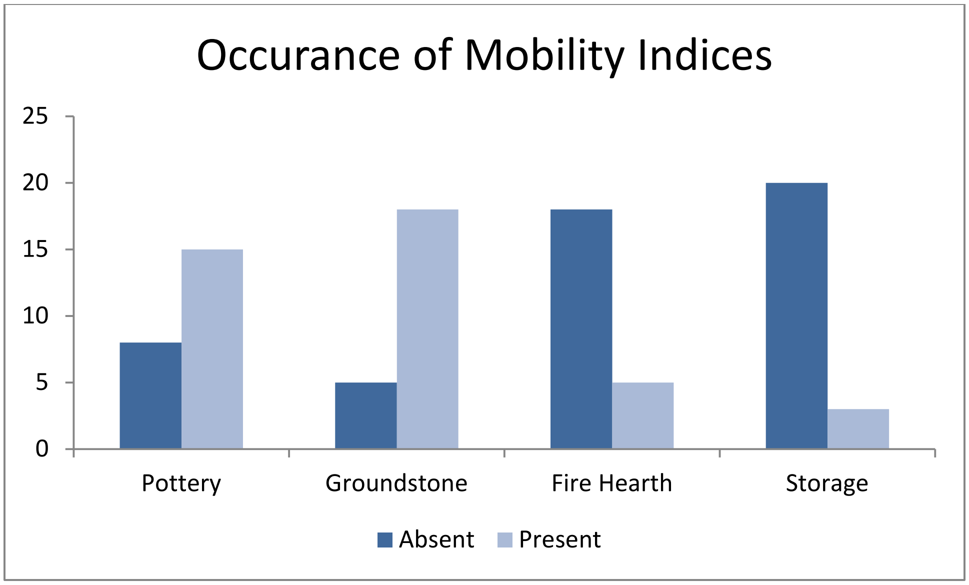

Figure 9: Bar chart showing the absence or presence of pottery, fire hearths, groundstone, and storage for 23 assemblages along the Snake River.

The non-normality of the outlined variables mandated the use of non-parametric statistical tests for all analyses. Due to the overwhelming occurrence of sites categorized as reflecting high levels of mobility, the analysis of the additional variables (pottery, fire hearths, groundstone, and storage) were analyzed internally for correlations using Kendall's Tau. When looking at the amount of each variable inventoried, pottery and storage were significantly correlated with all other variables (Table 2).

Table 3. Kendall's Tau correlations for numerical values of pottery, fire hearths, groundstone, and storage features for 23 sites on the Snake River. Correlation is significant at the .05 level (two-tailed).

	Pottery	**Fire Hearth**	**Groundstone**	**Storage**
Pottery	1.00	**.445***	**.346***	**.495****
Fire Hearth	**.445***	1.00	.341	**.568****
Groundstone	**.346***	.341	1.00	**.476****

Storage	**.495****	**.568****	**.482****	1.00

When pottery, fire hearths, groundstone, and storage were converted into binary absence/presence variables, fire hearths were significantly correlated with storage and pottery (Table 3; Figure 9). Fifteen of the 23 sites reported pottery ranging from 1 to 947 sherds indicating that there is a wide range of variability in the presence of pottery in the data set. Notably, sites that did not report pottery all had artifact assemblages of 27 items or less. This in conjunction with the fact that pottery was significantly correlated with fire hearths, groundstone, and storage could suggest that sites with minimal use-life are not likely to have pottery in the assemblage. As noted earlier, evidence of storage has been rarely identified along the Snake River (Plew, 2003). Of the 23 assemblages only three (13%) were noted as having any evidence of storage. In contrast, 65% of assemblages included pottery, 78% included groundstone, and 21% included evidence of open fires or fire hearths (Figure 9).

Table 4. Kendall's Tau correlations for absence and presence of pottery, fire hearths, groundstone, and storage features for 23 sites on the Snake River. Correlation is significant at the .05 level (two-tailed).

