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HERRING USE IN SOUTHERN PUGET SOUND: ANALYSIS OF FISH REMAINS AT 45-KI-437

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ABSTRACT

The Burton Acres site (45-KI-437), a shell midden on Puget Sound, Washington, contains fish remains that complement long-standing notions of the dominant role that salmon (*Oncorhynchus* sp.) played in Northwest Coast cultural evolution. The fish remains from Burton Acres bracket a time period before, during, and after European-Native American contact and demonstrate the utilization of a variety of fish, most notably herring (*Clupea harengus pallasi*). Analysis of these fish remains, as well as those from other sites in the Puget Sound area, reveal that a wide variety of fish procurement strategies were utilized before and after contact with Euroamericans. The fish remains at Burton Acres show a consistent focus on herring use both prehistorically and after contact. Along with fish bone assemblages from other sites, these data reiterate the need to examine Northwest Coast cultural evolution with attention to the wide variety of potential fish resources in the region, instead of assuming a dominant role for salmon.

Introduction

Archaeologists have created models of cultural evolution for the Northwest Coast using the appearance of intensive salmon harvesting as an indication of the achievement of cultural complexity (Mitchell 1971; Fladmark 1975; Burley 1980; Matson and Coupland 1995). These models, however, are supported more from historic observations and ethnographic records than from analyses of archaeological faunal remains. Fish remains have the potential to resolve this issue, but their use entails problems. One problem is the narrow focus on salmon and trout (*Oncorhynchus* sp.) by many archaeologists in the region (Schalk 1977; Coupland 1988). Another more specific problem is that little is known archaeologically of the transition from prehistoric to historic fish use (Ford 1989). The carefully excavated and analyzed fish bone assemblage from Burton Acres shell midden (45-KI-437) on the shores of southern Puget Sound addresses both of these problems. These remains suggest that herring, not salmon, played a relatively important role in subsistence activities at this location during the time of European-Native American contact. Other archaeological sites in the Puget Sound area support the notion that there was a high degree of variability in fish use during pre-contact times, instead of an exclusive focus on salmon as suggested from ethnographic or historic observation.

Monks (1987:119) has appropriately labeled as "salmonopia" some archaeologists' narrow focus on anadromous runs of salmon as a primary determinant of Northwest Coast native settlement patterns and social organization. Salmon runs are a predictable resource that offer a seasonal wealth of food, and they have been recorded as an essential part of the lives of many Northwest Coast Native American tribes (Suttles 1974; Eells 1985). This documentation and the copious amounts of easily-identifiable salmon remains found in shell middens have led many archaeologists to use intensive salmon harvesting as a benchmark of cultural evolution on the Northwest Coast (Fladmark 1975; Matson and Coupland 1995).

Archaeological recovery methods have also played a role in preventing other fish species from being incorporated into these cultural complexity models. Careful analysis of fish remains recovered from ⅛ in. or finer screens has shown that many archaeological sites in this region contain a wide array of fish species, many of which are small enough to be overlooked in larger screen sizes (Ham 1982; Butler 1987b; Nagaoka 1994; Wigen 1995). The Burton Acres site was excavated using ⅛ in. screens; fish remains found here are primarily very small herring bones found in the ⅛ in. screen. Salmon were recovered in the ⅛ , ¼, and ½ in. screens but found in much smaller numbers in the assemblage than herring.

Besides contributing to the "salmonopia" suffered by many archaeologists, the ethnographic and ethnohistoric record of Puget Sound (and the Northwest Coast in general) has influenced the patterns of fish use on which archaeologists focus. Left unanswered is the nature of fish use during the transition between prehistoric times and contact. For example, Myron Eells, a Congregational missionary on the Skokomish Indian Reservation from 1874 to 1907, was present to witness and record the lifestyle of the tribes around Puget Sound immediately after a period of rapid change as a result of contact with Euroamericans (Eells 1985, Boyd 1990). He observed the general subsistence patterns of tribal members and paid particular attention to fish as the most important food resource, recording 21 varieties that were caught. He focused, however, on salmon as "formerly the staff of life" (Eells 1985:58) for Native Americans in Puget Sound. The Burton Acres shell midden represents a Native American occupation before and during this transitional period that has at least 20 different taxa of fish remains in its deposits. People at Burton Acres were primarily utilizing an adjacent herring run and many other species of fish from the surrounding waters.

Although salmon are the dominant fish mentioned in the ethnographic record and modeled in explanations of prehistoric cultural evolution on the Northwest Coast, examination of a broader range of fish resources can expose variability in fishing strategies over time and across space (Cannon 1991, 1995; Kew 1992). Herring is an example of a fish species that has generally been overlooked in large-scale cultural complexity models for the Northwest Coast, but remains found at archaeological sites suggest economic importance both before and after European contact, especially in the Puget Sound and Gulf of Georgia region.

Analysis of the Burton Acres fish remains shows a facet of fish use in southern Puget Sound besides the salmon harvest, highlighting the variability of Native American subsistence just before, during, and after contact with Euroamericans. Examination of other sites in Puget Sound from both coastal and riverine settings supports this notion of variability. Attempts at synthesizing a model of cultural evolution on the Northwest Coast are necessary but may be generalizing the dominant role salmon has played in the development of cultural complexity at the expense of other fish species (Schalk 1977; Matson and Coupland 1995). Some archaeologists have recognized the difficulty in making these broad generalizations (Cannon

1996), but more zooarchaeological analyses of Northwest Coast faunal assemblages must be performed to better understand the variability of fish use in the region.

