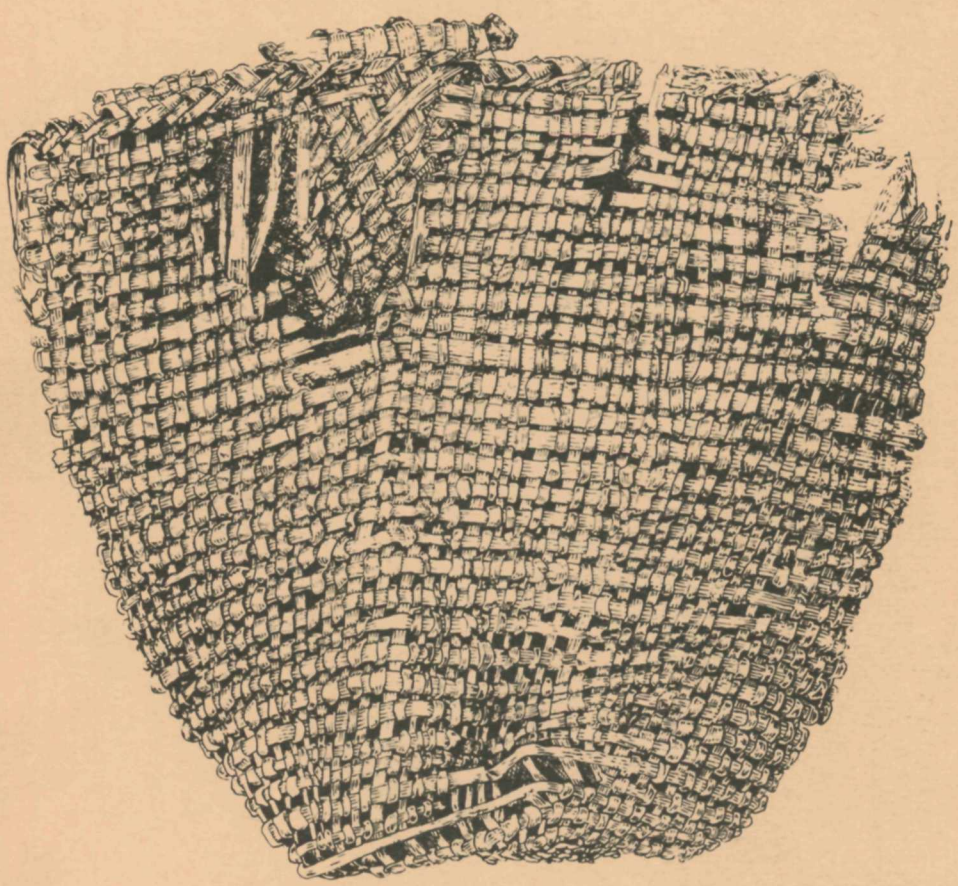
HOKO RIVER:

A 2500 YEAR OLD FISHING CAMP ON THE NORTHWEST COAST OF NORTH AMERICA



DALE R. CROES and ERIC BLINMAN
Editors

Washington State University
Laboratory of Anthropology
Reports of Investigations
No. 58

Hoko River
Archaeological Project
Contribution No. 1

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DEDICATION

To Nora Barker and Harold Ides, in memoriam--

two great Makahs, friends and teachers

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The Makah Tribal Nation, Neah Bay, Washington, has taken an active role in all aspects of the Hoko River Archaeological project. They have a particular interest in the excavations since the materials represent the early period of their cultural heritage. The Makah senior citizens have provided much guidance and invaluable information pertaining to several areas of investigation. Though the waterlogged fishing camp is 2,500 years old, the Seniors readily recognized the different kinds of fishing equipment, basketry, woodworking tools, harpoon points and other items recovered, and also could explain to us how they were used. This volume is dedicated to the late Nora Barker and Harold Ides, two Makah Seniors who greatly assisted, supported and encouraged our work. Nora fished as a youth at Hoko River, and provided information on individuals who used the entire region. She was a great Makah cultural leader and teacher. Harold Ides, 82 at his death, was a frequent visitor to the Hoko project. He and his wife Isabella assisted the project from the beginning. They lent us a rowboat, woodstove and other needed equipment and Harold actively participated in our research programs, teaching us how to fish with the replicated Hoko River fishhooks. He fished with us in the Strait of Juan de Fuca and in more controlled conditions at the Seattle Aquarium. Harold knew aspects of how and where to use these deep-sea hooks off the Hoko River and also information on baiting, fishing seasons, habitats of different fish, their behaviors and other related information--all things that can not be obtained from the site data alone. To both of these great individuals and Makahs, we owe a great deal of gratitude. Makah Seniors who have taken a special interest and participation in the Hoko project include: Isabella Ides,

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The field crew members, whose excavation skills produced the data included herein, and the numerous undergraduates and graduate students who contributed these papers deserve a special acknowledgment. To all these and the above mentioned individuals and organizations, this initial volume owes its existence.

ABSTRACT

Located on the northwest tip of the Olympic Peninsula, the Hoko River site (45Ca213) provides an excellent view of the material culture and lifeways at a 2,500 years B.P. coastal fishing camp. Preservation of normally perishable artifacts, including basketry, cordage, fishing equipment, hafted lithic tools, and other wooden artifacts offers new perspectives on many aspects of Northwest Coast prehistory. The abundance of artifacts is a basis for detailed studies of technology, both in the manufacture of tools and in the analysis of the fishing complex. Faunal remains and the limited range of subsistence activities evident at the site imply that the site was only one part of the prehistoric settlement pattern. Comparisons of stylistically sensitive artifacts from Hoko River with those of other Northwest Coast wet sites suggest 2,500 years of cultural continuity in this part of the Northwest Coast. The synthesis of the first year of paleoenvironmental studies, material culture studies, and replication experiments provides the framework for ongoing research at the Hoko River site. It also demonstrates the research potential generated from the excavation and analysis of prehistoric Northwest Coast wet sites.

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CHAPTER I THE HOKO RIVER SITE

INTRODUCTION

This volume characterizes, analyzes, and synthesizes data recovered from the initial excavations of the Hoko River archaeological site (45Ca213) and sets the framework for ongoing research on this Northwest Coast wet site. The important features of the site are many: it is a water-saturated archaeological site with excellent preservation of many types of perishable artifacts not normally recovered on the Northwest Coast; it is an early site, dating to 2,500 years B.P.; it represents a major fishing station, providing information on the fishing technologies of these early coastal people; and finally, some of the preserved artifacts are stylistically sensitive and can be compared with similar artifacts from other Northwest Coast wet sites, providing evidence for cultural relationships through time and across space.

Historic Northwest Coast cultures reached a stage of cultural complexity rivaled only by agricultural peoples (Suttles 1968:56). Several coastal groups had village populations of over 1,000 individuals; very large and semipermanent cedar plank houses; large, sea-worthy dugout canoes for long-distance transportation; a hereditary and ranked class system; elaborate woodworking, art, and ceremony; specialization in such skills as whaling, land-hunting, woodworking, art, and shamanism; and social units that spanned two or more villages. All along the coast these cultural developments were based on a sophisticated fishing and sea-mammal hunting technology and food-preservation procedures. Unfortunately, the antiquity of this distinctive culture is only sketchily known, due in part to the vagaries of preservation which usually reduce its rich material remains to scatters of charcoal, bone, and stone.

The 2,500-year-old materials recovered from the Hoko River site provide an opportunity to glimpse a stage of Northwest Coast cultural development. Objectives of the project are to develop an understanding of (1) fishing and sea-mammal hunting technologies, (2) woodworking technologies, (3) food procurement and processing procedures, (4) watercraft, (5) dwellings, (6) population sizes and (potentially) social

structure, (7) art and (potentially) ceremonial life, and (8) possible division of labor and specialization of skills. Also, styles of artifacts are examined to test for continuities in this south-central coastal region, and where possible, styles are compared with other Northwest Coast regions as well. In this manner, hypotheses concerning cultural continuity can be explored. Papers in this volume deal with aspects of these cultural features, and the results will be synthesized in the Summary and Conclusions section.

A part of this research deals with prehistoric site-use at Hoko River and, in particular, with scheduling, or when the site was occupied in terms of a probable seasonal round. Historically, Northwest Coast groups were involved in two annual subsistence cycles (Figure 1) that can be divided into two major annual periods: a period of intensive resource exploitation and accumulation, and a period of equally intensive resource expenditure/consumption and redistribution (cf. Fladmark 1975:90). The first period often involved movement to several resource areas, movement usually determined by the seasonal availability of these resources. Fladmark subdivides the first period into two segments: non-salmon and salmon. The non-salmon segment typically occurred during the spring and early summer and involved procurement of neritic fish, berries, and sea mammals. The salmon segment occurred in late summer and fall and was the time of intensive salmon harvesting. The second period typically took place at a winter settlement where subsistence activities were relegated to second place in favor of reallocation of food resources (through trade, gifts, potlatching, etc.), ceremonies, and the preparation of the next season's procurement equipment. The questions posed in light of this general but strongly developed historic pattern include: Was this general pattern in effect 2,500 years ago at Hoko River? If so, what segments of this seasonal pattern does Hoko River represent? If Hoko River is the location of only part of a seasonal round, where did these prehistoric groups go during the rest of the year? Many of the papers in this volume begin to approach these questions, but more complete answers await future research at the site.

Initially, this volume provides a background examination of the overall present-day setting of the site area, including the physiography and hydrography, climate, flora/fauna, and ethnohistory. The strategies of excavation, data collection, and artifact preservation are discussed, including sections on underwater exploration and onshore coring. Environmental reconstruction based on sediment and depositional sequences, floral analyses, faunal remains, and C-14 dating is considered. Finally, the well-preserved material culture from the site is examined through analysis, comparison, and replication. The summary and conclusions synthes-

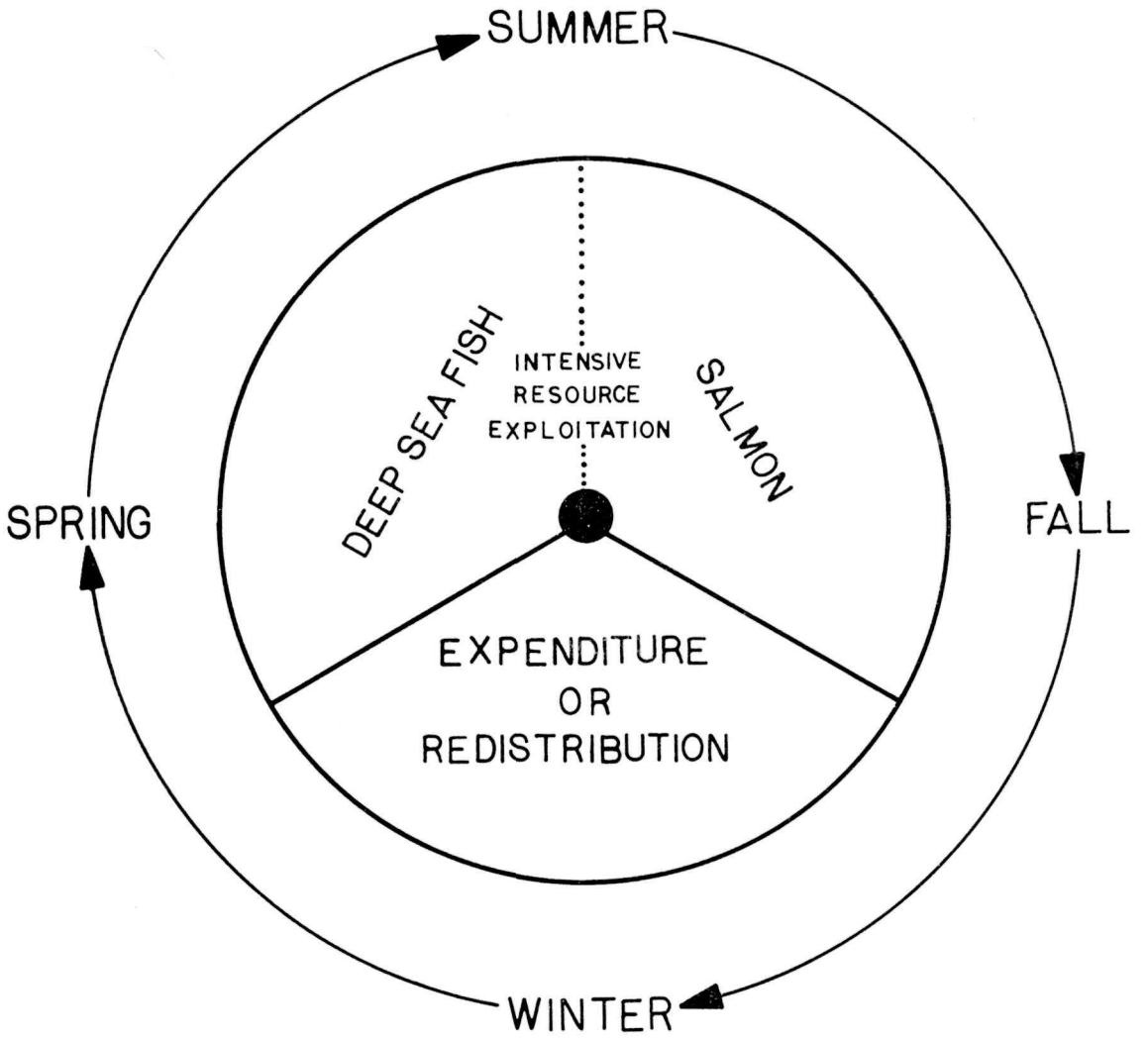


Figure 1. Annual subsistence cycle sequence for Northwest Coast native groups (after Fladmark 1975).

ize these data and discuss their implications for an understanding of the distinct cultural world of the prehistoric people using the Hoko River mouth approximately 2,500 years ago.

GENERAL SETTING

Location and Geology

The Hoko River archaeological site (45Ca213) is located on the northwest tip of the Olympic Peninsula, Washington, approximately 0.5 km upriver from the Strait of Juan de Fuca(Figures 2 and 3). It is situated on the east bank of the river and extends for at least 150 m along the bank. The river has cut off a meander loop (an event which occurred sometime between 1930 and 1940) and is eroding the high terrace covering the site area (Figure 3).

The riverbank exposure is oriented roughly north-south with a southwestern exposure. On sunny days, this exposure has especially warm afternoons, which may have been significant for setting up a fishing camp where sun-drying of fish would have been important. The site itself is on the river estuary and is affected by tidal fluctuation. Site deposits have been recorded from both above and well below mean high tide. Fresh water is available from springs behind and upriver from the site, and also flows through underlying aquifers into the estuary, helping to retain the water-saturated condition of the site.

The Hoko River site is located in the glaciated portion of the coastal lowland (plain) on the southwestern shore of the Strait of Juan de Fuca and northwest of the Olympic mountain range. The surface rocks are marine sedimentary rocks of upper Eocene to middle Miocene age (Clallam Formation; Mckee 1972:168). The predominant lithologies are marine conglomerates and sandstone. A massive outcrop of marine conglomerates extends north-south behind the site and forms a promontory called Kydaka Point, which extends into the strait in a northwesterly direction (Figure 3). Eroded segments of this outcrop form a natural rock reef offshore from the river mouth. Faulting is a common feature in this rock formation, and tectonic uplift appears to be active in this area, potentially contributing to the raised appearance of the site formations (Parke Snavelly, personal communication).



Figure 2. Aerial photograph of the lower Hoko River Valley.

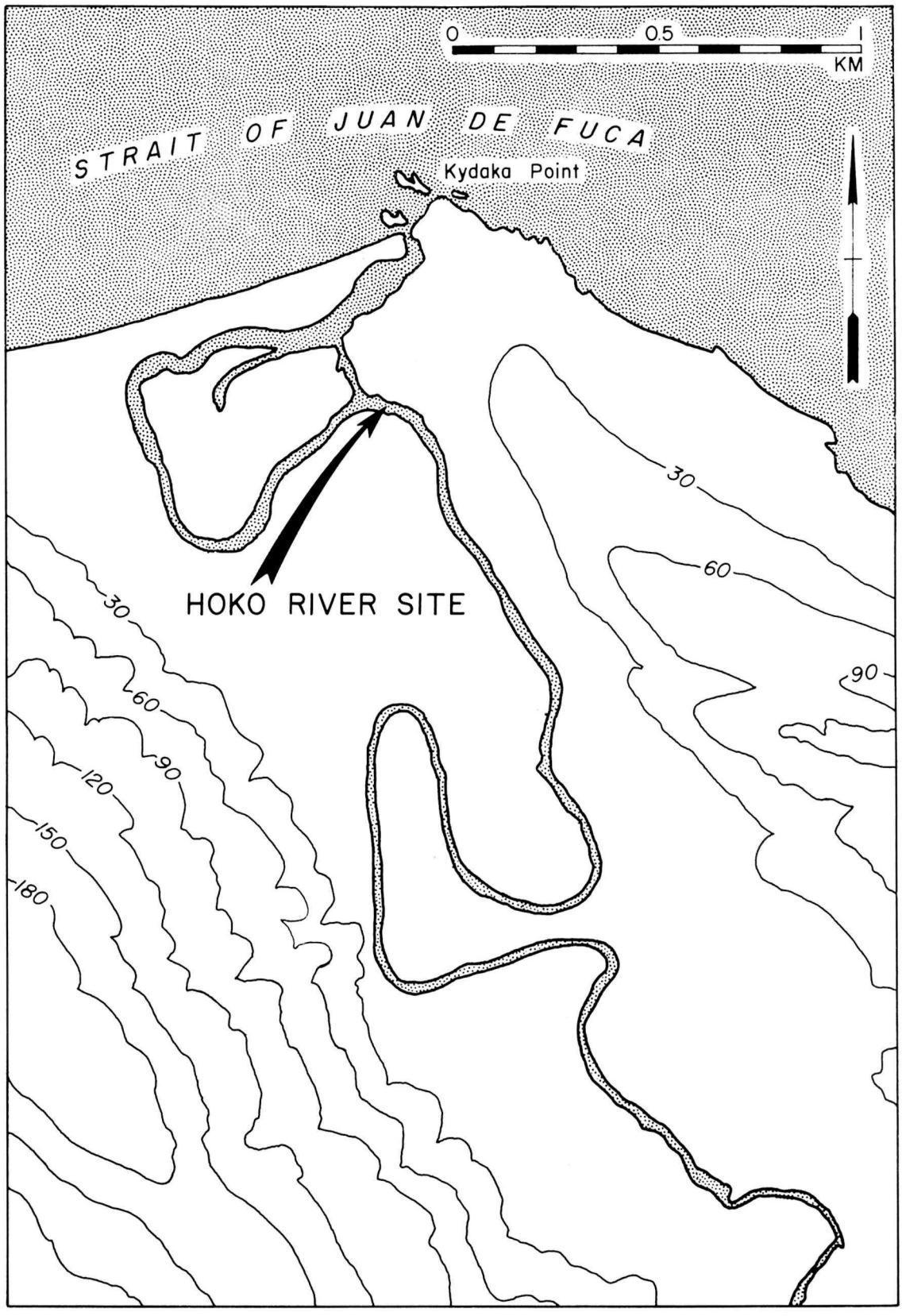


Figure 3. Map of the Hoko River site location and local topography.

