A Multi-Faceted Approach to Understanding Notched Net Sinker Manufacture in the Columbia Plateau

A Thesis
Presented in Partial Fulfillment of the Requirements for the
Degree of Master of Arts
with a
Major in Anthropology
in the
College of Graduate Studies
University of Idaho
by
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December 2019

Authorization to Submit Thesis

This thesis of Cynthia R. Hannold, submitted for the degree of Master of Arts with a Major in Anthropology and titled "A Multi-Faceted Approach to Understanding Notched Net Sinker Manufacture in the Columbia Plateau," has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

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Abstract

Used to weight fishing nets, lines, and traps, stone net sinkers, though abundant in the archaeological record, are understudied and underrepresented in the archaeological literature. Several distinct types of net sinkers are found in the Columbia Plateau culture area, where evidence of fishing dates as far back as 10,000 BP. Fishing was significant to the diets of the Native inhabitants of the Columbia Plateau, and grew in importance and spread geographically over time. Durable and unambiguous, recovered net sinkers are uniquely suited for the analysis of this incremental intensification of fishing subsistence. Notched net sinkers are the most common type found in the Columbia Plateau. This thesis analyzes specimens in collections to determine their frequency of occurrence across time and space in the Southern Plateau. In addition, experimental processes are utilized to determine probable methods for notched net sinker manufacture.

Acknowledgements

This research is only possible because of the assistance and approval of Columbia Plateau Tribes. These Tribes include, but are not limited to, the Nez Perce Tribe, specifically the Nez Perce Tribal Executive Committee and THPO Pat Baird, the Coeur d'Alene Tribe, specifically THPO Dr. Jill Wagner, and Wanapum, specifically collections manager Angela Neller.

My committee has been a great help throughout this process, as well as during my academic career. Dr. Robert Lee Sappington taught me everything I know about Columbia Plateau Archaeology and was gracious enough to chair my thesis committee. Dr. Mark S. Warner, who made sure I began attending and presenting at anthropology conferences during my undergraduate career, has been a constant encouraging force. Dr. Don Tyler continues to be supportive of my academic career and agreed to come out of retirement to be on my committee. Dr. Dale Croes, who graciously offered to be on my committee as an expert in experimental archaeology, has continually offered advice and guidance.

There are so many individuals who contributed to the success of this research, including Greg Applen, Marci Monaco, Dave Quinn, and Daniel Crandall, who all conducted separate net sinker experiments to confirm manufacturing methods, time and energy investment, and the physical effects of cobble tool manufacture. Thank you also to other University of Idaho Lithic Technology Lab personnel including Kailey Berube, Steff King, Cruz Botello, Byron Mitchell, and all other graduate and undergraduate students who have listened to months of deafening net sinker experiments.

University of Idaho Alfred W. Bowers Laboratory of Anthropology, Collections Manager Leah Evans-Janke, and laboratory staff members Allison Fashing, Steff King, and Dan Crandall have been supportive throughout this process. My Clearwater River research would not have been possible without you.

University of Idaho Geology Laboratory, Dr. Thomas Williams took time out of his already busy schedule to run XRD scans on samples of experimental debitage created during these experiments.

Diane Curewitz, Archaeological Collections Manager for the Washington State University Museum of Anthropology, as well as Museum Staff, have been very accommodating, and were even there doing the heavy lifting by my side. My lower Snake River research would not have been possible without you.

There are also a large number of government agencies that should be thanked: the Idaho Transportation Department, and specifically Marc Munch, the Bureau of Land Management, including David Sisson, the United States Forest Service, Dan Polito (Thank you for saying “hey, you need a field school!”), Steve Lucas, and Cindy Schacher, the Walla Walla District Army Corps of Engineers, specifically Leah Bonstead, and the United States Fish and Wildlife Service, specifically Nicholas Valentine and Anan Raymond. Their swift approval made the analytical portion of this thesis go smoothly.

The University of Idaho Library staff also need thanks, particularly Jylisa Doney, Social Sciences librarian, who quickly responded to a number of obscure literary requests.

Special thanks to my original anthropology advisor from the College of Southern Idaho, Jim Woods, whose passion for experimental archaeology started me down this path.

Dedication

This thesis is dedicated to my family, who cheered me on from the sidelines, and to my partner, Mason Footh, who has been there with me in the thick of it.

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Chapter 1: An Introduction to Net Sinkers

A toolmaker stoops on the beach of a Clearwater River terrace to pick up a flat, oblong river cobble. They examine the material type, how the thickness tapers from the middle of the stone to its edges and feel the weight in their hand. Deciding that this stone is worthy of a net that they have spent the past several days making, they strike the cobble with a heavy hammerstone just in from its edge, the cobble perched in their non-dominant hand, angled so it will react to the force of the blow. On the third strike a flake is removed. They flip the cobble over and repeats this action on the same side, opposite face. Eight strikes and another flake is removed. The opposing side is notched. One net sinker down, several more to go.

The anadromous and non-migratory fish that travel the many rivers and tributaries of the Columbia Plateau culture area have been an integral part of the subsistence of the region's original residents for millennia (Hewes 1947; Landeen and Pinkham 1999; Marshall 1977; Sappington 1997; Walker 1967, 1998). The relationship between the aquatic resources of regional river systems and the Native inhabitants is a carefully balanced one. Fish once comprised as much as fifty percent of the annual diet of Tribes like the Nez Perce (Anastasio 1985:120; Hewes 1947; Marshall 1977: Sappington 1997; Walker 1967) and were sought almost year-round (Landeen and Pinkham 1999). Because fish were such a significant part of Indigenous subsistence, there is an abundance of fishing-related technology associated with their procurement (Casserino 2017; Johnston 1987; Landeen and Pinkham; Ross 2011; Sappington 1994, 1997; Walker 1969). There is archaeological and ethnographic evidence for a variety of fishing methods, from spearfishing (Walker 1967), to using fishhooks (Landeen and Pinkham 1999) and a variety of nets (Landeen and Pinkham 1999; Polissar et al. 2016; Ross 2011; Sappington 1994, 1997). Many of these methods require composite tools; tools that involve more than one material. These tools include net sinkers, which hold a net beneath the surface of the water and are used in conjunction with fishing nets, woven from locally sourced plant fiber and, sometimes, net floats.

The importance of regional river systems to Columbia Plateau Natives has not diminished with time, though consumption rates are lower than they have been historically due to water contamination, the installation of hydroelectric dams, and either diminished or completely confiscated traditional fishing grounds (Colombi 2005; Harper and Walker 2015, Polissar et al. 2016). While some traditional fishing materials, such as stone sinkers, were temporarily replaced by westernized, machine-made approximates, many Native groups are rediscovering their traditional fishing technology (Neller 2019).

Research Statement

There is little discussion of net sinkers in the archaeological literature. These artifacts are under-recognized in site reports, journals, and books. Like many other cobble tools, they are often misidentified or overlooked. Even so, they have piled up in artifact repositories in boxes labeled *cobbles* or *cobble tools*, acquiring dust while other boxes filled with more commonly identified tools are explored by graduate students doing thesis or dissertation research, professors writing their next article, or landowners and museums looking for new displays and exhibits. The boxes are heavy, still wearing the original security tags placed on them after the salvage archaeology project that was responsible for their abrupt removal from their often thousand-year home. I do not blame the archaeological community for ignoring these boxes; after all, no one will move up the academic or professional ladder by writing about tested cobbles. However, professional advancement is not the principal goal of anthropology, and the tools in these dusty boxes are evidence of human behavior and activity that has been culturally transmitted throughout millennia. They should be both cared for and cared about.

It is the intent of this thesis to bring to light a ubiquitous, though little studied, artifact in the Columbia Plateau: the net sinker. The primary objective is to determine methods for notched net sinker manufacture in the Columbia Plateau. Notched net sinkers are the most common type of net sinker found throughout this culture area and beyond. Exploring net sinker manufacture requires the use of experimental, positivist methods and the analysis of both replica net sinkers and Plateau artifacts. A secondary objective of this thesis is to determine the frequency distribution of net sinkers along the Clearwater and lower Snake rivers and which net sinker types were preferred across time and space. To accomplish this, I analyzed archaeologically recovered net sinkers from the Clearwater and lower Snake rivers, after receiving approval from local Tribes and collections landowners. The final objective of this thesis is to determine methods of manufacture for all other types of archaeologically recovered modified sinkers in the Columbia Plateau using the same experimental, positivist methods noted above.

Research Questions

Despite the narrow scope of this thesis, the initial research on this topic was broad. The goal being to determine what was previously written about fishing technology and, specifically, net sinkers, as I did not wish to conduct a redundant study. The research questions in this thesis are: What methods were employed to manufacture notched net sinkers in the Columbia Plateau? What is the type and size distribution of select net sinkers across space and time in the Clearwater and lower Snake River regions? And finally, what other types of net sinkers were used and, relative to notched net sinker manufacture, what amounts of time and energy were expended during their manufacture?

Thesis Organization

This thesis is divided into six chapters, each tackling a different piece of the research puzzle. Chapter One states the research objectives and questions and introduces net sinkers broadly, assessing their ubiquity worldwide before narrowing the focus to North America, and finally to the Columbia Plateau. Chapter Two orients the geographic, geologic, and cultural history of the Columbia Plateau within the framework of this thesis. Chapter Three discusses the theory and methodology behind the experimental and analytical portions of this research. Chapter Four presents the experiments and their results. Chapter Five summarizes net sinkers found during intensive survey and excavation throughout the Columbia Plateau. Chapter Six combines the experimental and analytical portions of this thesis to suggest what can and cannot be inferred, before presenting the cultural implications of this research and future directions.

Net Sinker, Net Weight, or Netsinker?

Archaeologists have labeled net sinkers many ways during the century and a half they have been writing about them (Casserino 2017; Prowse 2006, 2010, 2013; Rau 1873, 1884; Sappington 1997). These tools have been called chipped stone net weights (Casserino 2017), net weights (Ames et al. 1998; Hunn, Turner, and French 1998; Landeen and Pinkham 1999), sinkers (Lahren 1998; Pokotylo and Mitchell 1998; Troche 2016), sinker weights (Tateda et al. 2014), net sinkers (Duffy n.d.; Pengilly and Yohe 2012; Ross 1998; Sparks et al. 2013), net-sinkers (Price and Feinman 2020) and netsinkers (Rau 1873). They are also referred to as anchors, anchor stones (Croes 1995), and plummets, though these are often specific designations associated with how they are used. Often, net weight and net sinker are used interchangeably within the same text (Ames et al. 1998). Perforated sinkers have also been called donut stones (Koerper 2017).

In this work I use “net sinker” describe this fishing technology. I use this particular term for two reasons. First, the term net sinker aptly describes how the tools are primarily used. Small sinkers may have been used for line fishing and large sinkers may have been used to anchor traps, weirs, or canoes. Even so, they were primarily used with nets. Second, the use of net sinker allows this study to be more easily found in future searches. The two most commonly used terms to describe this technology are net sinker and net weight. Every major search engine interprets net weight first as a measurement, burying vital information about this fishing technology. The term net sinker is used to describe this fishing implement throughout this thesis.

The Net Sinker’s Long and Lasting Legacy

Net sinkers are a technology with a long history in human subsistence. In 2018 archaeologists discovered the oldest known net sinkers, manufactured as early as 29,000 years before present along the coast of South Korea (DeCou 2018). Some archaeologists are skeptical of this date. For example, archaeologist Chuntaek Seong says, “[these] look similar to Neolithic sinkers” (DeCou 2018). However, there are only so many ways to notch a net sinker and only so much raw material to choose from within a given region. Grooved stone sinkers in Israel’s Jordan Valley may date as early as 23,000 years ago (Spivak and Nadel 2016) and sinkers have been found on the banks of the Amur River in northeast Asia, linked to a site which dates to approximately 13,000 years ago (Vasil'Evskii et al. 1998). Both grooved and notched net sinkers have been found at a Neolithic site on Akab Island, a part of the United Arab Emirates (Charpentier and Méry 2008). Perforated net sinkers have been found at ‘Atlit-Yam, a Neolithic site in Israel (Galili et al. 2004). Net sinker manufacture and use span great distances in both time and space.

Dates for the exploitation of anadromous and non-migratory fish in North America are also early, beginning at least 11,500 years BP (Halffman et al. 2015; Johnston 1987; Landeen and Pinkham 1999; Ross 2011; Sappington 1991, 1994, 1997) and continue today (Colombi 2005; Neller 2019). Archaeologist Luther Cressman discovered evidence for seine and dip-net fishing at The Dalles dating to 9,800 BP (Cressman et al. 1960). Archaeologists have pointed out that there is a rise in net sinker use in North America during the Middle Archaic period (8,000-4,500 BP), as many Indigenous groups—some temporarily—moved toward a more sedentary lifestyle (Casserino 2017; Prowse 2010; Sappington 1997). Fish were an important part of pre-Contact subsistence and, subsequently, camping near certain bodies of water like lakes and rivers was an integral part of seasonal rounds.

Net sinkers are typically found along river shores or nearby bodies of water, where raw material is plentiful. Unlike obsidian, flint, or chert, which are often sourced from a distant location and carried to the location of its manufacture, use, and discard, these tools can be sourced, manufactured, and used in the same location. Though net sinkers are not expedient tools, they can be sourced and manufactured easily, meaning it is not necessary to carry them from one use site to the next.

Traditional fishing practices and net sinker presence in the archaeological record remained much the same during European contact. The materials used to make that fishing gear, however, began to change:

> Formerly, fishing nets were made of Indian hemp (*Apocynum cannabinum*) or cedar bark (Teit 1909), with stones used as sinkers. During the twentieth century, commercial fiber and eventually nylon

> netting and metal pullies with lead sinkers and cork floats replaced the indigenous netting materials. (Ignace 1998:206)

In some regions of North America, stone sinkers were replaced by lead sinkers and organic netting was replaced by other, often machine made, material. In the Columbia Plateau some fishing implements, such as fishhooks, were replaced by metal approximates (Baenen 1965). There are accounts of European and Native exchange of fishing gear, which includes net sinkers, at Jamestown (Schmidt 2006). However, as relations broke down between Indigenous Peoples and the colonizers, it became a point of contention.

Lead sinkers meant the manufacture of fewer stone sinkers and, despite being easier to make, they cost much more environmentally. Recently there has been concern about lead poisoning in the earth's water sources and land from lead sinkers and bullets. There has been extensive discussion pertaining to how to recover them (Goddard et al. 2008; Tateda et al. 2014). It is reasonable to conclude that the Native methods for net sinker manufacture were superior to those of the Europeans.

Net Sinkers: Form and Function

Cobble tools come in a variety of sizes, weights, and shapes and their utility spans a wide range of activities. Cobble tools are modified, like choppers and scrapers, or unmodified, like hammerstones (see examples in Croes 1995). Both flake scars and cobble flakes themselves show the direction that the cobble was flaked. Finer grained materials exhibit microfractures in their flake scars, radiating from the point of impact (Chlachula and Le Blanc 1996:67). Flake scars with deeply stepped terminations are indicative of heavy hammer percussion (Chlachula and Le Blanc 1996:69). These deep step fractures show up frequently in the experimental net sinkers when the weight of the hammerstone and the angle at which the blank is struck increase. Many net sinkers included in this analysis exhibit step fractures.

Net sinkers also appear in the archaeological record in a variety of forms. They can be modified or unmodified (Croes 1995; Sappington 1994, 1997; Stewart 1973, 1977). They can be spherical, circular, oval, triangular, or rectangular and may be manufactured from a variety of materials (Casserino 2017; Neller 2019; Prowse 2010; Rau 1884; Sappington 1997). They can also be made from raw material other than stone such as ceramics, concrete, and wood (Rice et al. 2017; Ruikar 2013; Stewart 1977; Wozniak 2014). Regionally, the Columbia Plateau has four major types of modified stone net sinkers: notched, perforated, grooved, and shaped fishing weight ring stones (Casserino 2017; Neller 2019; Nez Perce National Historical Park n.d.; Sappington 1997).

Net sinkers can be used in a variety of ways and their morphology often depends on the net technology they are used in association with. They are often used with seine, gill, dip, scoop, cast, and hand nets (Johnston 1987; Landeen and Pinkham 1999; Ross 2011). Their size and weight can give us insights into the width of nets they were attached to and the possible size of the mesh. Their location can tell us which areas were most used historically by Native fishermen and what fish might have been targeted. Net sinkers can also help archaeologists understand the cultural practices of those who used them. There is some evidence to support net sinkers' inclusion as burial/funerary items in the Plateau (Johnston 1987:94). These artifacts were an integral part of life in the Plateau.

Net sinkers became increasingly common as certain Tribes became sedentary and as their populations grew. Without these artifacts, subsistence might have looked very different for many Native Plateau groups. Fish helped to supply food for the winter (Marshall 1977).

Without this resource, seasonal rounds might have steered away from the region's intricate river systems and toward medium or large game mammals.

Net sinkers, historically, have not been an artifact that archaeologists tend to study, though they are as important as any other subsistence-related artifact. These modified stones are evidence of a significant part of the Columbia Plateau history and the Columbia Plateau present. They should be treated by archaeologists and museum curators as a significant part of aboriginal subsistence wherever they are ubiquitous.

Net Sinker Types

Net sinkers have been noted by anthropologists in North America since the 19th century (Rau 1873, 1884). Morphological classification of net sinkers, as seen here, is necessary when presenting general manufacturing methods, but can be limiting as there are variations within each type as well as variations regionally, locally, and temporally. Toolmaker preferences in material and manufacturing methods can lead to a wide variety of sinker forms. Net sinkers are not exclusively made of stone. Rice et al. (2017) introduce the use of clay net sinkers, Wozniak (2014) the use of brick as a raw material for sinkers, and Ruikar (2013) the use of modern cement sinkers that are typologically similar to their perforated stone predecessors. Net sinkers in North America are both modified and unmodified and come in a variety of forms.

Prior to the last two decades, most of the interest in net sinkers has been confined to the east coast of North America. Charles Rau, one of the earliest individuals to document their presence in the archaeological record, focused mainly on net sinkers in eastern North America in his 1873 article and his 1884 book. There are many site assemblages with net sinkers along the East Coast and just inland, some of them include more than one hundred examples of this fishing technology (Anderson 2015).

Recently, interest in net sinkers has pushed westward in North America toward the Great Lakes region (Prowse 2006, 2010, 2013) and the Columbia Plateau (Casserino 2010; Johnston 1987; Sappington 1997). A small amount has been written about net sinkers on the Northwest Coast (Croes 1995; Stewart 1973, 1977). Casserino, Prowse, and Sappington all primarily discuss notched net sinkers in their articles. Perforated and grooved stone sinkers are mentioned briefly. Stewart focuses on grooved or unmodified stone net sinkers along the Northwest Coast in her books (1973, 1977). Of these three culture areas, the Columbia Plateau might very well hold the most diverse distribution of modified stone net sinker types in North America.

Four types of modified stone net sinkers were employed in the Columbia Plateau: grooved, perforated, notched sinkers, and shaped fishing ring stones (Casserino 2017; Johnston 1987; Neller 2019; Ross 1998, 2011; Sappington 1994, 1997). All sinkers in this thesis are referred to as net sinkers, though it is possible that some were used to anchor fishhooks, traps, canoes, or weirs. Ross (2011) describes large anchor stones needing to be reset at the base of "stanchion poles and supporting pylons," had they become dislodged, before the salmon arrived each year (Ross 2011: 361). It is not clear, however, whether these anchor stones are modified or unmodified. The range of net sinker sizes and weight, in both the experimental and the analytical sections of this thesis, vary greatly but without a sinker's associated organic counterparts—nets, traps, floats—it is difficult to determine function with absolute certainty.

The first and most common type of net sinker in the southern Columbia Plateau is the notched net sinker (Figure 1.1). This type of sinker is most often made by removing flakes from a flat river cobble or river pebble to create a notch by which the stone can be attached to a net or line. Notched sinkers are most frequently bifacially notched. Notched net sinkers can be made using direct or indirect percussion. These two methods can leave very different notching impressions in a stone and it is typically possible to determine whether direct or indirect percussion was used. Some net sinkers, however, exhibit so much wear that it is impossible to determine manufacturing methods (Prowse 2010:79).

The same principles that apply to other forms of lithic reduction apply to net sinker manufacture. Ridges are helpful for creating a clean line of negative flake scars. Direct percussion is not the only step in notched sinker manufacture. The newly released cobble interior presents itself in a straight-edged half-moon. If notch depth is required, it is necessary to take a smaller hammer stone or a chopper to carve out the notch through the exposed stone interior. Prowse attributed wear on net sinker notches to cordage rubbing against the stone for an extended period (2010:82-83). During the experiments, I observed the exposed stone interior to be very sharp. As is, the stone might cut through organic cordage. Therefore, it may be necessary to abrade the notched area before attaching it to a net. Notched sinkers require the least amount of time for manufacture, but they can also be the most physically taxing and have the highest rate of cobble rejection.

In her 2010 article "Much Ado About Netsinkers," Shari Prowse describes the various ways that net sinkers in the archaeological record are notched. They can be side-notched, end-notched, both-notched, or atypical (Prowse 2010:78-79). Side-notched refers to those sinkers that have notching on sides roughly parallel to the long axis. This is the most

Figure 1.1: Notched Net Sinkers from 10CW4

common type of sinker found in the Great Lakes region as well as in the Spokane River region (Casserino 2017; Prowse 2010). End-notched sinkers are notched on sides perpendicular to the long axis. This subtype frequently occurs in Clearwater and lower Snake River assemblages as well as in the Columbia River region (Sappington 1994; 1997: Figure 3). The reason for their occurrence may be due in part to their size and the mechanics of net sinker manufacture. Four-notched, also called both-notched, net sinkers are found in the archaeological record, and while they are much rarer than side-notched and end-notched, they are clearly the preferred type at some sites. Prowse has hypothesized that both-notched net sinkers were end-notched net sinkers that were repurposed as side-notched sinkers (2010:78). After analyzing more than three hundred net sinkers and given the prevalence of four-notched sinkers at some sites in the Southern Plateau, I believe many were manufactured purposefully. Atypical refers to those net sinkers with either an anomalous number of notches (three or more than four) or those sinkers which exhibit non-parallel notches. Sinkers with more than four notches are rare, but they do exist (Prowse 2010:79).

Grooved stone, also called ground stone, net sinkers come in many forms. Groove direction and groove frequency are the most common variations in this category. The greatest variability within a net sinker type occurs here, including the most artistic variability. Grooved stone net sinkers are some of the most ornate artifacts, particularly in the western Columbia Plateau and the Northwest Coast. Some have sunrises or sunsets, and others have geometric designs (Strong 1959). On the Northwest Coast, some ornate grooved sinkers are carved from wood (Stewart 1977:31). Though more than one groove is not necessary for sinker or anchor function, they are often found with a second groove. It is possible that additional grooves, despite increasing manufacture time, mean a more securely fastened tool. Grooved stone sinkers take much longer to manufacture than notched or perforated sinkers. Losing a grooved stone sinker while using a net would mean losing hours of work and, often, incredible craftsmanship.

No matter how ornate, their physical function and methods for manufacture remain the same. Grooved stone net sinkers (Figure 1.2) are made by pecking and grinding a stone with a more resilient stone flake or chopper (Martinez 2019). The blanks chosen for this type of net sinker are usually spherical, rather than the round and flat cobbles often used for notched or perforated net sinkers. This is a careful, time-consuming manufacturing method.

Perforated net sinkers (Figure 1.3) are manufactured by using a drill or perforator to bore a hole from both sides of a stone. Flat, elongated cobbles and pebbles are often the

Figure 1.2: Grooved Sinker from 10CW19

Figure 1.3: Perforated Sinker from 10NP105

preferred toolstone for this sinker type, though large perforated cobbles, likely anchors, are mostly spherical. Perforated net sinkers have the least variability of the net sinker types. A hole is drilled in the center, or to one side, of the stone. An analysis of Clearwater and lower Snake River assemblages shows evidence that these holes are drilled from both sides of the stone. Available regional tool stone would have a considerable impact on the manufacturer's ability to create a perforated sinker efficiently. For example, there is no flint in the Columbia Plateau; only chert and opal. This means that regionally, perforated sinker blanks would have needed to be a porous material, able to be penetrated by a cryptocrystalline silicate or other harder stone. Perforated sinkers can be both large or small [pebble-sized, cobble-sized, or boulder-sized (Blatt 1992)] depending on the needs of the toolmaker. The mass of a net sinker is proportional to its volume, and different sized sinkers are needed for different nets and different fishing strategies.

The Wanapum, the River People of the Chiawana (modern-day Columbia River), have recently reconnected with one of their traditional fishing implements, the net fishing weight ring. This technology was thought to have been lost when the Wanapum were forcefully relocated from their land by the Manhattan Project in 1943 (Andrews 2015). Because of this information, the stones found in the archaeological record can be accurately described as shaped fishing ring stones. There are four complete net fishing weight rings, curated in the Smithsonian National Museum of Natural History, the Smithsonian National Museum of the American Indian, the Burke Museum, and the Central Washington Museum of Culture and Environment, currently on loan for exhibit at the Wanapum Heritage Center (Andrews 2015; Andrews and Sharp 2015; Neller 2019; Neller 2019, Personal Communication). The stones, which are bound to a willow ring with chokecherry bark, are modified fully around their edges to create a rectangular shape (Figure 1.4). It should be noted that *shaped fishing ring stone* is not the approved name for these stones, and that the Wanapum are currently deciding on a proper name for this fishing technology.

Figure 1.4: Shaped Fishing Ring Stones; Curated at the Wanapum Heritage Center

Many kinds of fishing nets have been used by various North American Indigenous peoples. Seine nets, gill nets, cast nets, and hand nets (dip nets), are the most frequently used (Landeen and Pinkham 1999; Walker 1967, 1998). Each of these net types is useful in very specific ways. There is a significant amount of regional difference in net fishing, as different bodies of water or different fish species call for different net fishing strategies.

A seine net's goal is to gather a large amount of fish and drag them to a single location, often along the shore, circling the fish before pulling them in. This net can be used in a several ways. A common method involves an individual in a canoe dropping a seine net into the water in a U-shape, capped at the shoreline, while other members of the community stand on the shore and drag the net back towards them. Landeen and Pinkham (1999:93) describe one Nez Perce method, two canoes stretching the seine net across the lower Snake River. Seine nets floats keep the net vertical while the sinkers anchor the net to the river or lake floor. This means that their sinkers need to have few places that can snag. Seine nets are most often used in regions with larger bodies of water, like lakes, seas, or the ocean, but can be used in rivers as well. Seine nets catch a multitude of fish at once and are not as selective as other net types.

Gill nets are kept vertical using the same methods as seine nets; floats at the top and sinkers along the bottom. There are several variations of gill nets. Floating gill nets sit higher in the water, while set gill nets are placed toward the bottom of a river or lake. Gill nets are often set at an angle from the shore to ensnare fish swimming in their direction. The targeted fish species determines the width that the manufacturer makes the mesh. These nets are much more selective than seine nets, and instead of gathering everything in their path, gill nets make it easier to target wanted fish and leave the rest.

Dip nets are attached to a long pole and a ring. Their users typically stand on a platform fashioned above the water and use the net to catch fish from this perch. While dip nets did not require net sinkers, sinkers make the net drop quickly in the water, giving the fish less time to swim away. Regionally, there are several ethnographic accounts of their use by the Shuswap (Walker 1998:203), the Kalispel (Walker 1998:287), and many other Native People in the Plateau (Walker 1998:538-539).

Net sinkers are used in conjunction with other fishing technology, such as nets and net floats. The obvious goal of net fishing is to catch a large amount of fish in a short period.

These artifacts are found throughout the Columbia Plateau and come in a variety of forms. This thesis aims to explore methods of net sinker manufacture, specifically notched net sinkers, determine the distribution of net sinker types along the Clearwater and lower Snake rivers, and determine differences in time and energy investment for all forms of net sinker manufacture.

Chapter 2: Net Sinkers in the Columbia Plateau

The Columbia Plateau: Introduction

The Columbia Plateau culture area spans the inland Pacific Northwest of North America. Though the exact placement of these arbitrary boundaries varies (Walker 1998:2), culture areas bordering the Columbia Plateau remain the same. These include the Northwest Coast, the Subarctic, the Plains, the Great Basin, and California. The Columbia Plateau culture area (Figure 2.1) encompasses mountain ranges, plateaus, steppes, woodlands, forests, and high desert with an equally diverse variety of flora and fauna (Walker 1998).

More important than these arbitrary boundaries, however, are the people who have occupied this region since time immemorial. Their lifeways differ between and within their cultural groups. Their subsistence methods, their use of the landscape, and their day to day activities are unique. The cultural traditions of Columbia Plateau inhabitants are rich, beautiful, and dynamic, changing over time and across space. The archaeological record supports that humans have occupied the Columbia Plateau for at least 11,000 years (Daugherty 1962) and may have been present as early as 16,000 years BP (Davis et al. 2019).

Geography and Geology of the Columbia Plateau

The geography and geology of the Columbia Plateau are diverse and have changed drastically over millions of years. This culture area includes highlands, mountains, and steppes with significant changes in elevation and, subsequently, vegetation and wildlife (Chatters 1998). The geologic and climatic history of the Columbia Plateau is briefly summarized here to provide context for the region's diverse plant and animal life.

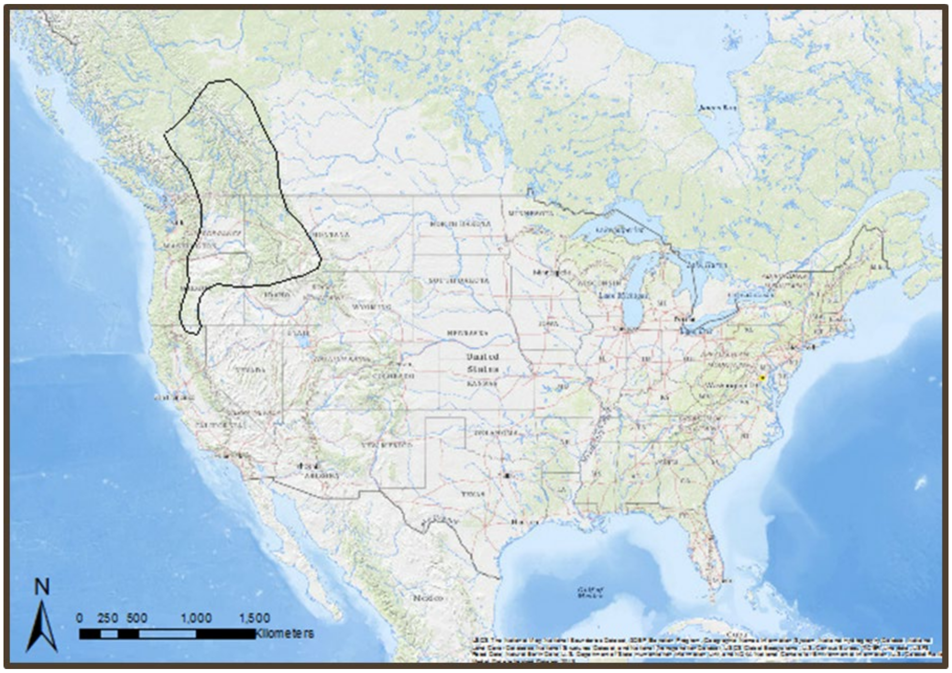

Figure 2.1: Approximation of the Columbia Plateau Culture Area. Map: Hannold 2019

Several catastrophic floods—the Lake Bonneville flood, approximately 14,500 BP, and the Missoula Lake floods, between 15,000 and 13,000 BP—and cycles of glaciation and glacier retreat helped to shape the Columbia Plateau. Floodwaters carved the rock and soil and carried boulders and large gravels great distances, depositing them far from their parent sources (Vallier 1998). Adding to the stratigraphy of the Columbia Plateau is tephra from the Mt. Mazama eruption approximately 6,900 years BP (Vallier 1998). The Columbia Plateau is home to an amalgam of different rocks, including breccia, sandstone, limestone, conglomerates, siltstones and shales, and volcanic flows (Vallier 1998:25). Much of the Plateau is characterized by deep basalt flows, punctuated by igneous protrusions. Landslide, alluvial fan, and flood deposits have all led to a wide range of river cobbles and pebbles forming over time throughout this region.

The early Holocene climate was colder around 11,000 years ago and began to warm between 8,000- and 4,000-years BP (Draper and Lothson 1990). Vegetation in the Columbia Plateau is wide-ranging, and each elevation marks a distinct mosaic of trees, grasses, and other flora that has drastically changed over time (Smith 1983). These distinct ecosystems range from steppes with sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus nauseosus*) and bunchgrass (*Festuca idahoensis*), where wild rose (*Rosa* spp.), chokecherry (*Prunus virginiana*), hawthorn (*Crataegus douglasii*), and snowberry (*Symphoricarpos albus*) are plenty, to transitional woodlands where ponderosa pine (*Pinus ponderosa*), and deciduous trees are abundant, with a dense understory below (Chatters 1998; Smith 1983). Nestled in the mountainous regions of the Plateau are meadows, where various grasses and huckleberries (*Vaccinium membranaceum*) grow. There are several types of forests in the Columbia Plateau, determined by elevation and geographic location. Xeric montane forests are coniferous forests and can be found in many variations, from areas with low precipitation, dominated by Douglas fir (*Pseudotsuga menziesii*), to dry regions with lodgepole pine (*Pinus contorta*), to western larch (*Larix occidentalis*) and white fir (*Abies concolor*) in regions with higher precipitation (Chatters 1998; Smith 1983). Mesic montane forests occur in regions with a warm, wet climate and are dominated by western hemlock (*Tsuga hererophylla*) and western red cedar (*Thuja plicata*). These forests may also contain Douglas fir and lodgepole pine. Subalpine forests can be found in either very wet or dry regions, and often consist of mountain hemlock (*Tsuga mertensiana*) and fir trees with huckleberry, grouseberry (*Vaccinium scoparium*), and common juniper (*Juniperus communis*) understory (Chatters 1998; Smith 1983). Vegetation changes with elevation, its corresponding climate, and terrain (Smith 1983).

This diverse vegetation supports equally diverse wildlife. Mammals that inhabited the Columbia Plateau include bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), bobcat (*Lynx rufus*), Canada lynx (*Lynx canadensis*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), marmot (*Marmota* spp.), and several species of rabbit and hare (*Sylvilagus nuttallii* and *Lepus* spp.), (Chatters 1998; Chadez and Sappington 2017). Birds were also plentiful in this region, varying from waterfowl to birds of prey to ground birds such as sage grouse (*Centrocercus uroplasianus*) and California quail (*Callipepla californica*).