Archaeological Setting

The Burton Acres shell midden is located on Vashon Island in southern Puget Sound, Washington. It lies on what is today a public boat-launch on the shore of Quartermaster Harbor (Fig. 1). The site has been known for years, but was officially recorded in 1994 by Joan Robinson on behalf of the King County Landmarks Commission and over the past few years has undergone severe erosion from winter storms. During the summer of 1996 it was excavated jointly by the Thomas Burke Memorial State Museum, King County Landmarks and Heritage Commission, McMurray Middle School, and the Puyallup Tribe of Indians, with the help of over 350 volunteers from the public. The data recovered from the excavation and subsequent analysis fill important gaps in our knowledge of this part of Puget Sound during the transition from prehistoric to contact times.

Four 1 m^2 units were excavated, generally trending north to south (Stein and Phillips 2001). The two southernmost units (22N58E and 26N57E) are separated by unexcavated expanses, while the two northernmost units (28N58E and 29N58E) are adjacent. Units 28N58E and 29N58E provided more information for analysis of fish remains because the cultural deposits were thickest in this northern region and the stratigraphy between these two units afforded relative dating. Also, more artifacts and faunal remains were recovered from these units.

Three general strata were identified in the excavation: a sod layer (Layer 1), a layer of cultural material, including the shell midden (Layer 2), and glacial drift that was devoid of cultural material (Layer 3). The deposits were excavated within these natural stratigraphic layers, with arbitrary level changes every 10 cm within layers thicker than 10 cm. The only layer that was thicker than 10 cm was Layer 2, the one containing cultural material. Layer 2 was divided into 10 cm subdivisions designated by a letter (i.e. 2A, 2B, 2C, etc. are all 10 cm thick). Underneath the sod layers, Unit 22N58E had 7 cultural layers (2A-2G), Unit 26N57E had 2 cultural layers (2A and 2B), Unit 28N58E had 3 cultural layers (2A-2C), and Unit 29N58E had 6 cultural layers (2A-2F).

Ten radiocarbon samples were taken from shell, charcoal, and unburned wood in all four units. Four additional samples on wood, one from each unit, were later sent in for AMS dates. The results of the radiocarbon analysis on shell await correction once the reservoir correction factor for marine carbonate has been determined for southern Puget Sound. The remainder of the dates, however, indicates an occupation span of more than the last 200 years, perhaps even 1000 years (Stein and Phillips 2001).

The artifactual material recovered from Burton Acres suggests a distinct stratigraphic difference between deposition of exclusively prehistoric material and deposition of both historic material (most notably iron) and lithic debitage. In strata 2A through 2C of both units 28N58E and 29N58E, large quantities of metal objects and fragments, bottle glass, gun paraphernalia, buttons, and a U.S. seated-liberty dime were recovered. These artifacts indicate mid-nineteenth century and later occupation. Lithic debitage in the form of small dacite and chert flakes were recovered in these upper layers as well. The transitional stratum, 2D, contains a few highly corroded and fragmented pieces of metal. The lower layers of Unit 29N58E, 2E and 2F, contained three broken ground antler adze handles, the tip of a ground bone point, two split longbone awls, and a few bifacially-chipped stone tools, but no historic material.