	Pottery	**Fire Hearth**	**Groundstone**	**Storage**
Pottery	1.00	**.483***	.279	.283
Fire Hearth	**.483***	1.00	.120	**.586***
Groundstone	.279	.120	1.00	.204
Storage	.225	**.586***	.204	1.00

Table 5. Distribution of artifacts by functional category for 23 assemblages on the Snake River.

Sites	Weapons	Domestic	Fabricating	General Utility	Ornamental
10-EL-215	5	2	5	10	1
10-EL-215	81	19.0	57	97	8
10-TF-352	18	20	7	44	3
10-TF-354	0	0	0	0	0
10-TF-350	0	2	0	0	0
10-GG-1	247	413	34	194	39
10-EL-110	87	110	34	13	31
10-EL-1577	224	108	132	125	17
10-EL-1367	30	35	12	17	1
10-AA-188	2	0	2	6	0
10-EL-1417	40	104	9	30	4
10-EL-294a	246	947	55	130	25
10-EL-294b	22	49	19	9	3
10-EL-294c	15	87	10	3	4
10-EL-216	9	0	5	8	0
10-CN-6	101	42	5	80	7
10-EL-392	15	17	6	11	0
10-AA-12	2	0	0	3	0
10-AA-14	5	0	0	0	0
10-AA-189	0	0	0	0	0
10-CN-1	63	17	21	28	12
10-CN-5	27	8	27	42	4
10-EL-438	23	48	9	13	3

Next, I analyzed the use of Winter's (1969) functional categories and their association with sites on the Snake River. The number of items in categories weapons, D (23) = .276, domestic, D (23) = .371, fabricating D (23) = .255, general utility, D (23) = .261, and ornamental D (23) = .306, p <.001, were all significantly non-normal. A Spearman's rho correlation for the five functional types in Winter's (1969) categorization resulted in significant correlation for every possible combination (Table 5). This is indicative of highly generalized, non-specific assemblages. This is similar to the pattern Bicho, Haws, & Davis (2011) found in their analysis of Northwestern coast where and they posit a generalized toolkit being advantageous in mosaic environments. The desert environment of the Snake River has been noted for patchiness in resources, an environment which patch choice predicts foraging behavior (Elston & Zeanah, 2002), and would explain the similar generalized assemblage results.

Table 6. Spearman's rho statistic for Winter's technological organization categories. **. Correlation is significant at the 0.01 level (2-tailed).

	Weapons	Domestic	Fabricating	General Utility	Ornamental
Weapons	1.00	**.838****	**.868****	**.914****	**.920****
Domestic	**.838****	1.00	**.790****	**.711****	**.849****
Fabricating	**.868****	**.790****	1.00	**.804****	**.873****
General Utility	**.914****	**.711****	**.804****	1.00	**.820****
Ornamental	**.920****	**.849****	**.873****	**.820****	1.00