Fish are also abundant and vary greatly, from anadromous species like the chinook (*Oncorhynchus tschawytscha*) and sockeye, or blueback, salmon (*O. nerka*) and white sturgeon (*Acipenser transmontanus*) to non-migratory species such as the chiselmouth (*Acrocheilus alutaceus*) and cutthroat trout (*O. clarki*) (Hewes 1998; Landeen and Pinkham 1999; Marshall 1977). The Nez Perce also harvested Dolly Varden (*Salvelinus malma*), lamprey (*Entosphenus tridentatus*), and minnow (*Ericymba* spp.), while other species like the whitefish (*Coregonus clupeaformis*), pikeminnow (*Ptychocheilus* spp.), and suckers (*Carpiodes Cyprinus*) were a less significant food source (Landeen and Pinkham 1999; Marshall 1977; Walker 1967:25). Coho, or silver salmon (*O. kisutch*), chinook (*O. tshawytscha*), sockeye (*O. nerka*), and steelhead (*O. m. irideus*) were important species to many Tribes, like the Spokan (Ross 2011:361).

When divided into subareas (Sappington 1994; Walker 1998), both the Clearwater River and the lower Snake River lie within the southern Plateau of the Columbia Plateau culture area. The southern part stretches as far west as the Cascade mountain range, as far south as Crater Lake in modern-day Oregon, and as far north as Chief Joseph Dam (Ames et al. 1998: Figure 1). Key sites in the southern Plateau follow the major rivers and their tributaries. Many of these sites are included in this thesis' net sinker analysis.

Fish remains are common throughout the Plateau, despite regional preservation properties (Ames et al. 1998: 104). Poor preservation is due to the inconsistent nature of the region's climate and very distinctive seasonal changes (Sappington 1994:2). This means that while fish bones are recorded in many archaeological sites, fishing activities are primarily documented in the archaeological record by fishing-related artifacts (Sappington 1994:11). No nets have been found attached to net sinkers or anchors at sites in this study, even those in dry caves. Several sites included in this analysis—Windust, Burr Cave, McGregor Cave, and Wexpusime—have perishable materials such as cordage and baskets, but no nets (Held 2006:Table 1). The further back in time, the less likely it is that archaeologists will find organic materials in the Plateau. Stone fishing implements, such as net sinkers, are therefore a crucial marker of fishing activity in this culture area.

Ethnographic History and the Repercussions of Colonization in the Columbia Plateau

Not all human behavior leaves material traces, and even those activities that do may be erased by natural processes or subsequent human activity (Sappington 1994:3). Ethnographic information is always valuable, but increasingly so in areas where those natural or anthropogenic processes have irrevocably altered or expunged the archaeological record. One such area is the Columbia Plateau.

Native Plateau residents were, and are, highly skilled in many lithic manufacture techniques (Daugherty et al. 1967). They used these skills to manufacture lithic tools necessary to hunt, fish, gather, and process regional resources. Fishing took place at various times throughout the year, including Spring and Autumn for salmon and steelhead runs (Daugherty et al. 1967; Marshall 1977). Other riverine resources utilized by Plateau People along the lower Snake River include mussels (Anastasio 1985).

There is significant diversity between and within Columbia Plateau Tribes, and it would be an error to place all Native groups in the same organizational, political, and cultural columns. Sappington (1994:3) argues for more regional demarcations within the Plateau, such as the Clearwater River region, as defined in his dissertation. In this thesis, social and political organization and subsistence in the Columbia Plateau is discussed broadly, with an emphasis on the Nez Perce. There is a considerable amount of variation in cultural practices throughout this culture area. Social organization was broadly divided into the village and the band (Anastasio 1985:189).

Ethnographers who noted fishing methods and implements include Lewis and Clark (Moulton 2001), Joseph Spinden (Spinden 1964), Alice Fletcher (Sappington et al. 1995), and James H. Teit (1928). Some of their accounts vary (Lewis and Clark versus Spinden), which could be attributed to the dynamic relationship between humans, technology, and the environment. Teit described the fishing practices of the Middle-Columbia Salish: "Salmon were caught with dip-nets from platforms. Large nets were used in some places… Small sinkers were employed for lines, and larger ones for nets" (1928:118).

As colonizers encroached on Native land in the North American west, indigenous groups were pushed into smaller areas, often separated from their traditional hunting and fishing grounds. Since this thesis focuses on Columbia Plateau fishing, technology, and manufacture methods, this section will primarily focus on the effects of colonization on indigenous fishing rights and traditional fishing grounds.

It is important to begin the discussion of the contact and post-contact periods with direction toward the reality of what European contact means. Even prior to Lewis and Clark's Corps of Discovery, European colonizers had clashed with indigenous populations across North America. Contact in the Pacific Northwest might have begun peaceably enough, but even the goals of Lewis and Clark were not entirely virtuous. Surveying and mapping North America was merely the first step taken toward the long and bloody genocide of its Native Peoples in the North American west.

Regionally, the Nez Perce War of 1877 was just one of the innumerable acts of aggression toward local indigenous communities in the Columbia Plateau. Treaties between the U.S. Government and the Nez Perce meant little, and over time, with the Treaty of 1855, the discovery of gold, and the Treaty of 1863, land was transferred from Native ownership to colonizing powers. Native land would continue to shrink as a greedy, xenophobic American government continued to steal land in the name of manifest destiny. By the time the Nez Perce War began in 1877, tensions were high and reached a breaking point when non-treaty Nez Perce were forced to move toward the reservation (Baenen 1965; Sullivan 2004). Reservation boundaries shrunk once again when the Dawes Act, or the Allotment Act, was passed in February 1887. The first anthropologist to work in northern Idaho, Alice Cunningham Fletcher, was sent by the U.S. Government during this time (Sappington et al. 1995). She worked among the Nez Perce for three consecutive summer/fall seasons, writing two manuscripts about her work with this region's inhabitants (Sappington et al. 1995). Fletcher's early anthropological work, based on her Nez Perce informant, *Kew-kew'-lu-yah*, whose English name was Billy Williams, and the photography of Jane Gay continue to be an invaluable addition to early anthropological literature (Sappington et al. 1995). The Dawes Act of 1887 was more sinister than Fletcher's intentions, however, and meant the forced acculturation of indigenous peoples. This only added to tensions between Native American and colonizing populations (Edmunds 2008; Kernan 2014).

Dams would become a part of the ongoing, systemic acts of aggression toward Native peoples in North America. In his 2005 article “Dammed in Region Six: The Nez Perce Tribe, Agricultural Development, and the Inequality of Scale,” Benedict Colombi presents the problems related to damming rivers in the Columbia Plateau, which continue today. The Nez Perce have spent thousands of years fishing the Snake, Clearwater, and Salmon rivers of the Columbia Plateau culture area. Dam construction along the lower Snake River—Ice Harbor Dam in 1955, Lower Monumental in 1969, Little Goose Dam in 1970, and Lower Granite in 1975—cost both the environment and the Nez Perce Tribe. Lewis (1995) also concludes that the Native peoples of the northwest were significantly affected. The dams, coupled with the commercialization of the region, took fishing sites away from their rightful indigenous users. In the 1940s, a court case pertaining to Nez Perce fishing rights found that the State of Idaho could not make indigenous fishermen pay for a fishing license (Baenen 1965). Historically, fish-ins were used to bring attention to this breach of treaty rights, which were eventually restored after Tribes took the issue to court. “Increasing pressure on fish resources, brought by commercial exploitation, resulted in several attempts by Euroamericans to preempt control of important fisheries” (Walker 1967:15).

The Nez Perce Treaty of 1855 outlined Nez Perce fishing rights: “[t]he exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory…” (Treaty with the Nez Perces, 12 Stat. 957:1855). Even so, disputes over indigenous fishing rights are ongoing (Hays 2006). This is likely, at its core, a problem with differing worldviews. Private sector developers see a river as something to be harnessed and exploited while Native peoples see a river as a significant element of their subsistence, of which they are stewards. While developers are currently more sensitive toward Native treaty rights, the problems, and repercussions of early development oversights, are ongoing. The Native Plateau inhabitants that white Americans, like Lewis and Clark, or anthropologists, like Alice Fletcher, met and interacted with and are very much still here. Native people live on—and their traditions live on—despite the historical, ongoing systemic ignorance, violence, and racism.

Subsistence and Fishing

Baenen (1965) predicted that, based on ethnographic accounts, the emphasis on fishing in Nez Perce subsistence would become apparent as more archaeological excavations were conducted in the Clearwater River region. Between ethnographic accounts and archaeological sites excavated on Nez Perce traditional land, the emphasis on riverine resources *has* become extremely clear. Heritage fish consumption rates were high for many Plateau groups (Hewes 1947; Sappington 1997; Walker 1967). According to Hewes (cited in Walker 1967:20-22), fish comprised more than fifty percent of many regional Native diets and, in many areas, fish consumption per capita averaged more than 400 pounds annually.

Most Columbia Plateau Tribes did not only rely on one kind of fish. For example, the Nez Perce often caught chinook and sockeye salmon, lamprey, and sturgeon and well as supplemental species like steelhead and cutthroat trout, whitefish, and pikeminnows (Landeen and Pinkham 1999:92). Fish that were used by other Tribes in the Columbia Plateau include sockeye and chinook salmon, steelhead and cutthroat trout, lamprey, whitefish, and chiselmouth (Chatters 1998; Landeen and Pinkham 1999; Sappington 1997). Walker (1967) describes principle elements of Plateau culture as including “riverine settlement patterns," "reliance on aquatic foods as a major element in their diet," and "a complex fishing technology" (Walker 1967:10).

Native inhabitants also used a wide variety of fishing technology to catch and process this resource (Landeen and Pinkham 1999; Walker 1998). Johnston (1987) divided fishing technology into four groups: harvesting, processing, catching, and hunting. A variety of Columbia Plateau fishing technologies are presented at length below. Within the Nez Perce Tribe, individual bands had their own fishing spots (Landeen and Pinkham 1999). In some regions of the Columbia Plateau, both large fishing sites and camas grounds were used for intergroup meetings (Anastasio 1985:122). Fish runs and camas harvests are somewhat predictable seasonal episodes, making it possible to prepare for these events. Ross (2011) mentions annual preparation activities, such as stabilizing anchor stones for fishing platforms, before the salmon runs every year.

150,000 salmon vertebrae were found at Fivemile Rapids, and while some argue this may have been a product of natural processes and their association with human artifacts is merely coincidental (Schalk and Cleveland 1983, as cited by Ames et al. 1998:104), they may be early evidence of the significance of fishing to Plateau subsistence (V.L. Butler 1993, as cited by Ames et al. 1998:104). Cressman interpreted these salmon bones to mean that intensive fishing existed in the Columbia Plateau by 9,800 BP (Ames et al. 1998:107). Salmonids were the most important species to most Plateau groups in relation to percent of annual diet (Marshall 1977:38).

The diets of the Native inhabitants of the Columbia Plateau did vary between groups and across space. Because the geography and geology of Columbia Plateau change significantly in elevation, the ecological background of one group in this culture area is different from the next. The rich and winding river systems of the Columbia Plateau were significant part of these diverse ecosystems.

This exploitation of anadromous and non-migratory fish begins this increase 8,000 years ago, with a trend toward a greater use of nets after 5,000 BP (Ames et al. 1998). Southern Plateau assemblages see a sharp increase in net sinkers and fish remains between 4,000 BP and the ethnographic period, suggesting an increased importance placed on this aquatic resource over time (Ames et al. 1998:111-112). This increase in fish procurement, and specific exploitation of anadromous salmon, is likely linked to an increase in population, in sedentism, and an all-around intensification of food procurement. This increase in sedentism is also marked by the use of more permanent residential structures, such as semi-subterranean houses. Many fishing methods and technologies were employed during this time.

Fishhooks, leisters, gaff hooks, spears, and harpoons were used as well as nets and traps (Landeen and Pinkham 1999; Hunn et al. 1998; Spinden 1964). Leisters are spears with two or three prongs. Gaff hooks are spears with a bent hook at the end, though do not seem to have been employed until the ethnographic period. Spears have a single prong. Harpoons have a detachable head. Spinden (1964) describes red fir, hackberry, elderberry, and bone as the primary materials used in these tools' construction. Dip and set nets were attached to a large willow ring, some of which were as long as seven feet (Spinden 1964). These nets varied, according to Spinden (1964), depending on whether the pursued resource was lamprey or other fish (Spinden 1964:210). Dip nets were used from platforms or rock outcrops (Ross 2011; Spinden 1964:211). Gill nets were angled from the shoreline, and similarly constructed nets were used as seines to catch fish from canoes, dragging the net back to the shore. Grooved stones were often used as sinkers (Hunn et al. 1998; Spinden 1964; 211). Weirs were used to direct anadromous fish into traps and enclosures (Hunn et al. 1998). Net fishing falls under harvesting, while fishhooks, barbs, and gorges fall under catching, and spears and harpoons under hunting (Johnston 1987).

Fishing implements were fashioned from organic material such as bone, wood, and plant fiber. Some nets were used in concurrence with net floats, made from wood, and net sinkers, manufactured from stone. While not all nets required the use of sinkers, many did, and their manufacture and use increase over time. Hewes notes that fishing technology across the Columbia Plateau was similar, evidencing "millennia of exchange" and that within each region was the most suitable technology for the environment (1998:623).

Net Sinker Distribution in the Columbia Plateau

Much of the archaeology done in the Columbia Plateau was salvage archaeology related to dam construction, beginning in the 1950s. Consequently, this meant that many river terrace camps and villages had to be excavated or be lost. Many of the sites included in this analysis were excavated prior to highway, dam, or recreation-related construction. These assemblages likely represent a small number of sinkers once present at the site, as looting is common in these regions.

At Kettle Falls, net sinkers are present prior to 6,800 BP (Carlson 2011:225 as cited in Casserino 2017), and net sinkers are unquestionably present in the Columbia Plateau by the Middle Archaic. Casserino (2017) found that raw materials most commonly used to manufacture net sinkers were basalt, quartzite, and mudstone. The mean length of net sinkers in his study was 74.5 mm, the mean width was 54 mm, and the mean thickness was 16.1 mm. These measurements are similar to the mean length, width, and thickness of net sinkers in the

Clearwater and lower Snake River regions. Most net sinkers from this study were side-notched (n=138), while four were four-notched, and one was end-notched. This preference for side-notched sinkers is similar to Prowse's 2010 analysis, in which side-notched sinkers comprised just over 74% of the net sinkers she studied from the Great Lakes Region. This sub-type distribution differs from trends in the Clearwater and lower Snake River regions. Casserino presumes that the selection of raw material mattered more than the selection of the metrics length and width (2017:235). As will be elucidated in Chapter Five, the experiments in this thesis support Casserino's conclusion.

The earliest evidence of net sinkers in this region may be at Hatwai (10NP143) in the Hatwai I occupation (10,800 – 9,800 BP). An "oddly flaked cobble" comes from this occupation and may be an early or attempted net sinker (Sappington 1997). The Ash Site field notes report "three flat pebble, notched net weights" (Sappington 1997). Arrow Beach (10NP102) assemblages include sinkers through the protohistoric period (500-200 BP), and a cache of net sinkers was found between 40-60 cm (Toups 1969:71). No net sinkers were found in the earliest occupations at the site. Net sinkers from the Lenore Site (10NP105) date to approximately 2,940 BP (Sappington 1997). The most common cobble tool found at 10CW4 was the net sinker. Five net sinkers were found together (Figure 2.2), suggesting they had been attached to the same net (Sappington 1991:91,93). Two net sinkers were also found in association at Canoe Camp and may have also been attached to the same net (Sappington 1997). Net sinkers are also present at 10CW34, the Kelly Forks Works Center Site (Longstaff 2013).

Fish walls, another fishing technology, were reported at 45GA32 and 45GA33 (Nelson 1965). Nelson reports that ethnographic accounts mention instances of canoes being

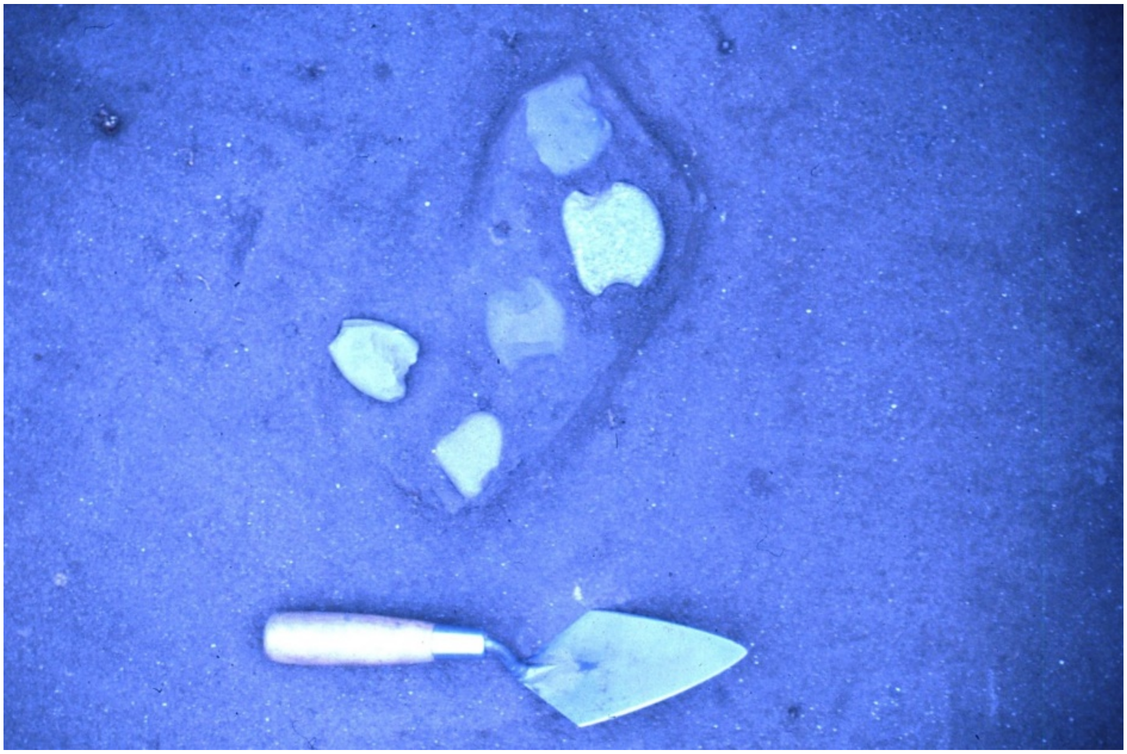
Figure 2.2: 10CW4 Net Sinker Cluster from Feature 6; Photo Provided by Dr. Robert Lee Sappington

anchored to the tops of these walls as fish were caught in dip nets (1965:3). Daugherty, Purdy, and Fryxell's report on Three Springs Bar (45FR39) indicate three perforated net sinkers and one notched net sinker between 1,006 and 1,380 CE (1967:35). They state that while notched net sinkers appear in the archaeological record earlier, the use of perforated net sinkers does not appear until after the emergence of semi-subterranean houses (Daugherty et al. 1967:35). Six more perforated net sinkers are documented in Component 9, Housepit C, during the ethnographic period and the final occupation period at this site. The nine perforated sinkers recovered range from 69-111 mm in length, 72-124 mm in width, and 15-28.5 mm in thickness. Each is oval and has a hole drilled near one edge of the stone (Daugherty et al. 1967:73). Materials used include andesite porphyry, diorite, quartzite, and vesicular basalt. The method described for the manufacture of these artifacts is alternative pecking to rough the stone surface and drilling with a sharp stone. Perforations range from 5-11 mm in diameter. These are more massive stones, ranging from 165 to 775 g (Daugherty et al. 1967:73). Not all of these grooved sinkers were available to study, though more notched sinkers have since been identified in the assemblage and are included in the analysis of lower Snake River net sinkers.

The Votaw Site (45FR32) assemblage includes a significant number of net sinkers (n=21), including notched, perforated, and grooved types. This site was occupied approximately five to 6,000 years ago and shows signs of hunting, fishing, and gathering activities (Grater 1966). The Miller Site, also referred to as the Strawberry Island Site (45FR5), is a late prehistoric settlement near the confluence of the Snake and Columbia rivers (Cleveland et al. 1976). Flenniken utilized experimental methods to replicate many tools and processes used at 45FR5 (1977:69-101), but these do not include the manufacture of any net sinker type. Net sinkers at 45FR40 were recovered from both in and out of housepits at the site (Kenaston 1966:55). Net sinkers were recovered from House Pit 3, occupational layer D and from the area outside of house pits in occupational layers VI and VII. Artifacts recovered during initial excavations at 45WT35, which was given immediate significance because of its proximity to Marmes Rockshelter, a site dating to between 8,000- and 10,000-years BP, include a net sinker. No material was recovered that could be radiocarbon dated. However, the projectile point sequence recovered here is similar to the projectile point sequence from Marmes Rockshelter (Sprague and Combes 1966:17). Fourteen net sinkers are mentioned in the Thorn Thicket (45WT36) site report within 60 cm of the surface (Sprague and Combes 1966:10). Site 45WT49, a rock shelter near the Thorn Thicket Site, lacked depth, but did include several net sinkers in the artifacts recovered (Sprague and Combes 1966). The 45CO1 assemblage, with earliest dates between 4,000 and 6,000 BP (Nelson 1965), includes several net sinkers.

Sinkers from the Clearwater Fish Hatchery (10CW4) are basalt, metamorphic, and granitic. Basalt was the most common raw material for net sinker manufacture in the Clearwater and lower Snake River regions. Basalt is also the most commonly used raw material in those sinkers analyzed along the Middle Columbia River for both shaped fishing ring stones and notched sinkers. Given the abundance of basalt throughout the Columbia Plateau, and its flakeability, it seems an obvious choice for net sinker manufacture. Though there seems to be a preference for basalt, an abundance of raw materials have been used throughout the Columbia Plateau.

All four modified stone net sinker types were manufactured and used in this culture area. Notched net sinkers are the most common type along the lower Snake River, Middle Columbia River, and their major tributaries (Casserino 2017; Casserino 2019, Personal Communication; Johnston 1987; Sappington 1994, 1997). Grooved and perforated sinkers are also present in lower Snake River, Columbia River, and major tributary assemblages. However, they constitute a smaller percentage of the total net sinkers and are often larger, suggesting a different function than smaller notched sinkers or those stones used in fishing net weight rings. Small sinkers were likely used for line fishing and larger sinkers for nets (Teit 1928). Wanapum fishermen used fishing ring net weights and, though upon first inspection this technology does not seem to represent a modified net sinker type, a shaped stone is wrapped inside their chokecherry bark binding (Figure 2.3).

The distribution of the raw material used for notched, ground stone, and perforated net sinker manufacture is largely dependent on the available tool stone in the area. As determined by the experimental portion of this thesis, not all river cobbles are equally suitable for net sinker manufacture. Historic net sinker manufacture likely has contributed to

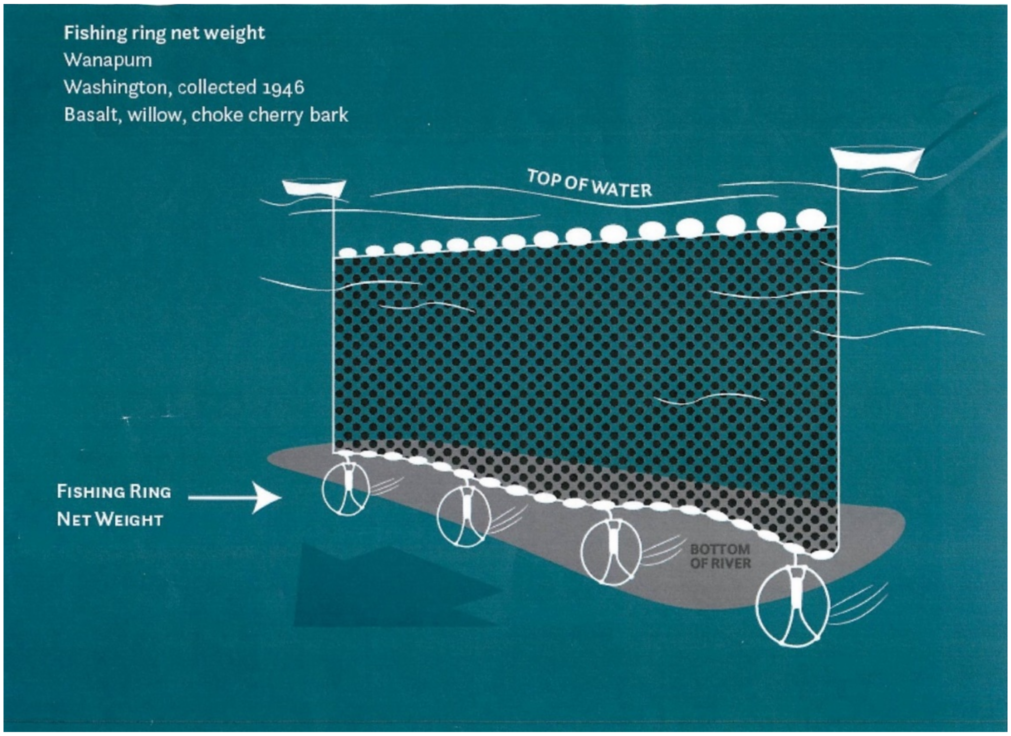

Figure 2.3: Fishing Ring Net Weight Diagram. Credit: Graphic from the David H. Koch Hall of Fossils – Deep Time, Courtesy of the National Museum of Natural History, Smithsonian Institution

the large number of tested cobbles in archaeological assemblages. As the experiments show, successful net sinker manufacture is determined by the metric attributes, mineral composition, and porosity of the cobble.

The analysis of sinkers concludes that there are size and weight preferences in blank selection from one region to another. Large, heavier net sinkers are required when rivers are fast-flowing or the targeted fish species is large and powerful. Changes in climatic conditions can affect both water levels/speed and migrations of fish. In his 1982 thesis, Gary Ford Coleman theorizes that one possible reason for the change in net sinker size over time in Tennessee is due to climatic conditions. Warmer, drier climates mean lower, slower water flow.

The majority (99%) of the net sinkers analyzed in the Clearwater and lower Snake River assemblages were notched. Preferences for subtype (end-notched, side-notched, and four-notched) can be seen from one site to the next, as well as the favored raw material and net sinker dimensions. Stone size and frequency may be linked to river depth and flow rates and the size and weight of the pursued fish species.

The indigenous people of the Columbia Plateau culture area relied on anadromous and non-migratory fish for a large portion of their annual diets. Net sinkers were a valuable tool utilized by Columbia Plateau First Peoples to catch this significant resource. Nets are composite tools, used with other fishing-related technology such as net sinkers and wood net floats. When large enough to be anchors, net sinkers can be used to weight the ends of nets in deep water and strong currents. This fishing technology is versatile and reflects the needs of the toolmaker.

Chapter 3: Theory and Methodology

Theoretical Considerations

In simplest terms, anthropology is the study of humans. The four-field approach (Kelso 2003) uses Cultural Anthropology, Biological Anthropology, Linguistic Anthropology, and Archaeology, to holistically address humanity's place in the past and present. Each of these approaches require the use of theory to interpret collected data through a specific lens. Methodology determines variables and constraints of research, whether analytical or experimental.

Theory in anthropology is crucial to interpreting and explaining the past. It helps us contextualize material culture and its transmission, the spatial orientation and uses of archaeological sites, and explain changes in subsistence related technology over time. Theory can help us understand the significance of sites and the artifact assemblages connected to them and helps us move beyond description, measurements, and a non-explanatory understanding of the past. The past is not static, and neither are the lithic tools we analyze. These tools have a life history, from the procurement of the raw material, to the realization of their intended form, to their use, curation, and final discard (Flenniken 1981). We find them after they are lost or spent, after hundreds or thousands of years in situ, sometimes displaced by bioturbation and weathering. Excavated artifacts had a life prior to their recovery, and it is that life that says the most about human behavior and activity.

This thesis blends a scientific, positivist approach with phenomenology to look at net sinker manufacture with a wide lens, forfeiting the fallacious either-or theoretical grounding that has held back much of the research in this field. There is no theoretical consensus in archaeology (Schiffer in Skibo et al. 1995:22; Skibo and Schiffer 2008:107). Many archaeologists have their preferred theoretical lens, which some believe to be the best way to interpret archaeological data. Historically, there has been disagreement between self-described processualists and post-processualists. Their theoretical back and forth has often been uncivil. This disagreement has occasionally led to theoretical improvement in the field, but more progress is made by discussion (Hegmon 2005) than argument (Moss 2005). This thesis does not add to this back and forth, but rather presents the anthropological and archaeological theory most relevant to this research. Some of these theories are competing (scientific vs. phenomenological approaches), but when used together provide a closer-to-complete explanation of net sinker manufacture.

Anthropological theory has a long history. No serious archaeologist still ascribes to unilineal evolutionism [Morgan 1877 (reprint 2000); Tylor 1871 (reprint 1958)]. Even so, it would be negligent to dismiss the proverbial stepping-stone that it was, while also acknowledging and disavowing the racism that it promoted. It is unnecessary to discuss in detail every theoretical step that led to the theory used in this research, but there are key theories that set the foundation for this study.

Culture history, the most concrete example of early theory in the field, is important in that it answers the questions *what*, *where*, and *who* and marks the temporal and spatial distribution of artifacts and how they change over time (Johnson 2020; Praetzellis 2015). In the context of this study, culture history can help identify net sinkers and their quantitative attributes, site locations, and which Columbia Plateau Tribes made and used net sinkers. A descriptive emphasis is still crucial to understanding the past. It simply cannot be the only foundation on which archaeological interpretations stand. Despite the field's early theoretical origins—18th century if we are to include those approaches and scientific traditions borrowed from Sociology and Geology—the theories most relevant to this thesis begin with New Archaeology in the mid-20th century.

A group of people is much more than the artifacts they used. The static, though polythetic, interpretation of culture by culture historians are both oversimplified and often take the human out of the equation. Archaeologists like Clarke, Binford, and Schiffer responded to the need to change how archaeologists approached theory. Initially coined by Willey and Phillips (1958), New Archaeology, later called processualism, aimed to steer the field away from the solely-descriptive and static interpretations used by earlier archaeologists and toward theory and methods that could help answer other questions like *why* and *how*. Processualism values a dynamic environment, addressing the people and processes rather than just the things (Praetzellis 2015). New Archaeologists also set out to be more scientifically rigorous than their predecessors (Johnson 2020:23). Since *why* and *how* are the primary questions this thesis attempts to answer, processualism is key to this research.

Originally designed by Robert K. Merton (1957) for the field of Sociology, Binford (1964, 1968, 1977) brought Middle Range Theory to prehistoric archaeology in "an attempt to strengthen a way of gaining knowledge of the past" (Leone 2007:21). Middle Range Theory is meant to combine both positivist, scientific methods with theory. It uses the dynamic past in conjunction with the static present to piece together answers to archaeologists' questions. While oversimplified and today problematic (Johnson 2020), Middle Range Theory did help develop ethnoarchaeology, which aims to use the study of material culture in the present to help us understand the past. It also helped develop experimental archaeology, which uses scientifically rigorous experiments to understand past processes (Ferguson 2010; Praetzellis 2015).

Experimental archaeology has been defined in many different ways (Coles 1973; Schiffer et al. 1994; Schimada 2005). Broadly, experimental archaeology is the replication or simulation of past technological processes or lifeways to understand any number of archaeological issues. There are small experiments, such as the study of projectile point fracture patterns (Titmus and Woods 1986), and large experiments, such as the Butser Iron Age Farm (Reynolds 1979). Experimental archaeology deals with archaeological phenomena around the world, from the technology and lifeways of our *Australopithecine* ancestors through those of the Colonial era. Recent University of Idaho Master's graduate Yuumi Danner used experimental methods to replicate the manufacturing processes of Klamath bone fishing implements (2017:91). Another recent University of Idaho Master's graduate Marci Monaco assessed whether skill level could be determined in biface attributes by comparing artifacts to those biface attributes manufactured by novice, intermediate, and expert flintknappers (2019). Additionally, a 2015 University of Idaho Master's graduate, Abram Grisham, experimented with the manufacture of quartz crystal tools, their use, and use-wear analysis in the Clearwater River Basin.

Flenniken's 1980 replicative systems analysis uses experimental methods to replicate vein quartz microlith tools. This process involves the replication of all events related to the life of a tool, from the procurement of the appropriate raw material to their manufacture, use, maintenance, and eventual refuse (1980:6). While the experimental research in this thesis does not span the entire life of a tool, it does deal with several aspects of the tool's life, including raw material procurement, manufacture, and curation.

While early archaeologists had tried to shift away from endless artifact collecting to say something meaningful about the past, New Archaeology took this shift further. New

Archaeology required the use of archaeological theory, context, and various forms of analyses to say something meaningful about not only chronological change, but also about the processes involved in that change (Clarke and Chapman 1978; Johnson 2020). Using the law of superposition to place them into context, a set of pottery sherds, each decoration or composition different than the last, can help us to identify different traditions and changes in technology over time. But what does that ultimately say about the people who lived there and temporally transmitted these cultural traditions? Without understanding the processes involved, an archaeological assemblage's meaning is static.

Another theory that informs this study is human behavioral ecology (HBE). Cultural ecology, the brainchild of Julian Steward, interpreted sites through an environmental and subsistence related lens, suggesting that societies become adapted to their environment and can be explained based on these cultural adaptations (Johnson 2020). The manufacture and use of net sinkers directly relate to how humans interact with their environment and when they interact with, and culturally adapt to, their environment. Net fishing has been interpreted as a way to catch a larger number of fish in a short amount of time (Johnston 1987:17). Human behavioral ecology, a theory that evolved from cultural ecology, applies the principles in cultural ecology to a population. HBE uses tools like site catchment analysis to look for a population's adaptive strategies in the context of risk minimalization. For example, desired anadromous and non-migratory fish were not available year-round in the Plateau. Net fishing allows for a greater number of fish to be caught during this resource window.

Perhaps the two most significant contributions of New Archaeology to the field of anthropology are the emphases on cultural processes and behavior. It was a focus on cultural processes that opened up the field of experimental archaeology, allowing archaeologists to simulate (attempt to replicate) past technologies and behaviors, moving beyond artifact descriptions to understand how past people interacted with their environment through technology (i.e., human ecology). Experimental methods allow archaeologists to challenge assumptions made by armchair anthropologists (Erin et al. 2019; Erin, SAA 2019). These methods can steer the field toward more accurate historical and cultural interpretations and to distance itself from its often egotistical, xenophobic roots.

A focus on behavior also makes New Archaeology different from prior theoretical approaches. Unhappy with the theoretical advancements made by New Archaeology—some claimed they were little better than those of Culture History (Skibo et al. 1995)—several archaeologists began to form new ideas about how the past should be interpreted. Behavioral archaeology defines behavior by addressing people, their environment, and artifacts all at once. Behavioral archaeology is not confined solely to the study of site formation processes (Skibo et al. 1995). It is also not confined to biology or physiology (Skibo and Schiffer 2008:6). This theoretical approach spans ethnoarchaeology, historical archaeology, prehistory, and, central to this thesis, experimental archaeology (Skibo et al. 1995:8).

Though behavioral archaeology is not confined to the study of site formation processes, they are still integral to this theory. Schiffer (1976) challenged the idea that site formation stops at artifact deposition, positing post-depositional processes that, like different groups of people, have their individual, unique progression. These processes are important because they can skew our interpretation of the static present.