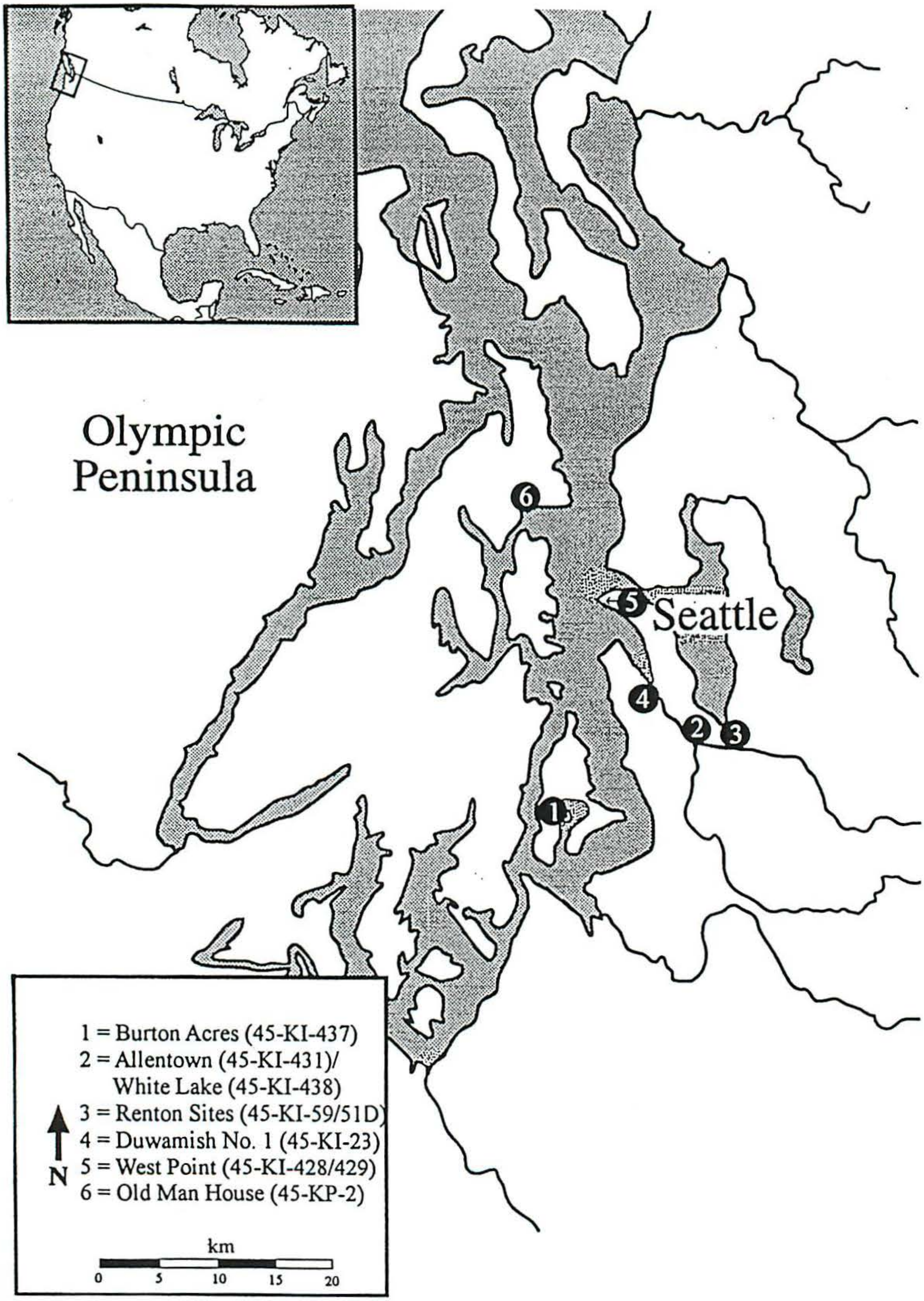

Fig. 1. The locations of Puget Sound archaeological sites referred to in the text.

During fieldwork, excavators maintained provenience and volumetric control by filling two-liter and eight-liter buckets with matrix. The matrix was then passed through nested screens of 1, ½, ¼, and ⅛ in. mesh sizes. All four excavation units provided some fish bone and teeth, primarily from the ¼ and ⅛ in. mesh samples. Fish remains were sampled and approximately 25% of the buckets excavated were analyzed by selecting the first and every fourth bucket from each excavation level.

Analysis Protocol

Fish remains were identified to the finest taxonomic level possible using the comparative collections of Virginia Butler (Portland State University), Mike Etnier (University of Washington), and the National Marine Mammal Laboratory at the Sand Point NOAA station in Seattle, Washington. Fish remains were quantified using NISP (Number of Identified Specimens). Other methods of quantification such as MNI (Minimum Number of Individuals) were not used. Both methods have inherent analytical problems. NISP often counts the same element more than once since it tallies each identifiable fragment present. MNI, on the other hand, is affected by how a faunal assemblage is aggregated before the elements are counted (Grayson 1984). Despite the remarkable preservation of many different kinds of herring elements in the deposits at Burton Acres, siding of the cranial elements is often not possible. Additionally, many of the larger-bodied fish taxa are represented primarily by vertebrae. For these reasons, NISP is used in this study because it is a more consistent measure between taxa than MNI.

Results

Of approximately 9000 fish bone specimens in the analysis, approximately 3500 could not be identified to any particular taxon (cataloged as "unidentifiable" and not shown in Tables 1 and 2). The remaining 5326 specimens were identifiable to at least Order-level and represent 21 taxa (Table 1). Pacific herring (*Clupea harengus pallasi*) dominates the assemblage as a whole with 4281 identifiable specimens. Salmonid (*Oncorhynchus* sp.) remains numbered 568 identifiable specimens. Flatfish such as sole and flounder (Order Pleuronectiformes) number 218 identifiable specimens and the remaining 18 taxa number 259 identifiable specimens.

Although most fish taxa are found in small densities throughout all units and layers, there are some noticeable patterns in the distribution of some taxa. Table 2 displays the abundances of fish bone from each family in every unit and layer (note that the families Bothidae and Pleuronectidae are combined in this analysis). Corrected for volume, the table shows that the densest deposits of fish bones in Unit 22N58E are in the middle layers, 2E and 2F. Herring are the most abundant taxon in this unit, although dogfish, skate, ratfish, salmon, rockfish, sculpin, surfperch, and flatfish are present in small quantities. There are very few fish bones in unit 26N57E, only four herring and one flatfish specimen. The densest deposits of fish bones in unit 28N58E are in the middle layers, 2B and 2C. Herring and, to a much lesser extent, salmon are the dominant taxa here. Small numbers of dogfish, skate, ratfish, toadfish, cod, sculpin, surfperch, and flatfish are present as well. Unit 29N58E has the most dense fish bone in its bottom layers, 2E and 2F. Like the other units, 29N58E is dominated by herring and salmon, but contains numerous remains of flatfish, surfperch, and sculpin. Dogfish, skate, ratfish, toadfish, cod, and rockfish are also present.

