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Meta-analysis in zooarchaeology expands perspectives on Indigenous fisheries of the Northwest Coast of North America

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ABSTRACT

Fisheries are of fundamental importance to Indigenous peoples of the Pacific Northwest of North America today and in the past but few archaeological analyses have documented geographic patterning in fisheries across the entire region. This paper adopts meta-analysis methods and GIS-based spatial visualizations to survey the single largest compilation of fine-screened zooarchaeological fisheries data reported to date, including 513,605 fish remains identified at 222 sites from Oregon to southeast Alaska. These systematically collected zooarchaeological data indicate the most ubiquitous and proportionally abundant fish taxa over the late Holocene and reveal previously undocumented spatial patterning, indicating where certain fish taxa are consistently found in high relative proportions. Rather than seeking to evaluate chronological and/or evolutionary change, this study explores the environmental and cultural basis for assessing variability in Indigenous fisheries over millennial time scales. Specifically, we observe Pacific herring and the Pacific salmons to be the two most ubiquitous and proportionally abundant fish taxa across the Northwest Coast followed by flatfishes, sculpins, rockfishes, greenlings, dogfish, and a host of other poorly known taxa that represent consistent fishing effort. We document geographic patterning in the abundance and ubiquity of a range of fish including greater abundance of salmons in northern portions of the study area and outline trends that could represent biogeographic ranges for northern anchovy, Pacific hake, and pollock, among others. We conclude that examining patterning in the ubiquity and rank-order abundance represented by archaeological fisheries data offers significant potential for linking regionally distinct cultural practices noted in the 18th and 19th centuries to much longer human and ecological histories over the Holocene.

1. Introduction

Fishing is fundamental to the social and economic lives of Indigenous and non-Indigenous peoples on the Northwest Coast of North America. As documented in hundreds of ethnographic and ethnohistorical accounts, fisheries helped sustain communities for millennia and continue to anchor the cultural identities of many Northwest Coast peoples. While fishing has been an economic mainstay since the earliest documented records of animal utilization on the coast dating to the early Holocene, 10,700 years ago (Fedje et al., 2005; Moss and Cannon, 2011a), community-based fisheries have significantly declined in the 20th century due to poor health of fish stocks, consolidation of commercial fisheries, and a myriad of other factors. Zooarchaeological research in the region, traditionally focused on the antiquity of coastal adaptations, is increasingly recognized as providing key information about the former abundance and distribution of fish populations prior to industrial-scale commercial fisheries. In this paper, we examine the archaeology of Indigenous fishing from Oregon to Alaska to explore the cultural and ecological dimensions of ancient fisheries. Rather than a conventional site-based study, our analysis focuses on the most frequently occurring taxa in archaeological sites across the coast (ubiquity) and uses GIS based visualizations to examine spatial patterning and variability between geographically associated sites. We observe that in the past a much wider range of species were utilized as food fish than is the case today and as commonly portrayed in archaeological literature. While there remain considerable gaps in knowledge, an increasingly rich archaeological dataset offers new perspectives on variability and geographic patterning.

1.1. Archaeology of fisheries in the 'Salmon Area'

Anthropologists have classically referred to the Northwest Coast of North America as the "Pacific Salmon Area" (Hewes, 1973; Kroeber,

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1923; Wissler, 1914) in reference to the seven species of anadromous Pacific salmon and trout (*Oncorhynchus* spp.) widely utilized by Indigenous peoples. Salmon[1] have an iconic status as a result of their cultural importance to Indigenous peoples as well as the rapid growth of Pacific salmon fishing and canning industries during the 19th and 20th centuries. Despite significant reductions in many wild populations, salmon remain the most widely recognized and regularly consumed food fish in the region today. Accordingly, archaeologists and anthropologists have long focused on the cultural and economic importance of salmon, and particularly its role in the emergence and development of distinctive Northwest Coast cultures (Cannon, 2001; Moss, 2012a; Moss and Cannon, 2011a). In a key paper published three decades ago, however, Gregory Monks (1987: 119) coined the term "salmonopia" to describe "the inability to see all the food resources because of salmon." Monks argued that archaeologists needed to temper speculation concerning the central importance of salmon and consider how other fish (and other animals) may have contributed to long term economic and cultural practices on the Northwest Coast. Monks emphasized the role of Pacific herring (*Clupea pallasii*) and other researchers have since demonstrated a plethora of fish species utilized (Butler and Campbell, 2004; Croes and Hackenberger, 1988; Moss and Cannon, 2011a). Despite this, salmon continue to play a key role in considerations of Northwest Coast economies (Coupland et al., 2010; Grier et al., 2013; Monks and Orchard, 2011).

A methodological factor that has historically constrained analyses of archaeological fisheries data is the limited use of fine mesh screens (≤3.2–2 mm) which are required for recovery of the overwhelming majority of fish bones (McKechnie, 2005; Moss and Cannon, 2011b: 7–8; Stewart and Wigen, 2003). In the absence of such recovery techniques, larger fish such as the salmons will be over-represented relative to smaller fish. Even though such sampling techniques have long been recognized as critical (Casteel, 1976), they have not been widely used until the last 15 years. Finally, an adequate number of assemblages have been analyzed enabling us to evaluate comparable data at a regional scale.