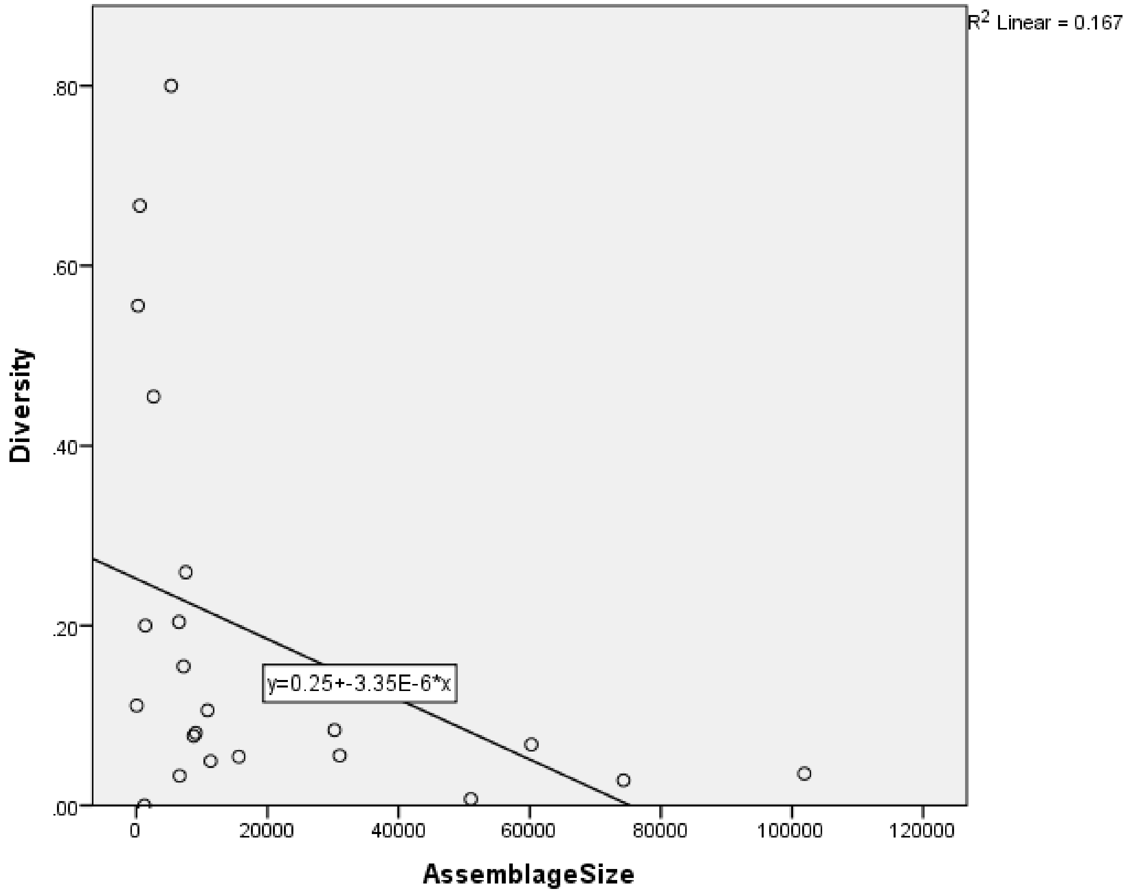

Figure 10: Linear regression model comparing diversity and assemblage size for 23 assemblages on the Snake River.

Finally, analyses of assemblage size and diversity calculated the slope of a linear regression comparing assemblage size and diversity. Kelly outlines this variable, but never defines or describes how it would be calculated for an individual site. I was unable to find any other literature that outline how to calculate the site size/density slope for an individual site. Bicho et al. (2011, p. 150-152) referred to Kelly's (2001) original text and used these variables to assess levels of mobility on the Northwest Coast. Their procedures were used for executing the linear regression needed to analyze a set of sites.

When using this procedure to look at the entire sample of sites, the regression results in a low slope (as defined in Bicho et al., 2011) (Figure 10). This suggests a pattern of low diversity or non-specialized toolkit patterns. This non-specialized tool kit is reflected in both the slope of the linear regression and the correlation of functional categories (Table 7). This is similar to the pattern Bicho et al. (2011) found in their analysis of Northwestern Coastal sites and suggests a generalized toolkit is advantageous in similar mosaic environments.

Figure 10 highlights the large residuals in the original model and occurring over the spread of assemblage size over 100,000+ range. To test how these affected the outcome, I performed another linear regression after conducting a log transformation for the variable assemblage size. I found that this increased the R-square value slightly and increased the slope, but the overall interpretation of the analysis is the same (Figure 11).

Overall, the analysis using KMI showed that a majority of sites sampled on the Snake River reflect high levels of residential mobility. In addition, functional categories are all highly correlated with one another, suggesting sites are often comprised of highly generalized toolkits. Finally, the analysis of the diversity and assemblage size of the data set also supported a non-specialized toolkit.