TABLE 1

SCIENTIFIC AND COMMON NAMES OF FISH TAXA FOUND AT BURTON ACRES

Scientific Name	Common Name	22N58E	26N57E	28N58E	29N58E	Total
Squalus acanthias	Spiny dogfish	3	-	4	8	15
Raja sp.	Skate	7	-	1	22	30
Hydrolagus colliei	Spotted ratfish	3	-	4	9	16
Clupea harengus pallasi	Pacific herring	428	4	1011	2838	4281
Oncorhynchus sp.	Salmon	9	-	291	268	568
Porichthys notatus	Plainfin midshipman	-	-	1	5	6
Family *Gadidae*	Codfish	-	-	2	6	8
Family *Embiotocidae*	Surfperch	24	-	2	55	81
Embiotoca lateralis	Striped seaperch	2	-	-	6	8
Rhacochilus vacca	Pile perch	-	-	-	3	3
Family *Scorpaenidae*	Rockfish	4	-	-	24	27
Family *Cottidae*	Sculpin	5	-	4	40	49
Leptocottus armatus	Pacific staghorn sculpin				14	14
Scorpaenichthys marmoratus	Cabezon	-	-	-	2	2
Order *Pleuronectiformes*	Flatfish	69	1	21	114	205
Family *Pleuronectidae*	Right-eye flatfish	-	-	-	2	2
Lepidopsetta bilineata	Rock sole	1	-	-	1	2
Microstomus pacificus	Dover sole	-	-	-	1	1
Parophyrs vetulus	English sole	-	-	-	4	4
Platichthys stellatus	Starry flounder	-	-	-	4	4

TABLE 2

FREQUENCY OF FISH REMAINS BY EXCAVATION UNIT AND TAXON[1]

			Count and Count per Volume Given in Each Column																							
Unit	Layer	Vol.	Dogfish		Skate		Ratfish		Herring		Salmon		Toadfish		Codfish		Rockfish		Sculpin		Surfperch		Flatfish		Total	
2258	2A	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
	2B	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
	2C	16	-	-	-	-	-	-	2	0.1	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	3	0.2
	2D	16	-	-	-	-	-	-	42	2.6	3	0.2	-	-	-	-	-	-	-	-	16	1.0	1	0.1	62	3.9
	2E	14	1	0.1	5	0.4	3	0.2	223	15.9	-	-	-	-	-	-	3	0.2	-	-	3	0.2	-		238	17.0
	2F	6	2	0.3	-	-	1	0.2	139	23.2	3	0.5	-	-	-	-	-	-	5	0.8	1	0.2	8	1.3	159	26.5
	2G	8	-	-	2	0.3	-	-	11	1.4	-	-	-	-	-	-	-	-	-	-	2	0.3	14	1.8	29	3.6
	3A	8	-	-	-	-	-	-	10	1.3	2	0.3	-	-	-	-	1	0.1	-	-	4	0.5	3	0.4	20	2.5
2657	2A	26	-	-	-	-	-	-	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1
	2B	10	-	-	-	-	-	-	2	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.2
	3A	4	-	-	-	-	-	-	1	0.3	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3	2	0.5
2858	2A	34	-	-	-	-	-	-	71	2.1	10	0.3	-	-	-	-	-	-	-	-	-	-	2	0.1	83	2.4
	2B	74	2	0.1	-	-	2	0.1	769	10.4	245	3.3	1	0.1	2	0.1	-	-	4	0.1	1	0.1	2	0.1	1027	13.9
	2C	32	2	0.1	1	0.1	1	0.1	149	4.7	34	1.1	-	-	-	-	-	-	-	-	1	0.1	11	0.3	199	6.2
	3A	16	-	-	-	-	1	0.1	22	1.4	2	0.1	-	-	-	-	-	-	-	-	-	-	6	0.4	31	1.9
2958	2A	40	1	0.1	-	-	-	-	160	4.0	6	0.2	-	-	-	-	-	-	-	-	-	-	1	0.1	168	4.2
	2B	22	-	-	-	-	-	-	176	8.0	16	0.7	3	0.1	1	0.1	1	0.1	-	-	-	-	4	0.2	198	9.0
	2C	44	1	0.1	-	-	-	-	50	1.1	76	1.7	-	-	3	0.1	5	0.1	2	0.1	4	0.1	27	0.6	168	3.8
	2D	32	2	0.1	8	0.3	3	0.1	136	4.3	46	1.4	-	-	-	-	8	0.3	10	0.3	9	0.3	11	0.3	233	7.3
	2E	36	3	0.1	9	0.3	4	0.1	984	27.3	94	2.6	2	0.1	1	0.1	4	0.1	24	0.7	28	0.8	36	1.0	1187	33.0
	2F	24	1	0.1	5	0.2	2	0.1	1332	55.5	30	1.3	-	-	1	0.1	6	0.3	17	0.7	23	1.0	46	1.9	1463	61.0
Total		508	15	0.1	30	0.1	17	0.1	4280	8.4	568	1.1	6	0.1	8	0.1	28	0.1	62	0.1	92	0.2	173	0.3	5273	10.4

[1] The first number in each column is the number of identifiable specimens (NISP) in each layer and the second number is NISP divided by layer volume, to give a standardized count of fish remains per liter.

Discussion

Recovery and Identification of Fish Remains

The fish remains from the Burton Acres shell midden suggest that generalizations about salmon harvesting as the most viable food procurement strategy in the Northwest may overlook other important seasonal resources, such as herring. While Monks (1987:119) coins the term "salmonopia" to describe this phenomenon, he does not go into detail describing why many archaeologists suffer from it. The two obvious explanations are the uneven ease of bone identification among fish taxa and the use of excavation screens that are too large to recover the remains of smaller taxa.

Ease of identifiability of fish specimens depends upon the experience of the analyst and the availability of adequate comparative collections, but salmon are arguably the easiest fish taxon to identify expediently in the field. Few other fish taxa have such recognizable elements, and those elements that are easily recognizable to a particular taxa, such as teeth and otoliths, are susceptible to the second problem above: they tend to fall through screens with mesh sizes larger than ⅛ in. Recovery of fish specimens from fine mesh screens (⅛ in. or smaller) compounds this problem further when tabulating NISP. Given the distinctive texture of salmonid vertebrae, over-representation of salmonids in small screen fractions is a likely outcome when the analyst counts all fragments identifiable to a particular taxon (Wigen and Stucki 1988; Moss 1989:146).