Physiography

The area drained by the Hoko River is maturely dissected. Upriver, the maximum elevations are 240+ m. At the divide between the Hoko River and Big River (which runs to the southwest and empties into the Pacific Ocean via Lake Ozette and the Ozette River) elevations are above 95 m. Elevations at river level are approximately 244 m at the source, 35 m at Hoko Falls, and 7.5 m at the junction of Hoko River and the Little Hoko River (see Figures 4 and 5).

The main stem of the Hoko River watershed measures 40.1 km; it drains an area of approximately 282 sq km. The maximum east-west width of the watershed is approximately 11.3 km. The prevailing stream pattern is dendritic, with numerous creeks and runs supplying the main stem. The Little Hoko River, entering the Hoko River 5.5 km upriver from the mouth, contributes a considerable watershed to the lower portion of the river. Little Hoko has a length of 10.1 km and a drainage area of 29.8 km, and the maximum east-west width of the watershed is approximately 5.2 km. Its source is a small lake, Lizard Lake, at an elevation of approximately 235 m. The steep gradient headwaters and tributaries of the Hoko River have their source in the foothills of the Olympic Mountains.

Two broad flat valleys characterize the descent of the Hoko River. In its middle reach, the river runs through a valley of deciduous brush and timber. Then the river enters a narrow canyon with steep walls, moderate to steep gradient, and several cascade areas including Hoko Falls (see Figure 5). Finally it descends to the lower reach and another broad flat valley and enters the Strait of Juan de Fuca at Kydaka Point. In both flat valleys the Hoko River meanders a great deal (Figure 4). The river mouth area is affected by tidal action to 2.41 km from the mouth.

Offshore topography at the mouth of the river is characterized by a gradual coastal shelf that extends approximately 4 km from shore (Figure 5). The edge of the shelf rapidly descends into the channel of the Strait of Juan de Fuca. This shelf area is noted for its flatfish and other demersal fish resources (see discussion below). Waves generated by storms in the Pacific carry sand eastward along the southern shore of the strait and maintain a spit at the mouth of the river.

Adjacent to the Hoko River are three other major watersheds (Figure 6). To the west is the Sekiu River, which empties into the strait 2.5 km west of the Hoko River mouth. To the east approximately 10 and 25 km, respectively, are the Clallam and Pysht rivers. All three of these rivers are quite similar to Hoko River in structure; all have their source in

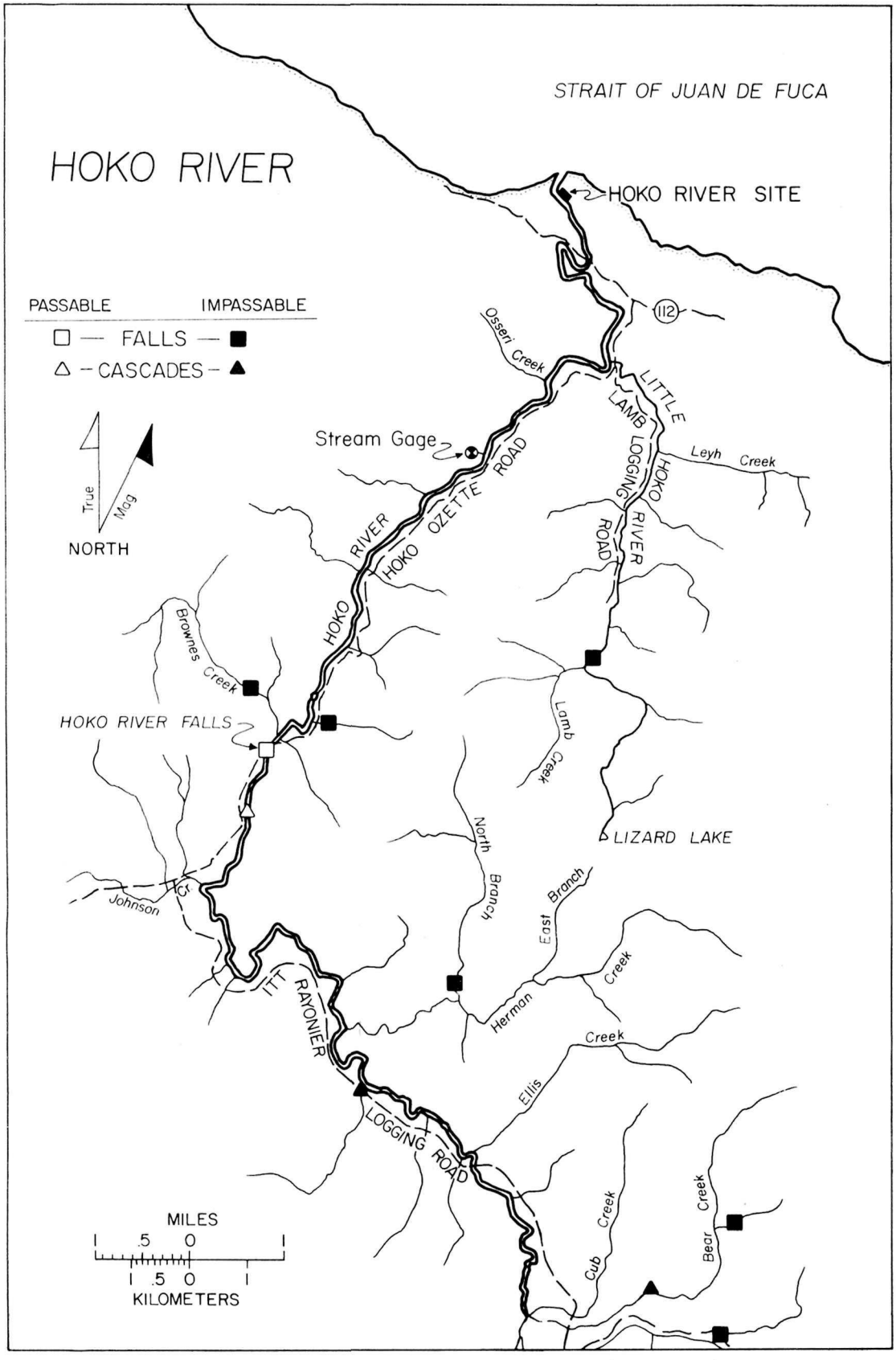


Figure 4. Physiography of the Hoko River drainage.

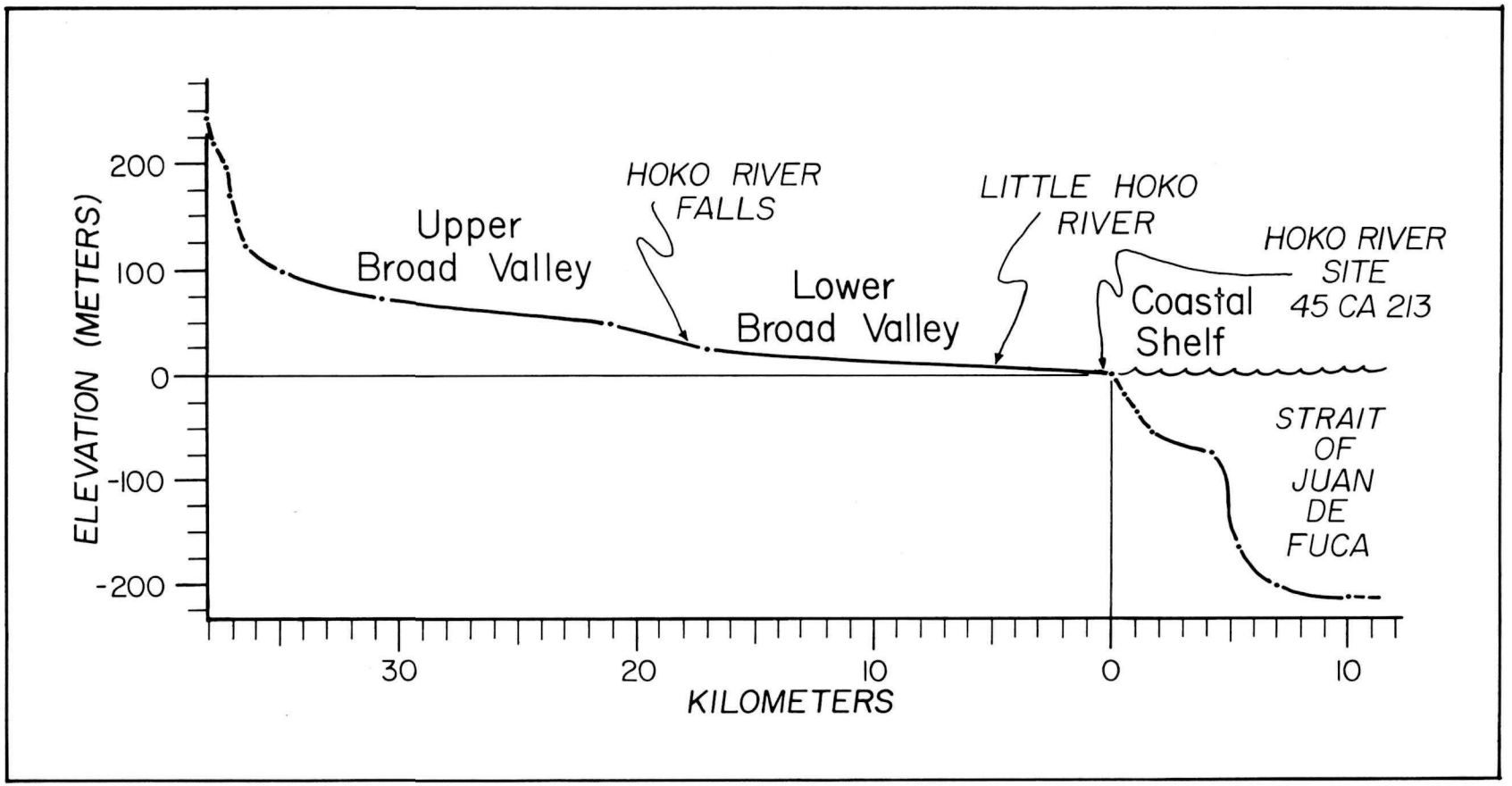


Figure 5. Profile of Hoko River drainage and offshore area.

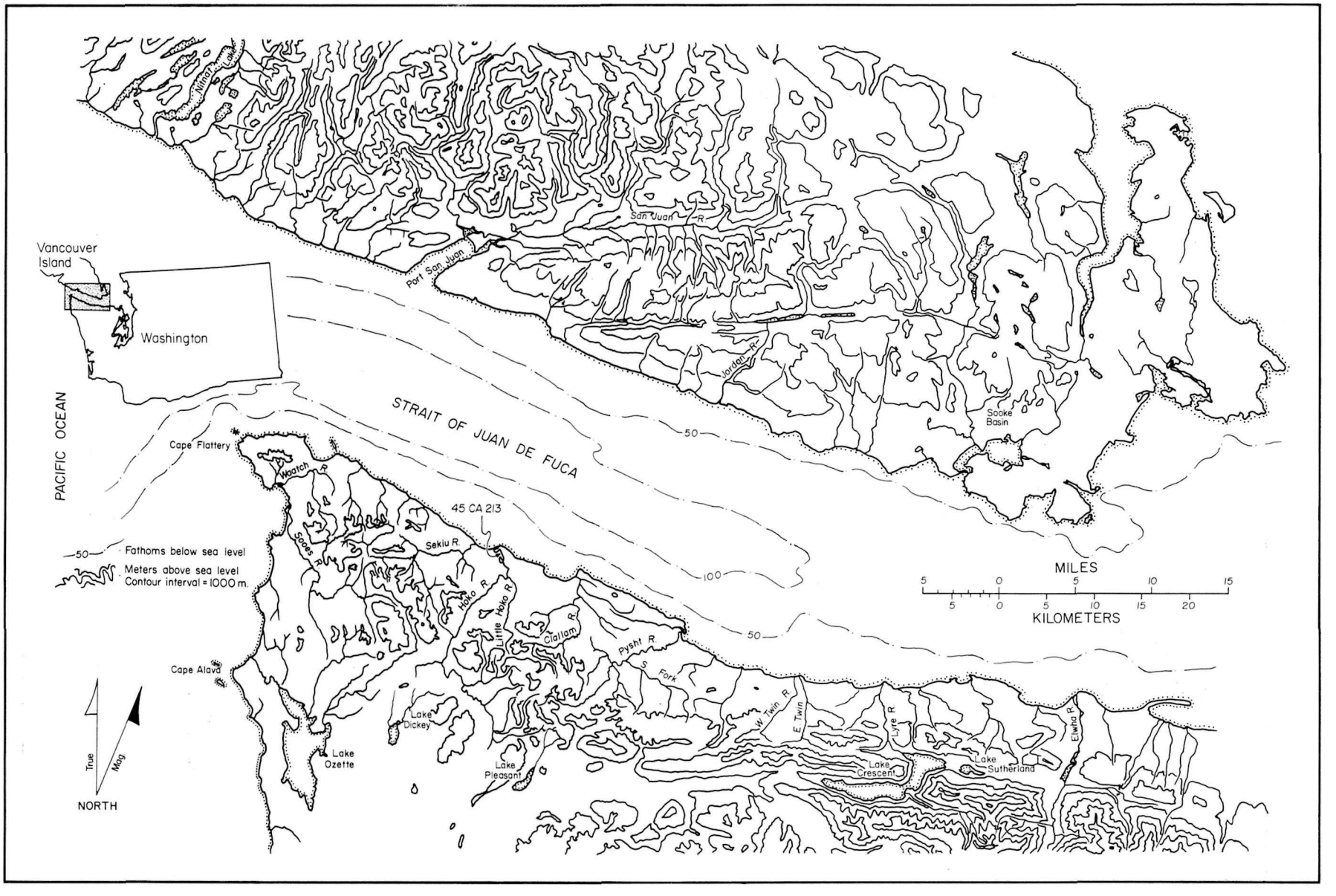


Figure 6. Major watersheds adjacent to the Hoko River.

the foothills of the Olympic Mountains to the south; and all flow into the Strait of Juan de Fuca.

Present topography throughout the area under discussion was formed during the latter portion of the Pleistocene when glaciers, originating on Vancouver Island, overran this portion of the peninsula and then receded back to the north. Glacial ice extended southward to a point approximately 40 km south of Hoko (McKee 1972:294), and much of the upriver surficial or unconsolidated sedimentary material was glacially transported and/or deposited. Following glacial withdrawal, runoff from the Olympic Mountains and foothills caused extensive downcutting.

Hydrography

The discharge of the Hoko River changes significantly from summer to winter. Peak discharge commonly occurs from November to March, following intense rainstorms or rapid melting of snowfalls; occasional high discharge can also occur in October and April (see Figure 7). The lowest discharge is from June to September. Monthly averages of mean daily discharge for the Hoko River at the gauging station are shown in Figure 4, for the period 1962 to 1974, and range from a low of .41 m3/second to a high of 33.33 m3/second (U.S. Geologic Survey 1963-1974). The gauging station is approximately 9 km upstream from the mouth of the estuary and approximately 3.5 km upstream from the major tributary, the Little Hoko River; thus, discharge into the ocean is greater than indicated by these figures. As can be seen, the greatest flow and the greatest potential for erosion at the archaeological site occur from November to March.

According to the 1977 tide tables, the maximum tidal height in the vicinity of the Hoko River is 3.0 m in winter and 2.9 m in summer; minimum tidal height is -0.7 m. The tidal range is 1.2 to 3.6 m in winter and 0.9 to 3.5 m in summer. There is considerable diurnal variation in tides. Usually a maximum high and a maximum low occur once during the day, and less pronounced highs and lows occur during the other half of the diurnal period. The tidal fluctuation in the estuary adjacent to the site causes the archaeological deposits to be alternately inundated and exposed twice daily. The general tidal fluctuation does not appear to be a major erosional factor at the site, except when combined with winter high waters in the river. At the very mouth of the river the effects of tides are magnified by storms. In winter, heavy storms and high tides batter and erode the Hoko River spit.

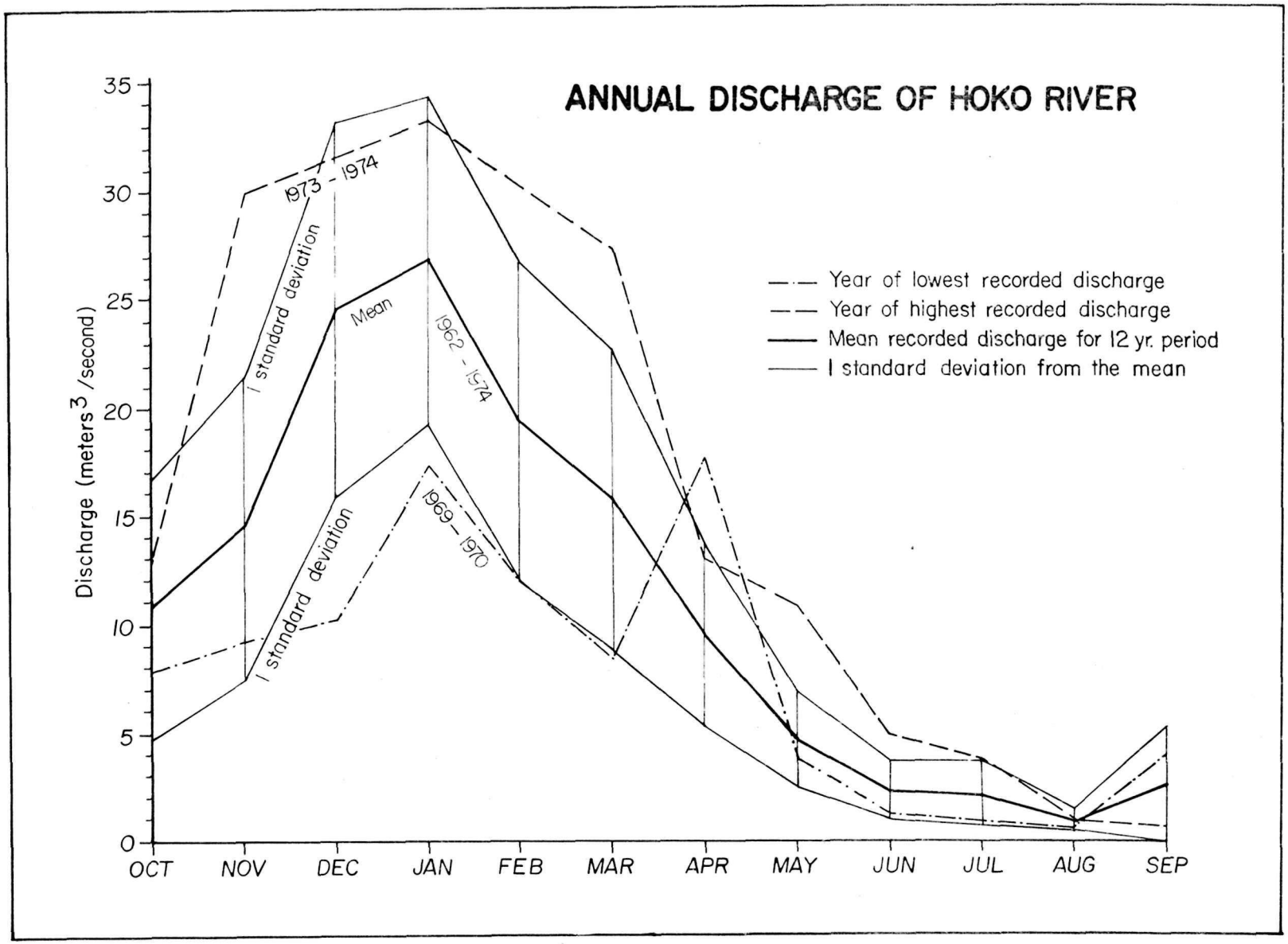


Figure 7. Annual discharge of the Hoko River

Climate

The modern climate of the Hoko River vicinity may be classified as temperate, characterized by low amplitude temperature ranges (approximately 6.7° C in winter and 13.9 °C in summer) and relatively heavy precipitation, a condition largely controlled by subtropical ocean currents (the Japanese Current and, to a lesser extent, the Alaskan Current). The late spring and summer season is dry, with westerly to northwesterly winds generated by the high pressure center over the cold surface of the North Pacific. Late fall and winter is the wet season, with southwesterly and westerly winds from over the ocean providing a source of moisture. The mean annual precipitation in the Hoko River vicinity is approximately 200 to 230 cm. Approximately 80 percent of the annual precipitation falls in the six months from October through March. Precipitation for July and August is less than 5 percent of the annual total (Phillips and Donaldson 1972).