While site formation processes and post-depositional history are key to the analytical portion of this study, it is Schiffer's ideas about the life of tools that applies to *both* the analytical and experimental portions of this thesis. It is this idea that links the positivist and phenomenological aspects of this approach. Schiffer's work informs both the experiments and interpretations in this research. He and Skibo used their work with pottery as a backdrop to expand on archaeological theory. They advocate for the value of experiment in our understanding of the past.

One of the goals of scientifically-driven research in New Archaeology was to be able to generalize data from one culture and map those same expectations and outcomes on another. This is problematic, as it is not culturally relativistic and discounts the nuances of each individual society (a lesson that should have been learned in culture history's heyday). A group of archaeological theoreticians known as post-processualists challenged processual theory and its methods for primarily this reason.

Experimental archaeology, though a product of processual thought, later evolved because of post-processual criticism. Experimental archaeology has always attempted to steer the field away from unsubstantiated speculation, which had plagued early anthropology, and toward a positivist-based practice grounded in the scientific and the objectively knowable. Post-processual criticism of experimental archaeology molded and continues to mold new experimental theory and methodology by encouraging this subfield to be more cognizant of how it performs and presents experimental research. The experimental side of the field had to reflect on the use of certain terms and how to phrase experimental results. For example, it is no longer acceptable to make absolutist statements about past technology. It is only by cross-comparison of ethnographic accounts, the archaeological record, and archaeological experiment that we can come close to the truth. Despite post-processual influence on experimental archaeology, it will always be at its core a positivist endeavor. Skibo and Schiffer wrote a chapter in *Expanding Archaeology* (1995) called "The Clay Cooking Pot:

An Exploration of Women's Technology" (1995:80-91). In this chapter, they posit that their research allows archaeologists to see the effects of decisions made by the potter. From this, Skibo and Schiffer theorize, we can make inferences about past people's behavior. "Experiments are the key to unlocking these decisions" (Skibo and Schiffer 1995:89).

Flintknapping, the act of making a stone tool (Whittaker 2009), gives archaeologists data that could not be produced with other archaeological methods (Flenniken 1984:192). This thesis involves the manufacture of stone tools not typically explored by experimental archaeologists. There are no brightly colored obsidian nodules, no smooth, glassy flake scars in the following pages. This research primarily involves the experimental replication of notched net sinkers. Because of its simplicity, the net sinker has been underestimated, under-recognized, and understudied. There is beauty in this simple design, however, and as Flenniken suggests above, their experimental replication produces data that could not be procured otherwise. The processes by which these tools are made can help us make inferences about human behavior (Skibo 1992).

Hegmon (2003) wrote "Setting Theoretical Egos Aside," in which she proposed a more holistic theoretical approach. This approach, known as processual-plus archaeology, points out the merits of processualism and encourages post-processual archaeologists not to throw the proverbial baby out with the bathwater. She suggests we can both have theoretical discussions that are not hostile and theory that is appropriate for different situations. Processual-plus archaeology mediates processual and post-processual considerations to create a theory that is mindful of anti-positivist critique while once again welcoming scientific methods into archaeology. Approaches like Hegmon's are valuable because they provide a foundation on which we can build, a jumping off point for archaeological action.

They do not stifle research, as some theories do, and can instead guide the field going forward.

Anthropology would do well to approach theory like Hegmon (2003), or even Kosso (1991), who found common ground between Binford and Hodder's approaches. Kosso begins his article by writing that archaeology is "…a border state between the natural and social sciences" (Kosso 1991:624). It takes an amalgam of theoretical approaches, and different theoretical formulas, to holistically address each discrete artifact or event. Being in extreme opposition to any one theoretical approach (excluding, of course, racist or otherwise discriminatory philosophies) is counterproductive and can terminate constructive conversation. A few angry back-and-forths have been successful in fleshing out theoretical ideas and forcing archaeologists to express themselves more clearly, but even Hegmon's response to Moss was level-headed, titled "No More Theory Wars" (2005). Again, as Kosso (1991) points out, there are often common goals between outwardly opposing viewpoints and these aren't recognized when theoreticians are at such emotional odds.

Processual-plus archaeology lends itself well to the experimental, but what about the experiential? What are the visual, auditory, and tactile sensations that toolmakers might experience as they are driving flakes off a river cobble? How difficult is this activity? What outside of the main toolmaking requirements might they be aware of, such as flying debris or back pain or how loud cobble tool manufacture is compared to other kinds of lithic reduction? A theory that directly relates to this research is phenomenology, an approach that tries to get at the "subjective human experience" (Praetzellis 2015:143). This is not the phenomenology of classical philosophy. This is phenomenology as it pertains to archaeology.

People both experience and interact with their landscape (Ingold 1993; Tilley 2004) just like they experience and interact with things. Artifacts cannot exist outside of human experience. Before making a cobble tool, a toolmaker needs first to select an appropriate stone, relying on both sight and touch. That toolmaker then needs to modify that stone, trusting a full range of senses. Archaeologists cannot say what an indigenous toolmaker was thinking or feeling as they were making a tool. However, phenomenology allows modern toolmakers to compile a list of environmental phenomena related to their subjective experiences during a toolmaking activity and present it as possible shared human experience.

During each segment of this study the auditory, visual, and tactile stimuli resulting from net sinker manufacture were recorded. Different muscle groups fire when a net sinker blank is held a different way. Flying quartzite debitage has a tendency to embed itself in whatever is in the way, be it boot, foot, or leg. Net sinker manufacture is much louder than other forms of lithic reduction. While these points might seem extraneous, I believe they can help us ultimately understand why one method of net sinker manufacture (and therefore type) might have been chosen over another.

The archaeology of the human experience (AHE) also relates to the definition of phenomenology used here. Though its scope is further reaching than that of this thesis, one point is clear. Just because we cannot determine how individuals in the past felt about what they were experiencing does not mean that we cannot focus on what they experienced (Hegmon 2016:8). The emphasis on phenomenology in this thesis attempts to get at a very small part of that experience.

Without experimenting with past technology, particularly where there are few or no ethnographic accounts to point us in the right direction, an archaeologist may be prone to conjecture. Previous experimental research with lithic reduction is well-known, perhaps because lithic material is often the only remaining material culture at sites worldwide and is therefore more readily available for study. A large portion of these experiments pertain to flakeable toolstone; specifically, projectile points. Experimentation with cobble tools is less common (Swanson 1975) and usually involves ground stone manufacturing methods—pecking and grinding—rather than chipped stone manufacturing methods—direct percussion (Adams 1989; Martinez 2019). Aside from being briefly mentioned in Prowse's 2010 article "Much Ado About Netsinkers," published experiments on net sinker manufacture and use are nonexistent, contributing to the relevance of this research.

Responsibilities of the Researcher

Experimental archaeologists have many responsibilities, most of which have been pointed out in post-processual critiques. Access to this research for descendant communities, academic or professional archaeologists, and the public is crucial. The scientifically unethical days of elitist academic gatekeepers, hoarding data and access, are coming to an end. It will take time to revise this system. In the meantime, researchers must ensure that their work is shared in a timely manner and made available to all who would request access.

Archaeologists should dispose of the replicated materials and the debitage we produce in a manner that does not risk the integrity of the archeological record. All net sinkers simulated for this experimental research have been marked with a diamond point scribe and all debitage collected and stored with them. If discarded in the future, they will be disposed of in a responsible manner.

Experimental Methods

The experimental methodology used in this thesis is heavily influenced by the work and publications of Schiffer and Skibo (Skibo 1992; Skibo et al. 1995; Skibo and Schiffer 1992, 2008; Schiffer 2001; Schiffer et al. 1994), Don Crabtree (1967, 1970, 1971, 1972, 1999; Crabtree and Davis 1968; Danner 2017), and Whittaker (2009). Skibo and Schiffer (1995:89) suggest that in replicative experiments it is necessary for the experimentalist to show how the tools being studied were both made and used. They also suggest that the manufacture of replicas be proximal to the original artifact. While it is not possible to do exactly this for notched net sinkers—the availability of toolstone is a major limiting factor—all replicative experiments are based on the platonic ideal of a net sinker as described in books (Rau 1884), articles (Casserino 2017; Prowse 2010; Rau 1873; Sappington 1997) and site reports (Sappington 1991). This platonic ideal became somewhat less rigid after the first experiment, since research with actual sinkers revealed how much individual style and regional variability influenced each one. There is no single net sinker that could represent all net sinkers, because humans are much more varied and expressive than that (lithic Platonists be damned). Though the classification of artifacts is here recognized as a useful abstraction, it is also an arbitrary one.

No hard-to-obtain equipment was used for any of these experiments and the processes used are purposely straightforward. Hammerstones were selected for their similar size, material, and oblong shape. Net sinker blanks were chosen in similar size and weight appropriate for each experiment. Detailed descriptions of the raw material used is included in each experiment narrative. The author was the sole tool manufacturer for the primary tests (all direct percussion related) and the only other toolmaker to assist in net sinker manufacture acted only as a vise to hold the pebble upright during an indirect percussion study.

Flenniken (1984) warns about morphologists' practice of equating the media with which pre-colonial tools were made. One raw material is not like another, and the processes to manufacture different tools are diverse. The methods for biface manufacture and net sinker manufacture are different, despite both involving direct percussion. The force needed changes, the angle needed changes, and the goal changes.

In his 1873 article, Rau suggests a possible method for net sinker manufacture in his region:

> Two workmen, I imagine, were active in the operation. One held the pebble, its narrow side upward, firmly in the hand; the other placed a piece of flint of suitable shape and strength at the spot where the notch was to be cut out, and gave the flint wedge a heavy blow with a hammerstone, thus effecting the indentation. In this manner a great many sinkers could be made in a short time. (Rau 1873:144)

In her 2010 article, Prowse cites Rau's interpretation of net sinker manufacture, and states that in her experience net sinkers can be made using direct percussion (2010:82). The notched sinker experiments in this thesis use direct percussion, as suggested by Prowse, and indirect percussion, as suggested by Rau. Prowse (2006, 2010, 2013) has done research with net sinkers for more than a decade. Her analyses include measurements such as notch width, notch depth, and inter-notch width. These measurements are included in the analysis portion of this thesis as well as standard length, width, thickness, and weight. Attributes of each net sinker are also recorded, such as whether a sinker is side-notched, end-notched, atypical, or both/four-notched. The same measurements taken for the experimental sinkers were taken for those from southern Plateau assemblages. The attributes of each sinker also were described and a photo was taken.

In summary, this research combines both a scientific, positivist approach with phenomenology to create a holistic method to assess and explain, as best as possible, net sinker manufacture. The theoretical foundation of this thesis draws from several approaches. These include behavioral archaeology, human behavioral ecology, experimental archaeology, and phenomenology. The methods used for net sinker manufacture in this thesis are rigorous and replicable. Continuity during experiments was critical, and variables were consistent throughout.

The Physics of Stone Tool Manufacture and Relevant Studies in the Field

Net sinkers are made primarily using river cobbles and pebbles. Though the size, shape, and composition of these river cobbles may change from one to the next, their post-geological deposition formation processes are similar. Pebble evolution, which was first pondered by Aristotle (Domokos and Gibbons 2012; Domokos et al. 2014), is an entire field of study in material science and geophysical research. Pebbles and cobbles are formed when large gravels break off from their original geologic deposits and are eroded by both water and exposure to weather over long periods (Domokos and Gibbons 2012; Domokos et al. 2014). They are rounded slowly by tumbling in rivers, coming into contact with other rocks, and exposure. Different rocks are abraded at different rates by steady state abrasion, mutual abrasion, and friction, dependent on their mineral makeup and the distance they are carried (Domokos and Gibbons 2012). Stones are also separated from other cobbles with the same parent gravel during transport, leading to a variety of stone types within each stone population (Domokos and Gibbons 2012). Sedimentary, igneous, and metamorphic rocks can all undergo these same processes, leading to a wide variety of raw material.

Mudrocks account for approximately sixty-five percent of sedimentary rocks (Blatt 1992:160) and limestones and dolostones comprise approximately ten to fifteen percent of sedimentary rocks (Blatt 1992:200). Sandstone and conglomerates comprise the remaining percentage of sedimentary rocks. These stones are typically easier to break than their igneous or metamorphic counterparts. This has to do with the formation processes, which influence the porosity of a stone.

Stone tools break when struck with a hammerstone because of the stress that results from the blow. Solid materials resist breaking by deforming, or bending, and when they are unable to deform, they break (Cotterell and Kamminga 1990).

In their 1997 study, Amick and Mauldin examine the role that raw material plays in flake breakage patterns, suggesting that, despite the likelihood that a stone will break predictably, there are other variables that need to be accounted for. The materials used by Amick and Mauldin include basalt and quartzite; two types of stone regularly used for net sinker blanks in this research. They found that basalt and quartzite debitage was more likely to include split flakes than the obsidian/flint/chert/chalcedony groups. After reviewing other relevant studies (Cotterell and Kamminga 1987:691-698; Domanski et al. 1994: Tables 4 and 5; Goodman 1944:433) they determined that granular stones may break more easily because granitic material and quartzite in particular "possesses lower compressive and tensile strength than chert and obsidian."

Glassy or cryptocrystalline rocks, such as obsidian, flint, and chert, break predictably. At the point of impact, they fracture either conchoidally, in the shape of a Hertzian cone (Cotterell and Kamminga 1990; Whittaker 2009) or fracture by wedging (Cotterell and Kamminga 1990). The Hertzian cone fracture is caused when a stone is struck with a hard hammer stone at approximately a 45-degree angle. Wedging occurs when a stone is struck at an angle greater than 90-degrees or struck on the side of the stone, as with bipolar percussion (Cotterell and Kamminga 1990:141). By controlling the angle and force of the impact, a toolmaker can predictably drive flakes from a stone. The same principles can be transferred to non-glassy rocks, such as sedimentary, igneous, and metamorphic river cobbles, sometimes with varying degrees of success. Many river cobbles, particularly those composed of quartzite, fracture in the same predictable way that glassy rocks do. Certain sandstones will, contingent on their grain size and sorting, crumble (Blatt 1992). Cobble composition is highly variable both within and between regions. The inability to flake in the same way as glassy material does not lead to failed net sinkers. The notch attributes will simply look different and have fewer large flake scars.

Some cobble tool flake scars resemble flake scars left on glassy or cryptocrystalline tools. Striking a platform with too much force or at the wrong angle can lead to undesirable flake terminations (Chlachula and Le Blanc 1996; Whittaker 2009:18). Not supporting a net sinker blank can lead to the same outcome as not supporting an obsidian biface. The stone will break by bending fracture. The same skills used to make other stone tools can be applied to net sinker manufacture.

Reduction strategy is another variable that influences flake breakage patterns (Amick and Mauldin 1997:21). Changing tools throughout the reduction process affects the debitage left after the tool is finished. Direct percussion was used during Experiments One, Two, and Three. The process was finished by using a chopper to remove the flat surface of the exposed interior along the net sinker’s edge. This creates much smaller debitage from crushing, rather than flaking. Debitage was saved during these experiments for later analysis.

Definitions That are Integral to This Thesis

There are several definitions key to understanding the following experiments. Blatt (1992) defines a pebble as falling between 2 and 64 millimeters, a cobble between 64 and 256 millimeters, and a boulder as being greater than 256 millimeters. For simplicity, all stones will be referred to as either net sinker blanks or cobbles. The actual size of these stones can be found in Appendices B and C.

Modified and unmodified sinkers have been found in the archaeological record. Unmodified sinkers are more difficult to identify, as the organic material they are used in association with often does not survive over time. When their organic portions decompose, an unmodified stone is left. Even so, there are many instances of both the organic and inorganic parts of the sinker surviving (Croes 1995; Stewart 1973, 1977). In this thesis, modified stone sinker refers to those sinkers whose stones have been altered by human activity. Some are used with organic material (Neller 2019), but if the organic material decays the sinker left behind has been obviously modified by humans. All sinkers analyzed or experimentally manufactured for this study are modified.

Direct percussion is a lithic reduction method that involves directly applying force to a target stone with a harder stone. Indirect percussion requires an intermediate tool, such as a flint or cobble flake, which is struck with a hammerstone to modify the target stone. Hammer and anvil methods require an anvil, either wood or stone, as well as a percussor, such as a chopper or hard hammerstone. Flaking refers to the process of removing flakes from a stone by one of the aforementioned reduction methods. Abrasion requires the use of a coarse stone to dull sharp edges, making a stone more conducive to flaking or less likely to cut through organic material. In net sinker manufacture, abrasion dulls notches, making them less likely to cut cordage and netting. A hammerstone is a percussor used to reduce a stone by any one of the aforementioned methods. Choppers are cobbles that have been flaked, either unifacially or bifacially, to have a sharp, strong edge. This edge can be used in net sinker manufacture to increase notch depth by pecking, can be used as the intermediate implement in indirect percussion, or as a percussor in one method using a hammer and anvil.

Research Limitations

One limitation of lab experiments is that the correlates produced in a lab, defined as "principles of human-artifact interactions" (Schiffer et al. 1994:210), cannot be used individually to infer something about a process or a culture (Skibo 1992:29). These sinkers are replicated under the assumption of intended function, but it is not until they are used in field experiments—the next step in the experimental process (Skibo 1992)—that assumptions about their intended function and their actual function can be reconciled (see Flenniken 1981). For example, the net sinkers manufactured here are produced under the assumption that they are used in conjunction with fiber net or other fishing-related technology, and that they are attached in a certain way. A field experiment—attaching these sinkers to a net and using them for their proposed function—would allow for the intended function to become their actual function. Sinkers can be replicated to resemble those found in the archaeological record, but without using these sinkers in field experiments we cannot say how many are necessary to hold a net beneath the water, or what the threshold is when added weight becomes either unnecessary or counterproductive.

A second limitation is variability not only from one region to the next, but also from one toolmaker to another. During the analysis of sinkers from repository collections it became clear that a great portion of the differences between one sinker and another could be attributed to the individuality of the toolmaker. Every new lithics lab student asks how they will know they are finished with a tool. The answer returns the responsibility to the student: "you'll know." This subjective end has played out in the physical world for thousands of years. A mental template has no concrete finish line. A toolmaker is finished when they believe the tool looks and feels as it should. After years of using these tools, their idea of what "finished" looks like could change.

These limitations are not detrimental to the integrity of this thesis. They merely demonstrate a need to continue this line of investigation beyond the scope of this research. It is through this long-term series of experimental programs that we can identify technical choices made by the prehistoric toolmaker, the possible reasons for those choices, and the human-artifact interactions that are consequences of those technical decisions (Schiffer et al. 1994:210).

Aside from human remains, artifacts are the best evidence of how humans interacted with their environment in the past. They can tell us about the choices they made, sometimes once and sometimes again and again. Humans relied on these artifacts and they are inseparably intertwined with human behavior (Schiffer 1992:1,131). This thesis attempts to interpret a small part of human behavior in the Columbia Plateau through experimental and analytical means. The nature of analysis and experiment in archaeology is that one can inform the other. The benefits of this multi-faceted approach are numerous. The most important benefit is that we can infer more about human behavior, and the technologically proficient Native people who came before us, with a multi-faceted approach rather than with an isolated approach.

Chapter 4: Net Sinker Experiments and Results

This thesis includes seven experiments. Each experiment was designed to answer one or more research questions. The first experiment assessed time and energy investment for direct percussion notched net sinker manufacture. Experiment Two determined to what extent cobble source plays a part in notched net sinker manufacture. The third experiment simulated whether procuring stones from a river rather than from a riverbank decreased the effort expended, both in time and energy, during notched net sinker manufacture. Experiment Four was designed to determine whether indirect percussion, suggested in Rau's 1873 net sinker manufacturing hypothesis, was a viable form of notched net sinker manufacture. The fifth experiment involved methods for grooved, or ground stone, sinker manufacture. Experiment Six focused on methods for, and time investment in, perforated sinker manufacture. The final experiment assessed whether the hammer and anvil method is practical for notched net sinker manufacture.

Experimental Processes

Each experimental design outlined below is different from the next because the goals are different from one experiment to another. The necessary tools, methods, and expected outcomes vary across experiment design, as does the scope of each. Experiments One, Two, and Three are the largest experiments, while experiments Four through Seven are narrower in scope. This section outlines significant elements of each experiment including methods and materials.

Experiment 1: One Hundred Notched Net Sinkers

One hundred notched net sinkers were manufactured over approximately six months. Water worn cobbles or pebbles, between 47 and 163 mm in length and 20 to 1474 g in weight, were chosen as net sinker blanks. Direct percussion, directly applying force to the target stone from another harder stone, was used for all one hundred sinkers. Direct percussion is the likely method for notched net sinker manufacture noted in archaeological literature (Prowse 2010). Hammerstones selected (Figure 4.1) were all of oblong shape and similar in size, ranging from 125.25 mm to 172.84 mm in length and from 453 to 1313 g in weight. A quartzite chopper was used to increase the depth of the notch after direct percussion flaking (Figure 4.2).

Net sinker blanks were collected from a wide range of sources. Consequently, the stones' size, weight, and mineral composition differ from one to the next. Dr. Thomas Williams, a geologist in the University of Idaho Geological Sciences Department of the College of Science, used x-ray powder diffraction (XRD) to identify a sample of the material used in Experiment One.

Both time and number of strikes per side were recorded for each net sinker. To ensure the same manufacturing processes for all one hundred net sinkers, a maximum number of strikes per side was set to determine when the process would end, should the material not be cooperative. The stopping point for all notched sinkers in the experiment was 200 strikes. Each net sinker blank was struck up to 100 times on side one, face *A* before turning the stone to strike side one, face *B* 100 more times. A sinker was labeled failed if no flake had been removed by 200 strikes. More than 200 strikes reflect a successful first notch followed by a failed or difficult second notch.

Figure 4.1: Hammerstones Used for Experiment 1; Note That All Four Hammerstones Were Broken During the Manufacturing Process.

Figure 4.2: Primary Quartzite Chopper Used During Experiment One

It was not necessary to continue to 200 strikes if the stone cooperated and a net sinker blank was notched. As Appendix A reflects, this was often the case. It was also not necessary to continue if the stone broke by bending fracture during the process. The process was terminated and the sinker labeled *failed* in the event of a bending fracture.

Historical net sinkers typically have two, three, or four notches. Two-notched sinkers are most common, evidencing their ability to perform their intended function without additional notch manufacture. Because of this, the first experiment only required the manufacture of two successful opposing notches.

The shape of each net sinker blank determined whether it would be end-notched, side-notched, or atypical. Even more important than the overall thickness of a net sinker blank is the tapering thickness of the stone (Figure 4.3). The tapering thickness of a net sinker blank was the primary factor influencing whether a net sinker was end-notched, side-notched, or atypical. A second factor that influenced notch orientation was the stone size. Due to the mechanics of net sinker manufacture, it is difficult to side-notch sinkers that are less than four centimeters wide. The likelihood of driving a successful flake from a stone decreases when the toolmaker's hand, rather than the target stone, absorbs the force applied by hard hammer percussion. Because of these awkward mechanics, smaller net sinker blanks were often end-notched. As the results show, there are additional problems related to end-notched sinkers because of the support they require during manufacture, making them a less ideal subtype for larger stones.

I held each net sinker blank in my non-dominant hand at a $\pm 45°$ angle from a plane parallel to the ground at approximately elbow height, fingers supporting the stone, and

Figure 4.3: Example of Tapering Thickness in a Stone

gripped the hammerstone in my dominant hand. Depending on the overall size of the stone, I struck the net sinker blank between one and thirty millimeters from its edge. The goal is to bifacially drive flakes from a small area which can then be indented using a quartzite chopper. The mental template used for this experiment is based on photos and sketches of net sinkers in books (Rau 1884; Stewart 1973, 1977), articles (Casserino 2017; Prowse 2013; Sappington 1997), and site reports (Sappington 1991). Because of this mental template, the notches on net sinkers from Experiment One are more exaggerated than those of later experiments. My analysis of Southern Plateau sinkers, which took place after the first experiment, showed that pronounced notch depth was not a requirement for functionality.

These preconceptions also included average size of net sinkers (Longstaff 2013) and the average number of net sinkers needed for a single net (Sappington 1991: 91, 93).

After its manufacture, each net sinker—successful or failed—was placed in a bag along with its corresponding debitage and labeled NS1 (net sinker one), NS2, and NS3 through NS100.

Experiment 2: Cobble Source Experiment

During the first experiment, it became clear that the source of the raw material mattered in successful net sinker manufacture. If a stone did not want to give, it would not give, no matter how promising the cobble's potential seemed upon selection. Several isolated sources of material were chosen to determine to what extent stone type and source mattered. Many of the sources share mineral content but differ in density and porosity. The results of this experiment show that stones with similar mineral composition can have different manufacturing outcomes, likely based on their initial formation processes.

Each discrete stone source used in Experiment Two was given a different acronym beginning with CS, cobble source, and ending with G*n*, indicating group number *n*. Group one, for example, is labeled CSG1. This experiment includes six cobble sources. The cobble source and cobble hydration experiments share four cobble sources (CSG2, CSG3, CSG4, and CSG6). Only dry cobbles are used here.

All net sinkers for this experiment were manufactured using the same methods outlined in Experiment One. Each sinker was notched using hard hammer direct percussion, followed by the use of a chopper to increase notch depth. I recorded the number of strikes per side and timed the manufacture of each net sinker. As in Experiment One, a failed notch required 200 strikes, 100 on each face of one side, before the process ended.

The first source, CSG1, is comprised of grey limestone cobbles measuring between 51 and 103 mm in length. The second source, CSG2, consists of pink and grey quartzite cobbles between 57 and 95 mm in length. CSG3 includes neutral-colored quartzite cobbles measuring between 47 and 91 mm long. The fourth source includes basalt cobbles with a waxy exterior. This group measures between 48 and 107 mm in length. CSG5, a source with a wide range of mineral makeup and an excess of iron inclusions, measure between 56 and 105 mm in length. CSG6, which like CSG5 includes a wide range of cobble types, ranges from 63 to133 mm in length.

Experiment 3: Cobble Hydration

Permeability is defined as "that property which permits any substance to penetrate or pass through it… usually conceived to be the rate at which water will flow through it" (Kessler 1926:155). Porosity, the measurement of how much water stone can hold (Blatt 1992:74), differs from one geologic material to the next (Camaiti et al. 2015; Blatt 1992). A rock absorbs water because its grain boundaries or crystalline structure allow room for water to get in (Heidug and Wong 1995). Variables that affect permeability include clay content, sorting of sand grains within, and diagenetic processes, defined by Blatt (1992) as biological, chemical, or physical changes to a sediment post-deposition. During diagenetic processes, the once prominent pore space is filled by outside substances (Blatt 1992:74).

In their 2015 study, Camaiti, Bortolotti, and Fantazzini used nuclear magnetic resonance (NMR) to determine stone porosity of several types of stone typical of monument manufacture—biocalcarenites and soft calcareous stones—before and after the application of polymers commonly used in artwork conservation efforts (Camaiti et al. 2015:34-45). Initially developed for the oil industry, NMR has more recently been applied to cultural heritage preservation (Camaiti et al. 2015:34). Although this thesis does not directly pertain to this type of preservation, NMR can be used to look at stone porosity and assist in explaining why cobble hydration might make cobble tool manufacture easier.

All stone is a "porous media" (Camaiti et al. 2015), but its level of porosity changes depending on its formation process and the geologic events that follow. All stones have different porosities, and there is variation in porosity within a stone type as well. Subsequently, most porosity percentages are estimates. Zeki Karaca's study, published in 2010, determined how quickly different classes of stone absorbed water and how long it took them to dehydrate. He took samples of marble, limestone, travertines, onyxes, and granites, hydrated and dehydrated in cycles up to twenty-four consecutive days (Karaca 2010:787). For the limestone, granite, and travertine samples, the time it took to dehydrate a sample was longer than the time it took to hydrate a sample. Granites, in particular, absorbed water quickly (approximately four days or less) despite taking as long as fifteen days to dehydrate (Karaca 2010:Figure 5). Travertines took up to nine days to hydrate (Karaca 2010: Figure 3) and up to eighteen days to dehydrate. Limestones absorbed water in under four days and took twelve days or fewer to dehydrate (Karaca 2010: Figure 2). Of all stone types, travertines absorbed the most water by mass (Karaca 2010:790).

The absorption of water by stone is not the end of the changes to that stone. The result of this water absorption is the swelling of the rock, which alters its crystal dimension (Heidug and Wong 1995). Rocks particularly affected by this include those containing phyllosilicates, such as shale, which quickly absorb water. In their experiment, Heidug and Wong found that when placed under constant external stress during the saturation process, the pressure gradually built (Heidug and Wong 1995:418), demonstrating swelling of the stone.

The evidence for cobble hydration presented in this section serves to support the hypothesis that cobble hydration could make net sinker manufacture easier. In a pre-contact context, this would mean choosing cobbles from the river rather than the shore and manufacturing the net sinkers within the amount of time it takes for a cobble to dehydrate (Karaca 2010). Experiment Three was conducted to simulate this potential difference.

Due to time constraints, the cobble source and cobble hydration experiments were conducted, in part, simultaneously. CSG2, CSG3, CSG4, and CSG6 from Experiment Two were split into two groups—hydrated and dry cobbles. Only dry cobbles are presented in the cobble source experiment. Here, however, both dry and hydrated cobbles from the discrete sources outlined in Experiment Two are used to look at differences in manufacturability. Each cobble source was divided into two groups of like small, medium, and large cobbles. One group was then selected at random to be hydrated while the other was flintknapped dry.

Hydrated groups were placed in a 14 by 12-inch plastic wash bin, water covering the stones, for seventy-two hours. After this hydration period, they were removed and immediately knapped. The dry group was knapped using the same direct percussion methods established for Experiments One and Two. Net sinkers for each cobble source were completed before moving on to the next to eliminate any variation extended periods of time might have introduced. The acronyms assigned to each cobble source for Experiment Two are used here, and hydrated cobbles continue the established number sequence (CSG2-7, CSG2-8…). I recorded time and number of strikes to successful net sinker manufacture and set aside the sinkers for later analysis.

Experiment 4: Indirect Percussion Notched Sinker

In his 1873 article, Rau describes an indirect percussion method of net sinker manufacture. This method involves two toolmakers; one to hold the stone and another to hold the flint wedge and hammerstone. Prowse (2010) acknowledges this method but says she has found that it is easy to manufacture net sinkers using direct percussion. Rau's description of indirect percussion does not match the attributes of the net sinkers he presents (1873:140); these sinkers were likely made using direct percussion.

Because there are no ethnographic accounts of indirect percussion or published archaeological experiments, it is necessary to test Rau's notched net sinker manufacturing hypothesis. This study was conducted in accordance with Rau's 1873 description to determine whether it is a viable method for notched net sinker manufacture or speculation by a 19th-century armchair anthropologist. This is the only experiment in this thesis that involves more than one toolmaker to manufacture each net sinker. To maintain continuity between this and previous tests, the second individual only acted as the stabilizer for the net sinker blank, holding the stone with its narrow side upward.

Forceful, single blows as described by Rau (1873) resulted in a broken flint or cobble wedge rather than a notched sinker. Each net sinker blank for this experiment was held, narrow side up, resting at its base on a wood anvil. A flint or cobble flake (specified in Table A.4) was placed perpendicular to the blank and was firmly tapped with a hammerstone, repeatedly, until a notch was made. Results varied based on stone type and whether a cobble flake, flint flake, or quartzite chopper was used.

Experiment 5: Grooved Sinker Experiment

Grooved sinkers are the second most frequently occurring net sinker type in the Clearwater and lower Snake River assemblages. They become increasingly common northwest of the Clearwater and lower Snake, adjacent to and along the Columbia River. They also occur more frequently in lower Snake River assemblages than Clearwater River assemblages. Wear rates in grooved sinker manufacture depend on the hardness of both the net sinker blank and the chopper (Cotterell and Kamminga 1990).

This experiment was conducted to determine methods for grooved sinker manufacture. Net sinker type distribution throughout the Columbia Plateau may be influenced by function or manufacturing time and energy investment. While notched net sinkers are the focus of this thesis, it is necessary to explore manufacturing methods for all net sinker types from this culture area. This includes grooved sinkers, perforated sinkers, and shaped fishing ring stones. Though these experiments are narrower in scope, they give a sense of the time, effort, and processes involved in their manufacture.

Raw material selection and methods for reduction were influenced by Hellweg (1984), who made axes and hammers by pecking and grinding bands around the waist of the stones (Hellweg 1984:70-81). The first grooved sinker was manufactured using a quartzite chopper, which was frequently re-sharpened throughout the process. Both pecking and grinding motions were used to create a single band around the stone. The process was repeated for short bursts, no more than two hours each, several times. This process took more than five hours (Table A.5).

It became clear after finishing this first grooved sinker that there had to be a more efficient way to make these tools. Kelley Martinez had recently published research that involved ground stone technology and the replication of a grooved net sinker from the Rylander site (35CO2), located in Oregon (2019). She found that using water during the experimental replication of a ground stone bowl greatly expedited the process. Subsequent grooved sinkers were hydrated for seventy-two hours prior to their manufacture. This period of cobble hydration, along with regular wetting of the grooved area as it dried, significantly sped up the process (Table A.5). The same pecking and grinding motions described for the first grooved sinker were used for all grooved sinkers in this experiment.

Experiment 6: Perforated Sinker Experiment

Perforated net sinkers, despite their more subtle presence in the archaeological record, are still part of many Columbia Plateau assemblages. Several perforated sinkers were identified in both Clearwater and lower Snake River assemblages. Like notched net sinkers, they seem simple to manufacture, but like grooved sinkers, they are time-consuming tools to make.

Flint drills were knapped specifically for this perforated sinker experiment. Because of limited access to the jasper and opal that Columbia Plateau inhabitants would have used, flint was used as a substitute. These drills worked by gripping the flat, distal end and twisting the drill back and forth while pressing in against the surface of the cobble or pebble. Each experiment was timed to determine how long this process takes.

Experiment 7: Hammer and Anvil Testing

The hammer and anvil method is commonly used for bipolar percussion in lithic reduction. If less force is used, this method can be used to drive off shorter flakes instead of splitting a stone into two or more pieces. This was hypothesized to be one possible method for notched net sinker manufacture and was explored to either confirm or reject this hypothesis. Two hammer and anvil methods were used in this experiment. The first method, described above, involves striking a stone, narrow side up, until flakes are removed or a notch is made. This was done first with a hammerstone and later in the experiment with a chopper. The second method involves lying a cobble flat on a stone anvil and striking the edge with a hard hammerstone repeatedly.

The same wood anvil used in the indirect percussion study was used for the first hammer and anvil method. A pebble or cobble was placed on the anvil, narrow side up, and a hammerstone or chopper was used to strike a localized area of the stone in an attempt to drive off flakes. This experiment is limited in scope and, after the first trial, was determined to be potentially the most dangerous method by which to manufacture notched net sinkers. Debitage, having been given no direction by the toolmaker, flies in a 180-degree arc, embedding itself into whatever surface is closest.