At archaeological sites in Puget Sound where fish bones were analyzed from screens as fine or finer than ⅛ in., such as Burton Acres, West Point (Wigen 1995), and Duwamish No. 1 (Butler 1987a), a great deal of variability in identified taxa becomes apparent from site to site. The size of the fish and their fragmentation after death affect the size of bones in the Burton Acres assemblage. There is a geometrical increase in abundance of fish bones from the 1 in. fraction through the ½, ¼, to the ⅛ in. fraction. Only one specimen at Burton Acres is found in the 1 in. fraction, a cabezon (*Scorpaenichthys marmoratus*) fragment in unit 29N58E, layer 2D. There are 20 specimens in the ½ in. fraction, 18 of which are in layers 2B, 2C, and 2D of unit 29N58E. Most of these ½ in. specimens are large herring cranial elements. Six specimens may be part of a cabezon, as they were found with the specimens that were positively identified as cabezon, but cannot themselves be identified positively to that taxon. The other two ½ in. specimens are in unit 22N58E layer 2E and are a flatfish and a rockfish. The majority of ¼ and ⅛ in. specimens is not surprising given that the most frequently found taxa are of herring and many of the other taxa found are small, such as surfperch. Given the small body size of many fish species found at Burton Acres, however, even the use of ⅛ in. screens may have lost many specimens. Cannon (2000) has noted that the methodology involved in many full-scale site excavations on the Northwest Coast makes assessment of the importance of small-bodied species such as herring difficult, and suggests systematic bucket-auger sampling as an alternative.

Changes in Fish Use Over Time at Burton Acres

The Burton Acres shell midden contains cultural deposits dating to a period of occupation within approximately the last thousand years. The proportion of herring, salmon, and other fish taxa changes from the base to the surface of the cultural deposits. Corresponding to this stratigraphic change in fish taxa is a change from prehistoric tools in the earlier layers to a combination of stone and bone tools with historic metal artifacts in the more recent layers. There is a slight increase in the proportion of salmon in the fish remains from the layers with historic artifacts. The continual dominance of herring, however, from prehistoric to historic layers and the minimal role salmon plays in the prehistoric layers of the site suggest that ethnographic observations of fishing in the area may be overlooking an important seasonal resource other than salmon (Ford 1990).

In Fig. 2 the fish assemblage from each layer is grouped into three categories (herring, salmon, and other) which are represented proportionally in each bar. The fish bones from corresponding layers in both units 28N58E and 29N58E were combined and used for this analysis because the units are adjacent and have continuous strata.

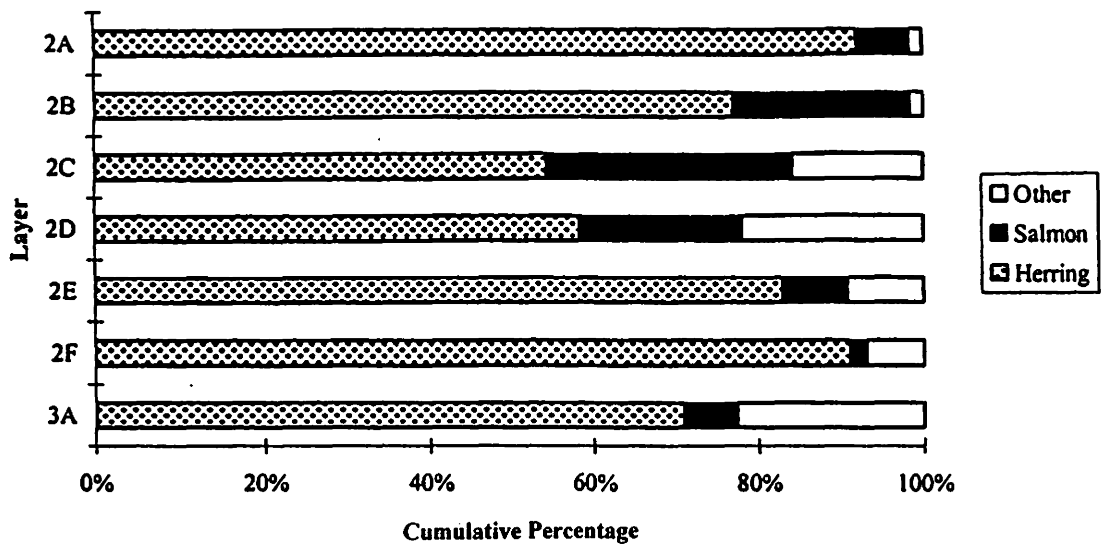

Fig. 2. Proportions of salmon (*Oncorhynchus* sp.), herring (*Clupea harengus pallasi*), and other fish taxa in each strata of units 28N58E and 29N58E combined

Herring is consistently the most abundant taxa in each layer. Herring is least abundant in Layer 2C, approximately 50%, while it is the most abundant in Layer 2A, over 90%. Salmon is the second most abundant category in the more recent layers (2A, 2B, and 2C), and reaches its highest proportion in layer 2C. The combination of all other fish taxa comprise over 20% of the fish remains in layer 2D and almost 20% in Layer 2C. In Layers 2E and 2F, which had the greatest numbers of fish specimens in the site, herring is maximally abundant, and salmon is less abundant than the other taxa. Although the "Other" category of taxa was not differentiated into specific types in the graph, there is a marked increase in flatfish and surfperch in Layers 2E and 2F (Table 2). Layers 2E and 2F, the bottom of the cultural deposit, are dominated by herring, despite an increase in other taxa. This increase in the number of other taxa may be explained by the larger sample sizes in the deposits towards the bottom of the units. Greater taxon diversity can be expected with larger sample sizes (Grayson 1984).