The amount of precipitation correlates closely with the nearness of the locality to the Pacific Ocean and Strait of Juan de Fuca, the elevation, and the exposure to wind currents. The site is low in elevation and somewhat protected from some wind currents by the low set of foothills to the southwest. Since these foothills constitute the main source of the Hoko and Little Hoko rivers, the higher annual precipitation in this region (approximately 345 cm) certainly affects the lower river (Figure 8).

Temperatures are rather uniform in the Hoko River area, corresponding with the uniformity of offshore temperatures. Surface temperatures immediately offshore range from about 8° C to 14° C at Cape Flattery. Total annual variation is about 6° C throughout the area. Onshore temperatures at Tatoosh Island range from a January mean of 5.6° C to a July mean of 13.1° C. Mean annual temperature at Tatoosh is about 9.6° C. Temperatures below freezing are infrequent; Tatoosh Island has a 20-year mean of 322 days with no temperatures below freezing (0° C) and no days recorded with temperatures below -4.4° C (Roll 1974:19).

FLORA

by Marcia Gross

The Hoko River area lies in the Humid Transition Zone of the Olympic Peninsula (Jones 1937:Plate 2), and the dominant vegetation type is that of the "Temperate Moist Coniferous Forest" (Fonda 1974). As mentioned above, its maritime cli-

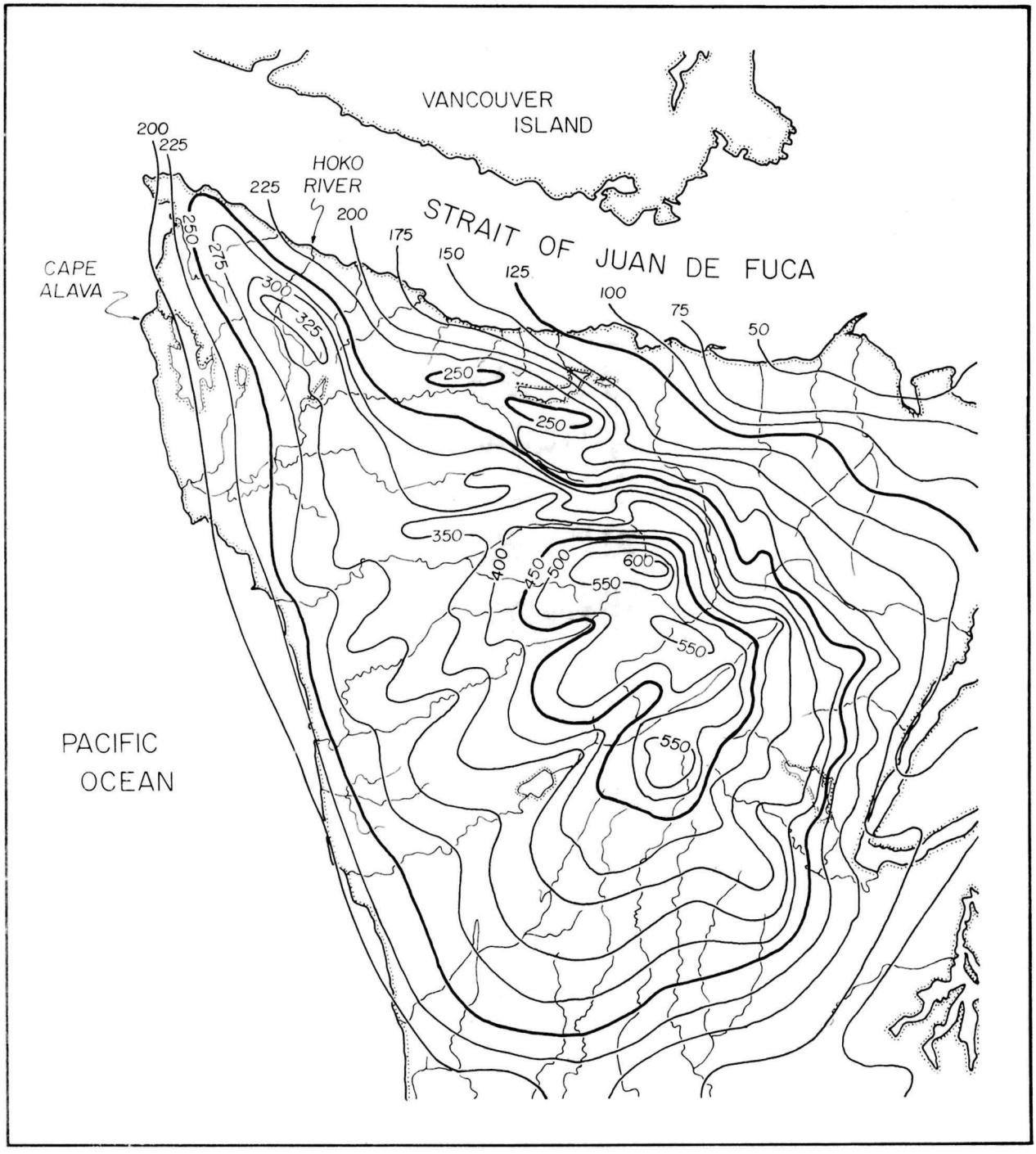


Figure 8. Annual precipitation on the Olympic Peninsula (in centimeters).

mate is relatively wet and mild, with small daily temperature fluctuations in both winter and summer (Franklin and Dyrness 1973). The forest is typically cool, dark, and humid with mosses and decaying logs in the rich humus (Jones 1937).

The project area contains elements of many different plant communities. This is due not only to the obvious environmental factors such as soil type, moisture, and sunlight in a given area, but also to natural and cultural disturbance. Seasonal flooding and shifting soils along the riverbank encourage the growth of one vegetation type, while the clear-cutting practices of local logging companies encourage the growth of other species. Both kinds of disturbance are conducive to the occurrence of "weedy" species that are not indicative of any particular community.

The project area falls into the Picea sitchensis Zone (Figure 9), which is part of the larger Humid Transition Zone. The latter classification covers the area along the coast of the Olympic Peninsula from sea level to 150 m in elevation. Included in the zone is the spruce-hemlock climax forest. Dominant species include Sitka spruce (Picea sitchensis), western red cedar (Thuja plicata) and western hemlock (Tsuga heterophylla). Also occurring occasionally is Douglas-fir (Pseudotsuga menziesii), although this species is not common so near the ocean (Jones 1937). At Hoko five basic communities have been mapped (Figure 10) and are described below.

Salt Marsh and Seashore Meadow Community

Recognized by Jones (1937:41) as a community of the spruce-hemlock climax, salt marsh and seashore meadow occurs along the banks of the Hoko River approaching Kydaka Point in relatively sunny areas where soils are composed of loose, rocky sand that is quite unstable and susceptible to movement with tidal action. Common herbs include cinquefoil (Potentilla pacifica), buttercup (Ranunculus sp.), and sedge (Carex lyngbyei) and (C. sitchensis), with grasses (Deschampsia cespitosa) and weeds like plantain (Plantago lanceolata) and cat's ear (Hypochaeris radicata) occurring as indicators of the soil's disturbance. Also present are a few seashore species like beach sandwort (Honkenya peploides) and beach pea (Lathyrus japonicus) which are reminders of the strong maritime influence at Hoko.

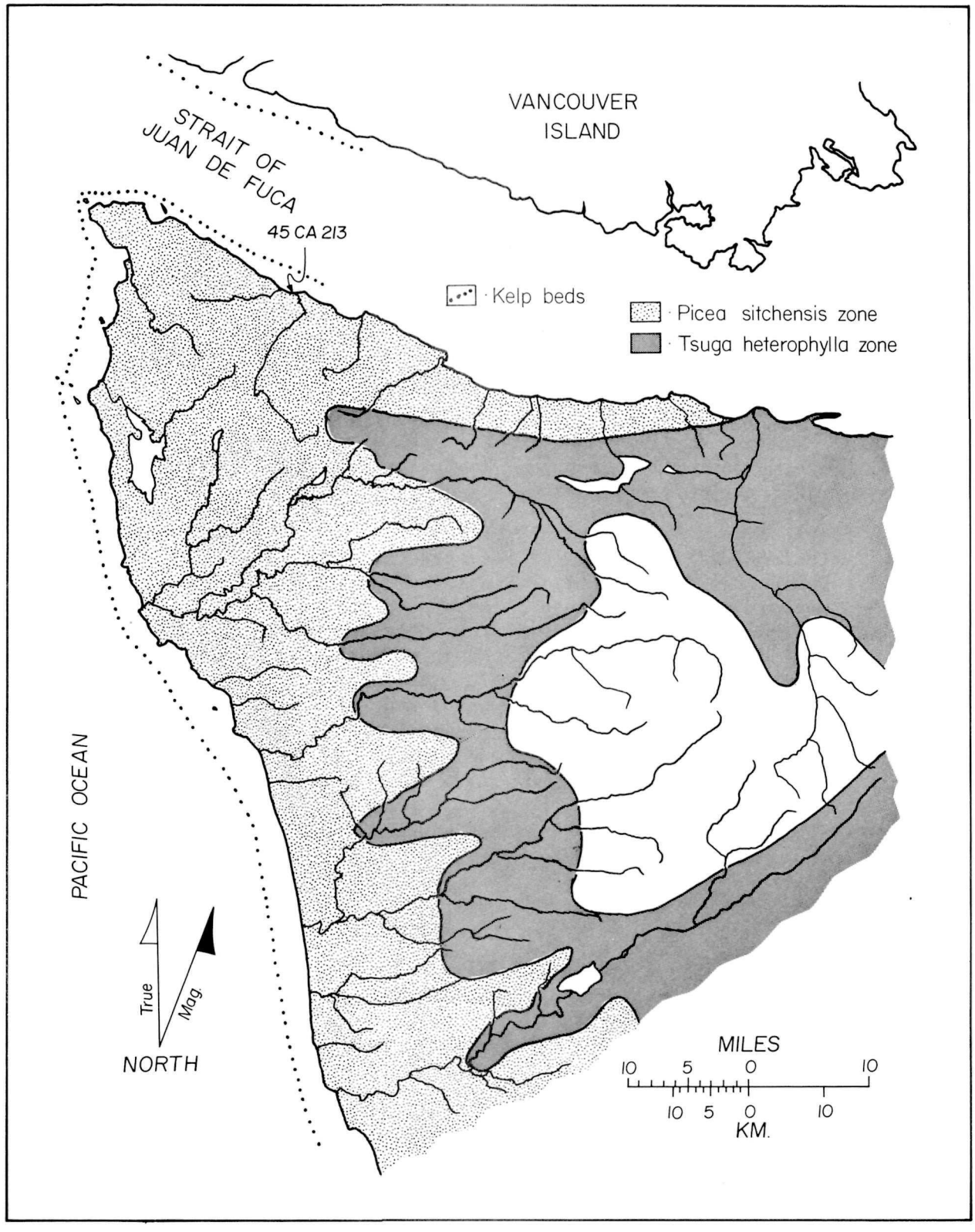


Figure 9. Principal vegetation zones and location of kelp beds in the Hoko River vicinity.

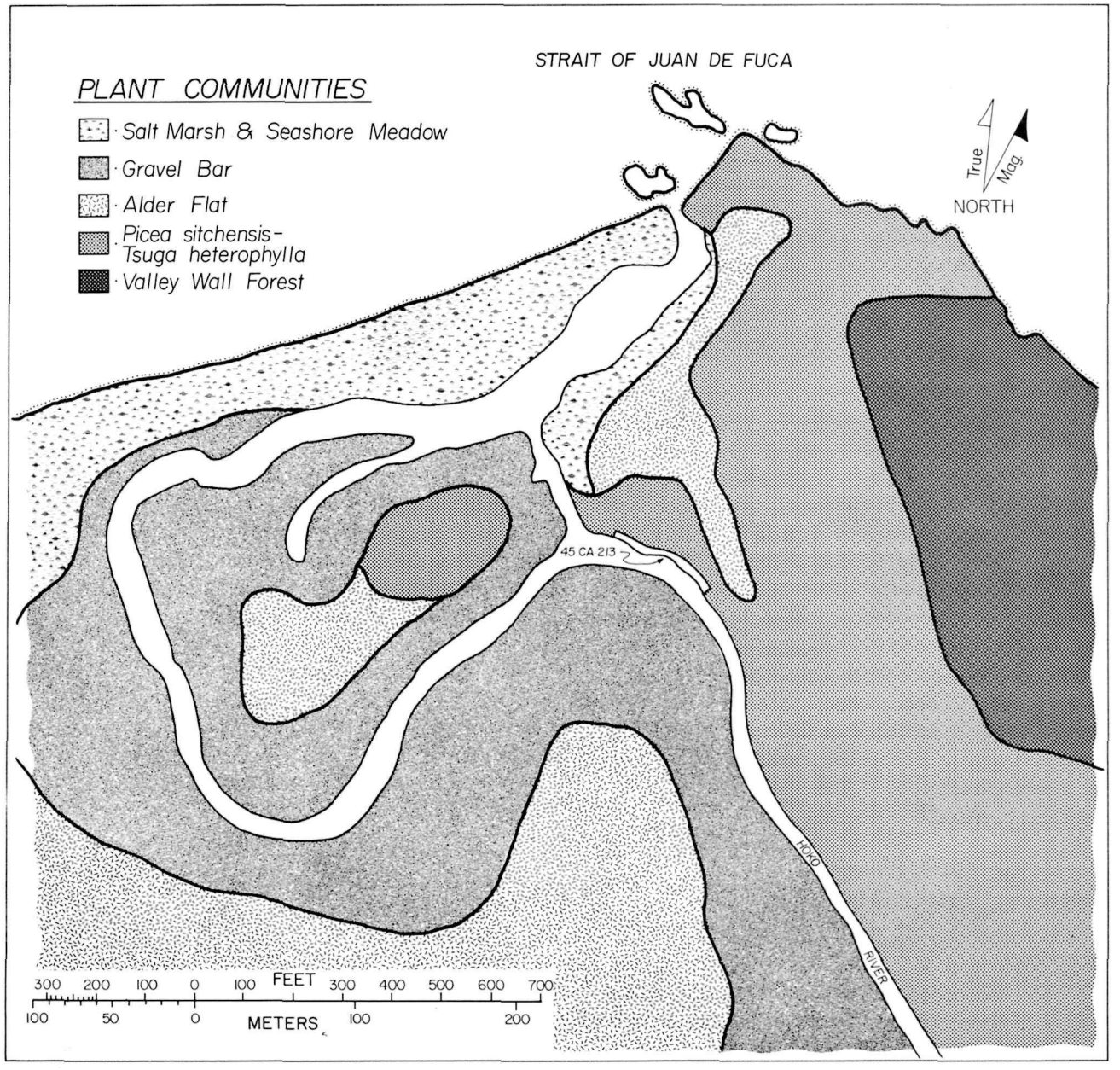


Figure 10. Vegetation map of Hoko River plant communities.

Gravel Bar Community (Fonda 1974)

Occurring farther upstream, nearer the actual Hoko site, this community is evidenced by the presence of willow (Salix sp.), horsetail (Equisetum sp.), and clover (Trifolium repens), as well as the buttercup, plantain, and sedge that occur in the salt marsh community. Slightly farther from the river's edge, where sand covers the cobbles more extensively, red alder (Alnus rubra) is found, with an understory of hedge nettle (Stachys mexicana), sword fern (Polystichium munitum var. munitum), and lady fern (Athyrium felix-femina). This community receives less direct sunlight than the salt marsh community.

Alder Flat Community

This community begins at the edge of the gravel bar (Fonda 1974), and often is a good indicator of man's disturbance. Jones (1937) writes "the red alder...soon springs up where the spruce trees have been felled by man," and this is especially true at Hoko where extensive logging has occurred. Whereas Fonda puts the maximum age of pure stands of alder at 65-75 years, he also states that older stands may show invasion by other trees. At Hoko, both spruce and hemlock occur in the alder stands. Associated shrubs include elderberry (Sambucus racemosa var. arborescens), salmonberry (Rubus spectabilis), salal (Gaultheria shallon), currant (Ribes laxiflorum), and false azalia (Menziesia ferruginea var. ferruginea). Common ferns in this community are licorice fern (Polypodium glycyrrhiza), sword fern, and lady fern in swampy areas and bracken fern (Pteridium aquilinum) in drier spots. Soils consist primarily of fine sand, and the area is generally cool, moist, and shady.

Picea Sitchensis-Tsuga Heterophylla Community

This is a relatively stable community, with the dominant spruce approaching ages of 500-600 years (Fonda 1974), and it would be the dominant community without the disturbance by the logging industry. The community is characterized by the absence of grasses and the abundance of herbs like wood sorrel (Oxalis oregana), trefoil foamflower (Tiarella trifoliata var. trifoliata), wood nymph (Pyrola uniflora), and bedstraw (Galium trifolium). Typical shrubs include huckleberry (Vaccinium sp.) and salmonberry, and lady fern is

abundant. Soils are rich in humus, and the area is moist, cool, and shady.

Valley Wall Forest Community (Fonda 1974)

This community occurs on the slightly higher elevations at the Hoko site, though its pure form is scarce due to extensive clear cuts and disturbance. Dominant trees include cedar and hemlock; salmonberry is the common shrub on north-facing slopes, while south-facing slopes are host to salal and huckleberry. The heavily disturbed areas provide an illustration of forest succession as described by Jones (1937). Fireweed (Epilobium angustifolium) and pearly everlasting (Anaphalis magaritacea) are early successors, followed by shrubs including thimbleberry (Rubus parviflorus), huckleberry, salal, and snowberry (Symphoricarpos albus var. laevigatus).

The general distribution of the five plant communities characterizing the Hoko River area is illustrated in Figure 10. The inventory of all plant specimens collected in the 1977 summer field season is listed in Table 1.

Offshore, the flora include giant kelp (Macrocystis pyrifera and Nereocystis lentkeana), which were important ethnographically as raw material for fishing lines.