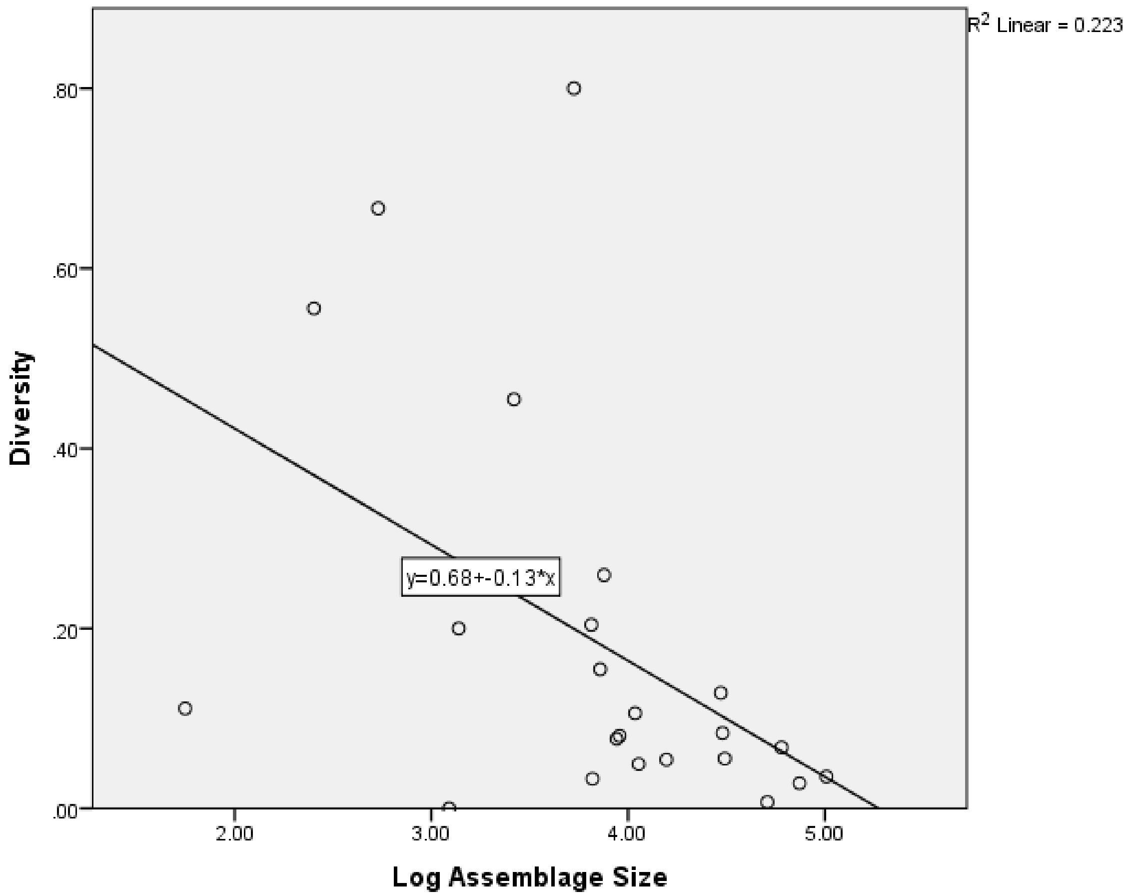

Figure 11: Linear regression model for diversity and log transformed assemblage size for 23 assemblages on the Snake River.

Table 7. KMI analysis for 23 assemblages along the Snake River.