During the second hammer and anvil method, a net sinker blank is set face down on a large stone anvil. A hard hammerstone is then used to strike the edge of the net sinker blank. The net sinker blank is struck repeatedly until the stone is notched. A quartzite chopper is then used to increase the depth of the notch. This method led to the highest percentage of failed sinkers in this portion of the study.

Quantitative Results of Net Sinker Experiments

The experiments outlined in section one of this chapter demonstrate the importance of raw material selection, no matter the method for net sinker manufacture. In Experiments One, Two, and Three, both the number of strikes required to manufacture a successful sinker and time to completion increase with denser, less porous material. Successful and failed net sinkers, and time to completion, in Experiments Four through Seven are also influenced by raw material. The mineral content, porosity, and life history of a stone all contribute to whether a material is flakeable. Stone porosity and permeability not only affect a cobble's ability to be efficiently notched when hydrated; these variables also affect a dry cobble's ability to be notched. Porosity allows for both water and air between the crystalline structure of the stone. This means that a higher porosity percentage allows for a cobble to be notched more quickly than a cobble with a lower porosity percentage.

Experiment 1: One Hundred Notched Net Sinkers

The results of Experiment One varied from one raw material to another. Some cobbles were easy to notch while others were impossible to notch. Of the one hundred net sinkers manufactured for Experiment One, seventy-six were successful. Of the twenty-four failed net sinkers, 33% (n=8) failed by bending fracture and 67% (n=16) were not able to be notched on at least one side. Time to successful net sinker manufacture ranged between 2.4 and 21.08 minutes, with a mean of 8.69 minutes. Successful net sinkers took 8 to 422 strikes to manufacture, with a mean of ~127 strikes. These numbers are a consequence of the hard quartzite stones used in this experiment.

An Oregon archaeologist with experience in lithic technology replication, Greg Applen, manufactured twenty net sinkers using direct percussion in 2019 and sent them for analysis. Each took approximately ten minutes to manufacture and exhibit similar attributes to those sinkers in Experiment One. His experiment further supports the time investment involved in notched net sinker manufacture suggested by this experiment.

Experiment 2: Cobble Source

CSG1 cobbles flaked more quickly and efficiently than any other material in this research. A quick test with diluted hydrochloric acid hinted that they were likely limestone.

Dr. Thomas Williams' XRD scans confirmed this. This source had one of the highest percentages of successful sinkers (~93%) in this experiment.

CSG2, the pink and grey stone source, proved to be nearly impenetrable during a separate attempt to make a grooved sinker with a quartzite chopper. Dr. William's XRD scans showed high levels of SiO_2. These cobbles are mainly quartzite with low levels of albite and, though a dense material, were able to be flaked given a proper tapering thickness. In further experimental research conducted for Experiment Three, these cobbles responded well to cobble hydration. In this experiment, however, these non-hydrated cobbles had a high rate of failure (~83%).

CSG3, like CSG2, proved to be challenging material. These stones would have likely been easier to knap had they been thinner. This morphological deficiency, combined with the hard stone, made the manufacturing process difficult. Despite this, CSG3 had an eighty-three percent success rate.

The waxy basalt cobbles from CSG4 broke too easily. This source had the highest rate of bending fractures in Experiment Two (~28%), the stone often crumbling into several pieces during manufacture. It is possible that internal fractures, caused by depositional and post-depositional history, contributed to this defect. The ease with which they broke increased the failure rate to ~43%.

Cobble source CSG5, which appeared to have promising exterior attributes, was riddled with iron inclusions. This group of net sinkers were more likely to split during manufacture along iron inclusions. Some sinkers could be salvaged, and those that could not contributed to this group's failure rate (20%). When there are iron inclusions in a cobble, the stone breaks along the blemish, increasing the likelihood of bending fractures, despite proper support during manufacture.

CSG6, which like CSG5 included a wide range of mineral composition, held up well to net sinker manufacture. All sinkers manufactured with this source for Experiment Two were successful. The success rate, however, did not hold for the hydrated cobbles (Experiment Three).

The results of the cobble source experiment show that material *does* matter to successful net sinker manufacture. The average number of strikes between the six sources ranges from 50 to 191. The average time to manufacture a net sinker also changes, ranging from 2.3 minutes to 4.7 minutes. Narrowing the scope to only the successful net sinkers, the average strikes between all six sources range from 75 to 102 and time to successful manufacture falls between 2.3 and 4.8 minutes. The difference between 50 and 191 strikes demonstrates the extra effort required to manufacture net sinkers between sources. This difference may have influenced preferences in net sinker type.

A small sample (n=10) from Experiment One, Experiment Two, and Experiment Three was taken to Dr. Thomas Williams in the University of Idaho Department of Geological Sciences. He ran x-ray powder diffraction (XRD) scans on debitage created during the experiments to determine the chemical content, and by extension the mineral content, of those cobbles used. The results are shown below in Table 4.1. An XRD scan is presented in Figure 4.4 (debitage sample ten from CSG2-7). Illite, seen in debitage sample nine, is an expandable clay mineral. This may account for the low number of strikes to successful manufacture. Sample six, which is limestone, was the easiest to flake, though sample nine was manufactured with fewer strikes. The Actinolite and Anorthite in sample

Debitage Sample No.	Experimental Sinker No.	No. Strikes to Manufacture	Chemical or Mineral Content
1	E1: NS-34	78	SiO_2; Quartz
2	E1: NS-33	281	SiO_2; $(AlSi_3)NaO_8$; $Si_{7.28}AlMg_{3.49}Fe_{1.33}Ti_{.06}Ca_{1.66}Na_{.625}$ Primarily Quartz and Albite; Some Hornblende
3	E1: NS-81	32	Unknown; Noisy Sample
4	E1: NS-87	75	$Na(Si_3Al)O_8$; Albite
5	E1: NS24	52	$NaAlSi_3O_8$; SiO_2; Albite and Quartz
6	E2: CSG1-1	27	$(MgCa)CO_3$; Magnesium Calcite
7	E1: NS-37	126	SiO_2; Quartz
8	E1: NS-80	54	SiO_2; $KAl_4Si_2O_{12}$; Primarily Quartz; Some Illite
9	E1: NS-83	23	$Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$; $Ca_{.325}Na_{.175}Si_{1.174}Al_{.824}O_4$; Actinolite; Anorthite
10	E3: CSG2-7	18 (hydrated)	SiO_2; $Na(AlSi_3O_8)$; Primarily Quartz; Some Albite

Table 4.1: XRD Scan Data and Corresponding Sample Information

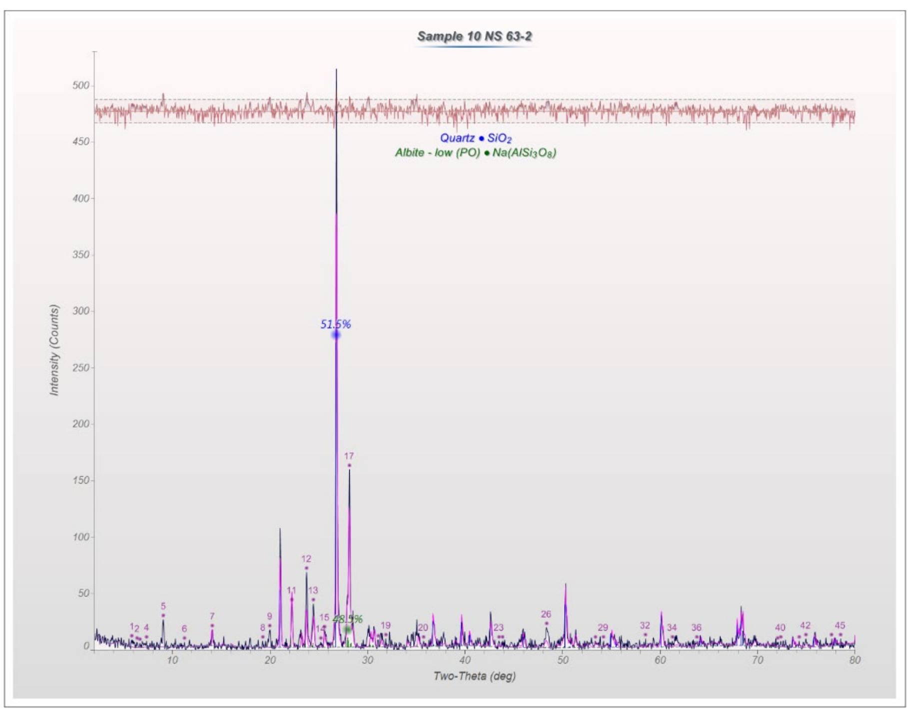

Figure 4.4: X-Ray Diffraction Scan from Debitage Sample 10. Further Scans in Appendix E.

nine, displayed in the aesthetics of the stone—blue and green exterior, striations—allowed for the stone to be flaked easily, though flakes were not the smooth product of conchoidal fractures as they were in sample six or any number of quartzite samples.

Experiment 3: Cobble Hydration

Stones absorb different amounts of water based on their porosity. The goal of this experiment was to determine whether procuring hydrated cobbles from the river would make net sinker manufacture easier than procuring cobbles from the river terrace or beach. Cobbles were sorted to create two groups with similar size and morphological distribution. One group was selected at random to be hydrated while the other set of net sinkers was manufactured dry.

The results for the first three groups were promising. In hydration experiments with the first three cobble sources, 89% of hydrated cobbles were successful versus ~53% of successful dry cobbles. The benefits became less stark, however, with the final group for the cobble hydration experiment. When all four groups are included in the analysis, the high percentage of hydrated cobble success drops to 79%, and the percentage of successful dry cobbles increases to approximately 71%. This shows that cobble source matters more to successful net sinker manufacture than cobble hydration, and while cobble hydration may expedite the net sinker manufacture process in some regions, it does not benefit all North American toolmakers.

Experiment 4: Indirect Percussion Notched Sinkers

Indirect percussion is a potentially successful method for notched net sinker manufacture. The net sinker notch attributes (Figure 4.5) are typically different than direct percussion notch attributes. Notches made using indirect percussion are much narrower than

Figure 4.5: Indirect Percussion V-Shaped Notch

direct percussion notches, and cortical flake scars are either smaller or non-existent. Indirect percussion notches are V-shaped, where direct percussion and hammer and anvil method notches are U-shaped. This experiment shows that there is a difference in notch attributes between net sinkers manufactured using direct percussion and those manufactured using indirect percussion.

Experiment 5: Grooved Stone Sinkers

Water or no water, grooved stone sinker manufacture is a time-consuming endeavor. The smallest sinker, only 54.52 mm long, took approximately 35 minutes to manufacture, despite the use of water, and the largest sinker, 101.69 mm long, took nearly three hours to manufacture. The use of water did, however, greatly expedite the process, as a similarly sized sinker without the use of water took more than five hours to complete.

Experiment 6: Perforated Sinkers

The attributes of perforated sinkers are unlike any other sinker attributes. The toolmaker drills a hole through a stone from both sides. The method employed for this experiment involves the manual use of a drill to penetrate the stone. This is not the only method used to drill holes in stones. Pump drills or sand and reeds can also be used. To determine whether another method was more efficient, I manufactured a third perforated net sinker with a pump drill attached to an iron nail. Though this tool did speed up the process, 2.92 mm per hour versus an average of 1.98 mm per hour, the process did still take several hours. The cryptocrystalline hand-drill method was chosen for the other two sinkers in this experiment to keep the experiment design simple and required materials and tools to a minimum. Each perforated sinker in this experiment took at least three hours to manufacture, and some more than five hours to manufacture.

Several students at the University of Idaho Lithic Technology Lab also replicated perforated net sinkers in 2019. Each student used flint hand-drills and similar raw material to that used in Experiment Six. Drilling was completed in short bursts, between thirty minutes and one hour each. The process took between three and five hours to successfully manufacture a perforated net sinker. This supports the time investment proposed by this experiment.

Experiment 7: Hammer and Anvil Testing

As outlined in section one, two hammer and anvil methods were tested in this experiment. The first hammer and anvil experiment, which involved upending a net sinker blank and striking it with a hammerstone or chopper only worked well when there was significant tapering of the sinker blank edge. When this significant tapering was not present, it was difficult to notch any sinker blank, either by using a hammerstone or a chopper.

In limited trials, the second method, which involved holding a net sinker blank flat against a stone anvil and striking the edge of the stone with a hard hammerstone, also had a low success rate (20%). The stone was more likely to break by bending fracture or shatter from internal flaws than to be successfully flaked (Figure 4.6).

Notches that *were* successfully made using these methods resemble direct percussion sinker notches. However, because of the low success rates using both hammer and anvil methods, it is unlikely that these were the primary manufacturing techniques employed throughout the Columbia Plateau. Direct percussion is easier and requires fewer tools.

The Phenomenology of Net Sinker Experiments

Experimental archaeology allows for a unique ability to feel, to experience, rather than simply observe. It would be remiss not to take full advantage of this descriptive opportunity. Phenomenology allows the toolmaker to address more subjective phenomena related to tool manufacture. We already describe artifacts as we perceive them regularly, but sight is not the only sense capable of such description. Because experimental archaeology allows the toolmaker to immerse themselves in the toolmaking process, there is greater opportunity to include descriptions related to the human experience.

Figure 4.6: Hammer and Anvil Method 2: Successful (n=1) and Failed (n=4) Net Sinkers

The net sinker manufacture process begins with a net sinker blank and a hammerstone. Net sinker blanks are chosen not only for their size and oval shape but also for their weight. The sinker blank is then held in the non-dominant hand at a ±(30 – 45)° angle, a hammerstone held in the dominant hand. The net sinker blank is frequently adjusted, as the force of the hammerstone blow moves it ever so slightly until small modifications with the modifying tool are no longer effective. The force traveling through the stone begins to affect the forearm, shoulder, and back muscles. The non-dominant hand, net sinker blank still angled and perched, is red from the continuous battering. The rocks smell like they are burning, and the percussion platform is hot to the touch. The muscles in the upper forearm stabilizing the hammerstone begin to strain on strike 173, while the muscles in the non-dominant forearm and up through the elbow will not start straining until the next sinker is manufactured. As debitage is driven from a quartzite cobble, it lodges itself in the inside of the toolmaker's leg, leaving a battery of flake scars from the small flying projectiles. After five net sinkers from especially hard material are successfully manufactured and one is rejected, the muscles in the lower back begin to tense. After another two the tension has crept *up the spine to the shoulders. The toolmaker stretches and continues, only finishing for the day when ten sinkers have been successfully manufactured.*

After the manufacture of one hundred net sinkers for Experiment One, the muscles in my right forearm (my dominant side) were more robust than those of my left. This exaggerated muscular imbalance returned to its normal, lesser, imbalance as I became further removed from the experiment. The mechanical processes of net sinker manufacture, particularly those involved in hard hammer direct percussion, require different muscles to be used than most day to day activities. During Experiment One I used my non-dominant hand (left) to stabilize the sinker, resisting the force applied by the hammerstone with my dominant hand (right). The force of each blow traveled up my left forearm and muscle soreness along the full length of the ulna and radius lasted days after each experimental session. The muscle fatigue from swinging the hammerstone is localized near the flexor carpi ulnaris muscle, near the proximal end of the ulna and radius. Joint fatigue in radiocarpal joints and elbow joints were common in both arms. Another University of Idaho graduate student who manufactured notched net sinkers by hard hammer direct percussion verified this prolonged muscle and joint reaction for days after the experiment.

Notched sinker direct percussion involves the strongest smells and the loudest sounds. When struck, certain stones smelled as if they are burning. The force applied with the hammerstone heats the cobble blank. Direct percussion is deafening compared to other forms of net sinker manufacture. The repetitive, metallic crack is unmistakable.

The manufacture of indirect percussion net sinkers uses different muscle groups than direct percussion manufacture. Indirect percussion requires muscles in the non-dominant hand to grip the chopper or flake, while the repetitive motion with a hammerstone causes muscle fatigue in the dominant hand and forearm. Muscle soreness begins in the non-dominant, gripping hand and comes to the dominant, hammerstone hand later. Several things become apparent during notched sinker manufacture via indirect percussion. The debitage produced from the net sinker blank and the chopper or flake becomes microprojectiles, shooting off in vectors parallel to the anvil. It also becomes almost immediately apparent whether a stone is a good candidate for notching or not. A small groove may be made within the first minute if the material is conducive to manufacture.

The constant pecking and grinding motions used for grooved sinker manufacture can cause muscle fatigue, though not as severe as that caused by direct percussion. As with indirect percussion, grip begins to go first, followed by muscle fatigue in the dominant forearm from the repetitive pecking and grinding motions. This manufacturing sounds as it would be expected to sound: a dull, repeated thud followed by the back and forth scratch of two coarse stones scraping against one another. Despite being louder than the tapping sounds of indirect percussion, this method of net sinker manufacture is far quieter than direct percussion cobble flaking.

Perforated sinker manufacture is simple, but like many other forms of net sinker manufacture, causes gripping muscles to wear out first. This experiment, in particular, caused the dominant hand to cramp while gripping the flint drill. Small cuts were common on fingertips when a piece of leather was not used to hold the drill. This form of net sinker manufacture was the least physically demanding, though perhaps the most tedious.

Net sinker manufacture using the hammer and anvil method causes the grip to go first in the non-dominant hand, either because it is gripping or because it is securing the stone to the anvil laterally (pressing). This, too, is a loud process, and the stones ring more during the second hammer and anvil manufacturing method than other manufacturing methods because of the addition of the stone anvil.

The aural and skeleto-muscular experience of manufacturing net sinkers, especially by direct percussion, is non-trivial. It is a loud, violent, and often painful process. Ignoring the phenomenology of their creation would lead to a blind spot in the analysis of their preference, use, and function. While not all toolmakers experience the full range of these phenomena, it is likely that all toolmakers experience some aspect of cobble tool manufacture described above. It is possible that one or more of these phenomena influenced toolmaker decisions, shaping the distribution of net sinkers locally and regionally.

Chapter 5: Net Sinker Analysis

This research uses experimental methods in conjunction with an analysis of historical net sinkers from the region's archaeological record to address net sinker manufacture in the Columbia Plateau. By comparing experimental net sinker attributes with artifact net sinker attributes, likely manufacturing methods can be determined.

A research permit request and a one-page prospectus were submitted to the Nez Perce Tribe for consideration in January of 2019. The permit request outlined the proposed study of net sinkers from archaeological assemblages along the Clearwater and lower Snake rivers. The goal was to determine methods for net sinker manufacture across time and space. The permit was approved in April of 2019 (Appendix C) and Leah Evans-Janke, Collections Manager at the University of Idaho Alfred W. Bowers Laboratory of Anthropology, promptly sent the approved permit with requests for landowner approval. Landowner approval requests were sent to the U.S. Forest Service, the Bureau of Land Management, U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers (ACOE), and the National Park Service. Historical net sinker research was initiated upon each associated landowner's approval.

Many of the collections associated with the lower Snake River are housed at the Washington State University Museum of Anthropology curation facilities. After receiving approval from the Nez Perce Tribe in April, I contacted Dr. Diane Curewitz, Archaeological Collections Manager at the Washington State University Museum of Anthropology, to begin the process to access these net sinkers for study. A research permit request, along with the approved Nez Perce Tribe research form, was sent to the Walla Walla District ACOE on 9 May 2019 and was approved on 1 August 2019.

This analysis includes net sinkers from site assemblages housed at the University of Idaho and Washington State University curation facilities. However, several Clearwater and lower Snake River sites are either not currently curated at these centers or are not currently available for study. These net sinkers are not included in this analysis. Sites include Canoe Camp (10CW25), Spalding (10NP108), Hatwai (10NP143) and Marmes Rockshelter (45FR50).

Angela Neller, Curator at the Wanapum Heritage Center, graciously invited me to look at Wanapum net sinkers in August 2019. I made the trip to Mattawa, Washington, in September 2019 to view the net sinkers in their care. One hundred and eight unprovenienced shaped fishing ring stones from the Trevor King Collection were measured, weighed, and photographed (Appendix B, Table 3). The Wanapum Heritage Center also curates a large number of notched sinkers. Due to time constraints, each of these sinkers could not be individually measured and weighed. They were photographed in groups, however, and their notch orientation and approximate size range assessed. Though the focus of this thesis is the southern Plateau, it was essential to look at these Columbia River sinkers for several reasons. First, these artifacts help to piece together subsistence fishing throughout the Columbia Plateau. Second, shaped fishing ring stones are not found along the Clearwater or lower Snake rivers, making this fourth net sinker type unique to this region of the Columbia river.

Net sinker type could be identified for most net sinkers in this study. In the following sections, the term *unknown orientation* refers to sinkers whose notching orientation could not be determined. This uncertainty is typically related to sinkers broken by bending fracture.

Net Sinkers along the Clearwater River

Net sinkers from 21 Clearwater River (Figure 5.1) and Clearwater-adjacent sites were analyzed for this thesis (Table 5.1). There are 102 confirmed net sinkers (Appendix B: Table B.1). Individual preference, as much as a regional preference, may have influenced net sinker size, weight, and type distribution throughout the southern Columbia Plateau. Many sites show a preference for one notch orientation over another. For example, approximately 70% of four-notched sinkers in Clearwater River assemblages were found at Arrow Beach (10NP102). Four-notched sinkers comprise 17% of the total finished net sinkers from the Clearwater River region sites, and 70% of the total complete sinkers at Arrow Beach. Net sinker function is also a possible reason for the wide range of sinker size, weight, and type. There are ethnographic accounts of large grooved stones used to anchor nets in strong currents (Hoghens 1949:83, as cited in Johnston 1987), while smaller stones kept the net submerged.

One hundred eleven artifacts were measured, weighed, and photographed for this thesis from collections in Clearwater River assemblages. Two perforated sinkers, two grooved sinkers, and one notched anchor are recorded, ranging in weight from 308 to 12,691 g. These artifacts are, on average, much larger and heavier than the notched net sinkers of the

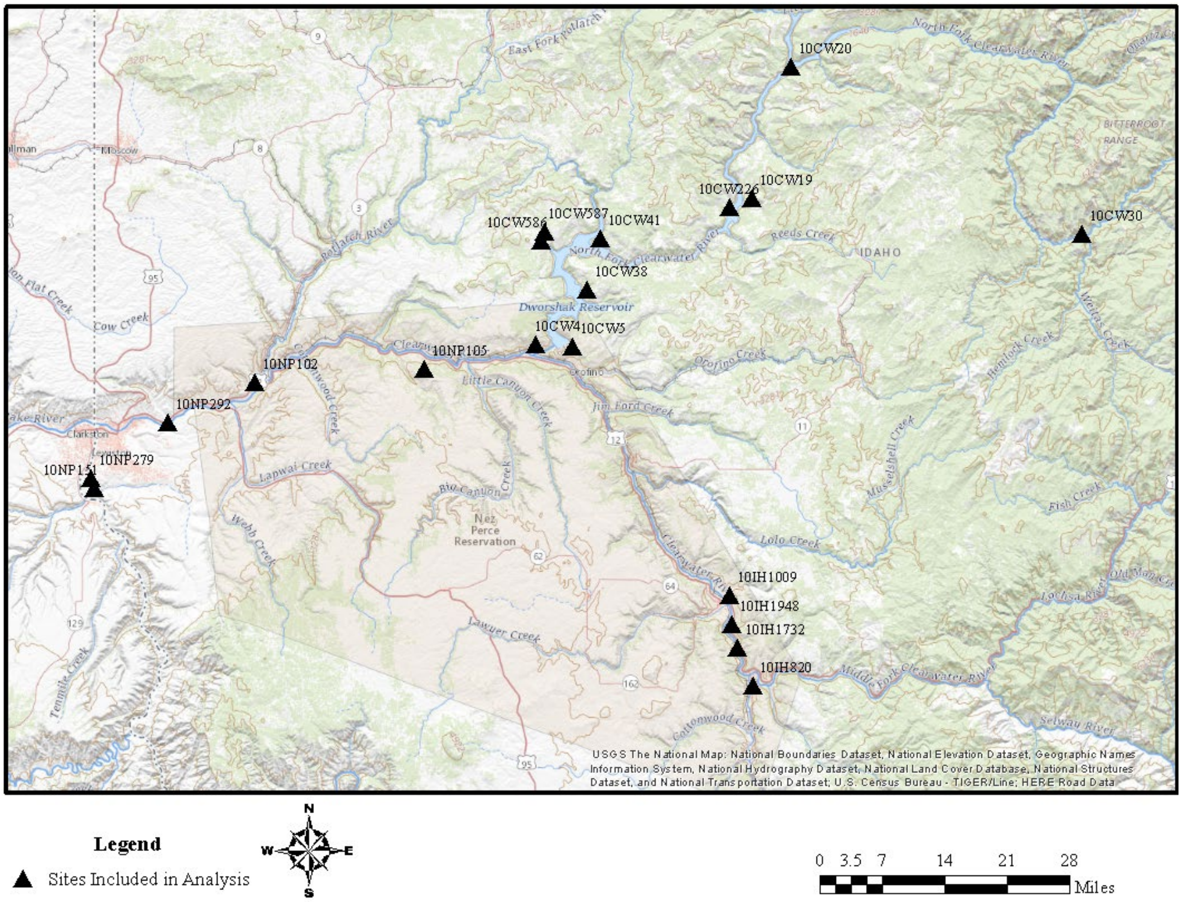

Figure 5.1: Nineteen Sites Along the Clearwater River Included in the Analysis

Clearwater River region. Of the ninety-seven notched sinkers, forty-seven percent are end-notched (n=46). The next most prevalent net sinker type is side-notched (n=25), while four-notched sinkers are the third most frequently occurring (n=17). Atypical sinkers, which either do not have symmetrical notches or have three or more than four notches, comprise less than nine percent of the confirmed sinkers (n=9).

Approximately 92% of the 111 artifacts measured from Clearwater River sites are confirmed net sinkers. The remaining eight percent is comprised of tested blanks and artifacts

Site Smithsonian Number	Site Name	Grooved	Perforated	Notched	Other	Total Net Sinkers/Anchors in Assemblage
10CW4	Clearwater Fish Hatchery			X		21
10CW5	Ahsahka Sportsmen's Access			X		1
10CW19	Airstrip Terrace	X				2
10CW20	Little North Fork			X		4
10CW30	Weitas Creek			X		9
10CW38	Indian Creek			X		2
10CW41	Elk Creek		X			1
10CW226	Upper Terrace			X		2
10CW586				X		1
10CW587				X		1
10IH820	Kooskia Fish Hatchery			X		6
10IH1009	Tuhkaytahs'peh			X		7
10IH395	American Bar			X		1
10IH1732				X		2
10IH1948	Waterline Trench			X		3
10KA45	Cataldo Mission			X		4
10NP102	Arrow Beach			X		21
10NP105	Lenore		X	X	X	18
10NP151	Hells Gate			X		3
10NP279					X	1
10NP292	Lower Goose Pasture			X		1
Totals						**111**

Table 5.1: Sites Located along the Clearwater River Region for Net Sinker Study

labeled "sinker/abrader." Three of the sinker/abrader artifacts (10NP105) include a groove down the long axis and impression at either end and another (10NP279) has a groove perpendicular to the long axis at its center and is bifacially flaked at one end, creating a point. It is possible, despite their labels, that these are not sinkers. However, because sinkers with similar attributes were found in other assemblages (Stewart 1973) they were measured and weighed for future net sinker research.

Measurements for six net sinkers, all from 10CW4, were adapted from the Clearwater Fish Hatchery site report (Sappington 1991) and include length, width, thickness, and weight. These sinkers (F6.7.7.2, F6.7.7.3, F6.7.7.5, 26.9.27, 35.6.15, 61.7.8) are, to my knowledge, on display and were not readily available for study. For this reason, these sinkers are not included in the notch width, notch depth, or inter-notch width statistics. However, because they were sketched by Sarah Moore for the site report (Sappington 1991), their qualitative attributes could be determined, and they were included in the notch orientation and manufacturing method statistics.

Each net sinker's notch attributes were inspected, and each was assigned to a manufacturing method category (direct percussion, indirect percussion, grooved, or perforated). The primary method for notched net sinker manufacture in these assemblages is overwhelmingly direct percussion (98%). There are two instances of possible indirect percussion from 10CW30. Though the notch attributes match the V-shaped notching seen in the indirect percussion experimental sinkers, flake scars are present. These scars may be attributed to raw material. Since they show an amalgam of attributes, further indirect percussion experiments with claystone would be needed to label their manufacture method definitively. The remaining notched sinkers in the Clearwater River assemblages were likely manufactured using direct percussion (Figure 5.2).

Figure 5.2: Notched Net Sinker Manufactured Using Direct Percussion from 45GA26

Peripherally flaked, notched cobbles (Figure 5.3) were noted in several collections (10CW30, 10IH1948, 45AS82, unprovenienced Columbia River net sinkers at the Wanapum Heritage Center) while many net sinkers in these assemblages exhibit at least one face completely, or nearly completely, removed (10IH820, 10NP102, 10NP105, 45AS78, 45AS82, 45WT39). Keeler (1976) noted that these may be net sinkers, based on their notch attributes. These tools are not peripherally flaked as defined by Mattson (1984), but rather have been completely flaked, or nearly completely flaked, down both faces of the cobble, leaving little to no cortex. The reason for their peripheral flaking could be to maintain preferred size while decreasing weight.

Figure 5.3: Peripherally Flaked, Notched Sinker from 10CW30

Net Sinkers along the Lower Snake River

Net sinkers from 21 sites are included in this lower Snake River research (Figure 5.4; Table 5.2). There are 226 net sinkers in these assemblages, ranging in size from 39 to 230 mm long (Appendix B: Table B.2). The distribution of these net sinkers, like in Clearwater River assemblages, can be attributed to both function and individual preference. There are a greater number of grooved (n=6) and perforated (n=4) sinkers than in Clearwater River assemblages, though the percentage in relation to the total number of sinkers is proximal (between two and three percent of the total sinkers).

Of the 226 artifacts weighed, measured, and photographed from lower Snake River assemblages, less than 3% were grooved sinkers, less than 2% perforated sinkers, and more

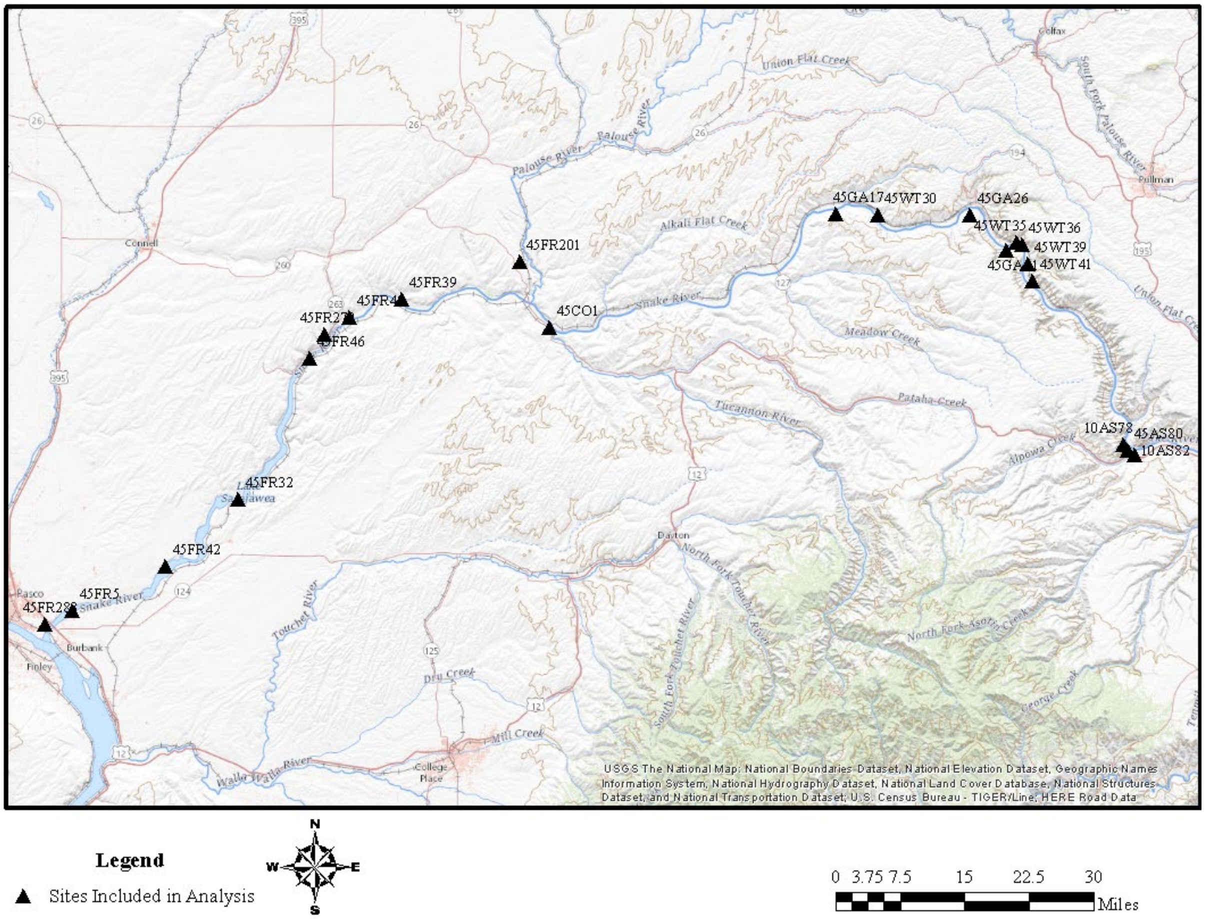

Figure 5.4: Twenty-one Sites Along the Lower Snake River Included in the Analysis

than 95% notched sinkers. The majority of these notched net sinkers, nearly 54%, are end-notched (n=117). Four-notched sinkers are the second most common type, comprising 27% of the notched sinkers (n=59). Side-notched sinkers comprise nearly 13% of the notched sinkers (n=27) and the remaining six percent is comprised of atypical net sinkers or net sinkers with unknown orientation.

The primary method for notched net sinker manufacture along the lower Snake River is direct percussion. No notched sinkers were identified as having been manufactured by indirect percussion. Notch attributes demonstrate a wide variety of toolmaking-related

Site Smithsonian Number	Site Name	Grooved	Perforated	Notched	Other	Total Net Sinkers/Anchors in Assemblage
45AS78	Alpowa			X		16
45AS80	Alpowa			X		1
45AS82	Alpowa		X	X		32
45CO1	Tucannon			X		10
45FR5	Strawberry Island	X		X		20
45FR32	Votaw	X	X	X		21
45FR39	3Springs Bar	X		X		10
45FR40	The Harder Site			X		3
45FR42	Fish Hook Island		X	X		2
45FR46	Windust Cave			X		2
45FR201	McGregor Cave			X		4
45FR272	Burr Cave			X		1
45FR283				X		2
45GA17				X		1
45GA26				X		8
45GA61	Wexpusnime			X		7
45WT30		X				1
45WT35				X		2
45WT36	Thorn Thicket			X		20
45WT39	Wawawai			X		42
45WT41	Granite Point	X		X		21
Totals						**226**

Table 5.2: Sites Along Lower Snake River Region in Net Sinker Study

behavior, such as angling the stone or rotating the stone differently. Several four-notched sinkers also demonstrate a choice on the part of the toolmaker to bifacially flake notches along one axis and unifacially flake notches along the second axis. This additional step may serve to add to the security in fastening the net sinker to the net while not adding to the manufacturing time. Several sinkers also display unifacial notching on opposite faces, suggesting the direction the stone was held, flaked, and rotated to be flaked again. As observed in Clearwater River assemblages, peripherally flaked, notched artifacts were present (45AS82).