Based on the quantification of fish taxa composition shown in Fig. 2, there is a change stratigraphically in the fish being deposited at the Burton Acres shell midden. Herring was being deposited in much greater quantities in the oldest layers, but reaches its greatest proportions relative to salmonids and other fish taxa within layers both earlier and later in time. Salmon is still dwarfed by herring in the more recent layers (Layers 2D through 2A) but nonetheless increases in relative abundance in these layers. This slight increase in the proportion of salmon corresponds with the appearance of historic artifacts in the deposits in these upper, more recent, layers. The older layers, 2F and 2E, contain stone and bone tools but no metal objects. Corresponding to these older layers are fish remains dominated by herring. Small numbers of salmon remains and other fish taxa remains are present in these older layers as well.

Variability Across Space: Other Puget Sound Area Archaeological Sites

A number of archaeological sites on or near Puget Sound contain fish assemblages that have been analyzed. Some contain mostly salmon remains, consistent with the notion that salmon was the fish resource procured at the expense of all other types of fish. Some contain salmon both before and after contact with Euroamericans. Many sites, on the other hand, contain an array of taxa similar to those at Burton Acres without an apparent focus on salmon and without much evidence of change at contact.

Differences in fish assemblages from site to site around Puget Sound may be explained in terms of several factors. Site function was probably different in the various settings that a large estuary can offer. Sites situated along rivers appear to have taken advantage of anadromous runs of salmon. Of the riverine sites examined below, all but one show a dominance of salmon in their fish bone assemblages. The sites situated along tidal areas do not show the same pattern. Another related factor affecting the relative abundances of fish taxa may be seasonality of site use. Just as riverine sites were probably most heavily utilized during the seasonal salmon runs in summer and fall, sites that focused on herring, such as Burton Acres, are usually interpreted as being most heavily used earlier in the late winter and spring when herring move inshore to spawn and could be caught en masse close to land.

Sites Directly on Puget Sound

<u>Old Man House (45-KP-2)</u>

The Old Man House site is located on the Port Madison Indian Reservation near the confluence of Port Madison Bay and Agate Passage (Fig. 1). Two components were defined on the basis of greater amounts of prehistoric artifacts relative to historic artifacts (Schalk and Rhode 1985). The radiocarbon ages on five samples indicate an occupation from approximately 1700 BP to modern historic times.

The abundance of historic artifacts in the top 40 cm of the site and the chipped and ground stone tools and ground bone tools in the lower strata of the site make it quite similar to the Burton Acres shell midden. In the upper 40 cm of the excavation, salmon and dogfish dominate the assemblage, and ratfish, rockfish, and perch are also present. Flatfish are absent from this upper portion of the site. From 40 cm to 100 cm below the surface flatfish, which were apparently not utilized at later times, are the most abundant fish taxa. Salmon rank third after dogfish. In a different excavation unit located in a wave-cut bank on the beach, herring was the most abundant taxa, although no differentiation was made between prehistoric and historic components in this unit. The fishing economy at this site appears to be broader in the prehistoric period than during historic times, and the beach unit indicates that herring was more than an incidental fish to the inhabitants of this location.

West Point (45-KI-428/429)

The West Point site is located on the western-most point of Discovery Park in Seattle (Fig. 1). Its location with direct access to the saltwater resources of Puget Sound made it an important processing site for the last 4000 years. The large site contained five cultural components spanning a period between approximately 4250 BP to 200 BP (Larson and Lewarch 1995).

Fish remains from the West Point site were collected from bulk samples using ⅛ in. screens. The largest numbers of fish remains are found in the earlier components, as well as the greatest number of different taxa (Wigen 1995). Wigen points out that the number of specimens and the number of taxa may be correlated (Grayson 1984). Wigen also notes that salmonids comprise the greatest portion of fish by NISP in all but the earliest component, ranging from 61% of the fish assemblage in Component 2 to 51% in Component 5. The greater numbers of salmonids in the later component may suggest resource intensification that matches a broad regional pattern of salmon use. Wigen also calculated the Minimum Number of Individuals of the fish remains, which surprisingly indicate that the greatest number of fish caught were in fact flatfish and Pacific staghorn sculpin. Once again, this may be a product of differential ease of identifiability of fish taxa when analyzing small fragments.

Riverine Sites

Allentown (45-KI-431) and White Lake (45-KI-438/438A)

Located along a point bar of the Duwamish River (Fig. 1), the Allentown site is in the present city of Tukwila (Lewarch et al. 1996). It contains four cultural components spanning the period from 550 BP to the present. A large quantity of fish remains were recovered in both ⅛ and 1/16 in. screens. Analysis of the Allentown fish remains suggests an almost exclusive focus on salmon, which comprise over 99% of the total fish NISP in the site (19,450 of the 19,619 identifiable specimens). Salmon dominate the fish remains from all strata in the site. Most of the non-salmonid fish remains found, such as minnows, suckers, sculpin, perch, and flatfish were from the lower strata (Butler and Corcoran 1996).