Sites	Informal Name	High-Low	Lithic Raw Material	Flake Tools	Fire-Cracked Rock	Site Size/Density	Tool/Deb	Biface/Flake Tool Ratio
10-EL-215	1987	5-1	CCS/Bas/Obsidian	Rare	Rare	Small/High	Low	High
10-EL-215	2012	4-2	CCS/Bas/Obsidian	Rare	Rare	Large/High	Low	High
10-TF-352	Bliss	6-0	CCS/Bas/Obsidian	Rare	Rare	Small/Low	High	High
10-TF-354	Bliss	5-1	Obsidian	Rare	Rare	Small/Low	Low	High
10-TF-350	Bliss	6-0	CCS/Obsidian	Rare	Rare	Small/Low	High	High
10-GG-1	Bliss	5-1	CCS/Bas/Obsidian	Rare	Rare	Large/Low	High	High
10-EL-110	King Hill	4-2	CCS/ Bas/Obsidian	Rare	Rare	Large/High	Low	High
10-EL-1577	Knox	3-3	CCS/ Bas/Obsidian	Rare	Common	Large/High	Low	High
10-EL-1367	Medbury	5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-AA-188		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-EL-1417	Swenson	4-2	CCS/ Bas/Obsidian	Rare	Rare	Large/High	Low	High
10-EL-294a	Three Island (2001)	4-2	CCS/ Bas/Obsidian	Rare	Common	Large/Low	High	High
10-EL-294b	Three Island (2010)	5-1	CCS/ Bas/Obsidian	Rare	Rare	Large/Low	High	High
10-EL-294c	Three Island (2013)	5-1	CCS/ Bas/Obsidian	Rare	Rare	Large/Low	High	High
10-EL-216		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-CN-6		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-EL-392		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-AA-12		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-AA-14		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-AA-189		5-1	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	Low	High
10-CN-1		4-2	CCS/ Bas/Obsidian	Rare	Rare	Large/Low	Low	High
10-CN-5		4-2	CCS/Obsidian	Rare	Rare	Large/High	Low	High
10-EL-438		6-0	CCS/ Bas/Obsidian	Rare	Rare	Small/Low	High	High

CHAPTER SIX: DISCUSSION & CONCLUSIONS

The analyses in this thesis reassessed the use of Kelly's chipped stone mobility index (2001) in conjunction with other variables discussed as indicators of mobility. This research examined mobility along the Snake River in a wider geographic range and set of variables than had been previously researched. The previous archaeological research suggested Late Archaic sites along the river have been used in short-term, highly mobile contexts. This pattern contradicts the ethnographically-based assertions of Steward (1938) and Murphy & Murphy (1960; see also Gould & Plew, 1996).

Seven sites were previously assessed using KMI, but did not maintain standardized measurements for each variable resulting in sites with similar KMI correlation criteria being designated as different levels of residential mobility. Through the process of descriptive and analytic statistical work, this research has created a standardized set of parameters with which future sites may be added into the analysis.

The reassessment also sought to identify the archaeological characteristics of Binford's (1980) foragers versus collectors concept, and compare the expectations with ethnographic and archaeological evidence. The ethnographic accounts given by both Steward (1938) and Murphy & Murphy (1960) depict a lifeway similar to Binford's (1980) collector strategy. This includes discussion of villages, suggesting some sort of permanent or semi-permanent encampments, storage, and extended use of riverbanks for fish collection and processing. Archaeologically, research indicates that increased occupation will result in larger sites, increased material densities, and stone acquisition, utilization, and processing activities that differ distinctly from a foraging strategy.

What Can the Frequencies of Functional Tool/Debris Types Tell Us About Levels of Mobility?

In regard to using functional tool categories, such as Winter (1969) as a means to use functionality as an indicator of mobility the analysis does not suggest this to be a viable possibility. With the high significant correlations among all of the categories of tools, the assemblages on the Snake River suggest that the tool kit was often wide in range even in the smaller assemblages. It appears that, if a site has any artifacts, more often than not there will be a wide range of items crossing functional barriers. Therefore, using functionality such as the instance of pottery or other specific tool types may not be the most accurate way in which mobility can be assessed.

The Knox site was originally characterized as having 12 of 14 KMI traits of a low mobility site and was ranked with the most indicators of low mobility, 3-3, in this analysis. The site has the largest debitage count of the data set at 80,948 lithic flakes and one of two sites with common occurrence of thermally altered rock. Of the examined mobility indicators, the site has pottery, a fire hearth, and the highest groundstone count in the data set.