Comparative Distribution of Net Sinker Types: Clearwater and Lower Snake Rivers

The most common type of net sinker in archaeological assemblages along both the Clearwater and lower Snake rivers is notched. There are subtle differences, however, in the notched subtype between these two regions. In both regions, end-notched is the most common notch orientation (45% and 54%, respectively). Four-notched and side-notched alternatively take second and third place in each region. Side-notched net sinkers are more common than four-notched sinkers along the Clearwater River (approximately 25% and 17%, respectively) while four-notched are more common than side-notched along the lower Snake River (approximately 27% and 13%, respectively). Atypical sinkers comprise just under 9% of Clearwater River notched sinkers and just over 5% of lower Snake River sinkers. Atypical net sinkers could be the product of abnormally shaped stones (more bulbous on one side than another) or could signal a change in a toolmaker's decision about a sinker's notch orientation.

The data demonstrate that there are preferences in net sinker type by region as well as by site. Four-notched sinkers are found in high concentrations at specific sites (10NP102, 45AS82, 45FR39, 45GA61), challenging Prowse's 2010 hypothesis that four-notched sinkers were likely originally notched with one orientation and were repurposed to have another orientation (Prowse 2010:78). End-notched are also found in high concentrations at specific sites (45GA26, 10NP105, 10NP151, 45FR5, 45AS78).

Perforated and grooved sinkers were, on average, larger than notched sinkers (Figure 5.5, Figure 5.6). This significant difference in size and weight points to the possibility that they were used for different technical tasks than notched sinkers. There are many water-related functions these stones may have served. These stones may have been used as anchors for traps or weirs or as anchors for canoes. There is ethnographic evidence to support that larger sinkers served as anchors for the ends of nets, while smaller net sinkers were attached along the base of the net or were attached to lines (Johnston 1987).

Manufacturing Methods

The majority of the notched net sinkers in both regions were likely manufactured using direct percussion. The distinct U-shaped notches and corresponding flake scars appear on 99% of net sinkers analyzed for this thesis. Though some net sinkers have unifacially-flaked notches, evidencing a net sinker's ability to function with unifacial notching, most sinkers are notched bifacially. Several net sinkers include a combination of bifacial and unifacial flaking. Possible cordage wear is evident on some net sinkers, rendering potential flake scars non-existent.

Perforated net sinkers (n=6) comprise 2% of the total net sinkers in these collections. Grooved sinkers occur slightly more frequently (n=6) in the lower Snake River region than

Figure 5.5: Perforated Sinker from 45FR42

Figure 5.6: Large and Small Grooved Sinkers from 10CW19

the Clearwater River region (n=2). In both Clearwater and lower Snake River assemblages, grooved sinkers still comprise less than three percent of the total sinkers. The grooves on two grooved sinkers from the 45FR5 assemblage stop centimeters apart on one side of the stone. Each groove wraps itself around one side to the next but stop short of meeting. All other grooved sinkers exhibit grooves that follow the full circumference of the stone. Several unprovenienced grooved anchors were examined at the end of this study. These anchors (Figure 5.7) exhibit a wide range of groove types and manufacturing practices. It is only through ethnographic accounts or field experiments with simulated experimental anchors that the function of multiple grooves might be determined.

Net Sinkers Along the Middle Columbia River

The shaped fishing ring stone is modified by direct percussion around the full perimeter to shape the stone into a rectangle. This stone is then wrapped in chokecherry bark and attached to a willow ring. The majority of these stones are basalt, but conglomerate sandstones and quartzite cobbles did constitute a small percentage of the 108 shaped fishing ring stones that were measured and weighed for this research (Figure 5.8).

In addition to these shaped fishing ring stones, a large number of notched sinkers were presented for analysis (Figure 5.9). These notched sinkers have a similar distribution to Clearwater and lower Snake River assemblages. The primary subtype is end-notched, with side-notched and four-notched occurring less frequently. A wide variety of raw materials

Figure 5.7: Unprovenienced Net Sinkers from the Pacific and Inland Northwest, Curated at the Washington State University Museum of Anthropology

were used including basalt, quartzite, sandstone, and conglomerates. Several sinkers exhibit a combination of both shaped fishing ring stone flaking and end notches. These sinkers may have been used as shaped fishing ring stones before being repurposed as notched sinkers. Several sinkers in these collections exhibit the same peripheral flaking, as if they were cobble spalls, with notches found in Clearwater and lower Snake River assemblages.

Figure 5.8: Shaped Fishing Ring Stones

Figure 5.9: Sample of Notched Net Sinkers From the Wanapum Heritage Center

Conclusion

Evidence of fishing activities appears in the archaeological record as faunal remains and fishing-related technology (Croes 1995; Johnston 1987; Sappington 1997). Because the Columbia Plateau is not conducive to the preservation of organic material, fish remains and organic fishing implements, such as fishhooks or harpoons, do not survive well over long periods. Stone net sinkers are therefore often the only remaining evidence of pre-Contact fishing. The Clearwater River and lower Snake River region net sinkers demonstrate preferences regionally, locally, and individually.

All four net sinker types have been found in the Columbia Plateau, including variations such as the notched, peripherally flaked artifacts Robert Keeler noted in 1976 as possible net sinkers. These artifacts are cobble-spall-like stones notched in several places. These artifacts occur in many assemblages from Clearwater, lower Snake, and Columbia River assemblages (10CW30, 45AS82, Wanapum Heritage Center unprovenienced net sinkers), increasing the likelihood that they were used for fishing activities. Further analysis of this artifact type is needed to definitively determine its function.

Chapter 6: Conclusion

Summary of Net Sinker Experiments

Experimental archaeology has been useful in forming theories related to lithic technology for more than a century (Coles 1973; Flenniken 1984; Shimada 2005). To date, most lithic studies are related to projectile point manufacture or other forms of flaked-stone technology. The net sinker experiments conducted for this thesis involve methods similar to those used in other lithic studies but apply to cobble tool manufacture instead of cryptocrystalline material. Similarly, many lithic experiments deal with hunting technology, while this research focuses on fishing technology.

Flake scars can be diagnostic of manufacturing methods. Step fractures, feathered terminations, and bending fractures are all present on the experimental sinkers and are indicative of the manufacturing process. Step fractures are due to heavy hammer percussion (Chlachula and Le Blanc 1996) and the angle of the net sinker blank during manufacture. Net sinkers manufactured by direct percussion have different notch attributes than net sinkers manufactured by indirect percussion. Direct percussion leaves fairly steep flake scars, except with certain sandstones, and a U-shaped notch (Figure 6.1), while indirect percussion leaves little to no flake scarring and a V-shaped notch (Figure 6.2). This thesis proves that it is possible to manufacture notched net sinkers using either of these methods but rules out indirect percussion as the manufacturing method for those sinkers sketched in Rau's article

Figure 6.1: Experiment 1 Net Sinkers Manufactured Using Direct Percussion; Note Flake Scarring and “U-Shaped Notches.”

Figure 6.2: Experiment 4 Net Sinkers Manufactured Using Indirect Percussion; Note the Lack of Flake Scarring or Debitage and the V-Shaped Notches.

describing this method (1873:140). The attributes of the net sinkers included with his description have heavy flake scars and a U-shaped notch.

Notched net sinkers are the least time-consuming type to manufacture. On average, notched net sinkers took 8.5 minutes, or .14 hours, to manufacture successfully. This type also has the highest failure rate (24% in Experiment One compared to 0% grooved and 0% perforated). Grooved net sinkers took approximately 2.25 hours to manufacture. Perforated sinkers took on average 4.9 hours to manufacture, or 2.2 millimeters per hour. Different muscles are used to manufacture each net sinker type, though forearm muscles are the primary muscle group activated during manufacture across all types.

Summary of Net Sinker Analysis: Clearwater and Lower Snake Rivers

Fishing in the Columbia Plateau dates to approximately 11,000- to 10,000-years BP (Halfmann 2015; Hewes 1998; Sappington 1997). Net sinkers from sites adjacent to the lower Snake River date to at least 8,000- to 7,000-years BP at Windust Caves (Johnston 1987:31, Table 2) and along the Clearwater River to possibly 10,800- to 9,800- years BP (Ames et al. 1981; Sappington 1997). Radiocarbon dates of organic materials in the same test unit levels as these net sinkers are used to date these artifacts. Between 8,000 BP and the Ethnographic Period there is a gradual increase in net sinkers in the archaeological record, particularly at camps and villages (Johnston 1987:Table 5).

Raw material does not always have to be quarried. Often, appropriate material occurs in portable pieces and is found near manufacture and use sites (Collins 1975:19). This is the case for net sinker blanks. Carried by glaciers and rivers, tumbled over extended periods, these cobbles and pebbles provide an ideal canvas for net sinker manufacture, notched or otherwise. Clearwater and lower Snake River assemblages suggest preferences in raw material, largely basalt, as well as stone shape and size.

Of the 102 confirmed sinkers measured and weighed from the Clearwater River assemblages, the most common type is notched (n=98). They range in size from small sinkers, 34 mm long, to the largest notched anchor, 337 mm long and in weight from 14 g to 12,691 g (Appendix B: Table B.1). The mean net sinker length in the Clearwater River assemblages studied is 68.01 mm.

Similar to trends in the Clearwater River region, the most common type of net sinker found in the archaeological assemblages from the lower Snake River was notched (n=216). The size distribution for these sinkers is less than that of the Clearwater, the smallest sinker ~39 mm long and the largest 230 mm long (Appendix B: Table B.2). The mean net sinker length from lower Snake River net sinkers studied is 72.59 mm.

In both Clearwater and lower Snake River assemblages, large net sinkers were likely used to anchor nets in deep or fast-flowing water or to anchor traps, weirs, or canoes. Percentages of grooved and perforated sinkers are similar in the Clearwater River and lower Snake River regions (~2-3% of the total sinkers recovered). Archaeological collection protocol and a history of looting in the region have likely influenced these numbers.

A Tale of Two Research Methods

Fishing technology costs the toolmaker both time and energy during its initial manufacture, and again during maintenance (Kelley 1996:209). A fishing net is much more of an investment than a notched sinker, but they both add to the total investment involved in net fishing. By replicating these processes, we can estimate the time and energy expended during the manufacture, maintenance, and use of these tools. Examining net sinkers from the archaeological record can give us insights into how many net sinkers were needed for net fishing, as in the case of the 10CW4 net sinker cache in which five net sinkers were excavated in association, the frequency with which these tools were manufactured, and their spatial and temporal distribution throughout regions where fishing was a significant subsistence method.

Individually, experimental or analytical research methods can inform a part of how net sinkers fit into life prior to colonization. The experimental methods can determine time and energy expended, phenomenological differences related to manufacture between net sinker types, and methods that lead to successful net sinker manufacture. The analysis of net sinkers in Clearwater and lower Snake River assemblages can be used to determine when net sinkers first began to appear in the archaeological record, their prevalence over time, and the significance of their relationship to fish procurement in the Columbia Plateau.

Together, the experimental and archaeological analyses tell a bigger story. As with all lithic tools, net sinker manufacture and use is part of a bigger system (Collins 1975). Understanding the processes by which these tools are made, and the technology they are used in association with, is key to understanding regional subsistence as a whole. Here, net sinker experiments determine methods for net sinker manufacture, and the attributes of experimental sinkers are compared to Clearwater and lower Snake River net sinkers, to determine which methods were likely used throughout the region.

After analyzing the attributes of the archaeological assemblage net sinkers and the attributes of the experimental net sinkers, I conclude that direct percussion was likely the primary method employed for notched net sinker manufacture and that notched sinkers were the primary type employed in the southern Plateau. Approximately 99% of the assemblage net sinkers analyzed for this thesis exhibit attributes also seen on experimental sinkers from direct percussion experiments (Experiments One, Two, and Three). While three net sinkers manufactured using the hammer and anvil method (Experiment Seven) exhibit attributes similar to those in the direct percussion experiments, it is less likely—based on experiment failure rates and the awkward mechanics involved with hammer and anvil net sinker manufacture—that this method was used. Direct percussion is a simple method that requires less bodily contortion, relatively fewer manufacturing implements, and involves similar methods to other forms of lithic reduction already employed by Columbia Plateau residents. It is possible that indirect percussion was used on net sinkers at 10CW30 (n=2) based on some of their notch attributes. However, these attributes might have also been achieved with, first, direct percussion, followed by carefully pecking and grinding the newly exposed cobble interior with a chopper.

A notched anchor from 10IH1732 is the heaviest artifact, at 12,691g, analyzed in these assemblages, and is broken in two pieces (Figure 6.3). There is one other notched

Figure 6.3: Broken Notched Anchor from 10IH1732

anchor, from 45WT41, which has five notches and weighs 3,384 g. Grooved and perforated methods were also employed in the Clearwater and lower Snake River regions. These sinkers comprise the remainder of the heaviest sinkers. Grooved and perforated sinkers constitute 2 to 3 percent of the total assemblage sinkers studied. They are much larger and heavier than their notched net sinker counterparts, and were likely used as anchors to hold nets, traps, weirs, or canoes in place.

Future Directions

This thesis is meant to spark interest in a little-studied artifact, demonstrate the value of a combined experimental and analytical approach, and inspire future experiments with these and related fishing implements. Further experiments are needed for perforated and grooved net sinker manufacture, as well as further indirect percussion experiments using the same raw material found where Rau (1873) speculated that this method was employed. Field experiments would be the next step in understanding these tools. Future research could determine methods to employ these implements successfully, how river depth and flow rates affect net fishing and net sinker size or weight preferences and identify successful or unsuccessful fishing techniques using nets and sinkers.

Additionally, future research is needed to investigate why a toolmaker would choose to manufacture one type of net sinker over another, despite the drastic differences in time and energy expenditure. First, it should be noted that how modern American archaeologists view time is not necessarily how others view time, globally in modernity as well as throughout history. This includes time as perceived by Native populations of the Columbia Plateau. Even so, my experimental research points to several possible reasons why a toolmaker would make a grooved or perforated sinker instead of a notched sinker.

The workability of raw material changes from one region to the next. The cobble source experiment data suggests that notched net sinker manufacture in one region may be significantly more difficult than notched net sinker manufacture in another region. Some cobble sources are comprised of dense material and do not have attributes conducive to notched net sinker manufacture. Further cobble source experiments could determine to what extent the source material influences toolmaker decisions.

The *physicality* of notched net sinker manufacture, particularly where cobbles are dense and hard to flake, may also have influenced the decisions made by Native toolmakers. Cobble tool manufacture is often a loud and violent activity and could potentially lead to bodily injury. Identifying phenomena related to cobble tool manufacture experienced by other toolmakers could help define to what extent muscle fatigue might have influenced choices in net sinker manufacture.

My analysis of net sinkers from the Clearwater and Lower Snake River regions also identified differences in attributes such as weight and length between notched net sinkers and grooved or perforated net sinkers. This suggests a difference in function, such as weighting one or both ends of a net or anchoring traps, wiers, or canoes. Experiments involving the use of net sinkers attached to nets could give insight into these size differences.

Research Relevance and Cultural Implications

Net sinkers, like other fishing technology, are found along the shores of rivers and tributaries wherever they were employed. Unfortunately, this means that they are currently at risk, and many have likely already been lost, from natural and artificially induced flooding, dam construction, and site looting. These artifacts mark a significant part of indigenous subsistence in the southern Plateau, and support the importance of riverine resources to many regional indigenous groups. Fishing has long been a significant subsistence activity throughout the Columbia Plateau, and this tradition continues today. Many Native groups in the Plateau have fought to win back fishing rights on their land.

The net sinker, like the heavily studied projectile point, offers insights into subsistence strategies and lithic toolmaking methods. This analysis shows regional, local, and individual variation in notched net sinker manufacture. This tool can not only point to fishing activities thousands of years after organic fishing implements have deteriorated but can also give us a glimpse into human behavior and manufacturing decisions, thousands of years ago. Net sinkers allowed Native Plateau inhabitants to procure large quantities of a highly valued resource and thrive in their ancestral home. Net sinkers are a significant part of Plateau cultural history.

To date, there are no published net sinker manufacture experiments or large publications concerning this artifact type. Historically, net sinkers have been understudied, underestimated, and undervalued. This research presents data from more than 300 Clearwater and lower Snake River net sinkers as well as data from approximately 200 experimental net sinkers. By comparing experimental sinker and artifact attributes, we can determine likely methods for successful manufacture as well as suggest reasons for broken or rejected sinkers in the archaeological record. Further, this multi-faceted approach leads to informed hypotheses concerning net sinker type preferences and frequency across space and through time.

Additionally, the narrative that we as anthropologists signal to the world is extremely important. Gone are the days of exclusive collection and classification. We understand that taxonomies and analysis are essential elements of archaeology, but that they only offer a piece of a very large puzzle. Historically, the focus of archaeology has been on projectile points and other artifacts that western archaeologists deem *cool* or *sexy*. Hunting technology and fishing technology should be addressed in equal turns, as both contributed to thousands of years of indigenous subsistence in the Columbia Plateau. It is only by studying the full range of tools in a region that we can fully understand subsistence technology there. This narrative also extends to assumptions made about the manufacture of these cobble tools. Net sinkers are not expedient tools. Their manufacture requires careful planning, from raw material selection through methods for lithic reduction.

It is hoped that this research contributes to the current body of archaeological literature pertaining to millennia of fishing in the Columbia Plateau. For many Native People in the Columbia Plateau, anadromous and non-migratory fish have been a significant resource since time immemorial. Salmon and other regional fish are woven into Native mythology, seasonal rounds, and rituals. Fishing is still a significant subsistence activity for many Columbia Plateau Natives, and many groups are rediscovering traditional fishing technologies thought to have been lost with colonization (Andrews 2015).

Native fishing rights are imperative, as is our stewardship of the land. By accurately identifying these artifacts, we can better locate ancient fishing grounds. Identifying places important to the indigenous inhabitants of the Columbia Plateau is key to preserving these spaces. Boxes of cobble tools are just as significant an indicator of past lifeways as the projectile points. Net sinkers, having been dated in relation to the occurrence of other artifacts and relative to their stratigraphic location in the archaeological record, are an important marker of time and of the intensification of fishing in the Columbia Plateau.

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Appendix A: Experimental Net Sinker Metrics; Supplemental Material to Chapter 4

Table A.1: Metrics for Experiment One: Notched Net Sinker Manufacture

S=Successful; F=Failed; NS=Net Sinker

NS Number	Successful/Failed	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Inter-Notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
1	Successful	94.58	79.05	24.21	297.21	2	SN	67.64	38		8.9
2	Failed	123.09	89.88	42.81	381.31	0	EN	N/A		3	1.42
3	Successful	88.44	87.02	20.22	204.83	2	EN	67.75	26		15.33
4	Failed	95.1	84.64	28.59	303.52	0	EN	N/A		49	6.67
5	Successful	53.35	49.55	11.62	49.86	2	EN	45.04	8		7.77
6	Successful	89.79	67.82	20.46	218.32	2	SN	61.16	32		21.08
7	Successful	115.48	111.28	30.35	579.02	2	EN	95.69	28		9.2
8	Successful	126.76	95.31	18.16	500.56	2	EN	96.28	74		10.85
9	Failed	90.96	53.2	35.58	216.11	1	EN	N/A		97	4.5
10	Successful	61.49	46.27	17.8	79.15	2	SN	41.18	69		5.68
11	Failed	64.28	40.99	13	41.05	0	SN	N/A		46	1.88
12	Successful	76.19	53.06	20.99	108.54	2	SN	46.81	35		3.3
13	Successful	91.95	69.01	22.43	172.77	2	Atypical	55.74	112		10.37
14	Failed	95.35	83.76	30.9	322.09	1	EN	N/A		417	11.15
15	Successful	104.74	69.34	26.16	300.29	2	SN	64.05	143		9.92
16	Successful	103.8	77.08	26.94	326.87	2	EN	73.98	112		10.4
17	Failed	86.92	71.38	24.29	234.44	1	SN	N/A		407	9.25
18	Successful	109.44	74.3	33.71	411.52	2	SN	68.87	250		12.8
19	Failed	99.76	81.82	31.04	398.92	1	SN	76.2		89	3.28

NS Number	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
20	Successful	126.44	88.6	32.83	553.93	2	SN	79.25	69		6.65
21	Failed	107.5	88.2	32.72	547.11	1	SN	77.35		279	8.6
22	Failed	126.4	74.5	15.63	282.97	0	SN	N/A		9	0.82
23	Successful	92.1	59.2	17.26	159.5	2	SN	54.94	200		9.18
24	Successful	115.6	79.2	24.98	365.93	2	SN	67.61	52		5.47
25	Successful	104.4	93.8	37.65	487.7	2	SN	73.26	120		6.65
26	Successful	163	129.1	33.16	1040.04	2	SN	118.16	135		9.38
27	Failed	130.7	93.8	26.14	524.79	0	SN	N/A		58	4.4
28	Successful	109.51	105.84	22.64	392.58	2	EN	72.56	204		12.88
29	Successful	112.75	86.69	31.26	450.12	2	SN	77.99	175		9.42
30	Successful	152.16	115.47	30.48	803.05	2	EN	107.71	52		5.28
31	Successful	117.78	95.33	31.18	565.94	2	SN	86.12	303		11.37
32	Successful	104.33	63.85	26.14	260.65	2	SN	56.12	259		12.67
33	Successful	86.95	68.86	28.04	251.24	2	SN	63.78	281		11.03
34	Successful	79.41	63	19.58	146.09	2	SN	56.64	78		5.22
35	Successful	92.08	81.41	30.46	335.85	2	SN	74.33	218		7.93
36	Successful	141.65	101.33	26.88	652.82	2	SN	86.15	121		9.97
37	Successful	80.4	67.9	19.41	142.46	2	SN	61.69	126		7.08
38	Successful	76.09	58.32	22.18	138.15	2	SN	52.87	189		7.71
39	Successful	93.75	74.21	25.92	259.85	2	SN	65.72	149		7.45
40	Successful	108.44	86.22	32.92	390.61	2	SN	73.76	210		11.83
41	Successful	77.42	73.89	29.58	240.66	2	SN	66.85	31		6.25
42	Failed	68.09	48.39	18.51	20.35	1	SN	43.34		222	16.95

NS Number	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
43	Failed	73.4	64.58	32.98	245.21	0	SN	N/A		400	8.32
44	Successful	99.21	79.53	33.33	446.56	2	SN	78.51	422		19.25
45	Successful	95.34	89.85	36.42	405.39	2	EN	82.04	88		9.32
46	Successful	83.14	79.98	31.71	306.59	2	SN	70.05	67		8.28
47	Successful	66.53	56.85	19.49	116.8	2	SN	49.97	114		7.17
48	Successful	96.01	83.26	24.14	216.57	2	SN	70.6	75		5.92
49	Successful	77.02	52.58	20.12	138.39	2	SN	47.73	127		7.88
50	Successful	76.77	46.97	19.1	104.9	2	SN	43.2	108		8.87
51	Successful	57.73	50.64	17.46	79.9	2	SN	46.75	110		7.48
52	Failed	79.05	57.99	29.55	202.85	1	SN	56.75		355	15.12
53	Successful	98.36	79.28	31.55	306.1	2	Atypical	70.92	81		8.1
54	Successful	123.08	86.31	36.85	582.35	2	EN	114.83	97		18.12
55	Successful	103.5	72.14	29.6	279.74	2	Atypical	57.62	232		18.05
56	Successful	125.12	95.21	35.56	676.02	2	SN	79.94	197		10.85
57	Successful	113.91	94.15	32.48	548.65	2	EN	98.14	390		20.05
58	Successful	106.43	86.84	26.07	338.132	2	SN	71.38	153		8.88
59	Successful	134.45	124.14	31.61	876.13	2	SN	111.6	137		13.13
60	Successful	85.45	81.09	30.26	316.49	2	EN	97.05	190		18.27
61	Failed	47.67	38.43	14.05	38.59	1	SN	30.6		392	14.65
62	Successful	107.43	77.63	24.45	357.04	2	SN	70	267		11.75
63	Failed	125.14	89.17	27.67	476.25	0	SN	N/A		296	18.37
64	Successful	93.42	69.63	22.26	224.89	2	SN	64.25	136		7.9
65	Successful	86.39	64.8	25.23	202.65	2	SN	57.25	223		7.51

NS Number	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
66	Failed	75.21	60.96	25.76	190.5	1	SN	60.3		284	8.85
67	Successful	80.51	77.04	30.64	273.34	2	SN	68.23	87		6.97
68	Successful	109.57	87.83	32.95	422.85	2	Atypical	79.22	348		11.8
69	Failed	155.32	146.19	40.78	1474	0	SN	N/A		200	5.85
70	Failed	80.34	68.45	23.55	200.68	1	EN	78.64		447	10.38
71	Failed	117.13	109.12	44.61	724.13	1	Atypical	110.01		238	6.35
72	Successful	83.15	76.56	32.04	285.37	2	SN	66.73	57		6.05
73	Successful	107.01	81.25	36.07	411.81	2	SN	70.49	57		5.5
74	Successful	78.09	61.57	20.06	140.27	2	SN	54.76	64		5.37
75	Successful	122.61	63.56	25.05	299.36	2	SN	56.23	87		3.62
76	Successful	78.23	71.9	30.91	259.73	2	SN	66.17	69		3.87
77	Failed	105.51	72.66	34.82	399.96	0	SN	N/A		200	5.45
78	Successful	64.3	58.54	16.78	102.23	2	SN	51.85	42		4.32
79	Successful	67.02	47.81	13.25	64.4	2	SN	43	47		2.93
80	Successful	68.42	45.35	12.63	73.88	2	SN	40.06	54		6.88
81	Successful	58.97	51.91	12.67	61.25	2	SN	47.93	32		3.17
82	Successful	76.77	67.4	20.26	168.59	2	SN	65.46	78		3.13
83	Successful	70.4	55.28	13.6	88.74	2	SN	52.87	23		3.65
84	Successful	57.41	42.95	12.34	53.94	2	SN	39.9	69		6.62
85	Failed	57.64	47.37	12.32	55.88	0	SN	N/A		5	0.78
86	Successful	64.99	55.95	20.84	114.95	2	SN	48.12	97		7.83
87	Successful	70.8	46.92	19.12	104.14	2	SN	42.62	75		3.65

NS Number	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
88	Successful	56.66	47.73	17.99	79.57	2	SN	44.34	56		4.98
89	Successful	133.35	86.47	35.31	631.08	2	SN	80.85	166		7.9
90	Failed	51.34	36.04	12.26	35.22	1	EN	49.28		310	14.22
91	Successful	113.69	110.59	39.57	710.33	2	EN	106.69	146		11.37
92	Failed	58.8	56.08	17.45	96.14	1	SN	53.66		241	4.97
93	Successful	120.19	94.56	37.28	621.33	2	SN	89.2	62		4.3
94	Successful	103.91	101.65	43.73	557.64	2	SN	81.14	45		6.9
95	Successful	84.57	68.91	30.82	241.99	2	SN	57.72	170		5.43
96	Failed	103.77	72.26	31.09	388.75	0	SN	N/A		200	4.6
97	Successful	126.5	94.05	38.58	677.26	2	EN	117.08	325		14.9
98	Successful	78.92	45.36	16.13	84.75	2	SN	37.81	60		2.83
99	Successful	48.28	47.53	17.59	66.62	2	EN	44.15	55		2.47
100	Successful	125.93	92.46	45.14	730.12	2	EN	118.78	157		8.22

Table A.2: Metrics for Experiment Two, Cobble Source

S=Successful; F=Failed; NS=Net Sinker

NS Number	Successful/ Failed	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Avg. Notch Width	Avg. Notch Depth	Inter-Notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
CSG1-1	Successful	84.76	64.09	14.61	102	2	SN	23.725	2.84	55.15	27		3.42
CSG1-2	Successful	76.03	53.31	21.17	109	2	SN	23.575	1.905	46.89	26		3.15
CSG1-3	Successful	84.01	58.07	14.76	98	2	SN	27.24	2.005	49.58	21		20:24
CSG1-4	Successful	86.74	59.77	21.01	165	2	SN	22.5	2.21	50.26	127		3.65
CSG1-5	Successful	50.93	4.87	12.28	39	2	EN	21.07	1.625	43.7	32		1.25
CSG1-6	Successful	93.91	63.31	23.22	188	2	SN	22.77	1.93	59.77	17		1.77
CSG1-7	Successful	102.97	71.05	25.34	224	2	SN	18.975	2.985	61.24	23		1.1
CSG1-8	Successful	95.62	70.56	17.79	170	2	EN	31.805	3.785	83.47	43		1.82
CSG1-9	Successful	73.66	45.35	18.31	79	2	EN	20.265	2.255	70.16	32		1.28
CSG1-10	Successful	54.7	36.55	8.33	29	2	EN	16.05	1.745	51.47	65		1.6
CSG1-11	Successful	65.29	44.58	19.97	79	2	SN	11.38	1.29	41.68	32		1.1
CSG1-12	Successful	78.13	78.03	21.51	161	2	EN	30.345	4.65	65.12	24		1.65
CSG1-13	Successful	92.59	74.99	31.83	323	2	SN	25.965	1.08	70.44	228		6.25
CSG1-14	Failed	68.81	57.83	21.8	136	1	SN	15.51	2.25	51.08		365	1.62
CSG2-1	Failed	88.24	51.58	19.22	143	2	SN	31.26	0.64	50.18		236	6.5
CSG2-2	Failed	71.97	55.53	26.27	129	1	SN	28.12	0.12	53.44		220	5.6
CSG2-3	Failed	60.49	48.16	19.09	87	0	SN	N/A	N/A	N/A		200	3.85
CSG2-4	Failed	69.55	63.06	23.57	155	1	SN	23.49	3.35	56.01		216	5
CSG2-5	Successful	72.89	57.27	26.71	160	2	SN	20.025	1.615	51.41	76		3.27
CSG2-6	Failed	95.32	56.08	27.81	224	0	SN	N/A	N/A	N/A		200	3.73
CSG3-1	Successful	75.77	67.53	28.35	196	2	SN	18.7	1.81	64.83	32		3.07
CSG3-2	Successful	88.19	68.39	30.77	269	2	SN	23.55	1.935	64.7	105		3.67
CSG3-3	Failed	46.98	29.21	14.3	34	0	EN	N/A	N/A	N/A		200	2.15

NS Number	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Avg. Notch Width	Avg. Notch Depth	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
CSG3-4	Successful	57.35	33.96	17.86	55	2	SN	17.855	1.24	31.77	166		5.1
CSG3-5	Successful	72.52	48.58	23.37	113	2	SN	20.465	2.49	41.42	17		1.8
CSG3-6	Successful	75.95	51.99	25.23	156	2	SN	19.885	2.075	49.73	58		3.27
CSG4-1	Successful	94.24	57.61	23.45	225	2	SN	19.235	1.485	46.78	44		2.22
CSG4-2	Failed	107.32	47.97	24.46	237	1	EN	21.47	1.24	103.5		143	3.33
CSG4-3	Successful	50.33	36.4	16.58	48	2	SN	16.565	0.97	33.48	60		1.35
CSG4-4	Failed	65.42	49.41	21.74	117	0	SN	N/A	N/A	N/A		200	3.08
CSG4-5	Successful	51.82	42.54	21.91	75	2	EN	16.7	1.355	50.09	97		2.33
CSG4-6	Successful	52.43	48.34	18.54	82	2	SN	16.465	1.29	47.82		208	3.55
CSG4-7	Failed	62.49	36.5	19.96	88	0	EN	N/A	N/A	N/A	3		0.62
CSG5-1	Successful	77.72	63.85	16.34	123	2	SN	23.975	4.59	52.64	52		5.1
CSG5-2	Successful	63.08	50.29	10.82	57	2	SN	13.925	2.535	44.31	20		3.48
CSG5-3	Successful	86.69	79.18	29.78	271	2	SN	30.895	4.335	69.82	38		5.21
CSG5-4	Successful	74.89	58.48	12.57	96	2	SN	19.525	3.32	51.78	115		3.65
CSG5-5	Successful	80.32	65.02	20.14	139	2	SN	23.455	2.925	58.15	67		4.25
CSG5-6	Failed	105.36	100.14	25.47	360	0	EN	N/A	N/A	N/A		12	0.65
CSG5-7	Successful	56.57	44.49	21.44	87	2	EN	17.665	1.395	55.51	32		4.57
CSG5-8	Successful	57.73	48.94	16.3	61	2	SN	15.905	2.205	40.01	87		5.05
CSG5-9	Failed	90.52	74.84	17.73	185	0	EN	N/A	N/A	N/A		47	4.1
CSG5-10	Successful	87.02	53.42	14.43	73	2	SN	18.91	3.205	48.94	37		3.8
CSG6-1	Successful	72.08	52.49	14.47	84	2	SN	14.705	1.37	45.56	97		6.82
CSG6-2	Successful	94.71	61.96	19.31	155	2	SN	22.29	2.86	53.85	51		4.15
CSG6-3	Successful	84.24	83.6	13.77	178	4	4N	16.05	1.22	81.31/78.18	86		4.73
CSG6-4	Successful	112.98	92.67	19.03	328	2	EN	23.06	2.9	97.53	161		6.55
CSG6-5	Successful	62.45	54.61	14.91	73	2	EN	14.405	0.96	54.46	81		5.9

NS Number	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Avg. Notch Width	Avg. Notch Depth	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
CSG6-6	Successful	102.21	77.39	32.01	379	2	SN	21.115	1.995	72.61	210		6.28
CSG6-7	Successful	100.52	74.51	29.26	320	2	SN	25.135	1.53	64.47	277		7.27
CSG6-8	Successful	132.36	91.46	33.53	615	2	SN	26.705	2.48	82.21	84		4.43
CSG6-9	Successful	76.99	74.1	27.99	207	2	SN	18.67	0.685	72.88	62		3.05
CSG6-10	Successful	76.26	52.65	20.72	126	2	EN	19.215	2.63	69.58	34		2.23
CSG6-11	Successful	101.89	71.91	31.78	274	2	SN	23.91	2.815	66.62	35		3.92
CSG6-12	Successful	95.4	50.93	23.4	174	2	SN	15.92	2.335	46.36	40		2.57

Table A.3: Metrics for Experiment 3, Cobble Hydration

H=Hydrated; D=Dry; S=Successful; F=Failed; NS=Net Sinker; EN=End-Notched; SN=Side-Notched; 4N=Four-Notched