Ethnobotany

Jones states that "two major catastrophic events have occurred in the recent history of the lowland areas of the Olympic Peninsula--the Ice Age and the Caucasian invasion" (1937:15). This statement applies to the alteration of communities from not only the taxonomist's standpoint, but from that of the ethnobotanist also. Erna Gunther lamented in her Ethnobotany of Western Washington (1945) that the combined impact of white contact, infiltration, and disturbance decreased the chances of locating both plant specimens and Native American informants to discuss their uses. Today, 34 years after Gunther's research was published, the situation is, of course, even worse. However, based on her information, it appears that almost every specimen collected at Hoko had some ethnobotanic value, and these uses are summarized in Table 2. (A more complete ethnobotanical discussion of each species can be found in Gunther 1945).

Table 1

Inventory of plants collected in the Hoko River vicinity

Species	Common name
Trees	
Alnus rubra	Red alder
Taxus brevifolia	Western yew
Tsuga heterophylla	Western hemlock
Pseudotsuga menziesii	Douglas-fir
Picea sitchensis	Sitka spruce
Thuja plicata	Western red cedar
Shrubs	
Rubus parviflorus	Thimbleberry
Rubus spectabilis	Salmonberry
Rosa nutkana var. *nutkana*	Nootka rose
Corydalis scouleri	Corydalis
Lonicera involucrata var. *involucrata*	Black twinberry
Gaultheria shallon	Salal
Aruncus sylvester	Goatsbeard
Menziesia ferruginea var. *ferruginea*	False-azalea
Pyrus fusca	Pacific crabapple
Sambucus racemosa var. *arborescens*	Red elderberry
Ribes laxiflorum	Currant
Vaccinium parvifolium	Red huckleberry
Vaccinium ocalifolium	Blue huckleberry
Symphoricarpos albus var. *laevigatus*	Snowberry
Cytisus scoparius	Scot's broom
Herbs	
Treintalis latifolia	Western starflower
Ranunculus uncinatus var. *parviflorus*	Little buttercup
Equisteum telmateia	Horsetail
Tiarella trifoliata var. *trifoliata*	Trefoil foamflower
Maianthemum dilatatum	Beadruby
Pyrola uniflora	Wood nymph
Calium trifolium	Sweetscented bedstraw
Lathyrus japonicus	Beach pea
Vicia gigantea	Giant vetch
Heracleum lanatum	Cow parship
Digitalis purpurea	Fox glove
Chrysanthemum leucanthemum	Ox-eye daisy
Stachys mexicana	Hedge nettle
Scrophularia californica	Figwort
Heuchera micrantha var. *diversifolia*	Alumroot
Carex lyngbyei	Lyngby's sedge
Honkenya peploides	Beach sandwort
Polyganum persicaria	Spotted lady's thumb
Plantago lanceolata	Narrow-leaved plantain

Table 1 (continued)

Species	Common name
Ranunculus repens var. *repens*	Creeping buttercup
Oenanthe sarmentosa	Waterparsley
Achillea millefolium var. *californica*	Yarrow
Potentilla pacifica	Cinquefoil
Prunella vulgaris	Common self-heal
Hypochareis radicata	Spotted cat's ear
Epilobium angustifolium	Fireweed
Anaphalis margaritacea	Pearly everlasting
Castelleja minata	Indian paintbrush
Conioselinum pacificum	Hemlock-parsley
Grasses	
Festuca pratensis	Meadow fescue
Phalaris arundinacea	Red canary grass
Elymus glaucus	Blue wildeye
Bromus sitchensis	Alaskan brome
Elymus mollis	Dune wildrye
Festuca arundinacea	Tall fescue
Deschampsia cespitosa	Tufted hairgrass
Ferns	
Adiantum pendantum	Maidenhair
Polystichium munitum var. *munitum*	Sword
Drypoteris austriaca	Wood
Blechnum spicant	Deer
Athyrium felix-femina	Lady
Polypodium glycyrrhiza	Licorice
Pteridium aquilinum	Bracken

Table 2

Ethnobotany

Plant	Purpose		
	Food	Medicine	Other
Red alder	x	x	dye extracted from bark; woodworking material; shelter
Western yew		x	needles dried and smoked; basketry material
Western hemlock		x	dye extracted from bark; boughs used as nets, shelter; firewood; charm
Douglas-fir		x	dye extracted from bark; firewood; woodworking material
Sitka spruce	x	x	basketry and woodworking material; pitch used as calking; charm
Western red cedar		x	basketry and woodworking material; plant parts used in ceremonies
Thimbleberry	x		
Salmonberry	x	x	stems used as pipe stems, fishing floats
Nootka rose	x	x	
Black twinberry		x	dye extracted from berries
Salal	x	x	leaves used as cooking aid; tobacco substitute
Goatsbeard		x	
False-azalea			sticks woven into canoe mats; love charm
Pacific crabapple	x	x	woodworking material
Red elderberry	x	x	
Currant	x	x	
Red huckleberry	x	x	
Blue huckleberry	x	x	
Snowberry		x	
Western starflower		x	
Buttercup	x		
Horsetail	x	x	sandpaper; horsefodder; basketry material

Table 2 (continued)

Plant	Purpose		
	Food	Medicine	Other
Trefoil foamflower		x	
Beadruby	x	x	
Sweetscenter bedstraw		x	love charm
Giant vetch	x	x	love charm
Cow parsnip	x	x	basketry material
Ox-eye daisy		x	
Hedge nettle	x	x	
Alumroot		x	
Sedge			basketry material
Waterparsley	x	x	stems used in children's whistles
Yarrow		x	
Cinquefoil	x		
Common self-heal		x	
Fireweed		x	fiber for blankets
Pearly everlasting		x	
Paintbrush		x	
Maidenhair fern		x	basketry material
Sword fern	x	x	
Wood fern	x	x	
Deer fern		x	
Lady fern	x	x	
Licorice fern		x	
Bracken fern	x		bedding; aid in fish cleaning
Dune wildrye		x	

FAUNA

by Edward Freidman and Dale R. Croes

The location of the Hoko River archaeological site at the interface of a variety of microenvironments appears to represent an attempt by the early inhabitants to maximize their potential economic resource base. It is noted by Odum that "the ecotonal community commonly contains many of the organisms of each of the overlapping communities and, in addition, organisms which are characteristic of, and often restricted to, the ecotone. Often, both the number of species and the population density of some of the species are greater in the ecotone than in the communities flanking it. The tendency for increased variety and density at community junctions is known as the "edge effect" (1959:278).

One of the problems inherent in studying the fauna of the coastal region in a microenvironmental scheme is that numerous species each occupy a variety of zones. Some, like the salmon (Oncorhynchus sp.), inhabit different environments during their life cycles. Others occupy different zones on a daily round, for example bears (Ursus americanus) coming from the coastal hills to the lowlands in their food quest. In fact, only shellfish resources maintain residence in a single microenvironment. Therefore, each of the major animal groupings, i.e., land mammals, sea mammals, birds, fish, and shellfish, will be considered in terms of its occurrence throughout the various coastal microenvironments.

Land Mammals

Land mammals played a role in the native economy of the area. The primary species are elk (Cervus canadensis) and black-tailed deer (Odocoileus hemionus) both of which are abundant and served as a food source. Elk can be found in herds of up to 100 head in the mountain areas. In the lowlands where herds are smaller, five to ten individuals per herd is normal (Dalquest 1948:393). Most elk are migratory to a limited extent; they are found in the higher mountains during spring and summer, and then move to lowland areas as snow fall accumulates. The black-tailed deer is ubiquitous. Individuals are encountered singly or in pairs, very seldom in herds (Dalquest 1948:402).

Numerous other land mammals are found in the vicinity and were used by the ethnographic population of the area. Table 3 lists those species which were hunted or trapped primarily for their fur or hides during aboriginal times. Other mammalian forms include the snowshoe hare (Lepus americanus),

Table 3

Fur-bearing mammals of the North Olympic Peninsula

Species	Common name
Ursus americanus[1]	Black bear
Canis latrans	Coyote
Canis lupis	Timber wolf
Felis concolor	Mountain lion
Lynx rufus	Bobcat
Procyon lotor	Raccoon
Martes americana	Marten
Martes pennanti	Fisher
Mustela vison	Mink
Mustela frenata	Long-tailed weasel
Mustela erminea	Ermine
Mephitis mephitis	Striped skunk
Lutra canadensis	River otter
Castor canadensis	Beaver
Ondatra zibethicus	Muskrat

[1] Scientific nomenclature based on Banfield (1974).

mountain beaver (Aplodontia rufa), Douglas squirrel (Tamiasciurus douglasii), northern flying squirrel (Glaucomys sabrinus), and Townsend chipmunk (Tamias townsendii). In addition to the above, numerous other rodent species occur in the region, as do several species of insectivores and bats.

Sea Mammals

Several sea mammal species occur within the exploitation zone of the Hoko site. Steller sea lion (Eumetopias jubata) is most commonly found along the outer coast, although there are exceptions, as young subadult males are known to travel along the inland passages as they migrate from one part of their range to another. The harbor seal (Phoca vitulina) is also found in the site vicinity. Individuals do not migrate but seek protected areas, such as bays or river mouths, as their territory. They are attracted to river estuaries when the salmon are migrating upriver. The last pinniped species found in the area, fur seal (Callorhinus ursinus) is recorded as an uncommonly observed straggler. It normally is found 16 to 24 km from shore along its Pacific migration route from northern California to the breeding grounds in the Bering Sea.

Whales, porpoises, and dolphins (Cetacea) also frequent the coastal waters off Hoko. The Pacific harbor porpoise (Phocoena phocoena) is the most common of all the cetaceans in the Strait of Juan de Fuca. The season of their greatest abundance in the strait is summer (Scheffer and Slipp 1948:291). The striped dolphin (Lagenorhynchus obliquidens) is found in the strait during the summer months. The killer whale (Orcinus orca) is a year-round resident in the inland waters of Washington state. The gray whale (Eschrichtius robustus), finback (Balaenoptera physolus), and the humpback (Megaptera novaeangliae) all have been recorded in the Strait of Juan de Fuca off the Hoko area. According to Scheffer and Slipp, "the humpback is probably the commonest of the large whales visiting the inland waters of the state" (1948:322).

Birds

The bird species that occur in the Hoko River area are quite numerous, and a listing of all the species would be of limited utility in understanding the economy of the inhabitants of the site. Rather, use will be made of Gunther's (1936)

report on the ethnozoology of the Makah, the most thorough study of native use of avian fauna on the central Northwest Coast. In that work, entitled "A preliminary report on the zoological knowledge of the Makah," 50 bird species are noted. Friedman, conducting an archaeological survey in Makah territory, identified 43 bird species (Table 4) as occurring in midden deposits (1976:127-129). Only ten of the species which were discussed in the ethnographic literature (Gunther 1936; Olson 1936; Swan 1870; Underhill 1945) were not recovered during archaeological investigations of Makah territory. Those recorded ethnographically but not recovered archaeologically are the mallard (Anas platyrhynchos), scaup (Aythya sp.), blue grouse (Dendragapus obscurus), red-headed woodpecker (Melanerpes erythrocephalus), belted kingfisher (Megaceryle alcyon), harlequin duck (Histrionicus histrionicus), golden eagle (Aquila chrysaetos), pigeon guillemot (Cepphus columba), sandpiper (Erolia sp.), and black oystercatcher (Haematopus bachmani). Although other species do occur in the area, they were neither recorded ethnographically nor recovered archaeologically.

Fish

Fish resources in the ethnographic accounts are dominated by the various species of salmon (Oncorhynchus sp.). Three species are common to the Hoko River: coho or silver salmon (O. kisutch) the chinook, spring, or king salmon (O. tshawytscha) and the chum or dog salmon (O. keta). For a detailed description of these salmon and their occurrence in the Hoko River vicinity, see the section on Fish Habitat Zones immediately following.

Other fish species common to the area that played an important role in the aboriginal diet are included in Table 5. Most of these fish species inhabit the neritic ocean zone, but several (notably the salmon, but including the eulachon, cutthroat trout, steelhead, and the starry flounder) can be found in the Hoko River at various times during their life cycles.

There are numerous additional fish species in the environs of the Hoko site, but those listed in Table 5 either are recorded as occurring in other sites of the area (Friedman 1976) or are mentioned in ethnographic accounts dealing with the local people (Swan 1870; Haeberlin and Gunther 1930; Gunther 1936; Drucker 1951).

Table 4

Birds recovered from midden deposits in Makah territory

Species	Common name
Gavia immer[1]	Common loon
Gavia artica	Arctic loon
Gavia stellata	Red-throated loon
Podiceps grisegena	Red-necked grebe
Podiceps auritus	Horned grebe
Aechmophorus occidentalis	Western grebe
Diomedea nigripes	Black-footed albatross
Fulmarus glacialis	Northern fulmar
Puffinus griseus	Sooty shearwater
Puffinus tenuirostris	Slender-billed shearwater
Oceanodroma leucorhoa	Leach's petrel
Phalacrocorax pencillatus	Brandt's cormorant
Phalacrocorax auritus	Double-crested cormorant
Phalacrocorax pelagicus	Pelagic cormorant
Ardea herodias	Great blue heron
Olor columbianus	Whistling swan
Branta canadensis	Canada goose
Bucephala albeola	Bufflehead
Clangula hyemalis	Oldsquaw
Melanitta deglandi	White-winged scoter
Melanitta perspicillata	Surf scoter
Mergus merganser	Common merganser
Mergus serrator	Red-breasted merganser
Haliaeetus leucocephalus	Bald eagle
Arenaria interpres	Ruddy turnstone
Arenaria melanocephala	Black turnstone
Heteroscelus incanus	Wandering tatler
Larus glaucescens	Glaucous-winged gull
Larus occidentalis	Western gull
Larus argentatus	Herring gull
Larus canus	Mew gull
Larus philadelphia	Bonaparte's gull
Larus californicus	California gull
Larus hermanni	Heermann's gull
Rissa tridactyla	Black-legged kittiwak
Sterno hirundo	Common tern
Uria aalge	Common murre
Brachyramphus marmoratus	Marbeled murrelet
Ptychoramphus aleuticus	Cassin's auklet
Cerorhinca monocerata	Rhinoceros auklet

Table 4 (continued)

Species	Common name
Lunda cirrhata	Tufted puffin
Corvus caurinus	Crow

[1]Scientific nomenclature based on Godfrey (1966).

Table 5

Fish species other than salmon which were used by Northwest Coast aboriginal peoples

Species	Common name
Squalus acanthias[1]	Spiny dogfish
Clupea pallasi	Pacific herring
Salmo clarki	Coastal cutthroat trout
Salmo gairdneri	Steelhead
Thaleichthys pacificus	Eulachon
Gadus marcocephalus	Pacific cod
Sebastes sp.	Rockfish (various)
Hexagrammos sp.	Greenling
Ophiodon elongatus	Lingcod
Scopaenichthys marmoratus	Cabezon
Hippoglossus stenolepis	Pacific halibut
Lepedopsitts bilineata	Rock sole
Platichthys stellatus	Starry flounder

[1]Scientific nomenclature based on Hart (1973).

Shellfish

The most common shellfish along the rocky shore east of the mouth of the Hoko River are mussels (Mytilus edulis and M. californianus). Also abundant in these intertidal rocky areas are sea urchins (Strongylocentrotus purpuratus), chitons (those of special ethnographic importance include Katherina tunicata and Cryptochiton stelleri) and various anemones, limpets, snails, and crabs. Sandy beaches immediately off the Hoko River mouth shift frequently and do not have large populations of shellfish. To the west of Hoko, in the vicinity of the Sekiu River, various species of clams can be found, including the butter clam (Saxidomus giganteus).

Fish Habitat Zones

by David Huelsbeck and Dale R. Croes

The Riverine Habitat Zone

In terms of human food resources, the most important riverine fauna are fish. Steelhead (Salmo gairdneri) and cutthroat trout (Salmo clarki) are common to Hoko River, living in either estuary or fresh water but spawning in fresh. Steelhead weighing as much as 22.5 kg have been captured (Hart 1973:129). The major steelhead run is from late November through March. The Hoko River was once noted as one of the best steelhead rivers in Washington.

The salmon (genus Oncorhynchus) were of particular importance to prehistoric inhabitants all along the Northwest Coast. As noted above, three species are common to the Hoko River: coho or silver salmon (O. kisutch) chinook, spring, or king salmon (O. tshawytscha) and chum or dog salmon (O. keta). The silver salmon run from early November to mid-December. The average size of a member of this species, according to Hart (1973:116), is about 76 cm and 2.75 to 5.5 kg. At present the size of the run varies between 200 and 5,000 fish--corresponding to the size of the hatchery plants. Historically, before planting, 800 to 1,600 silver were recorded (Randy Johnson, personal communication).

The runs of the chinook salmon occur in the Hoko River from late September through early November. This fish is the largest of the Pacific salmon and averages 91.5 cm in length and 4.5 to 6.8 kg in weight (Hart 1973:125). The size of the run varies between 100 and 800--again corresponding to the size of hatchery plants. Historically a larger count, 700 to 1,500, is recorded.

Chum or dog salmon run from November through December and only spawn a short distance above the tidal zone. Present size of the run is 100 to 300 fish, and there is no hatchery planting. Historically a much larger run occurred, varying from 1,000 to 2,500 fish. Average weight of this species is 4.5 kg. Native inhabitants valued this salmon since they are lean, have good keeping qualities, and are more easily dried than salmon that have more fat, such as the coho. The Hoko and the Lyre River, farther east (Figure 6), were fished by the Makah for dog salmon, which were smoked for winter stores (Lane 1973:20).

The historically reported sizes of runs of various species of salmon are undoubtedly much smaller than those of the pre-white-contact runs. A river in the area which is currently being intensively studied, the Ozette River, is reported to have had a sockeye salmon run of a few thousand fish in 1926 (Rounsefell and Keley 1938:756). However, the carrying capacity of the river system is conservatively estimated to be 30,000 salmon, and it is likely that precontact runs were approximately this size (Chris Dlugokenski, personal communication). While the actual size of the Hoko River runs cannot be estimated in this report, salmon definitely were a much larger potential resource than the historical figures suggest.

The Estuarine Habitat Zone

Fish of importance in the Hoko estuary include the starry flounder (Platichthys stellatus), spiny dogfish (Squalus acanthias), redtail surfperch (Amphistichus rhodoterus), and various sculpins (family Cottidae). Salmon, of course, pass through the estuary on their upstream migration and could be taken there as well as in the upper river. However, they are more difficult to procure here because of the depth and width of the estuary than they are further upstream.

The Intertidal Habitat Zone

A variety of small sculpins (family Cottidae) are present in the intertidal zone, but the surf smelt (Hypomesus pretiosus), which might occasionally spawn off the beaches in the area, is probably the only fish taken for food in this zone.

The Neritic Habitat Zone

To native inhabitants, the neritic microenvironment (here defined as waters less than 200 m deep) would have been important for its fish and sea mammals. After maturity, the salmon congregate in this microenvironment before moving into streams and rivers to spawn. Pink or humpback salmon (Oncorhynchus gorbusha) and sockeye or blueback salmon

(Orcorhynchus nerka) can be taken in this zone as can those species of salmon that spawn up the Hoko River. In these waters salmon can be caught by trolling or netting.

Herring (Clupea pallasi) are abundant in these waters in the winter and spring months when they are spawning. Anchovies (Engraulis mordax) and eulachon (Thaleichthys pacificus) also are present (Hart 1973:105,149).