Reflecting sentiment from previous research (Gould & Plew, 1996, 2001), there seems to be little archaeological bearing to the ethnographically based assertions made by Steward (1938) and Murphy & Murphy (1960). While there are instances where sites could reflect a Binfordian collector strategy, the evidence from Three Island Crossing and the Knox site at this time suggest otherwise.

Does Adding Non-Lithic Variables to Existing Mobility Indices Alter the Accuracy or Reliability of the Previous Assessment?

Fifteen of the 23 sites reported pottery ranging from 1 to 947 sherds. Sites that did not report pottery all had artifact assemblages of 27 items or less. This could suggest that sites of extremely minimal use-life are not likely to have pottery in the assemblage.

Fire hearths were examined and inventoried regardless of the formality of the possible hearth, reports featuring possible open fires or ash pits were considered in the fire hearth count. Sites including hearths ranged from one to six hearths per site and were in sites with non-artifactual assemblages ranging from 8,598 to 101,294 items and artifactual assemblages between 143 and 1,413 items. Fire hearths and storage, an accepted indicator of lower or logistical mobility, were the only two variables significantly correlated.

Groundstone included basin mortars, stone bowls, pestles, battered cobbles, and grinding slabs. Eighteen of twenty four site assemblages included groundstone and all the sites that lacked groundstone had less than ten artifacts. The sites did range in density, however, with non-artifactual assemblages ranging from 244 to 10,771. Similar to pottery, groundstone doesn't appear to be associated with extremely small assemblages or expedient sites.

Storage was the least recognizable of the examined variables, with only four sites mentioning possible storage facilities or caches: Three Island Crossing, Knox, and Bliss. These sites included all four variables suggesting the storage may be one of the most telling variables when it comes to assessing mobility. Storage on the Snake River does not appear to be an integral part of the highly mobile, evolving environment of the plain (Plew, 2003).

What Limiting Factors Are Currently Embedded in the Use of Chipped Stone Variables in Mobility Analyses?

As seen in the analysis above, not all of the variables in KMI are practical with the use of records alone (distal flakes, proximal flakes, complete flakes, bifaces as cores, bifaces as byproducts, and bifacial knapping/scavenging). Unless these criteria are specifically reported, which is extremely rare, they cannot be used without access to the physical collection. The archaeological identification of these variables is increasingly precarious, because none of the available literature has given a detailed or otherwise description of how archaeologically investigators are able to assess whether bifaces were used as cores or byproducts. There may be a relationship between the amounts of debitage to bifaces in any given location that speaks to this problem, but to my knowledge this has not been identified or assessed.

The relationship regarding site size/diversity is also increasingly tenuous when it comes to calculating this per site. Again, I was unable to find any literature, including the original source materials, which outlines how to calculate the site size/density slope for an individual site. Procedures from Bicho et al. (2011, p. 150-152) were used for executing the linear regression needed to analyze the set of sites as a whole, but the assessment of individual sites was never addressed.

When using this procedure to look at the entire sample of sites, the resulting low slope suggests a pattern of low diversity or non-specialized toolkit patterns. This is similar to the pattern Bicho et al. (2011) found in their analysis of Northwestern Coastal sites and suggested a generalized toolkit is advantageous in similar mosaic environments.

The objective of this research has been to evaluate the application of Kelly's mobility index and other suggested indices of mobility on the Snake River. Until now, studies were limited to individual site reports and the synthesis of work in a limited geographic area over the past decade (Plew, Huter, & Benedict, 2002; Plew et al., 2006; Plew & Willson, 2007, 2010, 2011, 2012; Willson & Plew, 2007). The addition of assemblages analyzed with KMI appears to support Gould and Plew's (1996; 2001) suggested pattern of high mobility, short-term usage analyzed support the pattern on the Snake River.