NS Number	H/D	Successful/ Failed	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Avg. Notch Width	Avg. Notch Depth	Inter-Notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
CSG2-1	D	Failed	88.24	51.58	19.22	143	1	SN	31.26	0.64	50.18		236	6.5
CSG2-2	D	Failed	71.97	55.53	26.27	129	1	SN	28.12	0.12	53.44		220	5.6
CSG2-3	D	Failed	60.49	48.16	19.09	87	0	SN	N/A	N/A	N/A		200	3.85
CSG2-4	D	Failed	69.55	63.06	23.57	155	1	SN	23.49	3.35	56.01		216	5
CSG2-5	D	Successful	72.89	57.27	26.71	160	2	SN	20.025	1.615	51.41	76		3.27
CSG2-6	D	Failed	95.32	56.08	27.81	224	0	SN	N/A	N/A	N/A		200	3.73
CSG2-7	H	Successful	72.89	65.42	54.44	137	2	EN	18.45	3.01	53.43	18		2.68
CSG2-8	H	Successful	60.99	54.83	20.08	100	2	SN	12.28	1.4	48.4	118		3.55
CSG2-9	H	Successful	66.01	56.62	20.57	113	2	SN	19.125	0.86	54.71	41		3.8
CSG2-10	H	Failed	70.37	50.65	28.38	148	1	EN	18.59	0.52	65.67		394	12.12
CSG2-11	H	Successful	70.26	56.85	20.4	110	2	SN	18.26	2.44	43.42	52		2.26
CSG2-12	H	Failed	56.82	53.72	26.83	115	0	EN	N/A	N/A	N/A		200	4.95
CSG3-1	D	Successful	75.77	67.53	28.35	196	2	SN	18.7	1.81	64.83	32		3.07
CSG3-2	D	Successful	88.19	68.39	30.77	269	2	SN	23.55	1.935	64.7	105		3.67
CSG3-3	D	Failed	46.98	29.21	14.3	34	0	EN	N/A	N/A	N/A		200	2.15
CSG3-4	D	Successful	57.35	33.96	17.86	55	2	SN	17.855	1.24	31.77	166		5.1
CSG3-5	D	Successful	72.52	48.58	23.37	113	2	SN	20.465	2.49	41.42	17		1.8
CSG3-6	D	Successful	75.95	51.99	25.23	156	2	SN	19.885	2.075	49.73	58		3.27
CSG3-7	H	Successful	90.61	66.84	31.43	272	2	SN	26.465	2.195	61.68	40		3.12
CSG3-8	H	Successful	61.17	55.14	22.74	116	2	SN	14.575	1.055	54.38	60		4.27
CSG3-9	H	Successful	47.79	31.98	11.88	32	2	EN	11.765	0.165	47.73	42		4.08

NS Number	H/D	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Avg. Notch Width	Avg. Notch Depth	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
CSG3-10	H	Successful	71.58	49.71	21.82	125	2	SN	16.04	1.22	47.07	25		1.6
CSG3-11	H	Successful	89.74	57.39	31.42	230	2	SN	24.99	1.535	54.28	59		3.23
CSG3-12	H	Successful	61.44	59.62	32.9	161	2	SN	22.67	1.335	54.99	84		3.83
CSG4-1	D	Successful	94.24	57.61	23.45	225	2	SN	19.235	1.485	46.78	44		2.22
CSG4-2	D	Failed	107.32	47.97	24.46	237	1	EN	21.47	1.24	103.5		143	3.33
CSG4-3	D	Successful	50.33	36.4	16.58	48	2	SN	16.565	0.97	33.48	60		1.35
CSG4-4	D	Failed	65.42	49.41	21.74	117	0	SN	N/A	N/A	N/A		200	3.08
CSG4-5	D	Successful	51.82	42.54	21.91	75	2	EN	16.7	1.355	50.09	97		2.33
CSG4-6	D	Successful	52.43	48.34	18.54	82	2	SN	16.465	1.29	47.82	208		3.55
CSG4-7	D	Failed	62.49	36.5	19.96	88	0	EN	N/A	N/A	N/A		3	0.61
CSG4-8	H	Successful	92.26	61.57	31.19	234	2	Atypical	18.505	1.425	54.58	46		2.87
CSG4-9	H	Successful	70.44	40.39	16.71	80	2	SN	17.325	1.135	40.03	11		1
CSG4-10	H	Successful	77.47	69.54	26.56	216	2	SN	19.625	2.015	57.61	19		0.67
CSG4-11	H	Successful	47.89	46.41	17.76	65	2	SN	15.87	1.17	43.54	89		3.52
CSG4-12	H	Successful	58.89	45.59	21.51	91	2	SN	17.595	1.2	44.46	25		1.15
CSG4-13	H	Successful	59.27	49.7	20.79	90	2	EN	18.795	1.25	50.58	58		2.05
CSG4-14	H	Successful	59.36	38.2	19.95	67	2	EN	14.145	0.42	57.59	85		3.12
CSG6-1	D	Successful	72.08	52.49	14.47	84	2	SN	14.705	1.37	45.56	97		6.81
CSG6-2	D	Successful	94.71	61.96	19.31	155	2	SN	22.29	2.86	53.85	51		4.15
CSG6-3	D	Successful	84.24	83.6	13.77	178	4	4N	16.05	1.22	81.31/78.18	86		4.73
CSG6-4	D	Successful	112.98	92.67	19.03	328	2	EN	23.06	2.9	97.53	161		6.55
CSG6-5	D	Successful	62.45	54.61	14.91	73	2	EN	14.405	0.96	54.46	81		5.9
CSG6-6	D	Successful	102.21	77.39	32.01	379	2	SN	21.115	1.995	72.61	210		6.28

NS Number	H/D	S/F	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	# Notches	NS Type	Avg. Notch Width	Avg. Notch Depth	Inter-notch Width	Total Strikes (S)	Total Strikes (F)	Time (min.)
CSG6-7	D	Successful	100.52	74.51	29.26	320	2	SN	25.135	1.53	64.47	277		7.27
CSG6-8	D	Successful	132.36	91.46	33.53	615	2	SN	26.705	2.48	82.21	84		4.43
CSG6-9	D	Successful	76.99	74.1	27.99	207	2	SN	18.67	0.685	72.88	62		3.05
CSG6-10	D	Successful	76.26	52.65	20.72	126	2	EN	19.215	2.63	69.58	34		2.23
CSG6-11	D	Successful	101.89	71.91	31.78	274	2	SN	23.91	2.815	66.62	35		3.92
CSG6-12	D	Successful	95.4	50.93	23.4	174	2	SN	15.92	2.335	46.36	40		2.57
CSG6-13	H	Failed	95.41	68.81	30.82	294	1	SN	23.95	0.76	66.84		223	7.07
CSG6-14	H	Failed	96.68	66.05	34.13	331	0	EN	N/A	N/A	N/A		200	6.97
CSG6-15	H	Successful	66.25	65.6	29.07	175	2	EN	18.48	2.485	60.28	60		4.3
CSG6-16	H	Failed	94.52	67.23	33.71	295	1	SN	25.92	2.89	61.34		295	7.78
CSG6-17	H	Successful	99.65	76.46	22.82	278	2	SN	25.16	3.05	74.77	47		3.32
CSG6-18	H	Successful	90.79	83.82	32.85	350	2	EN	18.36	2.27	84.33	107		5.73
CSG6-19	H	Successful	106.56	103.22	24.4	422	2	EN	27.76	4.77	90.42	87		7.03
CSG6-20	H	Successful	97.62	76.23	26.43	295	2	EN	21.905	3.745	84.88	134		7.1
CSG6-21	H	Successful	92.57	76.91	32.2	345	0	SN	N/A	N/A	N/A		200	6.98
CSG6-22	H	Successful	83.69	71.88	32.14	260	2	SN	20.395	2.315	61.14	65		3.76

Table A.4: Metrics for Indirect Percussion Net Sinker Experiment

Identification	Length (mm)	Width (mm)	Thickness (mm)	Average Notch Width (mm)	Average Notch Depth (mm)	Weight (grams)	Time (minutes)	Flake or Chopper
IP-1	53.08	42.99	16.08	5.11	4.31	57	12.78	Flint and Cobble Flakes
IP-2	53.06	43.54	17.12	8.02	1.46	59	31.47	Flint Flake
IP-3	54.12	38.37	10.46	4.16	1.66	37	22.38	Cobble Flake
IP-4	84.78	43.49	15.05	5.64	2.94	110	14.23	Chopper
IP-5	98.01	74.15	20.81	6.83	3.75	238	11.03	Chopper
IP-6	55.06	37.18	14.28	7.84	1.57	50	5.25	Chopper
IP-7	65.64	55.49	19.28	12.84	1.9	112	8.02	Chopper
IP-8	44.02	29.41	8.82	6.63	2.22	18	17.43	Chopper
IP-9	57.13	39.19	16.51	N/A	N/A	54	4.53	Chopper
IP-10	56.89	35.59	17.19	9.84	0.48	57	7.77	Chopper

Table A.5: Metrics for Grooved Stone Sinker Experiment

Number	Length	Width	Thickness	Notch Width	Inter-Notch Width	Weight	Time (hours)
GS-1	96.56	83.96	43.14	6.72	77.92	499	5.28
GS-2	94.48	81.34	46.44	21.42	77.7	503	1.46
GS-3	54.52	49.02	30.15	18.58	45.99	104	0.58
GS-4	71.86	65.53	44.29	18.57	60.81	290	1.47
GS-5	89.11	73.88	51.18	20.25	69.81	486	1.18
GS-6	101.69	66.6	49.5	15.79	61.81	492	2.77

Table A.6: Metrics for Perforated Sinker Experiment

Number	Length (mm)	Width (mm)	Thickness (mm)	Weight (grams)	Time (hours)	Manufacturing Time per 1 mm	Raw Material	Manufacturing Method
1	38.19	27.07	6.52	10	5.63	1.16 mm/hour	Basalt	Flint Hand Drill
2	57.63	45.86	14.62	58	5.22	2.8 mm/hour	Basalt	Flint Hand Drill
3	80.97	43.76	11.21	60	3.84	2.92 mm/hour	Metamorphic	Iron Nail Pump Drill

Appendix B: Net Sinker Metrics from the Clearwater, Lower Snake, and Columbia River Regions; Supplementary Material for Chapter 5

Table B.1: Net Sinker Metrics from the Clearwater River Region

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width (mm)
10CW4	92-3	Atypical	77.93	63.4	34.25	284	N/A
10CW4	R-30	End-Notched	38.39	31.85	12.09	22	36.83
10CW4	R-17	End-Notched	36.77	32.06	10.92	22	36.48
10CW4	R-16	End-Notched	46.36	37.93	12.2	29	45.59
10CW4	R-24	End-Notched	36.95	36.37	9.23	21	36.84
10CW4	61.6.11	Side-Notched	50.65	44.21	12.15	42	35.71
10CW4	52.5.22	Four-Notched	59.38	44.55	14.29	60	58.65/42.72
10CW4	38.8.9	Rejected Net Sinker	50.49	40.96	16.02	53	N/A
10CW4	10.11.1	End-Notched	67.26	55.54	16.8	108	67.17
10CW4	7.6.1	End-Notched	43.77	41.1	11.96	28	37.62
10CW4	6.5.2	End-Notched	54.72	48.75	17.97	74	54.18
10CW4	55.5.8	Side-Notched	114.78	87.69	16.69	283	76.81
10CW4	F6.7.7.4	End-Notched	50.61	48.61	15.03	59	41.98
10CW4	F6.7.7.5	End-Notched	39	42	13	30.9	Unknown
10CW4	F6.7.7.1	End-Notched	55.47	48.6	10.75	58	45.88
10CW4	61.7.19	End-Notched	58.27	53.27	17.25	78	52.64
10CW4	26.9.27	Side-Notched	34	56	12	38.9	Unknown
10CW4	61.7.8	End-Notched	51	52	14	63.9	Unknown
10CW4	F6.7.7.2	End-Notched	41	39	13	32	Unknown
10CW4	35.6.15	End-Notched	55	44	16	64	Unknown
10CW4	F6.7.7.3	Side-Notched	50	43	15	57.8	Unknown
10CW41	1352	Perforated	150.48	130.51	81.84	1527	N/A

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-notch Width (mm)
10CW586	9	Side-Notched	111.67	90.25	30.12	441	80.03
10CW587	3	Side-Notched	164.62	160.8	36.22	1602	152.14
10CW19	1346	Grooved	165.92	141.04	114.68	4520	N/A
10CW19	1353	Grooved	70.49	61.71	52.51	308	N/A
10CW20	1051	Side-Notched	60.48	53.39	22.63	114	51.36
10CW20	1001	Side-Notched	62.03	55.65	13.38	83	53.75
10CW20	1004	Side-Notched	66.42	54.9	13.26	92	53.64
10CW20	1334	Side-Notched	110.96	88.88	21.82	363	77.69
10CW38	2164	End-Notched	106.74	97.96	15.9	197.2	100.15
10CW38	2155	Side-Notched	52.37	43.97	21.03	68.2	37.7
10NP292	O.DA.1	Atypical	90.02	62.1	18.14	162.1	N/A
10NP151	TP2.L2.S1; 2-61	End-Notched	86.57	63.16	17.46	156	79.97
10NP151	Beach 265	End-Notched	60.31	59.18	14.24	88	51.75
10NP151	TP2.F2.Artifact2A	End-Notched	50.34	42.75	11.79	44	48.81
10CW5	SA3664;76-12	End-Notched	48.47	43.13	11.1	36	48.39
10IH820	AH.108.4	End-Notched	46.05	41.7	13.99	44	43.82
10IH820	26.5/3.31	Side-Notched	44.71	42.16	12.41	41	41.47
10IH820	26.5/3.33	Three Notched	93.77	85.6	24.55	280	79.56
10IH820	26.7/3.16	End-Notched	70.58	68.23	29.36	227	N/A
10IH820	22.1/1.37	End-Notched	46.97	34.4	12.63	31	44.69
10IH820	22.1/1.33	Four-Notched	48.78	45.59	11.84	41	42.31/45.29
10KA45	121	Side-Notched	41.39	27.94	8.4	14	26.48
10KA45	119	Side-Notched	37.24	32.15	9.5	14	28.33
10KA45	73	Rejected Sinker	65.56	55.09	16.03	91	N/A
10KA45	2	Side-Notched	39.34	37.93	11.26	24	34.12
10IH1732	2	Side-Notched	152.79	124.35	41.25	1149	115.56

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-notch Width (mm)
10IH1732	7 and 6 (two pieces)	Anchor	337.63	331.67	79.04	12691	N/A
10IH395	338	Unknown	91.3	85.87	38.41	281	N/A
10CW30	1662-252	Rejected Sinker	97.22	67.12	18.82	182	N/A
10CW30	1604-170	End-Notched	74.25	64.68	13.97	107	71.61
10CW30	1604-064	End-Notched	83.32	60.48	36.58	203	81.94
10CW30	1604-296	End-Notched	65.33	49.52	11.4	46	60.08
10CW30	1604-268-2	End-Notched	81.36	49.72	19.3	122	78.74
10CW30	1604-194	Side-Notched	81.89	78.06	17.08	139	71.29
10CW30	1604-121	Side-Notched	82.46	82.38	16.95	150	76.64
10CW30	1604-270	Side-Notched	84.39	79.69	15.07	136	77.22
10CW30	1604-202	Side-Notched	91.84	85.99	23.18	175	82.22
10CW226	1609-589	Side-Notched	66.19	64.06	20.73	116	56.24
10CW226	1609-1400	End-Notched	82.04	80.65	26.76	229	52.11
10IH1009	4.5.40	End-Notched	70.25	78	18.56	158	56.81
10IH1009	3.3.25	End-Notched	81.08	60.93	18.1	138	80.2
10IH1009	0.1.1	End-Notched	75.49	51.38	18.76	115	56.87
10IH1009	5.3.46	Atypical	39.25	46.18	13.49	45	35.82
10IH1009	0.1.2	End-Notched	48.36	48.04	12.81	48	38.04
10IH1009	1.SL.9	Four-Notched	67.8	50.39	19.07	118	65.56/46.97
10IH1009	6.3.17	Rejected Sinker	96.26	71.96	24.59	254	N/A
10NP279	82205	Labeled Abrader/Sinker	100.17	53.89	47.21	349	N/A
10IH1948	F3.4.4.2	Atypical	68.24	66.59	12.98	65	56.24/54.94/40.27
10IH1948	F3.4.6.13	End-Notched	55.27	49.61	19.81	79	49.62
10IH1948	F3.5.5.3	Side-Notched	60.53	49.28	21.99	103	41.71

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-notch Width (mm)
10NP105	2572	End-Notched	36.44	29.46	10.47	18	35.66
10NP105	3683	Side-Notched	49.84	45.07	12.6	50	44.91
10NP105	3681	End-Notched	51.87	51.01	13.59	61	50.55
10NP105	3682	End-Notched	45.07	35.71	10.8	28	44.18
10NP105	3189	End-Notched	37.66	36.66	8.71	17	34.42
10NP105	2707	End-Notched	45.58	33.39	16.03	36	43.51
10NP105	8481	End-Notched	56.91	55.81	13.84	67	51.96
10NP105	7629	Atypical	60.04	51.66	12.3	52	49.63
10NP105	6440	Labeled Abrader	52.01	30.56	14.02	33	29.22
10NP105	6444	Labeled Abrader	35.32	35.96	11.97	25	32.78
10NP105	6446	Labeled Abrader	55.05	39.26	13.51	40	N/A
10NP105	6365	Rejected Sinker	80.57	49.05	11.98	83	N/A
10NP105	4661	Three Notched	51.86	40.29	13.67	50	46.14
10NP105	12004	Side-Notched	41.09	40.72	12.41	26	34.72
10NP105	12005	End-Notched	46.17	42.23	11.16	36	44.45
10NP105	12006	Perforated	100.18	77.1	28.17	290	N/A
10NP105	13978	Four-Notched	52.12	42.11	16.01	57	38.02/49.91
10NP105	10418	End-Notched	49.16	42.78	10.15	37	47.53
10NP102	H127125	End-Notched	51.87	37.49	12.23	39	50.33
10NP102	H127110	Four-Notched	64.01	51.39	17.06	83	62.8/48.54
10NP102	H127883	Four-Notched	72.45	57.48	16.28	125	68.3
10NP102	H128030	Four-Notched	71.93	54.13	19.34	130	70.09/52.07
10NP102	H128080	Four-Notched	54.68	47.95	12.51	45	45.89/51.54
10NP102	H127483	Four-Notched	58.82	49.55	13.73	57	56.05/48.5
10NP102	H125948	Four-Notched	62.47	49.69	21.73	92	62.16/46.4
10NP102	H127245	Rejected Sinker	58.84	48.49	15.53	74	N/A

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-notch Width (mm)
10NP102	H126672	Four-Notched	53.33	42.86	15.97	62	53.44/41.75
10NP102	H127979	Four-Notched	59.25	45.85	17.13	64	52.89/44.31
10NP102	H125937	Rejected Sinker	64.54	57.21	15.56	89	N/A
10NP102	H126678	Four-Notched	98.56	68.75	17.68	192	87.15/66.82
10NP102	H126594	Side-Notched	48.49	35.95	13.11	37	31.97
10NP102	H126805	Four-Notched	50.68	43.08	18.04	64	50.08/42.81
10NP102	H126983	End-Notched	49.42	46.62	11.77	43	46.63
10NP102	H125540	End-Notched	48.45	44.03	15.99	48	43.6
10NP102	H125548	Rejected Sinker	70.51	52.42	20.18	110	N/A
10NP102	H125614	End-Notched	60.13	37.77	16	54	58.04
10NP102	H125891	Rejected Sinker	56.41	46.81	19.51	75	N/A
10NP102	H125949	Four-Notched	52	38.18	14.35	35	48.57/35.29
10NP102	H126992	Rejected Sinker	56.85	40.39	19.61	63	53.78/39.26

Table B.2: Net Sinker Metrics from the Lower Snake River Region

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width (mm)
45AS78	520	End-Notched	85.57	61.63	18.26	153	82.01
45AS78	535	End-Notched	50.91	38.12	13.16	44	46.54
45AS78	571	End-Notched	46.66	40.15	15.65	39	43.11
45AS78	572	Four-Notched	49.98	41.76	12.56	35	45.34/36.63
45AS78	574	End-Notched	44.73	45.84	15.16	40	35.66
45AS78	588	Four-Notched	41.68	35.03	12.26	31	37.13/33.99
45AS78	598	End-Notched	60.76	51.97	14.22	75	54.17
45AS78	599	End-Notched	51.77	45.9	12.36	44	47.39
45AS78	600	End-Notched	70.73	52.36	10.76	52	64.23
45AS78	601	End-Notched	75.48	54.84	17.62	114	66.44
45AS78	602	End-Notched	65.55	54.82	13.87	76	60.18
45AS78	603	End-Notched	69.01	54.59	16.06	91	58.09
45AS78	604	End-Notched	67.96	54.62	13.97	84	58.03
45AS78	605	End-Notched	58.93	53.01	13.07	74	54.27
45AS78	610	Four-Notched	82.73	62.68	16.94	133	78.14/59.56
45AS78	4862	End-Notched	64.32	57.93	13.98	87	55.69
45AS80	171	End-Notched	60.16	36.95	12.65	47	56.73
45AS82	20552	Side-Notched	72.01	53.78	18.17	75	51.65
45AS82	20696	End-Notched	63.37	39.83	16.47	61	62.17
45AS82	20698	Atypical	73.59	48.91	20.62	94	72.52/46.82
45AS82	20699	Four-Notched	82.64	47.62	13.67	66	80.17/44.17
45AS82	20743	Four-Notched	85.18	57.38	19.02	132	43.09/81.42
45AS82	157	End-Notched	52.56	50.34	17.64	75	49.4
45AS82	4015	Four-Notched	96.91	68.23	23.81	216	96.85/65.27
45AS82	4031	End-Notched	67.15	45.09	15.83	66	67.13

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45AS82	4034	Four-Notched	52.18	36.66	16.26	42	51.9/34.25
45AS82	4732	Four-Notched	61.53	52.86	19.67	99	58.99/48.84
45AS82	4841	Four-Notched	74.86	70.86	13.47	84	70.63/63.02
45AS82	4842	Four-Notched	44.19	39.38	16.63	38	41.09/38.27
45AS82	4916	Four-Notched	48.35	38.97	11.54	28	47.79/38.16
45AS82	11187	Side-Notched	60.2	42.62	11.22	50	41.12
45AS82	11690	Four-Notched	45.93	40.63	8.77	24	39.21/35.11
45AS82	11707	End-Notched	62.62	49.43	21.54	82	36.01
45AS82	13531	Perforated	89.23	83.01	25.57	252	N/A
45AS82	13533	Four-Notched	79.99	60.88	20.59	145	76.93/58.49
45AS82	13534	End-Notched	63.9	48.77	12.88	70	62.64
45AS82	13535	End-Notched	81.21	60.21	18.81	119	66.68
45AS82	13633	Four-Notched	86.52	52.6	24.26	165	69.31/N/A
45AS82	14292	Four-Notched	48.85	31.2	9.19	24	39.55/30.01
45AS82	14294	Four-Notched	50.16	34.89	14.1	25	46.56/30.33
45AS82	16105	Four-Notched	86.04	78.1	22.44	203	79.59/67.88
45AS82	16782	Four-Notched	62.8	42.65	17.63	63	56.91/41.42
45AS82	17806	End-Notched	59.65	49.42	15.27	83	57.74
45AS82	18674	End-Notched	80.98	75	20.6	188	79.33
45AS82	18689	Four-Notched	89.98	63.62	20.12	199	89.39/59.89
45AS82	18690	Four-Notched	53.23	41.48	10.29	28	51.3/31.37
45AS82	18691	Four-Notched	62.46	45.21	17.49	70	58.91/39.43
45AS82	18711	Side-Notched	152.88	126.4	44.05	1389	118.53
45AS82	18949	Four-Notched	64.39	51.54	19.3	92	60.12/44.4
45CO1	299	Side-Notched	93.94	82.77	19.78	205	54.02
45CO1	827	Side-Notched	93.48	67.95	17.94	190	66.34

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45CO1	1319	Four-Notched	64.09	50.34	17.48	75	48.66/60.89
45CO1	1648	Four-Notched	72.25	63.5	13.74	91	60.72/47.98
45CO1	1745	Four-Notched	76.33	60.88	15.84	121	71.42/55.26
45CO1	1985	End-Notched	48.21	43.74	9.83	40	44.65
45CO1	1988	Four-Notched	85.18	72.27	22.05	245	82.74/65.58
45CO1	2229	Side-Notched	57.55	42.87	15.27	57	36.74
45CO1	2253	Side-Notched	60.59	44.35	12.2	49	40.45
45CO1	3188	End-Notched	63.6	47.8	20.02	106	60.42
45FR5	36714	Grooved	138.65	112.05	74.73	1630	102.53
45FR5	36718	Four-Notched	101.36	84.55	20.36	273	93.65/77.31
45FR5	36730	End-Notched	78.01	64.57	19.97	149	70.3
45FR5	36734	End-Notched	59.68	49.9	12.03	54	52.07
45FR5	36742	End-Notched	61.17	52.5	19.27	83	49.6
45FR5	36757	End-Notched	100.79	84.36	23.49	329	93.4
45FR5	24589	End-Notched	73.72	62.08	13.38	102	64.61
45FR5	24611	End-Notched	83.28	65.99	15.89	152	71.28
45FR5	25188	End-Notched	80.39	73.24	13.96	141	76.25
45FR5	29954	End-Notched	60.79	53.13	14.03	69	49.94
45FR5	30394	Side-Notched	67.4	63.95	17.41	109	51.41
45FR5	31002	End-Notched	82.95	80.36	14.8	165	76.75
45FR5	31041	Four-Notched	118.26	96.22	20.69	358	107.31/81.77
45FR5	6521	Atypical	120.7	110.81	21.48	446	N/A
45FR5	7194	End-Notched	102.97	88.98	13.47	192	83.09
45FR5	7198	Side-Notched	75.38	68.76	15.78	121	62.1
45FR5	7413	Grooved	125.37	118.41	66.16	1457	111.68

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45FR5	14160	End-Notched	78.35	63.08	19.02	122	61.26
45FR5	19434	Four-Notched	93.72	85.48	14.3	178	73.46/85.28
45FR5	19435	End-Notched	79.63	62.49	13.19	108	62.92
45FR32	8	End-Notched	84.75	70.78	15.18	129	74.6
45FR32	19	End-Notched	73.16	65.96	13.82	108	60.5
45FR32	31	End-Notched	80.03	67.88	15.32	111	65.89
45FR32	43	End-Notched	60.07	55.09	15.16	81	58.24
45FR32	71	End-Notched	83.16	73.75	16.07	166	72.06
45FR32	82	End-Notched	82.62	68.6	14.57	144	70.22
45FR32	126	Side-Notched	111.03	67.71	27.07	294	55.26
45FR32	194	Perforated	142.87	133.54	57.35	1510	N/A
45FR32	233	Perforated	146.02	107.8	89	1772	N/A
45FR32	410	Four-Notched	84.54	78.16	20.01	200	81.07/76.71
45FR32	432	Side-Notched	90.89	87.78	19.82	221	71.85
45FR32	434	End-Notched	63.71	60.07	16.95	96	53.63
45FR32	435	Four-Notched	67.85	61.46	14.69	103	58.34
45FR32	436	End-Notched	84.15	80.13	22.11	208	69.02
45FR32	437	End-Notched	74.61	67.77	14.13	104	58.62
45FR32	438	End-Notched	62.41	61.31	15.61	87	56.49
45FR32	532	End-Notched	68.07	57.62	16.88	104	57.55
45FR32	561	End-Notched	84.02	72.67	23.83	220	74.63
45FR32	616	Side-Notched	99.42	99.36	25.65	343	99.03
45FR32	658	Four-Notched	85.4	60.17	25.19	170	81.4/58.21
45FR32	689	Grooved	118.07	102.36	80.14	1303	91.84
45FR39	3805	Four-Notched	60.45	54.01	14.45	60	50.35/47.91
45FR39	3806	Four-Notched	65.33	52.39	16.15	83	54.47/45.57

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45FR39	3807	Four-Notched	61.2	42.34	19.09	72	55.25/40.97
45FR39	3808	End-Notched	64.7	52.28	13.58	71	56.8
45FR39	3809	Four-Notched	50.75	50.48	10.5	43	45.48/43.46
45FR39	3813	End-Notched	60.33	55.1	11.12	60	49.61
45FR39	4326	End-Notched	69.61	55.32	12.32	68	59.11
45FR39	4412	Grooved	85.81	73.67	59.57	549	71.36
45FR39	4558	Four-Notched	64.29	54.65	12.79	73	58.37/47.3
45FR39	3810	Four-Notched	52.7	54.96	14.14	63	49.13/48.07
45FR40	457	End-Notched	60.61	60.43	14.29	85	47.67
45FR40	459	End-Notched	59.58	40	17.97	69	56.37
45FR40	470	Four-Notched	60.53	39	14.97	52	59.89/38.13
45FR42	1272	Perforated	155.19	126.06	26.19	752	N/A
45FR42	1718	Unknown Orientation	58.71	35.81	13.99	46	N/A
45FR46	1325	Atypical	118.95	77.03	33.77	446	N/A
45FR46	2582	End-Notched	148.53	134.18	47.69	1295	135.94
45FR201	1037	Side-Notched	51.84	48.2	16.28	65	44.01
45FR201	1039	End-Notched	57.55	38.84	14.06	49	53.63
45FR201	1040	End-Notched	54.11	43.44	16.8	61	51.61
45FR201	1041	Side-Notched	53.04	41.79	17.99	56	37.2
45FR272	127	End-Notched	89.94	80.49	18.67	216	73.59
45FR283	22 One	Four-Notched	120.26	102.33	27.77	481	111.16/82.07
45FR283	22 Two	Four-Notched	106.6	105.37	20.42	370	94.07/93.79
45GA17	102	Four-Notched	87.17	73.27	15.02	161	Broken
45GA26	2667	End-Notched	54.34	41.8	12.66	44	51.66
45GA26	3068	End-Notched	54.3	38.12	16.1	55	52.5

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45GA26	3345	End-Notched	57.69	44.28	44.11	58	54
45GA26	3442	End-Notched	58.15	48.26	16.28	78	56.41
45GA26	3578	End-Notched	52.46	46.16	19.35	69	46.58
45GA26	3619	End-Notched	53.47	51.18	14.45	55	48.3
45GA26	4258	End-Notched	54.66	41.6	14.2	50	52.24
45GA26	4298	End-Notched	44.82	37.21	11.64	33	44.59
45GA61	1619	Atypical	54.65	41.64	13.94	61	N/A
45GA61	2848	Four-Notched	93.78	78.7	19.31	244	88.35/68.98
45GA61	2849	Four-Notched	101.41	81.39	25.22	301	91.25/74.37
45GA61	3352	End-Notched	57.79	48.8	15.39	71	56.24
45GA61	3353	Four-Notched	76.91	49.63	13.7	89	73.19
45GA61	3715	End-Notched	53.94	51.7	16.93	72	46.48
45GA61	3827	Four-Notched	93.98	71.67	26.42	277	92.22/69.84
45WT30	228	Grooved	119.07	115.82	61.81	1182	112.8
45WT35	133	Side-Notched	119.43	74.88	21.24	310	70.71
45WT35	996	Side-Notched	141.29	106.85	22.45	549	95.47
45WT36	7	Four-Notched	87.53	72.41	20.82	166	79.58/57.39
45WT36	87	Four-Notched	87.22	72.75	20.47	181	78.05/66.91
45WT36	519	End-Notched	65.22	60.4	21.3	116	53.29
45WT36	520	End-Notched	56.42	48.27	13.39	61	42.73
45WT36	523	End-Notched	58.99	49.03	13.31	67	51.64
45WT36	533	Four-Notched	67.62	48.41	13.21	67	63.72
45WT36	578	Four-Notched	70.16	39.93	12.49	63	67.23/38.2
45WT36	581	End-Notched	43.45	49.9	14.74	53	39.83
45WT36	672	End-Notched	46.72	39.06	16.96	45	42.35

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45WT36	673	End-Notched	60	48.99	18.98	86	54.19
45WT36	686	Side-Notched	55.1	48.31	13.25	56	42.53
45WT36	710	Four-Notched	58.76	53.44	13.76	69	56.47/49.04
45WT36	743	End-Notched	63.46	57.38	12.22	79	56.53
45WT36	746	Atypical	48.33	44.37	13.91	39	44.54/43.33
45WT36	927	Side-Notched	61.17	56.31	14.56	83	48.02
45WT36	941	End-Notched	63.14	50.17	18.35	73	57.09
45WT36	1385	Four-Notched	94.05	63.4	15.33	134	67.46/50.71
45WT36	1404	End-Notched	80.83	57.47	18.43	124	80.67
45WT36	1475	Atypical	62.31	56.43	14.38	64	51.94
45WT36	1517	End-Notched	67.33	58.81	14.78	98	61.31
45WT39	1212	End-Notched	73.91	58.82	15.23	110	60.99
45WT39	1214	End-Notched	47.97	46.89	13.24	50	45.73
45WT39	1226	Side-Notched	43.35	38.93	13.89	33	31.29
45WT39	1229	End-Notched	56.28	37.39	14.43	47	49.59
45WT39	1357	End-Notched	61.99	44.22	19.92	88	59.4
45WT39	1359	End-Notched	80.39	76.37	16.23	170	76.4
45WT39	1365	End-Notched	47.98	40.91	12.92	41	46.55
45WT39	1651	End-Notched	40.84	32.93	41.66	36	41.45
45WT39	1691	End-Notched	46.3	44.09	11.14	35	43.15
45WT39	1828	Side-Notched	94.44	38.38	14.02	89	34.93
45WT39	1876	End-Notched	61.21	54.9	16.75	90	58.37
45WT39	1877	Four-Notched	80.75	59.42	16.82	135	78.87/57.39
45WT39	1882	Four-Notched	80.82	72.65	22.62	212	75.86/69.69
45WT39	2092	Atypical	74.76	58.48	18.67	105	67.73/54.06
45WT39	2098	End-Notched	42.79	37.26	9.7	26	38.77