Large numbers of demersal or ground fish inhabit this zone off the mouth of the Hoko River. Principal varieties are the flatfish (families Pleuronectidae and Bathidae), rockfish (family Scorpaenidae), roundfish (families Gadidae, Anoplopomatidae, and Hexagrammidae), sharks (Squalidae), and skates (Rajidae). Most of these are also found in the outlying and much deeper Oceanic Zone as well. There is a well-known halibut bank directly off the mouth of the Hoko River, where halibut (Hippoglossaus stenolepis) and other flatfish were once abundant. Rockfish common to these waters include black rockfish or bass (Sebastes melanops) and red snappers (Sebastes ruberrimus) roundfish include cod (Gadus macrocephalus) and lingcod (Ophiodon elongatus) and cartilaginous fish include dogfish (Squalus acanthias), skates (Raja spp.), and ratfish (Hydrolagus colliei).

ETHNOHISTORY

by Jenel Virden and Maureen Brinck-Lund

The mouth of the Hoko River, which is commonly referred to as the Okeho--a Makah name--in many of the early reports, maps, and texts (Figure 11), is located about 27 km east of Cape Flattery, the northwest tip of the Olympic Peninsula. North from the mouth of the river, Vancouver Island is visible 29 km away, across the Strait of Juan de Fuca (Figure 6). The strait is the main passageway of water from the Pacific Ocean to Puget Sound, and it undoubtedly served as a major route of contact between outer coast groups and Puget Sound/Gulf of Georgia groups for centuries. The Hoko River mouth is close enough to the Pacific Ocean to be considered exposed to its direct influence.

What is known of the aboriginal cultures at the Hoko River must be reconstructed from various sources. Fortunately, there are written documents from the earliest contacts. These sources, combined with the archaeological data and miscellaneous official reports and documents, make up a body of information on the cultures which flourished in the area prior to the influx of Europeans.



Figure 11. From one of the earliest maps (Gibbs 1877) of the Hoko area showing distribution of Indian linguistic groups ca. 1876. Note spelling of Hoko as "Okeho" River. Also note that there are several inaccuracies in the map.

The Hoko River is considered the boundary between the Makah and the Clallam tribes in both the Point No Point Treaty with the Clallams and the Treaty of Neah Bay with the Makahs in 1859. As early as 1854 there are reports of a settlement at the mouth of the Hoko. George Gibbs sent a report to the Territorial Governor on Febuary 7, 1854, declaring that the Hoko "is the resort of runaways from both the Clallams and the Makahs" (Gibbs 1854). This began the debate over use of the river that continues even today.

The Hoko appears to be a place of overlap between two distinct neighboring groups. Mention of the river-mouth settlement is missing in the list of Makah villages in the 1855 treaty with the Makahs; this is not surprising, however, since even today it is considered a major seasonal (spring/summer/fall) fishing camp rather than a large winter village. Historian Gibbs, who accompanied the treaty party of 1855, does list Hoko as a Clallam village, even though Makahs lived there as well. He states that the Clallam "have eight villages, viz: Commencing nearest the Makahs, Okeno, or Ocha, which is a sort of alsatia or neutral ground for the runaways of both tribes" (1855). Waterman, when considering Clallam territory, indicates "Hoko River is given by Gibbs as their westernmost stronghold and by Curtis as a village half Clallam and half Makah. My own information indicates that it was only a fishing station" (Waterman, quoted in Lane 1975:22). Curtis points out that Hoko is a Makah word meaning "projecting," referring to a large rock at the mouth of the Hoko Creek (1913:174;see Figures 12 and 13). He also says the "village" at that time consisted of of "six houses of mixed Makah and Clallam" (1913:174). These data indicate that both tribes were interested in the river; they probably used the rivermouth site as a major fishing station.

In discussing Clallam settlement patterns, Gunther (1927) mentions that the people generally moved from their sites on the strait to Hood Canal to fish the salmon runs. She mentions the residents of the Hoko as being the one exception (Gunther 1927:195). Apparently, this group remained in that vicinity. She states "the people from Hoko River do not go because their own river has every variety of salmon, but the same reason does not keep the people from Dungeness at home" (1927:195). Possibly joint use of the site allowed the residents of Hoko to be somewhat independent; they were intermediaries sharing and transferring resources from both directions, maintaining relationships on each side. This was possibly one of their most important economic assets. Certainly the historic Makah and Clallam families who used the Hoko River region did so with defined rights to those resources. As Drucker points out:

> each group regarded the areas it utilized as the exclusive property of the group. Group members used habitation sites, fishing grounds, clam beaches, hunting and berrying grounds, forest areas where timber and bark were obtained, through right; outsiders by invitation or trespass (Drucker 1965).

According to one Makah member giving testimony in 1975, each family had rights to fish in certain areas which were reaffirmed during potlatch ceremonies; one of these areas was Hoko. This would allow only certain families to fish on the river. Lane suggests that due to intermarriage between Makahs and Clallams over the years before and after 1859 (the year of the treaty), the right to fish at Hoko has pertained to members of both tribes. Cultural access was probably not equal, however. The proximity of Hoko to the historic Makah cultural center (and its comparative distance from the Clallam center further east) as well as the heavy Makah influence in the region as a whole would suggest that the balance of control would have been with the Makah. However the exact degree of influence or control of the locality by either cultural group may never be completely understood or defined.

In 1942 Edward Swindell, an agent for the Office of Indian Affairs, U.S. Department of Interior, obtained the testimony of several Makah and one individual who was half Makah and half Clallam concerning the Makah families who fished at Hoko River. They state that the families had fished there for as long as could be remembered, with the fishing area stretching from half a mile out into the strait to a point up the river where the falls are located, a distance of approximately ten miles. Included in the testimony were accounts of the camp at the river mouth, which consisted of four houses. Since Swindell's report is an early document and contains invaluable ethnographic statements concerning fishing and the use of the Hoko River, portions of pertinent interviews are quoted in the appendix following this paper. We would summarize the observations from these interviews that are most pertinent to the Hoko River Project as follows:

1. The Hoko River is clearly considered "Makah Indian fishing grounds."

2. At the turn of the century 30 to 40 adults and children moved seasonally from Neah Bay to Hoko River to fish.

3. They would go in September and come home in November.

4. Their main objective was to obtain and dry the winter stock of salmon. Upon the return to Neah Bay, surplus dried salmon (especially the valued dried dog salmon) was traded for products which the Hoko families wanted and to which they probably had limited access. Families in Neah Bay who had rights to halibut fishing grounds and whaling grounds probably were interested in obtaining dried dog salmon--a product to which they probably had limited access.

5. Slightly after the turn of the century some families (probably extended families) caught 300 to 400 salmon apiece from the Hoko River.

6. They used traps located up the river as far as the Hoko River falls to obtain the winter supply of salmon.

7. Traps were located well up river so salmon would be leaner and thus more easily preserved.

8. To obtain fresh salmon to eat immediately, spears were used.

9. Several camps were located on the river.

10. Ten canoe loads of fresh salmon were often transported at one time from traps to the camps for processing and smoke drying.

11. Potlatches were used, and especially by a Makah family named Kee-chuckh, to reserve rights to fish on the Hoko River.

12. One and one half miles out from the Hoko River mouth is a halibut and lingcod fishing ground.

Other references to Hoko River ethnography have also been found. Colson states that the Makah:

> claim that their lands extended in this direction as far as Hoko River, and possibly to Lyre River near Port Angeles. At the mouth of the Hoko, many gather in the fall to set their nets for the salmon that run up the Hoko in large numbers. It is an important economic asset to the tribe: the Hoko fishing often supplies a family with money to last the winter (1953:44).

In reference to Makah fishing, Lane points out that dog salmon were available to them in the Hoko River and in the Lyre River further east (Figure 6), and that this salmon was particularly valued since "they are lean and have better keeping qualities and are more easily dried than salmon with more fat...."(1973:20). Families with appropriate rights would stay for two to three months at the Hoko camp during the fall, then return to Neah Bay villages and trade some of their smoked fish for dried halibut or whale.

The Euro-American impact on the area basically resulted from logging and agricultural activities, especially clearing of the forests, which caused considerable alteration of the river valley (Figures 12-15). At this point only preliminary notes have been gathered on the history of this impact; additional information will be gathered in subsequent fieldwork.

Ethnohistory -- Appendix

The following are selected statements made by Makah elders in July of 1942 concerning the use of the Hoko River area. The interviews were conducted by Edward G. Swindell, Jr.(1942), for the United States Department of the Interior, Office of Indian Affairs. The complete document is on deposit at the University of Washington Law Library and is indexed as follows:

Report on Source, Nature, and Extent of the Fishing, Hunting, and Miscellaneous Related Rights of Certain Indian Tribes in Washington and Oregon together with the affidavits showing location of a Number of Usual and Accustomed Fishing Grounds and Stations.

United States Department of the Interior, Office of Indian Affairs, Division of Forestry and Grazing, Los Angeles, California, July 1942.

by Swindell, Edward G., Jr.

Discussion 1: Edward Swindell (E.S.) and Henry St. Clair (H.S.), Makah, age 67, born at Neah Bay, Washington.

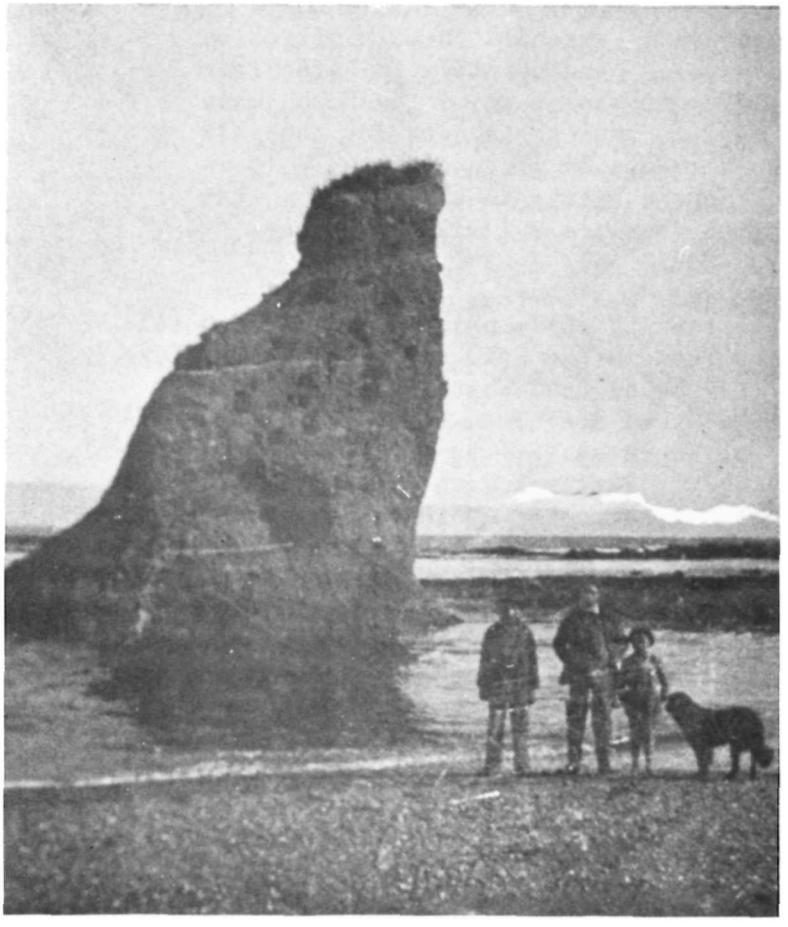


Figure 12. Portrait of unknown individuals next to the Hoko River rock, at the mouth of the river (ca. 1900). Photos in Figures 12-15 courtesy of Helena Talbot.

Figure 13. Pile driving operation next to the Hoko River rock (ca. 1900). Early logging operations used the pilings to position log rafts. Soon after this photograph was taken the rock was dynamited and removed.

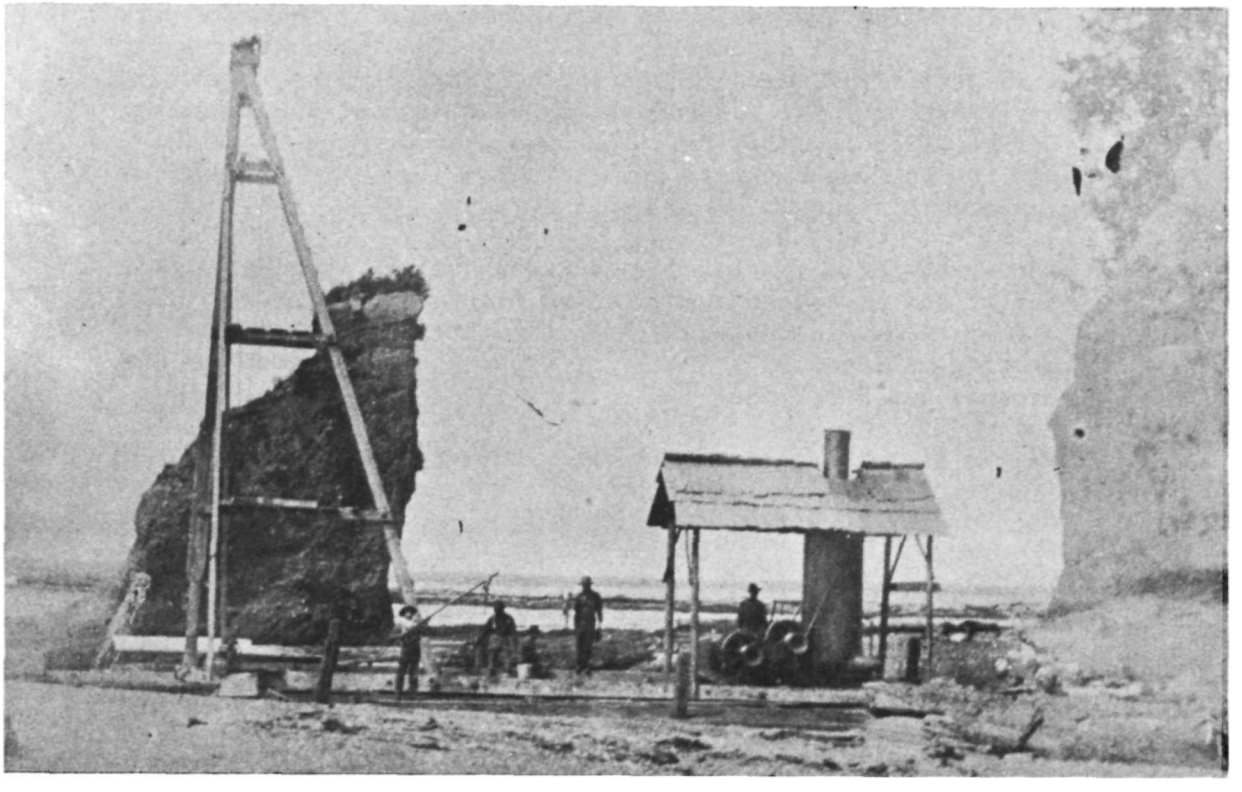




Figure 14. Sawn logs skidded into the Hoko River (approximately 1910).



Figure 15. Logs in the Hoko River awaiting the next high waters when a "log drive" would take place to move them to the river mouth (approximately 1910).

E.S.: Are you familiar with the location of the usual and accustomed grounds of the Makah's outside the boundaries of this reservation? Do you know where they are located? I wonder if you would tell me as generally as you can where those places are?

H.S.: Yes I know Hoko River. I know Lyre River and Sekiu River.

E.S.: Did you ever fish at those places?

H.S.: I fish the Lyre River and the Hoko.

Did you see Indians fish at Sekiu?

Yes I saw Luke Markishtum's old folks fishing there.

When was the first time you fished at the Hoko?

I was a little boy when first fishing at the Hoko.

Who was it you went to Hoko with to fish when you were a little boy?

I went with my grandfather and my father.

Why did your father and grandfather go up there to fish?

Because the river was Makah Indian fishing ground.

What did they catch there?

They caught silver and jack salmon, steelhead and little dogs.

Couldn't they catch that kind here at Neah Bay?

There were too many Indians at Neah Bay; they all fished the streams here, and they pick out that place where they can fish at Hoko.

Did other Indians move up besides your folks?

Lots of them. I would say about 30 or 40 adults.

Did they take children with them?

They used to.

How long did they stay at the Hoko?

They would go up in September and come home in November. Almost two months.

How far up the river?

Up to the waterfalls.

While they spent the time did they dry the fish?

Yes.

For what purpose?

For the winter, bring smoke fish to Neah Bay.

Did they catch lots of fish?

Some families caught 300 or 400, and then they trade some of them to other Indians for dried halibut.

While they were up there at the permanent Hoko Camp, did they have smokehouses and did they smoke their fish right there?

Yes.

Did they catch their fish right there?

Well, they had a trap.

How was the trap made?

Out of timber, cedar poles, and twisted cedar limbs. (Mr. St. Clair gave Mr. Swindell an illustration on paper as to how the traps were made.)

Was that the only way?

Well, they used to spear them with spear.

Why spear them?

They had that for fresh fish.

Couldn't they catch enough from the trap?

The traps were too far away from the camp.

They all lived at the same camp?

They would go up to the trap and get the fish and then they also went out and spear (sic) them.

In other words the traps were away from the river mouth. Why?

Because when the fish is up so long, it dries good, and when the fish is fat, it don't dry good.

Mr. Beaulieu here asked: "Wasn't that after the fish got thru spawning when they were better to smoke?"

Yes.

Did the Indians use these two rivers (Lyre and Hoko) before you were born, for fishing purpose?

That is what my father told me.

Did they use them before your father was born?

Yes, because my father told me my grandfather used to be there all the time.

Do you know how long they used it as a fishing ground?

Well, I couldn't tell you, my grandfather seen the time when there was big small pox there.

Have you ever heard how long the Indians have been using that place?

Well I heard they used it all the time, before the white settlers came in.

How did they go up there?

In canoes.

They couldn't go on shore?

There was no road there.

Discussion 2: Edward Swindell (E.S.) and Joe Sly (J.S.), Makah, approximately 83 years of age, born at Sekiu River. His mother belonged to the Makah tribe, and his father to the Clallam tribe. Luke Markishtum, Makah, interpreted for Joe Sly:

E.S.: Were you born at the mouth of the Sekiu River?

J.S.: Yes.

E.S.: Was that the permanent home of your father and mother?

J.S.: No, temporary home, a place to preserve food for winter use.

Where was the permanent home of your mother and father?

My father at Port Townsend and my mother lived here.

Even after they were married?

They were together at Neah Bay. My father was here whenever he wanted to be here.

Did you ever go back when you were a young boy or a young man?

I was in Hoko and Sekiu as a child. I fished both places.

Did you camp at the Sekiu River?

My mother used to be there whenever she wants to be there.

Why did she go there?

To preserve fish for winter use.

How long?

Sometimes 3 months, and sometimes for just a short time.

Sometimes for only two or three weeks?

They stayed whenever they went there.

Did other Indians go there to camp when your mother and father were there?

Just members of the family--not from the other family. (He named the following as those who went to Hoko: Kee-chukh, Quedessa, Yokum, LaChester, Circus Him, Tallacus, and Hoko Charlie.)

They were all from here?

They had permanent homes in Neah Bay. This is our own permanent home.