The key to using Kelly's model, in a context without access to the physical collection, is to view it as a preliminary framework. Relying on a model to plainly inform on a concept as complicated as mobility is impractical. Rather, the model can be used in conjunction with additional of non-chipped stone variables and a firm grasp on site function and regional patterns of site usage. The addition of those variables offers the opportunity to see that there is variability in common artifacts such as fired clay or pottery and their relationship to the duration of site use.

The use of functional categories is a common practice among archaeologists reporting site data. This study explored the premise that functional categories correlated with one another and could be used in contexts of mobility indices. While there is merit in the mere identification of artifacts, this research demonstrated that the generality and wide range of artifacts at any given site makes the use of functional categories difficult to justify in the region, as they all generally appear at the same sites on the Snake River

(Gould & Plew, 1996, 2001). With 22 of 23 assemblages reflecting a majority of high mobility characteristics, this assessment supports the previous assertions of high residential and short-term occupational use of sites along the Snake River (Gould & Plew, 1996; 2001; Plew, Huter, & Benedict, 2002; Plew et al., 2006; Plew & Willson, 2007, 2010, 2011,2012; Willson & Plew, 2007).

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APPENDIX A

Non-Artifactual Assemblage Inventory

Non-Artifactual Assemblage Inventory

Sites	Debitage	Bone	Shell	Botanical	TAR	Total
10-EL-215a	2317	207	0	0	80	2604
10-EL-215b	51624	8224	182	0	0	60030
10-TF-352	3109	3106	29	0	108	6352
10-TF-354	241	3	0	0	0	244
10-TF-350	10	37	0	0	0	47
10-GG-1	13249	60000	36	0	15	73300
10-EL-110	11272	2764	1339	0	0	15375
10-EL-1577	80948	19126	1170	50	0	101294
10-EL-1367	5380	2963	257	0	349	8949
10-AA-188	800	3000	1500	0	TAR more, never spatially concentrated	5300
10-EL-1417	6709	4062	0	0	0	10771
10-EL-294 a	1454	1306	5630	8	200	8598
10-EL-294b	2159	8327	667	0	0	11153
10-EL-294c	14211	25847	3148	0	6404	49610
10-EL-216	6666	410	440	0	0	7516
10-CN-6	16512	9500	2913	1823	0	30748
10-EL-392	3915	845	1252	63	380	6455
10-AA-12	225	11	294	0	extremely limited to a few small pieces	530
10-AA-14	514	22	785	51	extremely limited to a few small pieces	1372
10-AA-189	48	15	1168	0	extremely limited to a few small pieces	1231
10-CN-1	10161	17398	2454	68	small amounts	30081
10-CN-5	9852	13980	5289	382	noted but not found in hearths	29503
10-EL-438	2000	4216	423	0	471	7110