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45WT39	2101	End-Notched	47.92	43.13	13	43	42.8
45WT39	2102	Atypical	82.17	53.28	16.13	127	53.36
45WT39	2103	End-Notched	83.04	72.8	19.88	192	84.59
45WT39	2106	Four-Notched	62.1	54.56	15.23	70	55.51/47.89
45WT39	2107	Four-Notched	65.97	51.61	17.22	82	59.87/45.66
45WT39	2108	End-Notched	42.92	42.66	11.83	35	39.83
45WT39	2110	End-Notched	59.06	46.14	11.13	52	54.42
45WT39	2111	End-Notched	67.82	53.88	14.21	79	64.61
45WT39	2112	End-Notched	61.47	47.93	11.59	62	59.3
45WT39	2118	Four-Notched	64.54	57.69	17.14	99	55.76/50.89
45WT39	2122	End-Notched	56.31	35.07	16.7	53	51.15
45WT39	2124	End-Notched	50.43	37.91	12.04	33	40.41
45WT39	2165	Side-Notched	89.21	54.02	13.64	109	47.83
45WT39	2172	End-Notched	71.12	51.52	16.51	69	70.53
45WT39	2179	End-Notched	73.61	52.41	18.12	102	73.17
45WT39	2187	End-Notched	47.84	39.39	13.25	36	45.99
45WT39	2191	Atypical	51.15	25.98	16.26	8	36.66/24.49
45WT39	2210	End-Notched	56.91	49.12	14.12	65	50.66
45WT39	2229	End-Notched	45.69	37.07	11.94	33	43.06
45WT39	2234	End-Notched	63.33	53.43	15.06	57	42.95
45WT39	2250	End-Notched	68.58	52.36	17.95	98	53.31
45WT39	2251	Four-Notched	62.88	61.75	17.4	108	54.48/55.2
45WT39	2252	Atypical	66.91	61.06	20.12	111	63.99/60.69
45WT39	2277	End-Notched	56.42	45.53	14.7	59	46.1
45WT39	2279	End-Notched	55.85	49.07	13.11	44	53.94
45WT39	2300	End-Notched	71.76	62.05	16.97	117	70.12

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Inter-Notch Width
45WT39	2446	End-Notched	63.18	51.15	12.56	71	54.72
45WT41	101	Side-Notched	84.47	71.75	16.06	176	65.72
45WT41	381	End-Notched	64.98	53.07	14.95	79	56.87
45WT41	382	End-Notched	71.68	63.85	12.54	91	64.5
45WT41	383	End-Notched	68.87	56.67	17.78	100	60.4
45WT41	384	End-Notched	64.41	63.05	12.66	86	54.16
45WT41	385	Side-Notched	75.34	63.77	19.15	141	57.03
45WT41	386	Side-Notched	90.08	73.25	17.35	180	65.43
45WT41	387	End-Notched	67.4	45.37	14.18	67	63.84
45WT41	388	End-Notched	64.54	51.47	13.84	70	57.73
45WT41	389	End-Notched	68.73	58.59	12.63	82	61.73
45WT41	390	Side-Notched	59.02	56.92	13.99	74	47.51
45WT41	420	Grooved	148.72	119.05	101.81	2467	110.96
45WT41	421	Four-Notched	83.5	59.89	19.34	121	77.95/53.16
45WT41	423	Side-Notched	46.93	37.79	12.45	44	46.49
45WT41	900	End-Notched	50.88	45.47	14.18	50	48.61
45WT41	903	End-Notched	48.92	42.76	15.4	49	45.61
45WT41	906	End-Notched	53.19	45.4	14.75	50	47.35
45WT41	908	Unknown	51.24	28.88	12.71	29	N/A
45WT41	1408	End-Notched	46.83	38.75	14.5	41	43.47
45WT41	2455	Atypical	230.2	217.71	48.21	3384	N/A
45WT41	5818	Side-Notched	39.34	37.72	10.63	23	35.22

Table B.3: Shaped Fishing Ring Stone Metrics from the Wanapum Heritage Center; Trevor King Collection

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
No Provenience	2013.004.0001	Shaped Fishing Ring Stone	110.3	54.82	16.94	191
No Provenience	2013.004.0002	Shaped Fishing Ring Stone	94.97	58.06	21.02	206
No Provenience	2013.004.0003	Shaped Fishing Ring Stone	121.43	45.88	18.67	210
No Provenience	2013.004.0004	Shaped Fishing Ring Stone	122.86	60.37	19.41	262
No Provenience	2013.004.0005	Shaped Fishing Ring Stone	129.53	72.54	27.24	381
No Provenience	2013.004.0006	Shaped Fishing Ring Stone	80.9	73.13	12.76	134
No Provenience	2013.004.0007	Shaped Fishing Ring Stone	73.44	47.98	13.08	87
No Provenience	2013.004.0008	Shaped Fishing Ring Stone	102.24	63.48	19.44	198
No Provenience	2013.004.0009	Shaped Fishing Ring Stone	131.55	64.36	34.34	509
No Provenience	2013.004.0010	Shaped Fishing Ring Stone	89.86	51.71	14.27	100
No Provenience	2013.004.0011	Shaped Fishing Ring Stone	86.91	71.89	14.65	173
No Provenience	2013.004.0012	Shaped Fishing Ring Stone	92.78	59.59	18.42	156
No Provenience	2013.004.0013	Shaped Fishing Ring Stone	76.29	58.68	11.37	88
No Provenience	2013.004.0014	Shaped Fishing Ring Stone	111.03	69.36	24.23	293
No Provenience	2013.004.0015	Shaped Fishing Ring Stone	102.71	60.18	24.48	231
No Provenience	2013.004.0016	Shaped Fishing Ring Stone	86.78	61.5	14.4	149
No Provenience	2013.004.0017	Shaped Fishing Ring Stone	97.62	15.21	28.99	220
No Provenience	2013.004.0018	Shaped Fishing Ring Stone	116.92	69.49	21.84	264
No Provenience	2013.004.0019	Shaped Fishing Ring Stone	119.39	59.43	27.09	285
No Provenience	2013.004.0020	Shaped Fishing Ring Stone	85.45	58.93	19.3	152
No Provenience	2013.004.0021	Shaped Fishing Ring Stone	71.46	61.14	16.1	127
No Provenience	2013.004.0022	Shaped Fishing Ring Stone	98.9	67.33	22.69	281
No Provenience	2013.004.0023	Shaped Fishing Ring Stone	75.39	58.1	14.68	98
No Provenience	2013.004.0024	Shaped Fishing Ring Stone	85.79	57.74	12.97	119
No Provenience	2013.004.0025	Shaped Fishing Ring Stone	68.77	68.33	15.87	131

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
No Provenience	2013.004.0026	Shaped Fishing Ring Stone	107.14	74.25	24.57	320
No Provenience	2013.004.0027	Shaped Fishing Ring Stone	85.26	75.53	13.84	159
No Provenience	2013.004.0028	Shaped Fishing Ring Stone	96.95	78.28	17.33	217
No Provenience	2013.004.0029	Shaped Fishing Ring Stone	92.49	77.6	18.56	217
No Provenience	2013.004.0030	Shaped Fishing Ring Stone	69.69	51.64	14.23	84
No Provenience	2013.004.0031	Shaped Fishing Ring Stone	75.17	61.27	17.88	129
No Provenience	2013.004.0032	Shaped Fishing Ring Stone	72.51	57.54	11.71	85
No Provenience	2013.004.0033	Shaped Fishing Ring Stone	73.42	60.77	12.9	114
No Provenience	2013.004.0034	Shaped Fishing Ring Stone	69.48	58.41	10.81	93
No Provenience	2013.004.0035	Shaped Fishing Ring Stone	78.94	64.69	16.89	152
No Provenience	2013.004.0036	Shaped Fishing Ring Stone	82.07	51.96	19.56	135
No Provenience	2013.004.0037	Shaped Fishing Ring Stone	83.92	77.05	16.72	178
No Provenience	2013.004.0038	Shaped Fishing Ring Stone	73.58	33.89	14.16	61
No Provenience	2013.004.0039	Shaped Fishing Ring Stone	94.97	77.05	16.89	216
No Provenience	2013.004.0040	Shaped Fishing Ring Stone	96.04	61.05	14.9	166
No Provenience	2013.004.0041	Shaped Fishing Ring Stone	83	58.63	18.27	157
No Provenience	2013.004.0042	Shaped Fishing Ring Stone	83.7	67.49	19.89	205
No Provenience	2013.004.0043	Shaped Fishing Ring Stone	86.94	68.29	16.55	198
No Provenience	2013.004.0044	Shaped Fishing Ring Stone	99.04	57.67	14.15	135
No Provenience	2013.004.0045	Shaped Fishing Ring Stone	114.52	59.03	29.86	316
No Provenience	2013.004.0046	Shaped Fishing Ring Stone	88.62	62.11	13.43	131
No Provenience	2013.004.0047	Shaped Fishing Ring Stone	136.53	88.01	31.71	509
No Provenience	2013.004.0048	Shaped Fishing Ring Stone	85.43	72.04	19.71	230
No Provenience	2013.004.0049	Shaped Fishing Ring Stone	89.05	59.89	19.53	185
No Provenience	2013.004.0050	Shaped Fishing Ring Stone	75.06	56.33	12.61	94
No Provenience	2013.004.0051	Shaped Fishing Ring Stone	86.64	61.68	18.97	181

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
No Provenience	2013.004.0052	Shaped Fishing Ring Stone	82.93	61.22	25.1	217
No Provenience	2013.004.0053	Shaped Fishing Ring Stone	81.68	61.36	23.92	217
No Provenience	2013.004.0054	Shaped Fishing Ring Stone	86.97	54.55	29.82	209
No Provenience	2013.004.0055	Shaped Fishing Ring Stone	127.66	96.66	27.3	608
No Provenience	2013.004.0056	Shaped Fishing Ring Stone	89.39	70.04	15.68	183
No Provenience	2013.004.0057	Shaped Fishing Ring Stone	87.87	53.63	17.66	153
No Provenience	2013.004.0058	Shaped Fishing Ring Stone	100.77	67.55	28.81	293
No Provenience	2013.004.0059	Shaped Fishing Ring Stone	87.83	69.25	22.99	229
No Provenience	2013.004.0060	Shaped Fishing Ring Stone	91.7	52.39	19.62	186
No Provenience	2013.004.0061	Shaped Fishing Ring Stone	98.98	66.6	15.66	173
No Provenience	2013.004.0062	Shaped Fishing Ring Stone	88.67	62.5	16.7	158
No Provenience	2013.004.0063	Shaped Fishing Ring Stone	102.21	49.38	21.89	181
No Provenience	2013.004.0064	Shaped Fishing Ring Stone	98.43	56.54	29.23	258
No Provenience	2013.004.0065	Shaped Fishing Ring Stone	68.54	57.51	13.16	93
No Provenience	2013.004.0066	Shaped Fishing Ring Stone	88.7	66.69	14.11	143
No Provenience	2013.004.0067	Shaped Fishing Ring Stone	67.74	67.14	14.61	119
No Provenience	2013.004.0068	Shaped Fishing Ring Stone	74.2	62.41	15.03	129
No Provenience	2013.004.0069	Shaped Fishing Ring Stone	71.35	59.17	13.13	103
No Provenience	2013.004.0070	Shaped Fishing Ring Stone	107.26	56.83	17.27	182
No Provenience	2013.004.0071	Shaped Fishing Ring Stone	94.08	52.53	21.05	177
No Provenience	2013.004.0072	Shaped Fishing Ring Stone	107.29	64.71	15.07	208
No Provenience	2013.004.0073	Shaped Fishing Ring Stone	86.64	61.04	17.82	164
No Provenience	2013.004.0074	Shaped Fishing Ring Stone	84.99	61.31	18.91	160
No Provenience	2013.004.0075	Shaped Fishing Ring Stone	89.87	55.67	23.27	208
No Provenience	2013.004.0076	Shaped Fishing Ring Stone	68.74	64.11	13.14	111
No Provenience	2013.004.0077	Shaped Fishing Ring Stone	91.7	52.84	18.92	167

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
No Provenience	2013.004.0078	Shaped Fishing Ring Stone	73.29	56.9	12.02	97
No Provenience	2013.004.0079	Shaped Fishing Ring Stone	63.7	51.01	13.6	83
No Provenience	2013.004.0080	Shaped Fishing Ring Stone	78.61	62.01	11.46	106
No Provenience	2013.004.0081	Shaped Fishing Ring Stone	66.17	62.34	16.13	116
No Provenience	2013.004.0082	Shaped Fishing Ring Stone	101.26	47.78	23.06	199
No Provenience	2013.004.0083	Shaped Fishing Ring Stone	99.4	65.3	11.62	138
No Provenience	2013.004.0084	Shaped Fishing Ring Stone	65.19	56.86	11.22	81
No Provenience	2013.004.0085	Shaped Fishing Ring Stone	79.37	52.6	12.7	105
No Provenience	2013.004.0086	Shaped Fishing Ring Stone	92.86	85.65	21.02	194
No Provenience	2013.004.0087	Shaped Fishing Ring Stone	103.43	81.25	20.77	283
No Provenience	2013.004.0088	Shaped Fishing Ring Stone	101.08	91.07	21.59	333
No Provenience	2013.004.0089	Shaped Fishing Ring Stone	97.75	91.94	17.07	268
No Provenience	2013.004.0090	Shaped Fishing Ring Stone	123.15	49.47	21.16	211
No Provenience	2013.004.0091	Shaped Fishing Ring Stone	111.13	73.79	23.76	344
No Provenience	2013.004.0092	Shaped Fishing Ring Stone	115.96	50.32	19.14	174
No Provenience	2013.004.0093	Shaped Fishing Ring Stone	93.92	65.56	19.23	207
No Provenience	2013.004.0094	Shaped Fishing Ring Stone	99	50.65	21.4	175
No Provenience	2013.004.0095	Shaped Fishing Ring Stone	61.99	51.3	14.42	78
No Provenience	2013.004.0096	Shaped Fishing Ring Stone	106.86	62.37	26.8	259
No Provenience	2013.004.0097	Shaped Fishing Ring Stone	105.21	50.21	22.08	186
No Provenience	2013.004.0098	Shaped Fishing Ring Stone	83.1	51.29	22.63	177
No Provenience	2013.004.0099	Shaped Fishing Ring Stone	85.28	59.93	10.99	116
No Provenience	2013.004.0100	Shaped Fishing Ring Stone	89.57	64.77	16.39	168
No Provenience	2013.004.0101	Shaped Fishing Ring Stone	98.16	73.62	14.35	194
No Provenience	2013.004.0102	Shaped Fishing Ring Stone	86.75	53.8	19.28	157
No Provenience	2013.004.0103	Shaped Fishing Ring Stone	70.28	58.29	18.02	144

Site Number	Artifact Identification	Net Sinker Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
No Provenience	2013.004.0104	Shaped Fishing Ring Stone	90.33	56.77	21.21	196
No Provenience	2013.004.0105	Shaped Fishing Ring Stone	72.3	67.49	13.84	109
No Provenience	2013.004.0106	Shaped Fishing Ring Stone	76.35	52.94	16.03	110
No Provenience	2013.004.0107	Shaped Fishing Ring Stone	74.7	59.37	14.68	119
No Provenience	2013.004.0108	Shaped Fishing Ring Stone	116	56.62	22.48	213

Appendix C: Approved Nez Perce Research Permit

RESEARCH PERMIT SIGN-OFF SHEET

Name of Research Project: A Study of Notched Net Sinkers in the Columbia Plateau

Project Representative: Cynthia Hannold

Project Representative Address & Phone No.: 301 Sweet Avenue Apt. #1, Moscow ID
(208) 961-1979

Project Funder: Unfunded

The attached research application has been reviewed by the individuals below with recommendations as follows:

1. Program Director Signature:
   Program: CULTURAL RESOURCE PROGRAM Date: 2/4/19
   Recommendation RECOMMEND FOR APPROVAL

2. Branch Director Signature:
   Department: DNR Admin Date: 2/4/19
   Recommendation: recommend for approval

3. Executive Director Signature:
   Date: 2-14-19
   Recommendation: Approved

4. Office of Legal Counsel Signature:
   Rcvd by OLC: 2-14-19
   Date: 3/13/19
   Recommendation:

NPTEC presentation by: (Department Manager or Executive Director):

Nez Perce Tribal Executive Committee Authorization:

Date: 4-15-19

Research Regulation Ordinance Process

To obtain a written permit

1. Applicant must complete and present to the appropriate Program Director or Department Manager, the attached forms at least ninety (90) days prior to proposed study, survey, or research project start date.

2. Applicant must read and obtain a working understanding of the Research Regulation Ordinance and its contents.

3. Applicant must prepare multiple copies of a brief and concise written prospectus (one page) of project, or a verbal presentation to the appropriate Tribal Council Sub-Committee. The project representative will be placed on the agenda through the appropriate Department Manager or Program Director.

4. **Only** written permits will be official and must include the authorizing signature and tribal resolution number.

5. The Nez Perce Tribal Executive Committee sign off will be the final approval/ disapproval for the request. A $75.00 permit fee will be paid upon final approval of the request.

Any person attempting to conduct research not specifically requested or contracted by the Nez Perce Tribal Executive Committee or permitted pursuant to provisions of the ordinance shall be subject to any and all civil or criminal remedies available pursuant to the Law and Order Code of the Nez Perce Tribe, including but not limited to: exclusion from tribal property, criminal trespass, and civil remedies provided for in the Nez Perce Tribal Law and Order Code.

Research Permit
Nez Perce Tribe

1. Name of Applicant: Cynthia Hannold

2. Address: 301 Sweet Avenue Apt. #1, Moscow ID 83843
Phone Number: (208)961-1979
E-mail: Channold@uidaho.edu
Type of Application: _X_ Individual ___ Agency ___ Other
Corporation ___ Institution ___

3. Purpose of study, survey, or research (*Be concise*): The archaeology of the southern Columbia Plateau is characterized by an abundance of stone tools including net sinkers, which were used along the Clearwater, Salmon, and Snake River regions. The purpose of this study is to determine the raw materials, dimensions, and methods for the manufacture of notched net sinkers in this area. This non-destructive study will examine existing assemblages. There will be no ground disturbance, excavation, or surface collection.

   Is this project conducted for profit? No, this project is not being conducted for profit.

   If this project is not for profit now, could this information be used in a profit seeking venture in the future? No, there will not be any profit involved with this project, now or in the future.

4. Will an honoraria be offered to tribal people interviewed? No interviews are anticipated for this thesis project. If any tribal people are interviewed during my research, I would gladly offer an honoraria.

5. Sources of funding to conduct study, survey or research: Any costs that have surfaced for my thesis project have been paid out-of-pocket.

6. Project or actual cost of project: $0

7. Name and Addresses of all persons authorized to be involved and/or participate in conducting the project: (*Include those that will not be present on site*).
   a) Cynthia Hannold, 301 Sweet Avenue Apt #1, Moscow, ID 83843

   b) Dr. Robert Lee Sappington, Thesis Advisor, Department of Sociology and Anthropology, University of Idaho, PO Box 1110, Moscow, ID 83844

8. Proposed dates of study: From: 03/15/2019 To: 09/15/2019

9. Location of project and sources to be researched: Bowers Laboratory of Anthropology at the University of Idaho; the Museum of Anthropology at Washington State University; Nez Perce National Historical Park.

   Sources to be researched: Net sinkers currently housed at the Bowers Laboratory of Anthropology at the University of Idaho, the Nez Perce National Historical Park, and the Museum of Anthropology at Washington State University. Specific sites include: 10CW1; 10CW4; 10CW5; 10CW19; 10CW20; 10CW25; 10CW30; 10CW38; 10CW41; 10CW226; 10CW586; 10CW587; 10NP102; 10NP105; 10NP128; 10NP151; 10NP279; 10NP292; 10IH395; 10IH1009; 10IH1732; 10IH1948; 10IH820; 10KA45.

10. Methodology for conducting this project (*be concise*): Net sinkers are tools used to keep fishing nets vertical in the water while net fishing. Stone net sinkers have been used in the southern Columbia Plateau for thousands of years (Landeen and Pinkham 1999; Johnston 1987; Sappington 1997). Notched net sinker manufacture leaves negative flake scars that can be used to determine which methods were used during manufacture. This will be a non-destructive visual analysis of notched net sinkers from the southern Columbia Plateau to determine raw material type, dimensions, and methods for manufacture. There would be no ground disturbance, excavation, or surface collection during this research and the study will be limited to the net sinkers in existing archaeological assemblages.

11. Describe the intended final product of this project: The final product of this project will be a Master's Thesis about notched net sinkers in the Columbia Plateau.

   Is publication intended? Yes. It is my intention to publish both a Master's Thesis and an article in the *Journal of Northwest Anthropology*.

12. How will the results of the project be used? The results of this project will be used to determine net sinker manufacturing methods and preferred tool stone in the southern Columbia Plateau.

13. How will this project benefit the Tribe? The Nez Perce Tribal People have fished regional river systems for thousands of years (Colombi 2005; Johnston 1987; Sappington 1997). Traditional fishing methods included net fishing, which required the use of stone net sinkers (Landeen and Pinkham 1999). The information published in this thesis will be of use to the Nez Perce Tribe in their future dealings with State and Federal agencies as they navigate negotiations pertaining to the regional water sources and treaty rights. I will send a copy of this study to the Nez Perce Tribe Cultural Resource Program once finished. Additionally, I would be happy to pay any tribal members for their time and knowledge if interviews are conducted.

References Cited:

Colombi, Benedict J.
2005 Dammed in Region Six: The Nez Perce Tribe, agricultural development, and the inequality of scale. *The American Indian Quarterly*, 29(3 4), 560-589.

Landeen, Dan and Allen Pinkham
1999 *Salmon and his people: Fish & fishing in Nez Perce culture* (1st ed., Nez Perce Nature guide). Lewiston, Idaho: Confluence Press.

Johnston, Robbin
1987 *Archaeological evidence of fishing in the southern plateau, a cultural area of the Columbia Plateau.* Master's thesis, Department of Sociology and Anthropology, University of Idaho, Moscow.

Sappington, Robert Lee
1997 Prehistoric Fish Procurement in the Clearwater River Region, North Central Idaho. *Idaho Archaeologist* 20:1 3-14

14. Proposed tribal program(s) and/or employee(s), member(s) identified to assist/ supervise in project: N/A, unless the Nez Perce Tribal Executive Committee suggests otherwise.

15. **Assurances**: I give my assurance that the rights of individual tribal members, their families, and the Nez Perce Tribe will be protected throughout the duration of this project. I understand that I am subject to the Law and Order Codes of the Nez Perce Tribe as it pertains to the research. I further understand that the Nez Perce Tribe has a drug free policy and will adhere to the policy as it pertains to the participants, researchers and others involved in this project. I will employ or utilize local resources, with tribal members given first preference, in the project study, survey, and research. I have read and understand the Nez Perce Tribe's Research Regulation Ordinance and agree to adhere to its contents. I further attest that the information provided on the application for research permit is true and correct, and I understand that false information may result in denial or cancellation of a research permit.

Signature ________________
Date January 11, 2019
Title Graduate Student
Organization University of Idaho

RESEARCH REGULATION ORDINANCE

Section 1: Authority

This regulatory ordinance is established by the Nez Perce Executive Committee under authority contained in the Constitution and by-Laws of the Nez Perce Tribe, including the amendments therein.

Section 2: Purpose

The purpose of this ordinance is to regulate studies, surveys, research and service delivery projects on the Nez Perce Tribe in order to preserve and protect the rights of the Nez Perce Tribe and their tribal members, their privacy, integrity and their interests in the results and products of such studies, surveys, research and service delivery projects.

Section 3: Permit Required

Any individual, corporation, agency or institution, whether public or private, wishing to undertake a study, survey, or research project for any purpose, on the Nez Perce Tribe, must obtain a permit approved through The Research Regulation Ordinance process as stated herein. This does not apply to those entities specifically requested or contracted for and by the Nez Perce Tribe.

Section 4: Written agreement required for issuance of permit

No permit will be issued for any study, survey, or research project, without a written agreement with the Nez Perce Tribe. (Verbal agreement are not authorized agreements). The agreement shall contain assurance of protection of individual as well as tribal rights, methodology of the research, timeliness, study results, review opportunity prior to publication, final authorization and parameters for publication, and if product is published for profit, the percent of royalty due to the Nez Perce Tribe. A $75.00 permit fee will be assessed and payable upon final approval of the permit.

Section 5: Information required for issuance of permit

No permit shall be issued to conduct any study, survey or research project until the following information has been provided to and approved by the Nez Perce tribal executive Committee:

1. Name and signature of individual applicant or authorized agent of any corporation, agency or institution designing to conduct or participate in the

conduct of the study, survey or research project.

2. Purpose of the study, survey, or research, including whether it is being conducted for profit.

3. Source of funding and amount of funding of the study, survey or research project.

4. Methodology to be used in conducting the project.

5. Names and qualifications of all persons authorized to be involved and/or participate in the conduct of the project, whether or not those persons will actually be present on the Nez Perce Reservation during the term of the project.

6. Dates between which the study, survey, or research project will be conducted on the Nez Perce Tribe and indication of the location of sources of information to be investigated during the term of the project.

7. A description of the intended final product of the study, survey or research project, whether or not publication is intended.

8. How the individual, agency, or institution conducting the study, survey, or research project intends to use the results thereof.

9. An indication of steps to be taken to insure the protection of the rights of individual tribal members and their families and the rights of the Nez Perce Tribe.

10. A performance bond in circumstances deemed appropriate by the Nez Perce Tribe.

Section 6: <u>Cancellation of Permit</u>

The permit issued pursuant to this ordinance is conditional and may be canceled at any time if it appears that the individual, corporation, agency or institution conducting the study, survey or research project has deviated from the study design approved in the granting of the permit or from provisions of the required underlying agreement upon which issuance of the permit is based.

Evaluation Form
Nez Perce Tribe

1. What were the problems encountered in completing the project?

____
____
____
____

2. How many release forms were signed by Nez Perce Tribal members interviewed for this project?

____

3. How much was paid to each of the tribal members?

____
____
____
____

4. Date project completed:______________________________
____

______________________ ______________________
Signature Date

____
Title

____
Organization

______________________ ______________________
NPTEC Chairman Date

______________________ ______________________
NPTEC Secretary Date

A PROPOSED STUDY OF NOTCHED NET SINKERS IN THE COLUMBIA PLATEAU

by

Cynthia R. Hannold, Department of Sociology/Anthropology, University of Idaho, Moscow

11 January 2019

The ancestors of the Nez Perce people (the *Nimiipuu*) have lived in the Columbia Plateau for thousands of years and during that time fishing has been an important part of traditional subsistence. While fish bones do not preserve, evidence of traditional fishing methods can be determined from the archaeological record. Many methods have been used to procure anadromous and non-migratory fish including spear fishing, line fishing, weir fishing, and net fishing. Seine and gill net fishing require the use of stone net sinkers, river cobbles and pebbles that were modified and used in conjunction with floats, to keep a net vertical in the water. Since organic materials like fishing nets do not survive, stone sinkers are often the only surviving evidence of early Nez Perce fishing practices.

Notched, perforated, and grooved stone sinker manufacture spans more than 6,000 years in the lower Snake River and Clearwater River regions. Notched net sinkers are the most common and they have been recovered at dozens of sites since the 1960s. These artifacts are being curated at regional repositories including the University of Idaho, Washington State University, Nez Perce National Historical Park, and elsewhere. The manufacture of notched net sinkers leaves distinctive negative flake scars that can be used to determine which methods were employed. The author proposes to conduct a non-destructive study of net sinkers in existing archaeological collections as part of her master's thesis. This study would also be useful in determining preferences for tool stone type and size during net sinker manufacture. No ground disturbance, excavation, or surface collection would be conducted.

This thesis will expand our limited understanding of net sinker manufacture in the southern Columbia Plateau. I will describe and explore the distribution of net sinker types (notched, perforated, and grooved) across the Columbia Plateau, and analyze variables that might explain why the Native residents of this region would choose to make one type of net sinker rather than another. This examination will include a survey of relevant literature, an experimental process, and a study of artifacts systematically excavated from key sites in the Columbia Plateau. The completed study will help archaeologists, federal and state agencies, Nez Perce Tribal members, and others to understand the development of diverse fishing methods over the past 6000 years. This thesis will acknowledge the support of the Nez Perce Tribe.

7. Research Permit Authorize the research permit for Cynthia Hannold; A study of Notched Net Sinkers in the Columbia Plateau to research net sinkers to determine the raw materials, dimensions, methods for manufacturing.

8. Indian Health Service Scattered Sites Liaison Designate the Snake River Basin Adjudication Project Coordinator as the liaison between the Nez Perce Tribe and Indian Health Service to fulfill duties and responsibilities for individual water & sewer projects within the exterior boundaries of the Nez Perce Indian Reservation.

9. Utilities Coordinator Designate the Utilities Coordinator as a liaison between the Nez Perce Tribe and Indian Health Service to fulfill duties and responsibilities for community water & sewer projects within the exterior boundaries of the Nez Perce Indian Reservation.

BUDGET & FINANCE SUBCOMMITTEE-APRIL 3, 2019

10. Lease to Purchase Authorize approval to purchase two (2) additional police vehicles from the Enterprise Fleet Program for the Nez Perce Tribal Police Department.

11. BPA South Fork Salmon River Big Creek Watershed Restoration Authorize the Nez Perce Tribe to financially cover the Tribe's expenses for operating one Bonneville Power Administration contract, South Fork Salmon River Big Creek Watershed Restoration #2007-127-00 until the contract is received and approved by the Natural Resources Subcommittee and the Nez Perce Tribal Executive Committee.

12. February 2019 NPTEC Treasurer's Report Accept the NPTEC Treasurer's Report for the period ending February 28, 2019.

13. NPTHA Annual Home Fair Authorize two (2) hours of Administrative Leave to attend the Nez Perce Tribal Housing Authority 19th Annual Home Fair on June 6, 2019, with supervisor's approval.

14. Elder's Day Administrative Leave Authorize administrative leave on June 7, 2019, for elders, age 55 and older, and volunteers, with supervisor's approval, to attend the Nez Perce Tribe Elder's Day activities.

15. Reconnect Grant Application Authorize the Department of Technology to pursue the U.S. Department of Agriculture, Reconnect Grant Program for $25,000,000.00 with a 25% match requirement.

Appendix D: Selected Readings

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1976 Early Holocene Evidence for the Aleut Maritime Adaptation. *Arctic Anthropology* 13(2):32-45.

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2010 *Ancient nets and fishing gear: Proceedings of the International Workshop on "Nets and Fishing Gear in Classical Antiquity: A First Approach",* Cádiz, November 15-17, 2007. Cádiz : Aarhus, Denmark: Servicio de Publicaciones de la Universidad de Cádiz. Aarhus University Press, Aarhus.

Bernier, Helene
2010 Craft specialists at Moche: Organization, affiliations, and identities. *Latin American Antiquity,* 21(1):22-43.

Binford, Lewis R.
1964 A Consideration of Archaeological Research Design. *American Antiquity* 29(4): 425-441.
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1977 *For Theory Building in Archaeology: Essays on Faunal Remains, Aquatic Resources, Spatial Analysis, and Systemic Modeling. Studies in Archaeology*. Academic Press, New York.

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1972 *An Archaeological Perspective. Studies in Archaeology*. Seminar Press, New York.