Why didn't other people go up there to fish?

Those that had rights at the place, they would ask others to come along and fish with them so that they could have fish for themselves. I am talking about when I was a young man. They used to start making the traps about in August before the fish comes. When the water begins running high in the river, they had a place where they could be blocked, they also had a opening where the fish could go through. Sometimes there were 7 or 8 camps, and there were lots of fish in the trap. They would divide up the fish.

They loaded these fish into the canoes, did they?

They put it in the canoes--ten canoe loads at times.

You mean they had 10 canoe loads of fish after they were all dried?

No, when they first get the fish from the trap they put it into the canoes.

How far was the camp from the trap?

Couple miles.

The camp was at the mouth of the river was it?

There were 4 houses there.

In other words more Indians went to Hoko than Sekiu.

Yes.

On Hoko they used the trap you described, did they?

Yes.

The trap was located about two miles above the mouth of the river?

Yes I can point it out to you where it used to be.

After the Indians caught fish at the trap, they took them down to the camp with their canoes?

Yes, to dry them.

After they obtained enough fish there did they return to Neah Bay?

Those that wanted to came back bringing dried fish.

After they came home did they trade any of these fish with people that lived here and had not gone to Hoko?

Yes, they traded with whatever they wanted to trade with: dried whale, dried halibut.

This was before the white man came?

Yes, and ever since there has been daylight!

Did any of the boats of the white man stop for water and get fish for trade for something?

They traded for salmon and halibut. The white man did. And we got sugar and pilot bread. The Indians never used to eat pork and bacon. The boats bought from the Indians halibut oil, skins with molasses, and liquor and cranberries.

Did you ever get cash from the white man?

The Indians did not know money at that time. They only knew blankets.

When did they start selling their fish for cash?

I don't really remember.

Do you know of any other place besides Hoko and Sekiu?

I don't know about Ozette because I was not raised there, but I know on this side.

Are those the only places that you know?

I would tell you (sic) how they owned these lands and rivers. The Indians used to give what they call potlatch. That was the time when they used to show that they owned this land. There was Kee-chuckh at Hoko, when he gave that potlatch, he would tell them that he owns that Hoko. This is why the outsiders could't go there because it was someone else's place. That was not the only one. It was like that all over. People knew then who had the rights. We couldn't just go there and live on that place regardless of what. Wa-atch, Suez, Ozettes, were all the same. That is what I know. I saw that as a boy.

Where did the Indians fish that did not own a location?

Those who had no fishing grounds, the owners used to ask them to go with them when they didn't have any fishing rights elsewhere. This is what I want to say, listen young men! I used to hear inspectors coming down here to help us. Nothing was ever made of their visit with us, I would like to see the white man finish this business that we are talking about tonight.

Discussion 3: Edward Swindell (E.S.) and Chester Waterhard (C.W.), Makah, age 67, born at Ozette Village. Chester Waterhard points out where and what fish could be caught off the Hoko River mouth.

C.W.: You spoke about Hoko. That used to be our line on Makah reservation. We used to fish at Eagle Point--my judgement about 1 1/2 miles from Hoko River--east. (He went on to explain that one Makah Indian had been arrested for trolling on his own fishing ground, Eagle Point, recently.)

From Eagle Point toward outlet, it is 1 1/2 miles out, is a halibut ground. When you are out there you can see Hoko bluff which is Indian landmark to that fishing ground. It is midway to Clallam and Sekiu, that is another landmark. That is Makah halibut fishing bank.

Now coming to Hoko, lying straight out 1 1/2 miles is a lingcod bank. These Makah used to fish over there, to dry it.

Now after you pass the halibut bank, you got to go through another 1 3/4 miles, another halibut bank which was a Makah fishing station.

Discussion 4: Edward Swindell (E.S.) and Henry St. Clair (H.S.) (introduced above):

E.S.: Outside the mouth of the Hoko at Hoko, how did you fish in the early days?

H.S.: I used to fish 1/2 mile out there for salmon and halibut, also ling (sic) cod.

E.S.: Did other Indians do the same?

H.S.: Yes.

You say you fished as far as 1/2 mile out from the land line in Hoko river out in the ocean? And from the same land line you say you went up the river to fish?

Yes I went as far as the waterfalls.

Did the group that owned the fishing rights, fish up that way?

About 5 miles I guess.

CHAPTER II THE HOKO RIVER ARCHAEOLOGICAL PROJECT

HISTORY

The Hoko River site is located on property presently owned by Crown Zellerbach Corporation, with some of the site extending onto property owned by Clevenger Road Company. Major erosion began to expose the site after the river changed course and crossed a large meander loop (ca. 1940). During the 1960s, Mr. David McMinn, manager of Crown Zellerbach's Clallam Managed Forest, became aware of the perishable artifacts eroding from the Hoko River bank. Realizing the scientific value of the site, McMinn hiked to the Ozette archaeological site at Cape Alava during the 1967 field season and discussed the situation with Dr. Richard D. Daugherty, the site director, and Harvey Rice, Washington State University staff archaeologist. This immediately led to a test excavation directed by Harvey Rice and carried out by Dr. Roald Fryxell, Dr. Maynard Fosberg, Mr. Robert Johnson, Mr. Gerald Grosso, and Mrs. Ruth Kirk (Daugherty 1969). The group used what are considered to have been the first hydraulic archaeological excavation techniques employed on the Northwest Coast, techniques later improved at Ozette and on other archaeological projects.

The test excavation produced woodworking tools, basketry, and fishing equipment and made clear the value of this site. A proposal was written in 1969 by Richard Daugherty to conduct a full-scale excavation, but unfortunately no funds were available, and excavation could not be initiated that year. Shortly thereafter, Washington State University field research began to focus on the eastern Washington Early Man site, the Marmes Rockshelter, and further efforts to begin investigation at Hoko River were suspended.

In the winter of 1969-1970 an extremely violent storm exposed the Ozette Village site houses. These water-logged deposits contained numerous house timbers and planking, baskets, boxes, woodworking tools, hunting and fishing equipment, and other perishables, all dating to approximately 400 years B.P. This emergency situation initiated the Ozette Village archaeological project, which is still in progress at the time of this report.

Dale R. Croes, a staff member on the Ozette archaeological project since the village site excavations began in 1970, visited the Hoko River site in the early summer of 1973 and

planned further tests of the site after that season's field school session. In late summer Croes, Mr. John Turney, Mr. Bob Martin, and several local volunteers began test excavation with hydraulic equipment to determine the horizontal extent of the site along the river bank exposure. Equipment and facilities for this test were provided by the Ozette archaeological project. Many perishable artifacts were recovered, and the large areal extent of the site was revealed. Five adjoining 1 x 2 m squares were excavated along the river bank exposure, through four organic depositional units. Three-dimensional provenience was recorded for all artifacts from a datum established on the upper bank. Also an onbank lithic workshop area was noted and tested. It was decided from this test that large-scale excavation along the exposure was feasible and would be productive.

During this summer, Croes and Turney also recorded three major collections of Hoko River artifacts in the possession of local residents, who had removed exposed artifacts from the site after major winter floods. These individuals were most cooperative in providing materials for description, measurements, and photographs, and many of the artifacts were donated to the project. Approximately 200 collected artifacts were recorded, providing an expanded perspective on the kinds of artifacts common to the site.

The 1973 test excavation of Hoko River was described by Croes in a preliminary report at the 1974 Northwest Anthropological Conference. His was one of a series of symposium papers concerning Northwest Coast water-saturated archaeological sites published by the National Museum of Man Mercury Series in a volume entitled "The excavation of water-saturated archaeological sites (wet sites) on the Northwest Coast of North America" (Croes 1976a).

In the winter-spring of 1976 Daugherty and Croes submitted a proposal to conduct full-scale archaeological investigations of the site that summer. Funding was not immediately obtained, however, and additional proposals were submitted in the fall of 1977. Croes also met with tribal members at a meeting of the Makah Tribal Council and proposed a joint project administered through the tribe. The council requested and received a formal proposal, which was reviewed and accepted unanimously. Funds were obtained for 1977 summer fieldwork from the Washington State Historic Preservation Office, with matching support and services provided by the Makah Tribe. Following this, Washington State University was awarded funds for the Hoko project from the M. J. Murdock Charitable Trust, Vancouver, Washington. Crown Zellerbach Corporation and Clevenger Road Company, the site property owners, granted permission for the proposed work. Everett Gents, the owner of adjoining property, provided space for the field camp. Finally, after ten years, full-scale investigation of the Hoko River site was possible.

The 1977 fieldwork focused on (1) excavation along the river bank exposure and (2) determination of the depth and areal extent of the remaining site. Over 1000 artifacts were recovered and recorded from the exposed bank and in approximately 25 overlapping stratigraphic layers. In addition to artifacts, environmentally significant materials such as twigs, seeds, cones, and bark and culturally significant detritus such as wood chips, residual basketry materials, and split wood were recovered in level-bags. A botanist conducted a botanical survey of the area, collecting herbarium specimens. Because of the excellent preservation of plant materials from the site, a good collection of present-day plants was considered important for comparisons and environmental reconstruction. Sediment and pollen samples also were collected for use in environmental reconstruction. To determine the areal extent of the site behind the river bank exposure, cores were systematically taken with a trailer-mounted coring machine. The cores were carefully recorded so that a three-dimensional reconstruction of the depositional sequence at the site could be developed. Also, the cores were carefully examined for cultural materials in an effort to determine probable locations of campsite areas.

In the past 40 years or so, since the major change in the river course (ca. 1940), several thousand cubic meters of site deposit are estimated to have been eroded from the river bank. Consequently, offshore areas adjacent to the exposure were explored with underwater archaeological techniques. The objectives were (1) to develop general techniques for underwater survey and excavation at wet sites and (2) to determine whether any large amounts of eroded and redeposited Hoko River site materials could be located. The excavation techniques were perfected, but only a small amount of archaeological material was located and recovered. The conclusion was reached that the eroded deposits, and especially the lighter perishable materials, would have been rapidly carried from the area, and probably most would have been redeposited some distance from the mouth of the river. The 1977 fieldwork, then, consisted of onshore coring to determine the extent of the unexposed site, excavation along the river bank exposure, and offshore exploration to determine whether extensive underwater archaeological deposits were present.

The regular 1977 field season was extended three weeks with funds provided by the Washington State Historic Preservation Office and matched by the Makah Tribe, so that as many of the objectives discussed above as possible could be accomplished before the following winter's high water. This allowed many projects to be finished while we were equipped and already in the field, adding substantially to our data recovery.

The role of the Makah Tribe in the 1977 Hoko River Project went well beyond financial administration and provision of matching funds; in many respects, the excavations were a tribal project. The tribe has taken active responsibility for recovery, preservation, and display of archaeological materials that represent their past. The Makah Cultural and Research Center is the administering body, and Mr. Greg Arnold is the principal in charge of coordinating with the Hoko River Project. Two Makah young persons trained with the project; one became particularly involved and will continue with the project, potentially pursuing a career with the Makah Cultural and Research Center. Many individuals from the tribe, including the senior citizens, tribal councilpersons, and many youngsters often visited the site, providing opportunities for us to discuss the progress of the work with them. The crew was involved in several community functions, including family picnics, a sixtieth wedding anniversary party (potlatch), and the Makah Day parade and festivities. The tribe provided the project with generous support, including all the major camp tents, a jeep, help with carpentry, secretarial assistance, access to a telephone, photocopying facilities, a photographer and photographic processing, and many other services.

Future plans at Hoko River include extensive excavations along the river bank exposure in the 1978 summer field season and excavation of a trench perpendicular to the river and into a lithic workshop area onbank. Excavation strategies are being modified based on evaluation of the 1977 materials and excavation procedures. More extensive areal survey of surrounding areas is also planned.

Unfortunately severe high waters in the 1977-1978 winter have eroded and significantly damaged part of the excavation area. On a midwinter visit to the site, we observed that a 5 x 10 m area of the bank, with a grove of six alder and spruce trees, had slumped into the river (Figures 16 and 17). Fortunately much of the well-preserved section of the site is still intact.

EXCAVATION PROCEDURES

Excavations at Hoko River included (1) onshore coring (Figure 18), (2) hydraulic excavation along the exposed river bank, and (3) offshore underwater archaeological survey and excavation (Figure 19). To control overall provenience in the three excavation categories, a grid plan was established over the entire site with true north coordinates (Figure 20). The datum point is a large steel shaft that is buried on a raised bank well southeast of the site area. From this



Figure 16. High waters at the Hoko River site, November 1977.

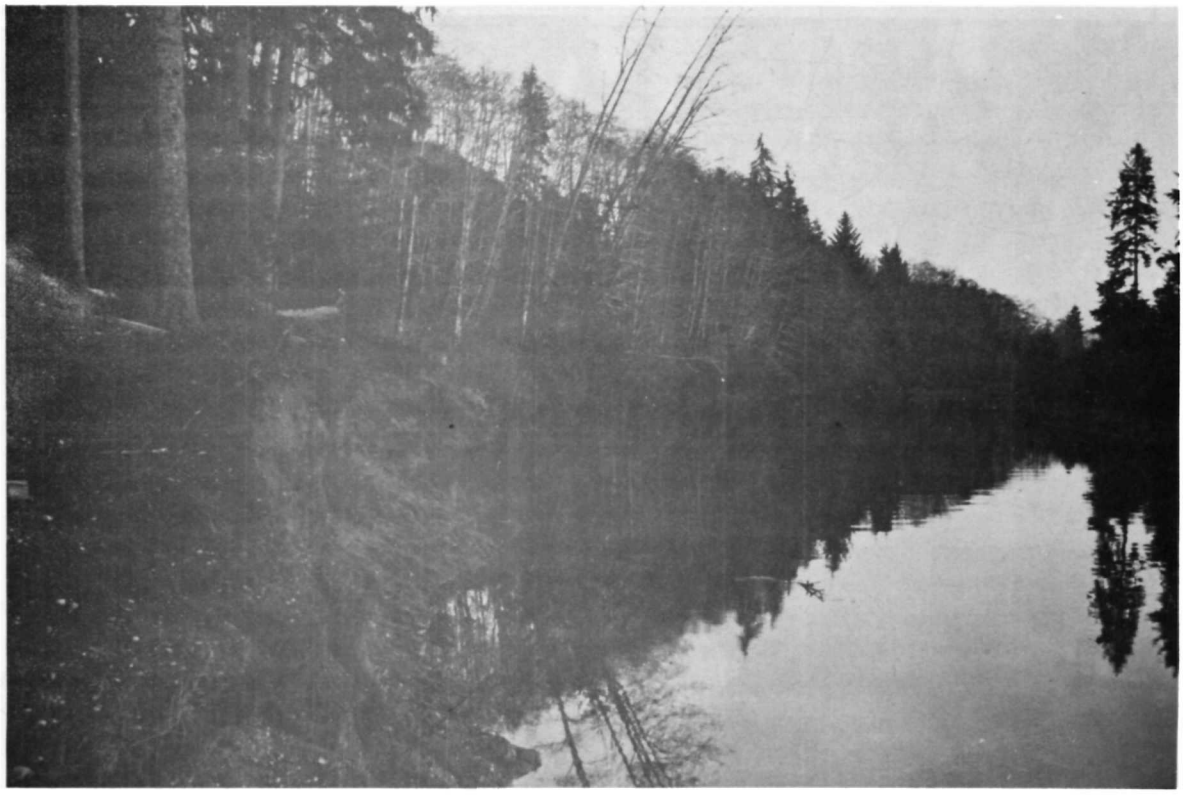


Figure 17. Collapse of bank over part of the site, January 1978.





Figure 18. Left. Coring in the forested areas behind the river bank exposure.

Figure 19. Underwater archaeology at Hoko River (see figure 23).

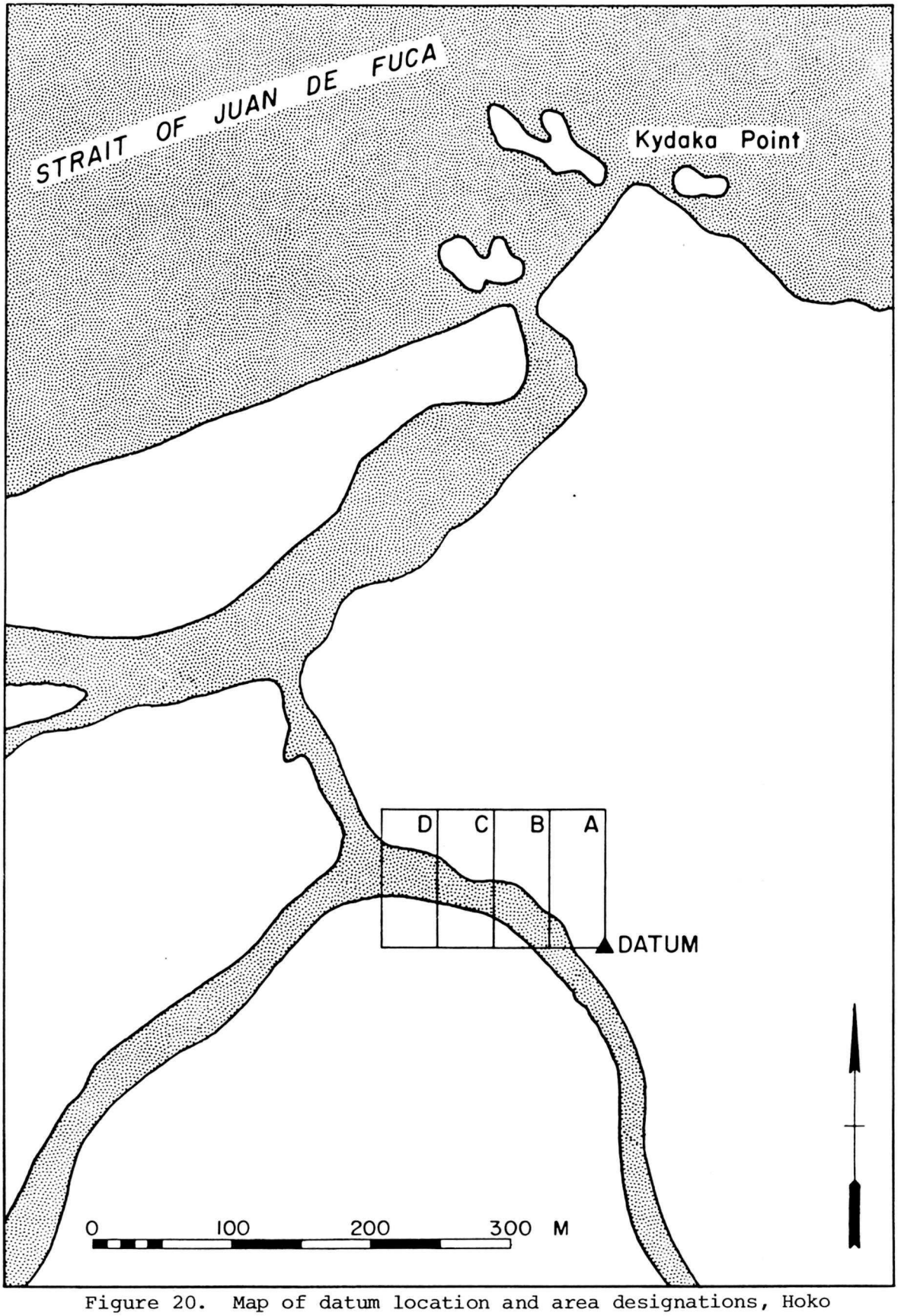


Figure 20. Map of datum location and area designations, Hoko River site.

datum, a 2 m grid system was established, with all points measured to the north and west of the datum. The grid system was divided into areas designated by letters (A, B, C, etc.), and the 2 m grid squares were numbered sequentially within each letter-designated area. Each area comprises 1000 2 m squares and is 40 x 100 m in area. This division into lettered areas was done so that grid square numbers would not be in the thousands, becoming cumbersome to work with. Most hydraulic excavation was conducted in area B, most coring in area A (Figure 20). All elevations on the site were calculated as elevation above or below mean low tide.