Previous syntheses of zooarchaeological abundance data have been hindered by differences in quantification and recovery methods, concerns over the reliability of morphological identification, and the adequacy of sample size (Driver, 1993). Those who have attempted to overcome these challenges have done so with a limited number of sampled datasets which seek to comprehensively estimate the numbers of individuals as well as relative meat weight contributions (e.g., Croes and Hackenberger, 1988; Moss, 1989). These concerns, combined with the relative lack of published zooarchaeological datasets for many areas of western North America, have created conditions where analyses of multiple sites are limited in scope and often fraught with perceived methodological limitations. For instance, Diane Hanson (1991) observed that although there were many zooarchaeological datasets in the Salish Sea region of southern British Columbia, very few were sampled adequately or reported consistently and thus very few could be comprehensively compared. More recently, Butler and Campbell (2004) evaluated a large dataset that treated classes of fauna separately (e.g., mammals, fish, birds) further reducing analytical incongruencies between taxonomic classes but included both fine and conventionally screened assemblages. Others have followed a multi-dimensional scaling approach (Orchard and Clark, 2005; Orchard and Clark, 2014) which examined temporal and spatial trends in the proportional abundance of birds, mammals and fish across sites but did not specifically focus on fish.

In this paper, we present and explore a database of fine screened archaeological fisheries data from throughout this large coastal region which demonstrates persistent use of a wide variety of species over the Holocene. This is the largest database of fine screened faunal data compiled from the Northwest Coast to date. By way of comparison, the recent analyses conducted by Orchard and Clark (2014) were restricted to 63 assemblages from 39 'large' shell midden sites while Butler and Campbell's (2004) important study examined 13 Early Holocene assemblages (from both the Northwest Coast and the Columbia Plateau) and 42 later Holocene faunal assemblages from 19 sites.

2. Materials and methods

2.1. Assembling a foundation for Northwest Coast ichthyoarchaeology

To assemble the database of 513,605 NISP from 222 archaeological sites used in this paper, we built upon existing databases that we compiled to analyze herring distribution and abundance (McKechnie et al., 2014; Moss et al., 2011). We compiled data from well-sampled sites with adequately recovered and identified fish bone assemblages located within 500 horizontal meters of the current marine shoreline in southeast Alaska, British Columbia, and Washington. The original herring database and the expanded database used to inform this paper required an extensive literature review of published and grey literature zooarchaeological analyses completed over the past 40 years. These data only include sites subjected to conventional excavation and fine screen recovery and quantification of fish remains. This reflects archaeological effort and necessarily excludes the vast majority of known site locations as well as unrecorded sites that occur both above and below current shorelines. Given the small size of herring, eulachon, and other culturally important forage fish bones (i.e., with vertebral centra 4 mm or less in diameter), we only included sites where the zooarchaeological remains were systematically recovered using a fine-screen mesh (equal to or smaller than 3.2 mm [1/8 in.]). All zooarchaeological remains were identified by established analysts or students working under the analysts' direct supervision using one or more of several comparative osteological collections. This earlier effort resulted in a database of 435,777 NISP from 171 sites (McKechnie et al., 2014). We have since expanded the database using newly available literature and extended the geographic coverage to include Oregon and numerous additional sites elsewhere in the study area. Only sites containing a minimum of 50 fish bone specimens identified to at least family level were included, forcing us to drop 35 site assemblages from consideration. Over 90% of the 222 sites have >100 fish bones. This is a reasonable threshold for assessing the ubiquity and relative abundance of the most common taxa.

To explore patterning in this larger dataset, we employ three measures of taxonomic abundance: ubiquity, rank order, and relative abundance data. We also use GIS visualizations to document geographical patterning for groups of ubiquitous taxa using relative abundance.

2.2. Ubiquity as a measure of regularity

Ubiquity is a measure of abundance based on the presence and absence of certain items in a number of discrete contexts. Calculated as the percentage of contexts in which a certain specimen type is found, ubiquity indicates the 'frequency of occurrence' or how consistently a certain item is encountered in an archaeological deposit. While this measure of abundance is regularly used in paleoethnobotanical research (Lepofsky and Lyons, 2003; Pearsall, 2000), it is infrequently applied in zooarchaeological research (Lyman, 2008; VanDerwarker, 2010). As a measure of consistency of use, ubiquity[2] is well suited to assessing the frequency of occurrence of animal bones in food refuse contexts as this relates to how often animals are consumed and/or discarded. Ubiquity is less subject to variations in the numbers of bones between

[1] In describing our results, for taxa represented by a single species (e.g., herring or dogfish) we treat the noun as singular. For taxa represented by multiple species (e.g., salmons, sculpins, flatfishes) we use the plural forms. When we discuss Northwest Coast literature more generally we refer to "salmon" in the singular form, following more traditional usage.

[2] Sometimes also known as 'percentage presence analysis'.

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