Another site just upriver from the Allentown site, on the shore of a former lake called White Lake, is the White Lake site (45-KI-438/438A). This site dates to the same recent prehistoric/historic period as the Allentown site (Lewarch et al. 1996). The fish remains of the White Lake site have an even higher overall proportion of salmonids than Allentown, 99.9% of the total identifiable NISP (of over 2400 fish remains, 4 were identified as minnow/sucker, 1 was identified as "non-salmonid," and the rest were salmonid). The results of the analysis of fish remains from both the Allentown and White Lakes sites show that salmon dominated the fishing economy of these sites on the Duwamish River waterway (Butler and Corcoran 1996).

Duwamish No. 1 (45-KI-23)

The Duwamish No. 1 site is located on the west bank of the Duwamish River, 3.75 km upstream from the present location of Elliott Bay (Fig. 1). Three cultural components are defined for the site, representing consistent occupation from about 1350 BP to historic times. Although the mammal (Lyman 1981) and bird remains were not particularly abundant, over 11,000 fish specimens identifiable to at least family or order (in the case of Pleuronectiformes) were analyzed, representing 30 taxa (Butler 1987a). The fish represent typical estuarine taxa, including various species of sculpin, codfish, flatfish, and dogfish. Unlike the Allentown site, also on the Duwamish River, the relative frequency of salmon at Duwamish No. 1 is lower than the other fish taxa. The greatest abundance of salmon remains is in the earliest component at the Duwamish No. 1 site, from around 1350 to 1100 BP (Butler 1987a).

Renton Sites

Tualdad Altu (45-KI-59) is located along the channel of the former Black River (Fig. 1). The midden contains four cultural stratigraphic units (Chatters 1988). Three radiocarbon ages and projectile point types present at the site indicate a short occupation between approximately 1800 and 1600 BP. Three-quarters of the excavated materials were water screened through ¼ in. screen, while the remaining quarter was water screened through ⅛ in. screen.

Salmon comprise about 87% of the identifiable fish assemblage in this site, indicating that the anadromous salmon run of the Black River was an important source of food for the site's occupants (Chatters 1988). Also occasionally found in the site are dense deposits of dogfish and flounder bones. Despite the inland location of Tualdad Altu and its proximity to available freshwater fish taxa, fish such as sucker (*Catostomus* sp.) are only found in trace amounts here (Butler 1990).

The fish remains from the Sbabadid-D site (45-KI-51D), in the vicinity of Tualdad Altu, were also analyzed by Butler (1990). This site lies 350 m east of Tualdad Altu and is an important historic village. The number of fish remains recovered was very small (248 elements), however, and they were exclusively salmonid.

An examination of other sites in the area besides Burton Acres indicates more variability in fish use, strongly tied to local habitat. Herring appear in archaeological sites across most of the Northwest Coast. Just to the north of Puget Sound, the Strait of Georgia region is perhaps one of the most intensively studied areas by Northwest Coast archaeologists. While sites along rivers, such as the Glenrose Cannery site (Matson 1976), usually contain fish remains dominated by salmon and an interpreted economic focus on salmon harvesting, shell middens along tidal areas around the Strait have revealed significant variation in fish species being utilized. The Little Qualicum River site (DiSc-1) contains a waterlogged portion that has preserved a predominantly salmonid fish bone assemblage, while herring are the most abundant fish in the dry component. Dogfish, plainfin midshipman, greenlings, rockfish, and sculpin are also found in significant quantities (Bernick and Wigen 1990). Other sites near the Strait of Georgia, such as DeRt-1, the Pender Canal site (Hanson 1995); DgRr-1, Crescent Beach (Ham 1982); and DiSe-7, the Deep Bay site (Monks 1987); contain relatively large amounts of herring remains as well.

On the northern Northwest Coast, Maschner (1997) surveyed a portion of Kuiu Island, Alaska and found large amounts of herring in shell middens. Although he acknowledges that herring was probably undercounted in his samples, this species contributes a significant proportion to the total fish remains recovered in his survey. Shell midden components dating after about AD 1300, however, show a very heavy reliance on salmon. Maschner interprets this as a switch from generalized open-water fishing to intensive salmon harvesting. Madonna Moss analyzed the faunal remains from ten sites on Admiralty Island, Alaska in part to specifically test whether or not the ethnographic model of the Angoon Tlingit corresponded to archaeological evidence in the area (Moss 1989). Fine-mesh recovery of fish remains revealed a pattern similar to that of Puget Sound—a complex estuary in which site function and location seem to play an important role in the species deposited at particular sites. Moss (1989:11-12) notes that closer scrutiny of ethnohistoric records of the Tlingit after Euroamerican contact suggests more variability in subsistence than an exclusive focus on salmon. Resources that were recorded as important to the Angoon Tlingit such as halibut and deer, however, appear to be less important prehistorically based on the archaeological record.

Despite the great ecological variability between and within fish taxa in the waters of the Northwest Coast (McPhail 1967; Hart 1973; Miller and Borton 1980) the interpretation of fish remains from archaeological sites frequently treats fish as one homogenous resource regardless of whether the sites' locations are on rivers or along tidal flats (Wilkinson 1981). Each one of the sites described above has a unique faunal assemblage that included fish remains procured, consumed, and deposited in the vicinity of the site. The availability of fish near a site most likely influenced the locations of that site, likely placed strategically to take advantage of particular seasonally abundant resources.