Onshore Coring

The coring project was conducted (1) to determine the depth and extent of the remaining site, (2) to provide data needed for a three-dimensional reconstruction of site deposits, and (3) to aid in the location of the prehistoric campsite and other activity areas. A trailer-mounted coring machine was moved over the area behind the river bank exposure. The coring equipment is hydraulic, powered by a 12.5 horsepower Wisconsin engine, and has both rotary and straight-drive options (Model GSRP-ST Hydraulic Soil Coring and Sampling Machine, Giddings Machine Company, Colorado).

At Hoko the coring machine could only be moved and set up where the dense forest allowed, and a considerable amount of brush clearing and cutting of downed trees was necessary in order to move the machinery. A gasoline-driven chainsaw winch was used to move the trailer into place, which permitted the core rig to be moved approximately 10 to 20 m between drives. The location and surface elevation of each drive were recorded on the site grid map after each move.

After the trailer was securely positioned a core drive was begun. Coarser overlying layers, representing flood plain sands and gravels, were penetrated and sampled with a 105 cm long, 4" diameter auger. A sediment sample from each drive was taken and a field description made, including drive number, depth, Munsell color, and estimates of particle size and sorting. When finer textured, gleyed stratigraphic deposits were penetrated, a split core (one which opens on both ends and along the length for removal of complete cores without extrusion) measuring 100 cm long and 3" in diameter was used. The split core was driven straight down and not rotated. These deeper cores were water-saturated and contained alternating deposits of gleyed sands, silts, and clays and vegetal mats. Field descriptions were made of these cores, and they were removed and wrapped in plastic

for transport to the Washington State University sediment laboratory. Drives were made until penetration was obstructed and no longer possible. Some core drives reached a depth of over 5 m. The correlation of the core sample information and the sediment analysis is considered below (see Stratigraphy section).

Site Excavation

Excavation along the river bank terrace exposure was conducted using hydraulic techniques. A Marine Pacific Pumper was used, secured to a platform and centralized in the excavation area (Figures 21 and 22). An intake valve in a screen box was secured to a 2" plastic pipe and lowered into a deep location in the river. A large iron anchor held the box in place, and a large plastic bouy held the box off the silty bottom. The length of 2" pipe was caulked and connected to the pump intake. A pressure release valve was connected to the output side to adjust the amount of pressure, and a 1" pipe extended from this back into the river to release excess water pressure (Figure 21). A 1 1/2" rubberized fire hose was attached to the output end of the pressure release valve. An adjustable fire hose nozzle could be attached to the end of this and used for high-pressure hydraulic excavation to remove slump overburden from the site surface. However, this was too erosive to the exposure, and most overburden was removed by shovel. Attached to the end of the fire hose with a quick-release coupling was a "T" for attaching garden hoses. It consisted of a set of bell fittings, 3/4" outlets, and 3/4" garden hose spouts with shutoff valves. Seven spouts were mounted, and as many shutoff "Y"s could be attached to these as were necessary for the number of hoses. As many as 15 3/4" garden hoses could be attached to and run off the pressure of one pump. The hoses were then run to appropriate areas of the site, and each excavator was supplied with a corrosion resistant, four-way adjustable garden hose nozzle for excavation.

The first squares to be excavated were immediately along the edge of the river bank, providing slope drainage back into the river that would not crosscut unexcavated areas. As an excavation unit was completed, a square immediately above the previous square was excavated through the same unit. Runoff went over plastic sheeting covering the original square (Figure 22). Careful adjustment of garden hose nozzle pressure and spray allowed excavation through a vegetal or sediment excavation unit. The vegetal units were very compact, and hydraulic excavation only slowly penetrated through the matrix. This allowed excellent control

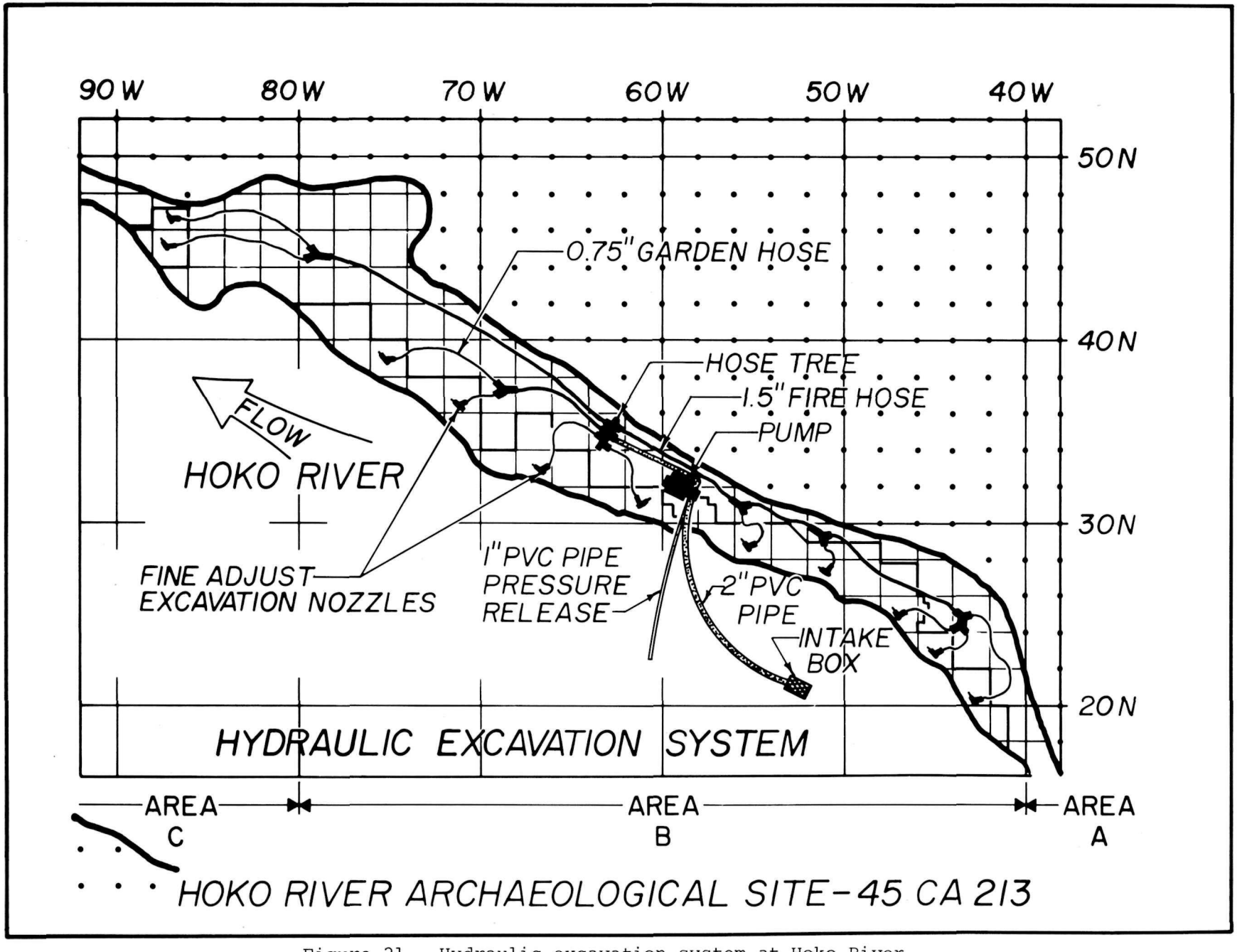


Figure 21. Hydraulic excavation system at Hoko River.

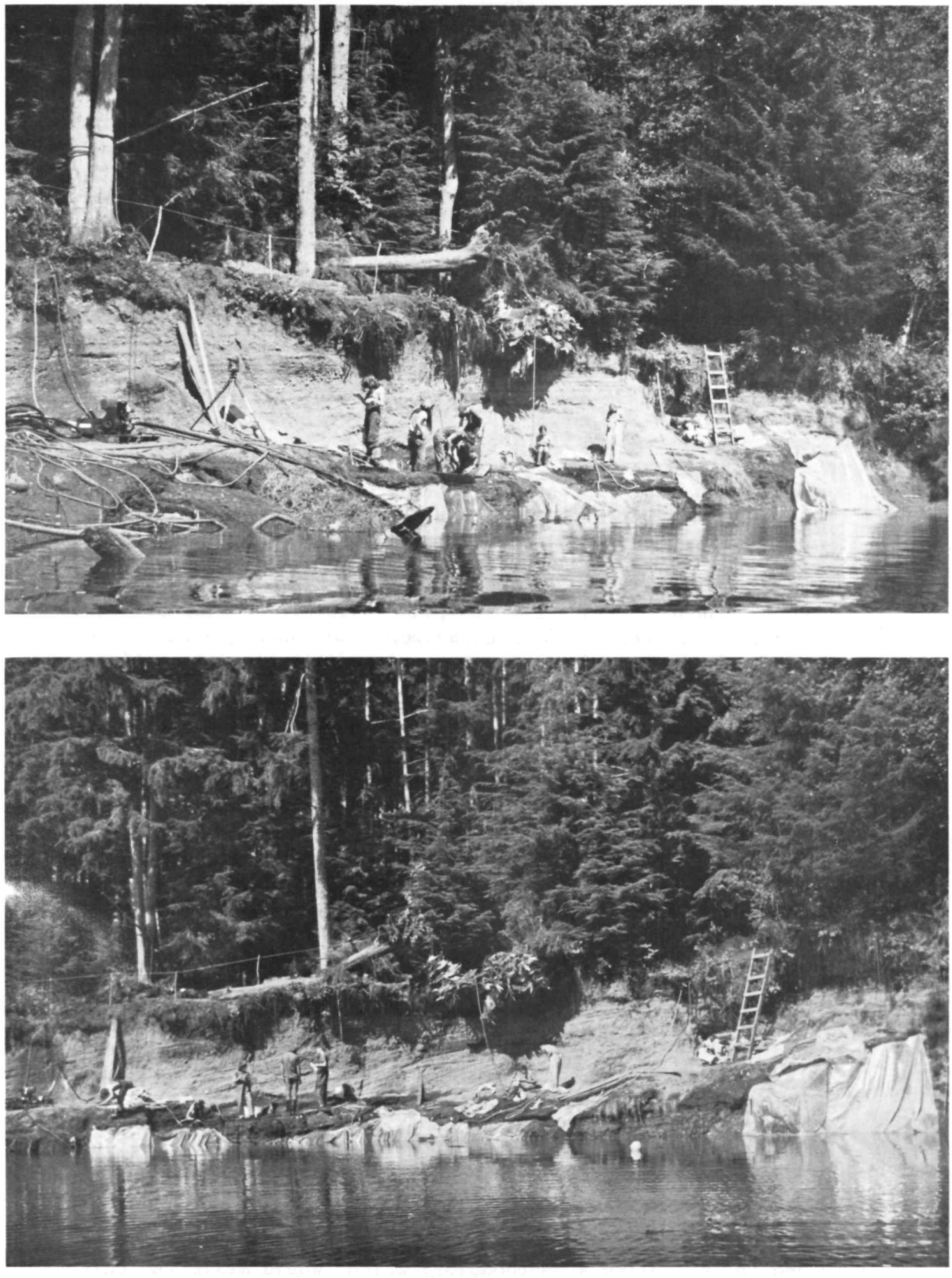


Figure 22. Hydraulic excavation in progress. Note pump and hose "T", garden hose distribution, and buoy for intake.

of provenience with only occasional premature dislodging of any artifactual or other materials.

Excavation units at Hoko generally alternated between thin vegetal mats and silt-sand sediment deposits. Each vegetal mat was given an alphabetic unit designation, sequentially from upper to lower units. These layers contained large quantities of naturally deposited vegetal materials (i.e., sticks, twigs, cones) and discarded or lost artifactual materials (i.e., fishhooks and lines, basketry, wooden wedges and other discrete artifacts, as well as wood chips, basketry waste materials, and carved and split wood). Each vegetal layer is particularly significant, since it represents a single depositional event.

Each excavator worked through the vegetal layers in his/her square, sorting and keeping significant floral, faunal, and artifactual materials. A topographic map was drawn of the surface of each vegetal unit. Discrete artifacts were given three-dimensional coordinates, mapped onto an artifact plat-map, photographed, tagged, and described on artifact fieldnote forms. The artifact plat-maps, topographic maps, and artifact fieldnotes were recorded on special triplicate, self-carboned grid forms so that multiple copies of the records were kept. Each excavator also had a general field notebook to record artifacts and additional information. Artifacts were then removed and taken to the field lab for further processing. Field excavators also kept plastic level-bags for each vegetal excavation unit, including separate level-bags for lithic materials, wood chips, residual basketry materials, split wood, and cones-twigs-bark samples. These were also processed in the field laboratory.

Underwater Archaeological Exploration

by Barbara Stucki and Greg Sparkman

As noted above, seasonal flooding erodes artifact-containing sediments from the Hoko site and redeposits them elsewhere. It was hoped that some of the artifacts washed into the river from their in situ position could be recovered by underwater archaeological methods. Although provenience data would be lost, these artifacts could be used for some analyses and could provide specimens for museum display.

The purpose of the underwater exploration was to assess the potential for recovery of artifacts washed from the exposure and to establish a methodology which would maximize this recovery. Due to the tertiary nature of the river deposits, locational information was not considered analytically sig-

nificant, though provenience could be recorded if the situation warranted it. Since little work has been done in applying underwater archaeological techniques to Northwest Coast wet sites, an assessment of the applicability of these techniques was considered to be a major goal of this project.

Preliminary Precautions

Special considerations have to be given to safety when underwater work is done. Simple tasks become more difficult underwater, and fatigue, cold, and stress limit the diver's working capabilities. In order to facilitate rescue of an injured diver, the Coast Guard was notified as to the nature of the work and location and time of the diving operation. Onsite safety precautions included arrangements to contact the Coast Guard from the site. Contact was maintained between the diver and the surface crew, and between the surface crew and a shore safety person. Also, the nearest decompression chamber was located; it is in Port Angeles, approximately 45 minutes away by helicopter.

Project Strategy

Since there were no examples to follow for underwater archaeology applied to Northwest Coast wet sites, a three-phase program was designed to facilitate successful location and recovery of artifacts.

Phase 1--Bottom Survey: Definition and location of potential excavation sites. Land excavation has shown that layers of water-logged vegetal materials and artifacts commonly are found in association with blue gleyed silts. Using excavation equipment (a metal probe), spot checks of the river bottom were made, and these revealed that artifact-containing sediments are not distributed evenly. Therefore a bottom survey was designed in order to differentiate sediment types and their locations, and to determine the relationship between sediment types and artifact associations. Forces governing artifact deposition are slumping of the vegetal layers and subsequent breakup and transportation by currents. Therefore primary areas to be considered were those near slumped vegetal layers where silty deposits appeared to have gathered, and areas where transported sediments had accumulated. Since only one diver could be down due to limited time and air, emphasis was placed on slumped deposits associated with known in situ vegetal layers. River-transported sediments which had accumulated within large log jams were considered too dangerous to be excavated by a single diver. The diver did a survey of the river bottom, focusing on sediments within 2 to 3 m of the river bank. The survey included location of slumped materials and differentiation of types of slump deposits based on composition, covering, and compaction.

The bottom survey established guidelines for the definition and location of potential excavation sites. Artifacts would most likely be found in blue silt slump and in areas of unconsolidated sediment. Slump and sediment areas were mound shaped and often enclosed by obstructions. The presence of worm tubes in an area was indicative of slow-moving water where deposition of sediments from the bank might occur, but occurrence of the tubes hindered identification of specific sediment types.

Phase 2--Equipment and Set-up: An underwater excavation technique was needed which would establish suction and there by remove sediments from the underwater excavation area while maintaining reasonable visibility for the diver/excavator. The first method of matrix removal used involved forcing water from the onshore pump up a pipe by means of a fire hose nozzle. We hoped that the suction created would draw sediment up to an on-surface, floating screen box for secondary examination while primary excavation would be done underwater. When this method was tried there was some flow of water into the screen box, but there was not enough suction to move sediment.

After considerable experimentation, it was determined that the most effective method of establishing suction involved the introduction of compressed air into the bottom of the underwater pipe (Figure 23). The air rises, and expands in the pipe, creating a partial vacuum and suction. Equipment consisted of a 4" diameter PVC pipe and elbow extending from the excavation area to a floating screen box attached to a two-person rubber raft on the water surface. The screen was a 1/4" galvanized mesh with 1 mm plastic screening placed on its surface to retain finer matrix for examination. As vegetal materials and sediments were caught in the screen box, they were examined by the person in the raft (Figure 19). The compressor hose gave 30 pounds of pressure and was placed securely into a hole drilled into the bottom opening of the PVC pipe. Suction produced was sufficient to remove and transport sediments ranging in size from fine silts to gravels measuring up to 3 cm in diameter. This system worked well and provided enough suction for matrix removal and maintenance of visibility.

Phase 3--Excavation Techniques: Excavation and Recovery. Three excavation techniques were employed to maximize the potential for artifact recovery. A wide-spread surface excavation technique was used to recover artifacts near the surface of the slump. Several 2 X 2 m areas were excavated along the profile of the slump until gravels were exposed. The near-shore end of the slump profiles consisted of up to 23 cm of unconsolidated silts, which thinned toward the toe of the slump. Cordage was found in the first 5 cm of the surface of one slump area.