APPENDIX B

Artifact Inventory

Artifact Inventory

	Projectile Point	Biface	Knife	Perforator	Scraper	worked Flake	Hammer -stone	Core	Battered Cobble	Basin Mortar	Grinding Slab]	Pestle	bowl Fragment	Net Sinker	Abrader	Bone Awl	Bone Needle/P erforator	Bifacial Bipoints	Ornamental
10-EL-215a	5	4	0	1	3	2	1	3	0	0	2	0	0	0	0	1	0	0	1
10-EL-215b	81	47	16	3	6	12	16	53	0	11	0	5	2	0	1	0	0	0	8
10-TF-352	18	15	0	0	2	25	2	4	0	4	0	0	0	0	0	3	0	0	3
10-TF-354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-TF-350	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
10-GG-1	247	42	17	5	10	118	7	14	0	7	0	0	0	0	4	11	1	0	39
10-EL-110	87	5	3	2	0	4	1	32	0	0	0	3	0	0	0	0	3	0	31
10-EL-1577	224	69	16	15	11	6	11	113	10	4	0	6	0	3	1	3	0	2	17
10-EL-1367	30	13	0	1	0	0	4	10	0	0	0	0	0	0	0	1	0	0	1
10-AA-188	2	2	1	1	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0
10-EL-1417	40	11	13	1	2	4	0	8	0	0	0	0	0	0	0	0	0	0	4
10-EL-294a	22	5	0	1	0	0	3	16	1	0	0	0	0	0	1	1	0	0	3
10-EL-294b	15	2	0	0	0	0	1	8	0	0	0	3	0	0	1	1	0	0	4
10-EL-294 c	246	44	36	20	24	15	11	26	0	3	2	7	0	0	3	6	0	0	25
10-EL-216	9	3	0	1	3	0	1	4	1	0	0	0	0	0	0	0	0	0	0
10-CN-6	101	26	11	5	12	27	4	0	0	0	0	5	0	0	0	0	0	0	7
10-EL-392	15	3	7	4	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0
10-AA-12	2	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
10-AA-14	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-AA-189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-CN-1	63	6	5	4	4	12	1	16	0	0	0	1	0	0	0	1	0	0	12
10-CN-5	27	19	8	6	0	8	6	19	1	2	0	0	0	0	1	1	0	0	4
10-EL-438	23	7	2	1	3	0	1	7	0	1	0	0	0	0	0	1	0	0	3

APPENDIX C

Additional Variable Analysis by Site

Additional Variable Analysis by Site

	Pottery Sherd Count	Fire Hearths	Groundstone	Storage
10-EL-215a	0	0	2	0
10-EL-215b	1	0	16	0
10-TF-352	16	0	4	0
10-TF-354	0	0	0	0
10-TF-350	0	0	2	0
10-GG-1	405	3	7	1
10-EL-110	104	0	3	0
10-EL-1577	98	1	20	1
10-EL-1367	35	0	0	0
10-AA-188	0	0	1	0
10-EL-1417	104	0	0	0
10-EL-294 a	49	5	1	0
10-EL-294 b	84	0	3	0
10-EL-294 c	935	3	12	2
10-EL-216	0	0	1	0
10-CN-6	37	6	5	0
10-EL-392	16	0	1	0
10-AA-12	0	0	1	0
10-AA-14	0	0	0	0
10-AA-189	0	0	0	0
10-CN-1	16	1	1	0
10-CN-5	6	0	3	0
10-EL-438	47	0	1	0

APPENDIX D

Variables Included in KMI Analysis

Variables Included in KMI Analysis

Sites	Total Artifacts	Artifact Types	Density	Diversity	M^3
10-EL-215a	22	10	1750.7	0.45454545	1.5
10-EL-215b	221	15	3482.7	0.0678733	17.3
10-TF-352	243	8	356.5	0.03292181	18.5
10-TF-354	9	5	63.3	0.55555556	4
10-TF-350	9	1	17.5	0.11111111	3.2
10-GG-1	1000	28	194.5	0.028	382.1
10-EL-110	276	15	1534.4	0.05434783	10.2
10-EL-1577	594	21	3903.8	0.03535354	26.1
10-EL-1367	99	8	712.4	0.08080808	12.7
10-AA-188	10	8	1129.8	0.8	4.7
10-EL-1417	85	9	1550.9	0.10588235	7
10-EL-294a	155	12	1006.1	0.07741935	8.7
10-EL-294b	162	8	1271.3	0.04938272	8.9
10-EL-294c	1413	10	1244.5	0.00707714	41
10-EL-216	27	7	567.1	0.25925926	13.3
10-CN-6	270	15	661.4	0.05555556	46.9
10-EL-392	49	10	433.6	0.20408163	15
10-AA-12	5	4	356.7	0.8	1.5
10-AA-14	5	1	139.1	0.2	9.9
10-AA-189	0	0	212.2	0	5.8
10-CN-1	143	12	1386.4	0.08391608	21.8
10-CN-5	109	14	1731.7	0.12844037	17.1
10-EL-438	97	15	809.8	0.15463918	8.9