Even in the interior Northwest, where salmon use by Native Americans has been a focus of ethnographers and archaeologists, there is evidence of a wider variety of fish resources that contributed not only to diet but to language and social life as well. Although salmon and trout are the most frequently mentioned species of fish in ethnohistoric records of Columbia River Plateau and interior tribes (Stewart 1991), fishing technology used by tribes such as the Lemhi Shoshone-Bannock was capable of capturing a variety of species (Walker 1993). Lamprey eels, chub, squawfish, and suckers were all known to supplement the diet. Hunn (1980) notes that the Sahaptin language indicates a native natural history comparable to the known Linnaean classification of fish inhabiting the middle Columbia River. The language can inform us of the relative importance of both anadromous and non-anadromous species. For example, Hunn notes from the Sahaptin fish classification that lamprey eels and red-sided shiner were favored, while sturgeon was avoided. The economic importance of sucker is apparent in the Sahaptin language as well. The Sahaptin names for sucker skeletal elements even reflect their mythological origins. Fish remains found in archaeological sites from the inland Northwest show a long history of non-anadromous fish use along with salmon and trout (Chatters 1995; Ames et al. 1998; Pokotylo and Mitchell 1998; Roll and Hackenberger 1998).

Evaluations of models of cultural complexity for the Northwest Coast cannot rest upon the "salmonopia" assumptions about one particular species. These models acknowledge the seasonal nature of salmon and incorporate strategies for and results of taking advantage of their limited availability (Ames 1985). The contribution of other fish resources must also be taken into account. This has been done with ratfish (Cannon 1995) and flatfish (Croes and Hackenberger 1988) for example. Herring, although smaller in size than salmon and less visible in the ethnohistoric record, provide a seasonally and ecologically complimentary food resource.

Conclusions

Almost 9000 individual fish bones were analyzed from the Burton Acres shell midden, indicating the utilization of a wide variety of taxa both before and after contact with Euroamericans. Salmon does not represent the majority of fish in this assemblage, nor is it a majority in several assemblages from other sites in or near Puget Sound. This is not to say that salmon are not important to Northwest Coast people or do not play a critical role in their spiritual beliefs. It does suggest that salmon are not the most abundant fish caught, processed, and deposited at many habitation sites in the area.

Eells (1985), Suttles (1974), and others observed and recorded the subsistence strategies of Native Americans after Euroamerican contact and placed the seasonally intensive harvest of salmon at the center of subsistence for these people. Some Northwest Coast archaeologists have in turn taken this notion and created models that implicitly assume that salmon was the primary fish around which these peoples' lives revolved. Fladmark (1975:253) hypothesizes that the appearance of shell middens on the Northwest Coast after 5,000 BP indicates a shift to intensive salmon use and a settlement pattern involving winter villages. Burley (1980), in his definition of the Marpole Culture Type, follows Mitchell's (1971) ecological model of prehistoric Northwest Coast settlement patterns and subsistence, which designates access to salmon from the Fraser River run as having had a causal role in settlement. This is accepted despite Burley's acknowledgment that a variety of fish are usually found in Marpole components of Gulf of Georgia archaeological sites (Burley 1980:54-55). Matson and Coupland (1995:244) note that both shellfish use and salmon use occur much earlier than 5,000 BP but winter villages cannot be dated prior to 3,200 BP, and they continue to use salmon as a yardstick to measure the development of the "Developed Northwest Coast Pattern" in the archaeological phases created for this region. Fish remains often go unanalyzed even after these interpretations have been made. Carlson (1960:582) noted that fish vertebrae from archaeological sites on the San Juan Islands were not analyzed, but maintains that, "many of [the vertebrae] undoubtedly belong to the salmon which formed the mainstay of the historic Indian groups," despite an analysis of cranial material that indicated a majority of rockfish (*Sebastes* sp).

Detailed zooarchaeological analyses of fish remains across the Northwest Coast usually point to a more diverse picture of Native American fishing economies both across space and over time (Monks 1987; Moss 1989; Cannon 1995, 1998; Hanson 1995; Maschner 1997). The fish remains at Burton Acres suggest that a change occurred in fish use around the Puget Sound after Euroamerican contact. Fish remains from the earlier, prehistoric layers are primarily herring with small amounts of other diverse taxa, including flatfish, rockfish, sculpin, and salmon. Fish remains from the more recent layers of the site in which lithic, ground bone, and metal tools are found have a greater proportion of salmon but are still overshadowed by herring. This change may be the result of restrictions from access to large stretches of the coastline placed on Native Americans by the American Territorial government in the mid-1800s (Suttles 1990; Suttles and Lane 1990:500). As Euroamerican settlers bought or homesteaded land in Puget Sound, Native Americans were denied access to fishing near those places. Burton Acres was a place where herring were collected before and after contact, along with other kinds of fish as well.

Besides some riverine archaeological sites (e.g. Duwamish No. 1, Tualdad Altu) Burton Acres is the only site excavated in an embayment directly on southern Puget Sound that has analyzed fish remains. The fish remains from these sites, and many other sites along the Northwest Coast indicate a high degree of variability in Native American fish use during both historic and prehistoric times. This is in contrast with many theoretical models that explain the evolution of cultural complexity on the Northwest Coast by focusing on the relationship between people and salmon. The importance of salmon prehistorically and ethnohistorically is not denied in this paper, but the importance of other fish species such as herring is emphasized as a resource that zooarchaeologists studying fish remains must deal with, and models of coastal cultural complexity can take advantage of as a complement to salmon.

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