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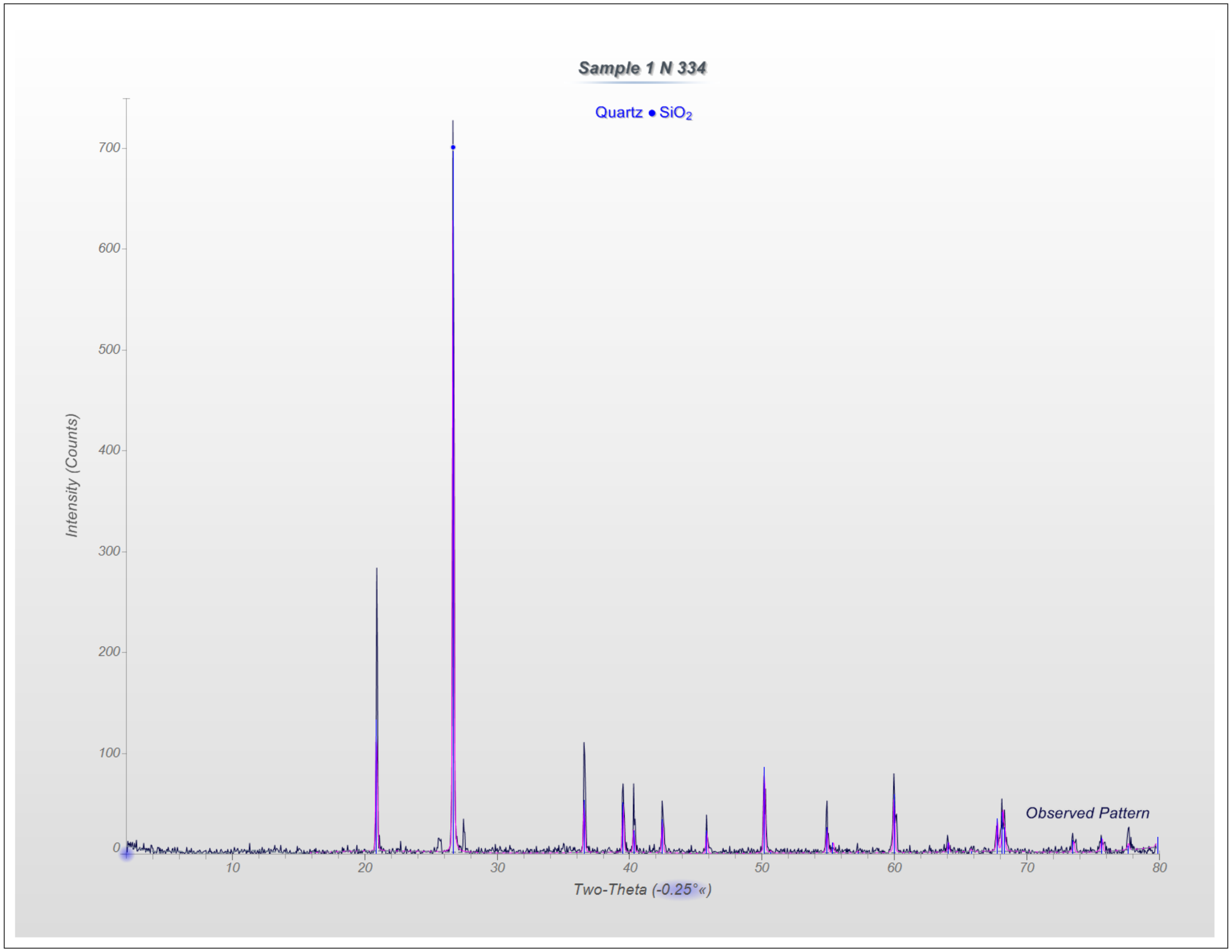
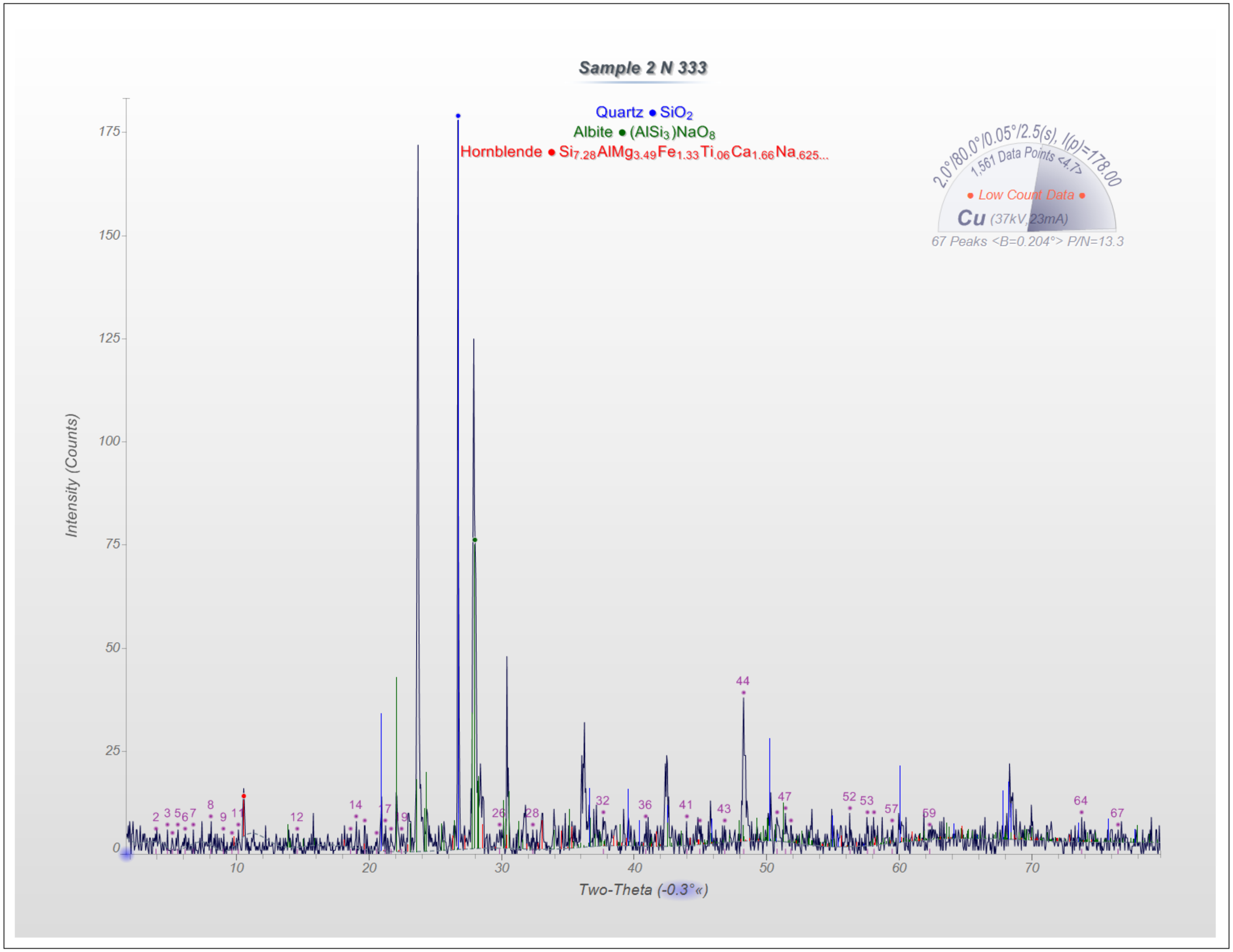
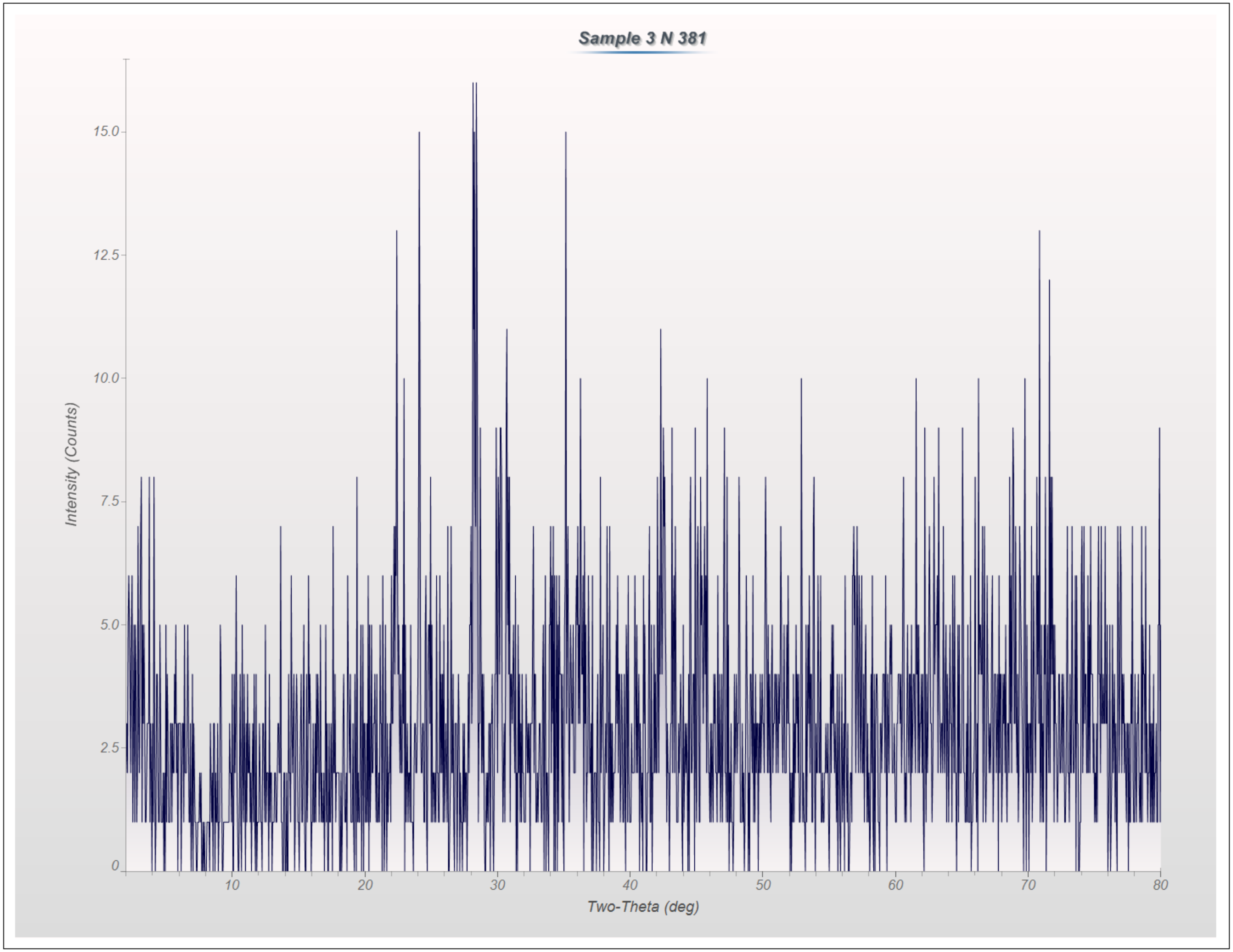
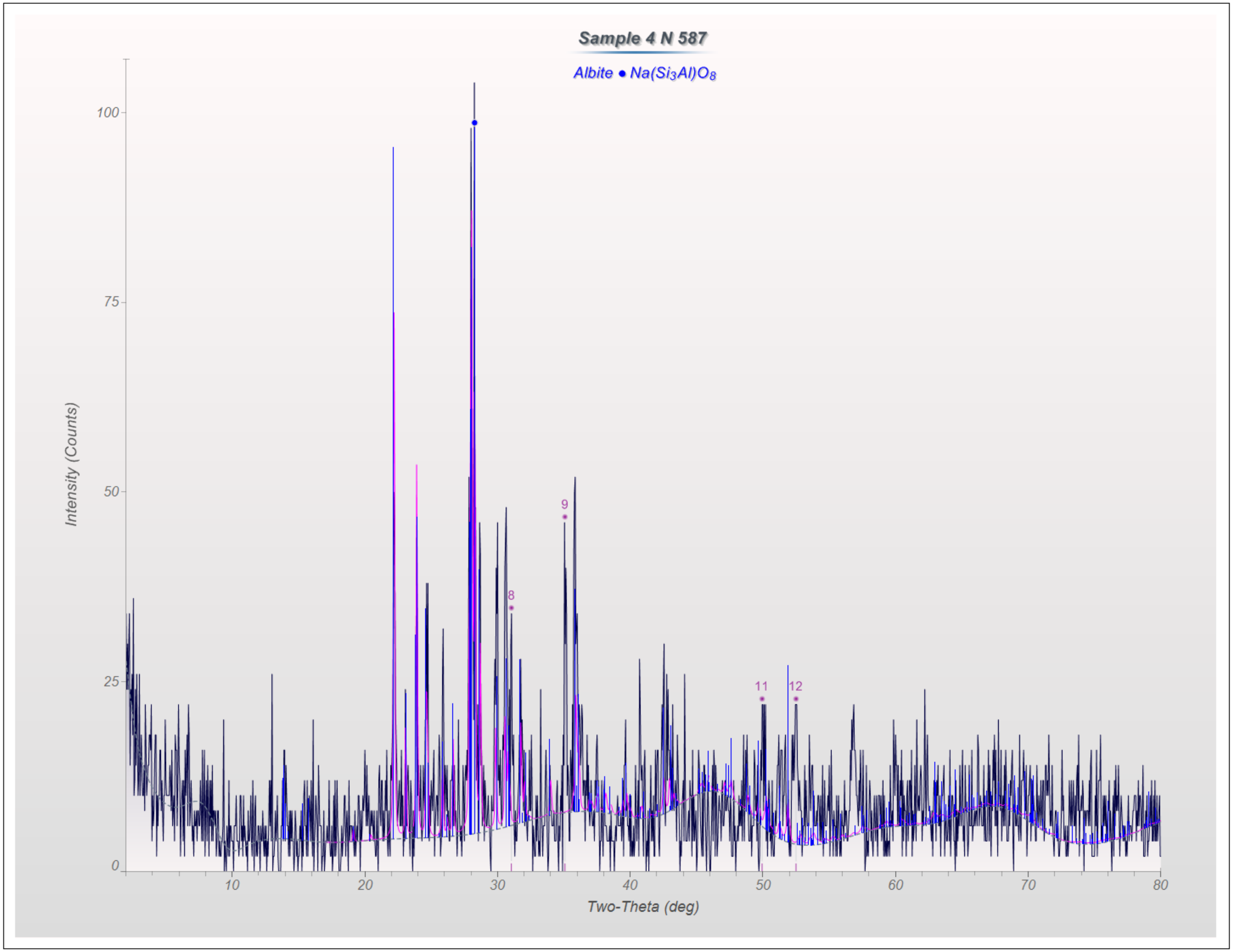
Appendix E: X-Ray Diffraction (XRD) Scans for Debitage Samples 1 – 10

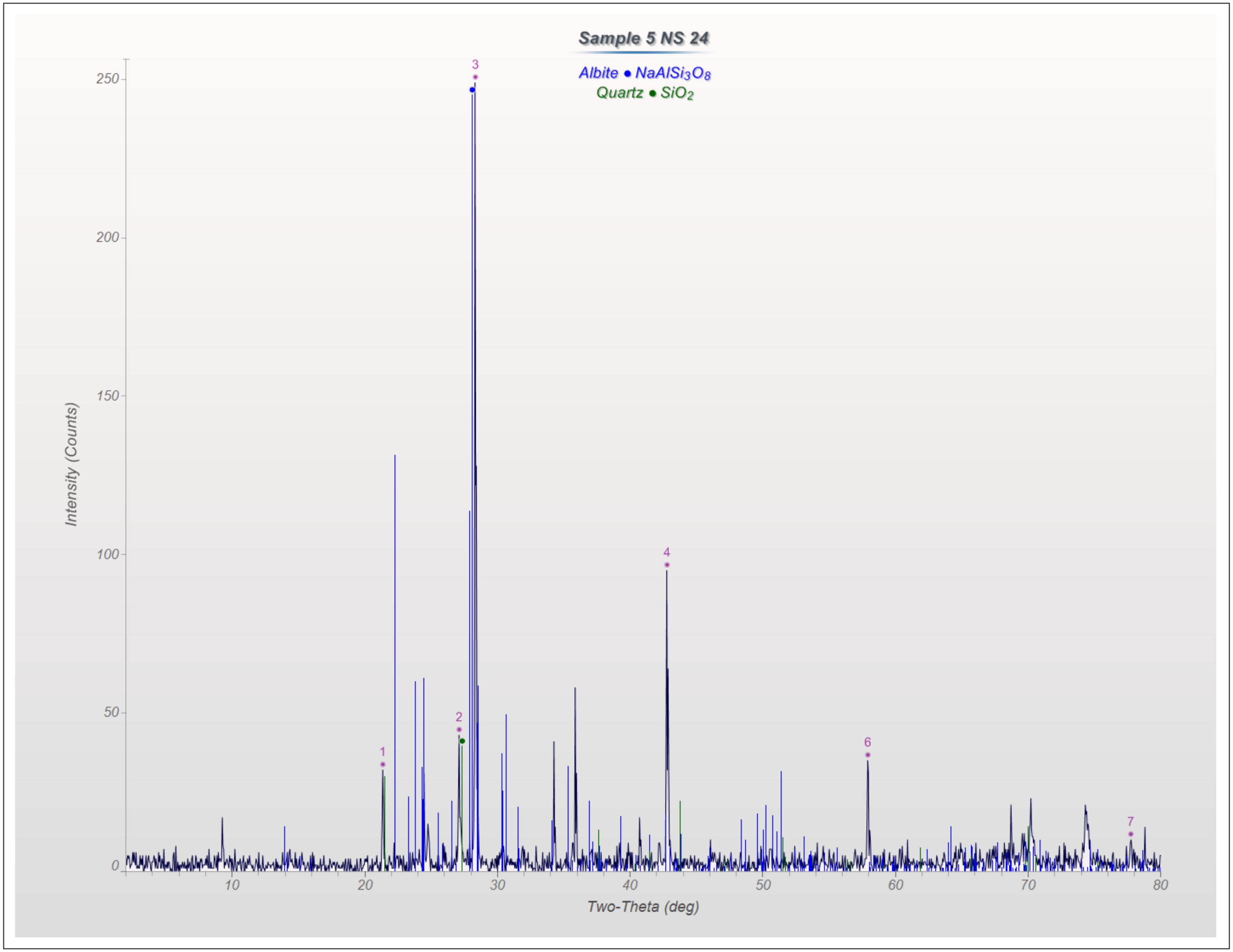


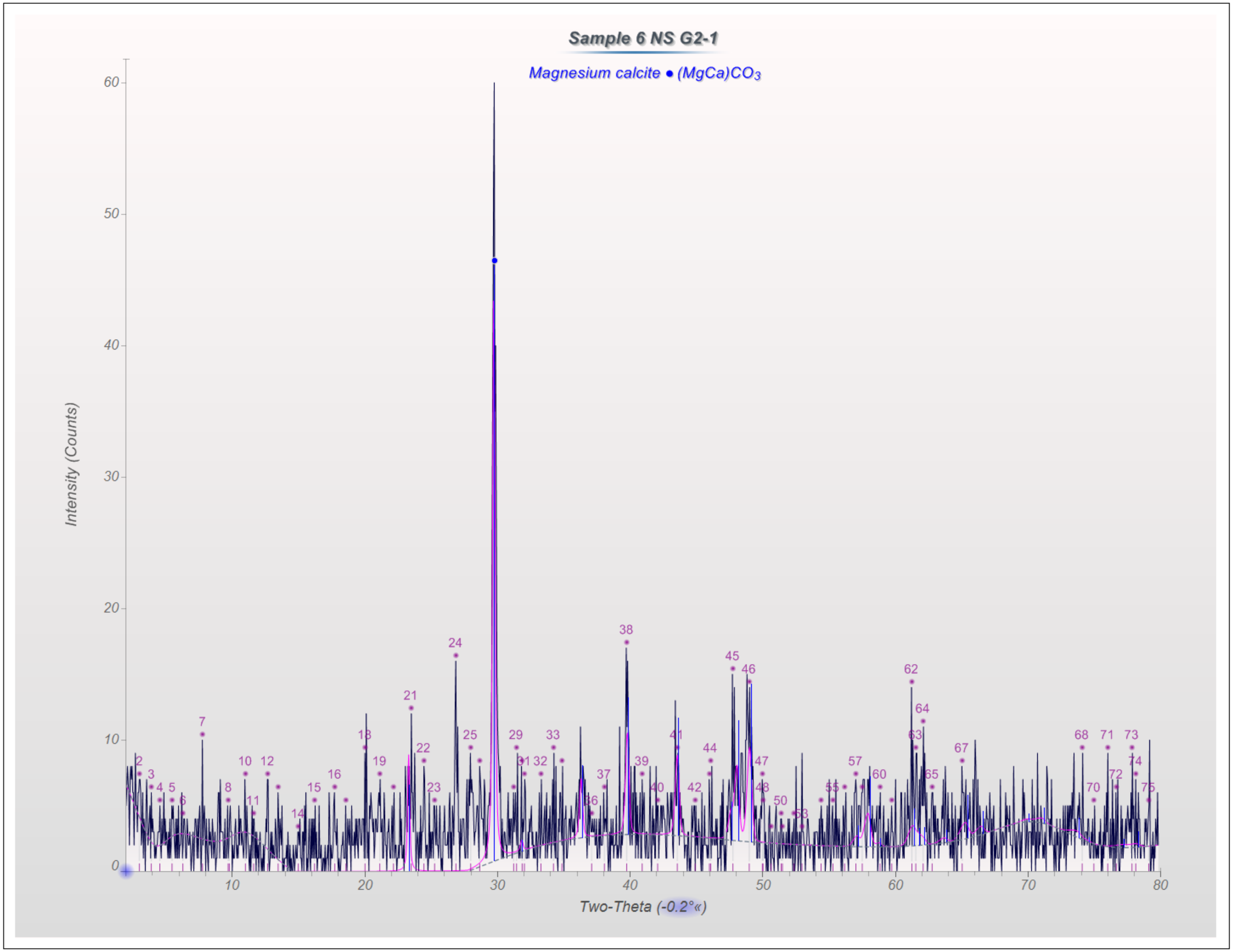

Sample 2 N 333
Quartz • SiO2
Albite • (AlSi3)NaO8
Hornblende • Si7.28AlMg3.49Fe1.33Ti.06Ca1.66Na.625...
2.0°/80.0°/0.05°/2.5(s), I(p)=178.00
1,561 Data Points <4.7>
• Low Count Data •
Cu (37kV,23mA)
67 Peaks <B=0.204°> P/N=13.3
Intensity (Counts)
Two-Theta (-0.3°«)
0
25
50
75
100
125
150
175
10
20
30
40
50
60
70

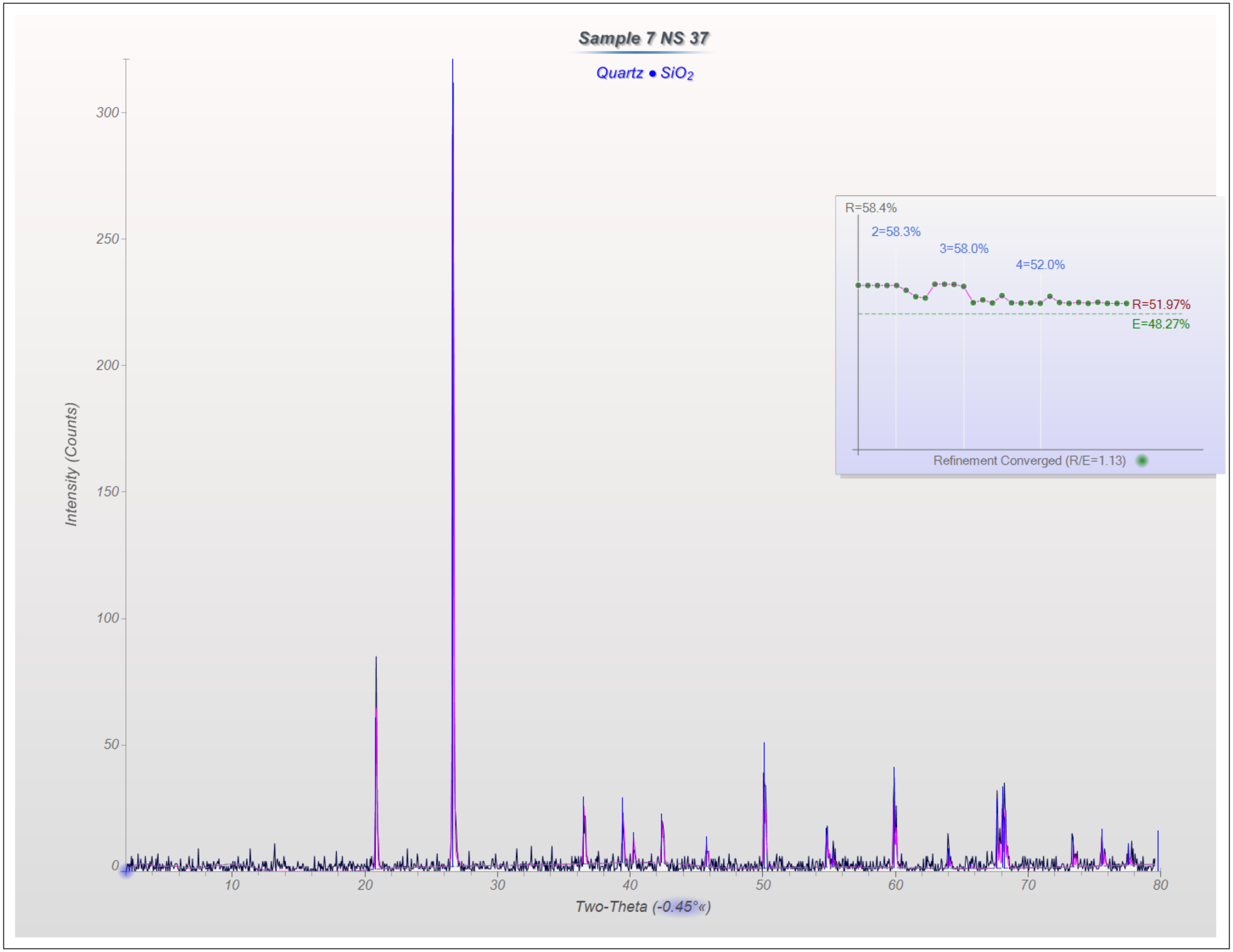

Sample 3 N 381
Intensity (Counts)
Two-Theta (deg)
0
2.5
5.0
7.5
10.0
12.5
15.0
10
20
30
40
50
60
70
80

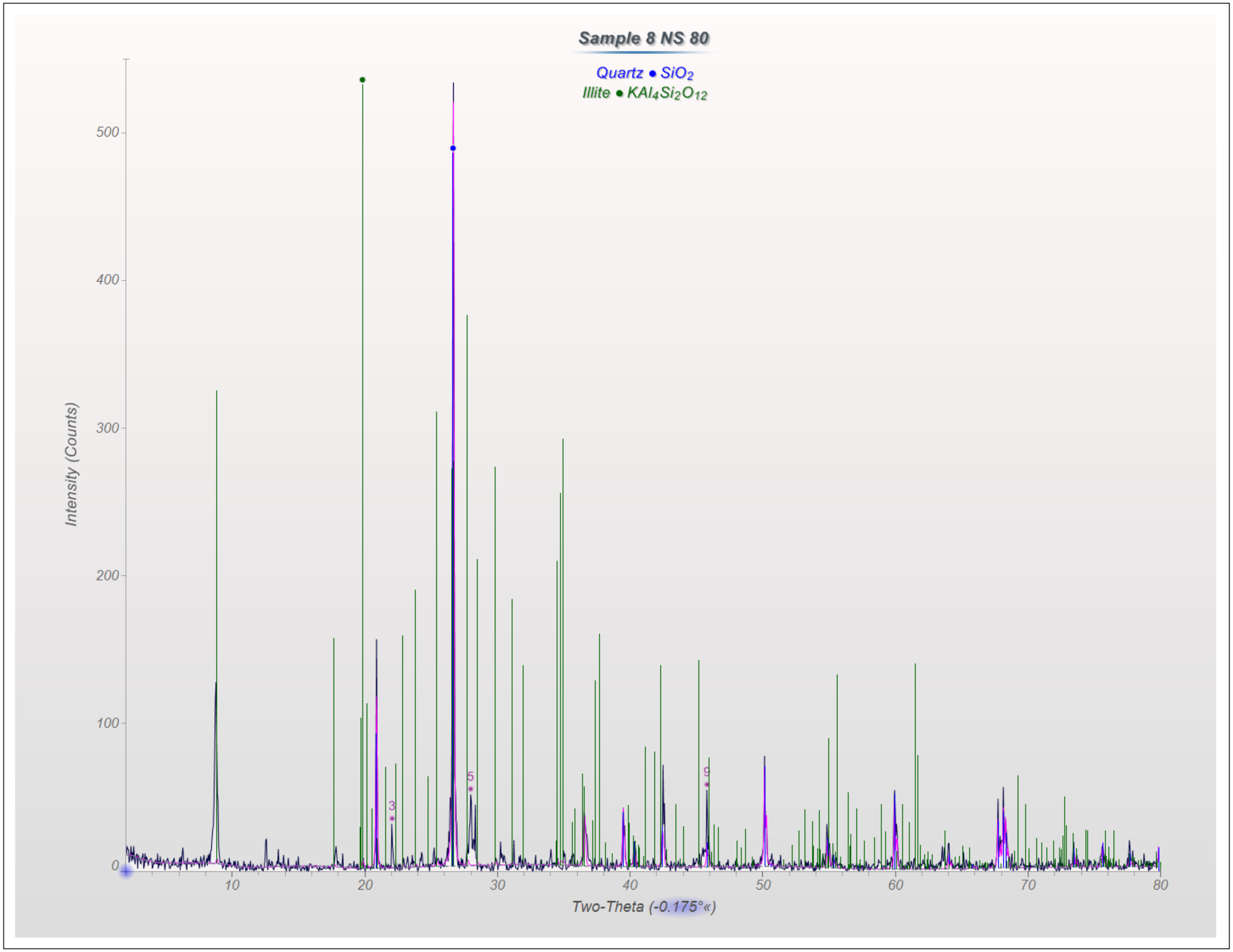


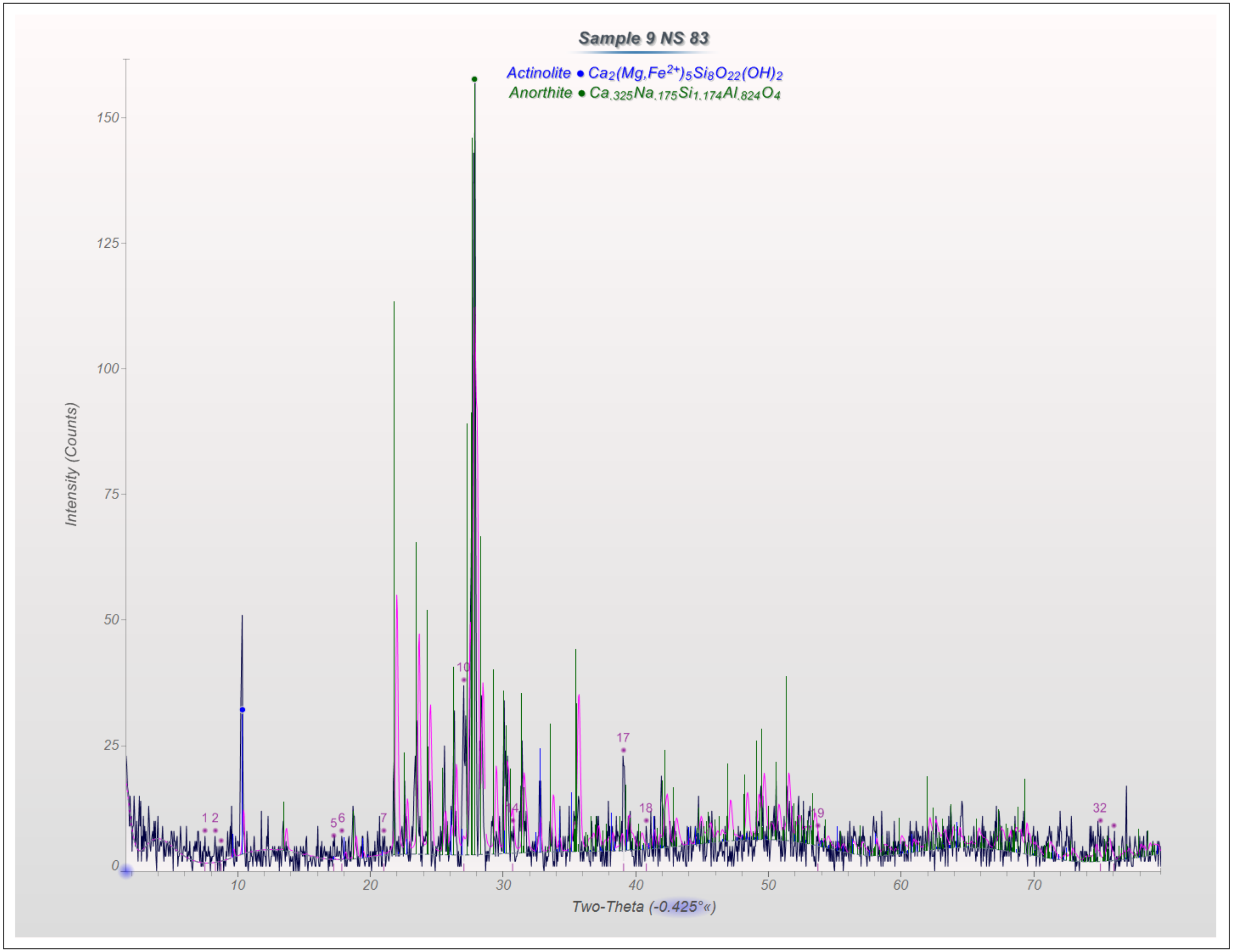
Sample 4 N 587
Albite ● $Na(Si_3Al)O_8$
Intensity (Counts)
100
75
50
25
0
10
20
30
40
50
60
70
80
Two-Theta (deg)
8
9
11
12

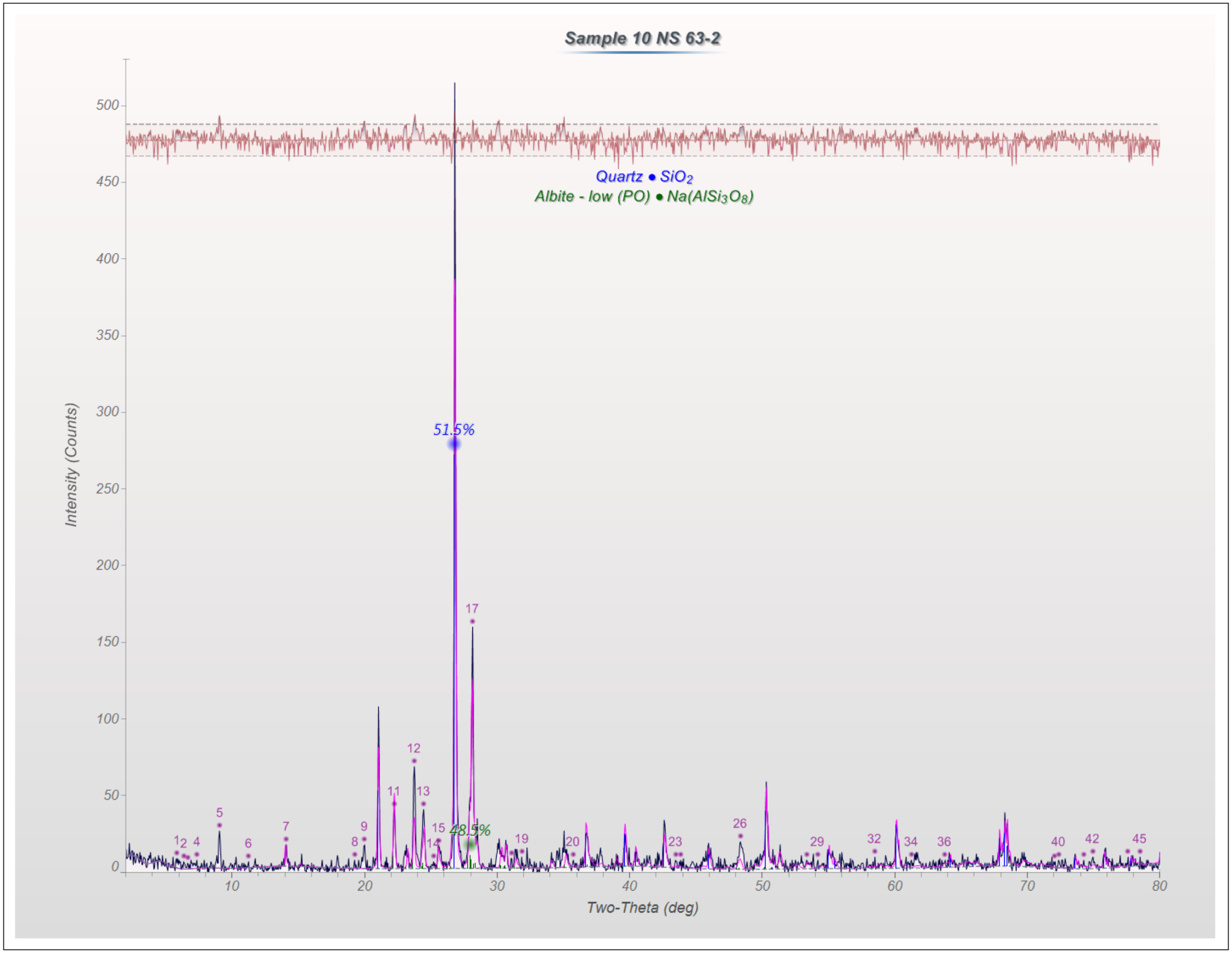

Sample 5 NS 24
Albite ● $NaAlSi_3O_8$
Quartz ● SiO_2
Intensity (Counts)
Two-Theta (deg)
0
50
100
150
200
250
10
20
30
40
50
60
70
80
1
2
3
4
6
7


Sample 6 NS G2-1
Magnesium calcite • (MgCa)CO3
Intensity (Counts)
Two-Theta


Sample 7 NS 37
Quartz • SiO2
Intensity (Counts)
Two-Theta (-0.45°«)
R=58.4%
2=58.3%
3=58.0%
4=52.0%
R=51.97%
E=48.27%
Refinement Converged (R/E=1.13)


Sample 8 NS 80
Quartz ● SiO2
Illite ● KAl4Si2O12
Intensity (Counts)
Two-Theta (-0.175°«)
0
100
200
300
400
500
10
20
30
40
50
60
70
80


Sample 9 NS 83
Actinolite • $Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$
Anorthite • $Ca_{.325}Na_{.175}Si_{1.174}Al_{.824}O_4$
Intensity (Counts)
Two-Theta (-0.425°«)


Sample 10 NS 63-2
Intensity (Counts)
Two-Theta (deg)
Quartz ● SiO_2
Albite - low (PO) ● $Na(AlSi_3O_8)$
51.5%
48.5%