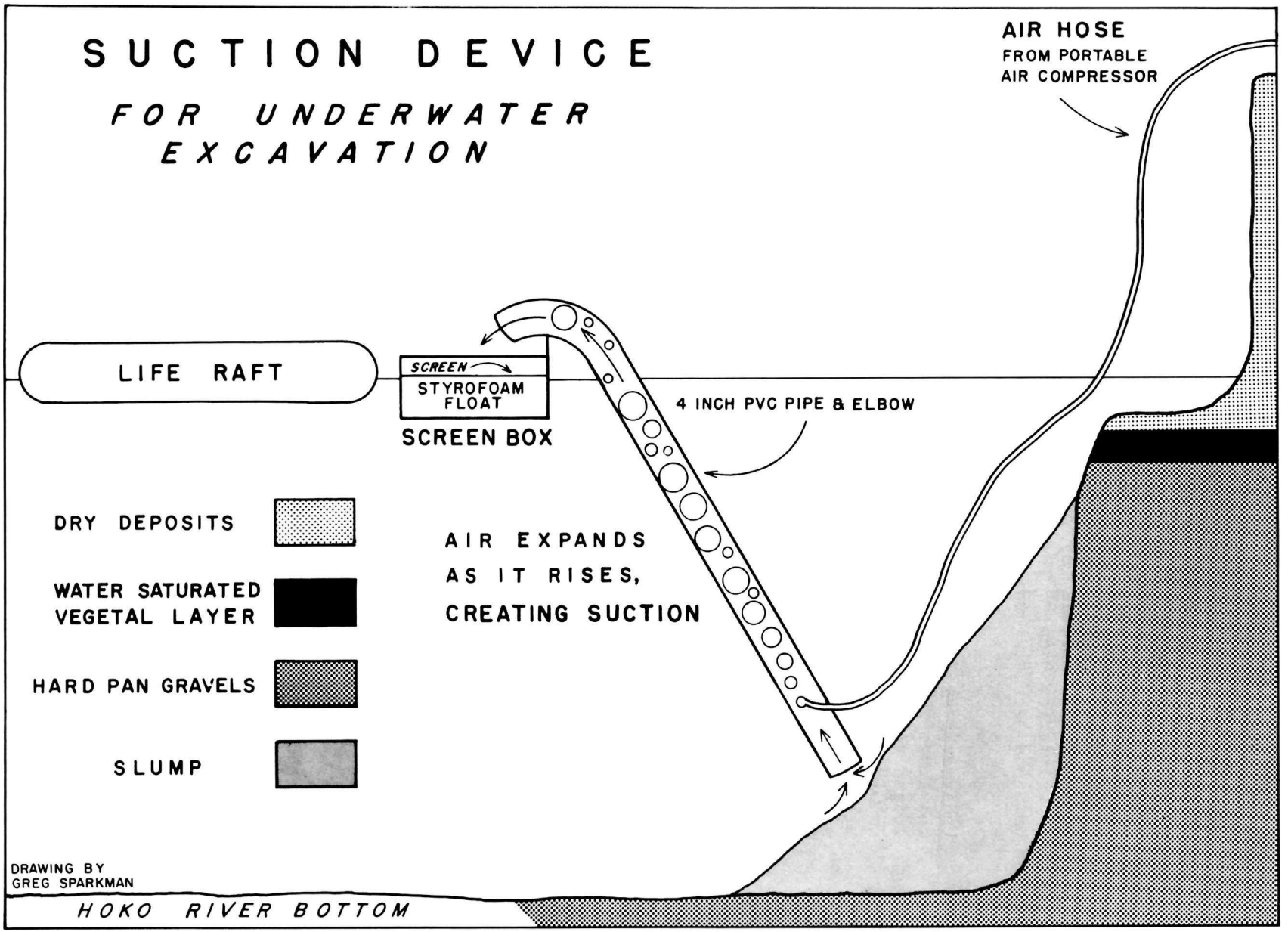


Figure 23. Underwater excavation system at the Hoko River site.

Trenches 30 cm wide were dug in the top, middle, and bottom of the slump, in order to ascertain whether slumped layers of water-logged vegetal materials and artifacts were buried deeper, within a range accessible by the suction device. The resulting vertical profile revealed that blue silt and organic matter were concentrated in the top 2 cm, and that these were underlain by sterile blue silt and sand for approximately 9 cm. These silts were in turn underlain by hard-pan gravels which corresponded with a gravel bed exposed along the shelf just up river.

Underwater excavation of consolidated in situ vegetal layers was attempted to assess the feasibility of excavating dislodged vegetal layers. The suction tube was placed within 4 cm of a vegetal layer, loosening the blue silt matrix and allowing organic materials and artifacts to be removed by hand and with the aid of a probe. Smaller objects were sucked to the surface for secondary examination. A bentwood fishhook was exposed in situ using this technique and hand carried to the surface. On-surface (secondary) examination of sediments in the screen box revealed fish and mammal bone, basketry materials, and wood chips.

Results and Conclusions

The primary focus of this project was to assess the potential for recovery of artifacts washed from a site exposure, and to establish guide lines by which to maximize this recovery.

Two types of deposits have a high potential for containing artifacts: slump in association with vegetal layers, and transported sediments caught in an obstruction. In this project, recovery of artifacts from underwater slumps was emphasized. As a result of the river bottom survey, guidelines were established for the location of slump deposits. These mound-shaped deposits are unconsolidated, often enclosed by obstructions, and covered by organic matter and worm tubes indicative of areas of slow-moving water. The only artifact-containing sediments accessible with our equipment were located at the surface of the underwater slumps, so a wide surface excavation strategy would be most effective in the recovery of these artifacts.

Greatest potential for the recovery of artifacts would be after a flood. Seasonal flooding leaves some of the consolidated vegetal layers in place as shelves along the river, while other portions of these layers are broken off, transported downstream, and either deposited in areas of obstruction such as log jams or swept out to sea. Vegetal layer fragments could be found on the river bottom at this time before they are disintegrated by further flooding.

The other purpose of this project was to assess the practicality of underwater archaeological techniques as applied to a wet-site situation.

The suction system was an effective tool in the recovery of slumped off underwater materials. An adequate volume of matrix could be removed with enough control of the force so that delicate objects could be recovered by hand. On-surface examination of the silts in the screen-box recovered objects too small to be recovered by the diver/excavator. Gravels up to 3 cm in diameter could be removed, and visibility was maintained for 20 cm around the excavation area. The primary limitations were that larger gravels could not be moved, and that the volume of sediments moved was restricted by pipe diameter and air pressure. At this wet site, we were dealing with natural deposits containing cultural materials, with a high volume of potentially nonproductive sediments. Therefore, given the limitations of the equipment, large-scale excavations would have been very time consuming.

The inherent problems of working underwater, combined with fatigue due to stress and cold, make underwater archaeology more time consuming and difficult than excavation on land. However, this entire project was conducted using only ten tanks of air, with 10.3 hours of down (scuba diving) time and 30 hours total on the project. If a hookah system could have been used, eliminating the necessity for conserving air, more extensive survey and excavation would have been possible.

Another aspect to be considered in the use of underwater archaeological techniques is the salvage of artifacts, versus the controlled excavation of an area with complete provenience. Due to the tertiary nature of artifact deposition, this project was concerned with the salvage of eroded artifacts. However, a grid could have been established for in situ underwater layers in order to determine the provenience of the excavation area relative to the rest of the site. Underwater archaeological techniques might thus permit controlled excavation of permanently inundated deposits which would not otherwise be accessible to the archaeologist.

Though few artifacts were recovered, the practicality and potential of underwater archaeology for wet-sites would seem sufficient to warrant further testing and investigation. This project has shown that materials can be located and recovered and that additional information concerning underwater erosional features, permanently inundated deposits, and river depositional features can be recorded. Such information can be important for a more complete understanding of a wet site.

STRATIGRAPHY AND DEPOSTIONAL ENVIRONMENT

by Eric Blinman

Introduction

Initial stratigraphic investigations at the Hoko River site resulted in the definition of two major depositional units and the formulation of hypotheses about the environments of their formation (Croes 1976b:205-206). The upper 3 to 4 m of the site (designated deposit A) were described as consisting of coarse sand and gravel with strong downstream imbrication. From the base of deposit A to below the level of the lowest observed tide (about 2 m), sediments consisted of alternating thin layers of clays and silts and water-logged vegetal materials. These sediments were designated deposit B and included perishable artifacts.

The layers of deposit B were interpreted as having formed in a lagoonal or estuarine environment. During periods of standing water (possibly summer and fall) vegetal and cultural materials may have become water-logged, sinking to the bottom of the estuary and forming an organic mat. Subsequent higher discharges of the river (possibly winter and spring) covered each mat with layers of clay, silt, or sand. Repetition of this cycle produced the observed alternating layers of the site.

Sand and gravel of deposit A were interpreted as representing a later beach development on top of the site. A higher relative sea level was postulated (probably of tectonic origin), and the downstream imbrication was explained by a net northward movement of sediment.

Stratigraphic studies during the 1977 field season were designed to test and expand these hypotheses. Specifically, sedimentological data were gathered to determine the changing depositional environments of the site, and pollen samples were taken from the water-logged deposits in the hope that seasonal differences might be observable. In addition, stratigraphy was used to establish time relationships within the site.

Stratigraphy

The Hoko River site was discovered in a cutbank of the river about 500 m upstream from the Strait of Juan de Fuca (Figure 24). It lies at the base of the highest terrace on the east side of the valley and is currently being eroded by a meander loop of the river. Cultural material has been exposed along 130 m of the terrace deposits. Erosion of the upper 4 m of terrace sediments along part of the cutbank has progressed faster than erosion of the lower sediments, creating a shelf about 1 to 2 m wide. Excavations during the summer of 1977 were carried out on this shelf, and stratigraphic studies were focused on this area of the site.

Two profiles were established in the continuous stratigraphic exposure provided by the cutbank (Figure 25). These profiles were chosen to represent the two sediment sequences observed in the area. Their locations were also determined in part by the need for access without hindering excavation and by their freedom from surficial slump. This latter condition was part of our compliance with the request of Clallam County and of the Washington State Department of Fisheries that modification of the river bank be minimized. Each profile was described in terms of bedding, sedimentary structures, particle size, particle shape, sorting, and composition.

In addition to the profile descriptions, the sediment sequence of the terrace back from the cutbank was investigated with a trailer-mounted hydraulic core rig. Coring locations were controlled by the spacing of the trees and are shown in Figure 25. The core rig was equipped with both a split-barrel core and an auger, but the former could be used only in relatively fine sediments. As a result, some sediments had to be recovered with the auger and were mixed. The machine operators made field estimates of particle size, shape, and sorting, and samples were collected for analysis at the Geoarchaeology Laboratory, Washington State University.

These laboratory studies of the sediments were limited to grain-size analysis. Samples were dried at 50 C, although an oven malfunction subjected 10 samples from the core to 150 C. Macroscopic organic materials were present in several samples and were removed by hand, but no other pretreatment was carried out. About 100 g of each sample were sieved through 1-phi interval screens. Samples containing gravel were first placed in a hand-operated shaker to separate out particles larger than 2 phi (medium sand). The fine sand and silt/clay were then placed in sieves on a mechanical shaker for ten minutes to separate the sand fractions from the silt/clay.

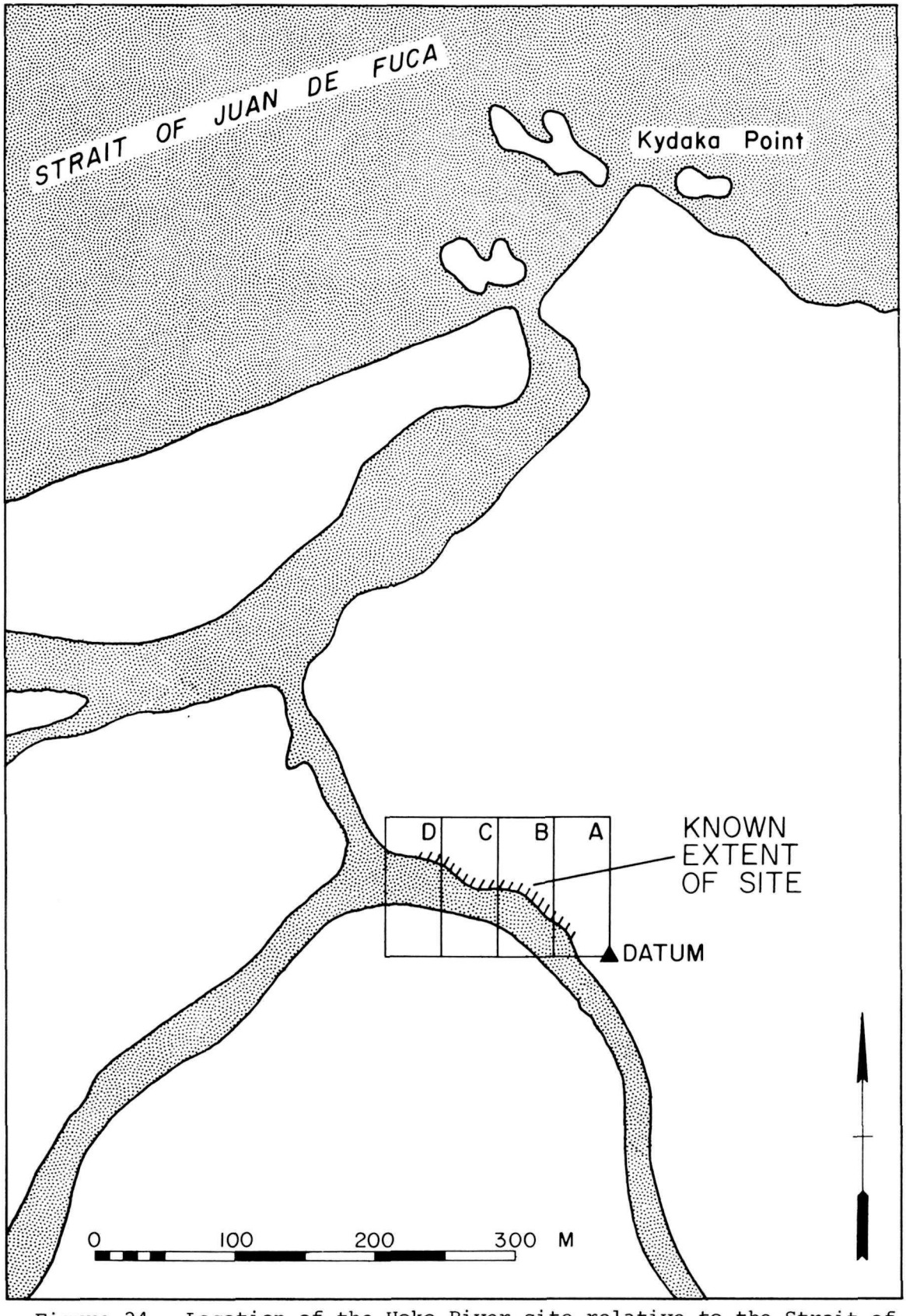


Figure 24. Location of the Hoko River site relative to the Strait of Juan de Fuca and the mouth of the river.

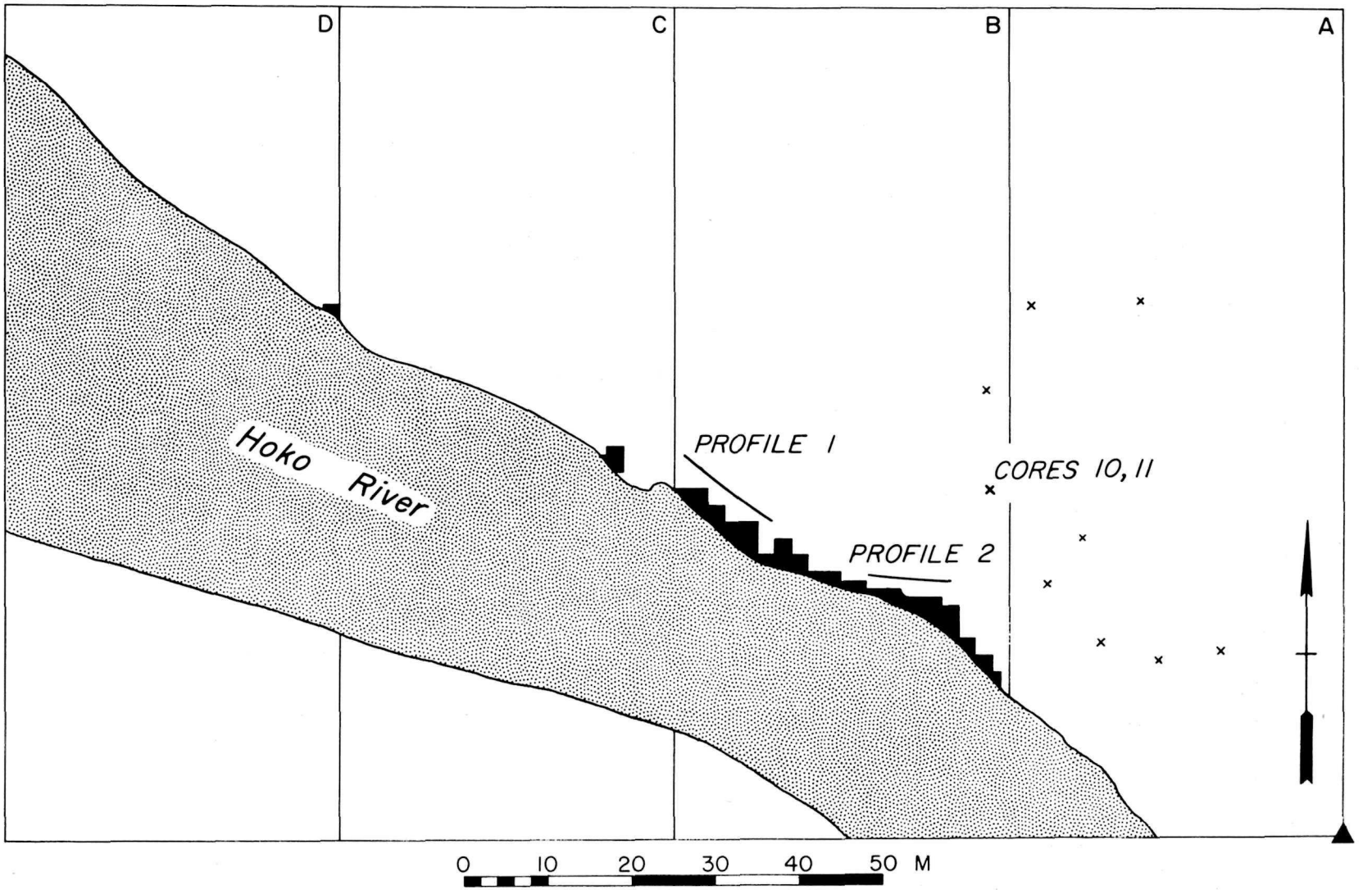


Figure 25. Location of stratigraphic profiles, cores and excavation units at the Hoko River site.

In 12 samples the silt/clay fraction exceeded 5 percent of the total sample weight. For these cases, between 20 and 30 g of the silt/clay fraction were analyzed using the hydrometer method. Each sample was dispersed in 1000 ml of 5 percent Calgon and transferred to a graduated cylinder. After one minute of agitation, a hydrometer was used to measure the changing density of the suspension as the sediment slowly settled. These data were combined with the results of the sieving, and cumulative weight percentage curves were drawn for each sample. From these curves, Folk and Ward (1957) indices of sorting, skewness, and kurtosis were calculated. The results are presented and discussed later in this paper.

Profile 1

Profile 1 is about 5 m upstream from excavations in area C and about 32 m downstream from the major excavations at the site. Twelve sedimentary units were defined, based on the criteria of grain size, bedding, and composition (Figures 26,27). Field descriptions of the units are summarized in Table 6, and the results of laboratory analyses are presented in Figure 28. All sands and gravels are well rounded unless otherwise noted.

Similarities in grain size and bedding allow these 12 units to be lumped into five generalized units. The lower portion of the profile consists of at least 0.85 m of weakly bedded gravels (the lower boundary is unknown). Several heat-fractured rocks were noted, and they showed no evidence of streamrolling. This unit is covered by slump upstream from the profile but terminates before reaching profile 2. Downstream, the gravels can be traced for tens of meters and underlie the artifact-bearing sediments excavated in area C.

Immediately overlying the gravel in profile 1 is a 10 cm thick layer of fine sand with lenses of organic material, charcoal, and occasional gravel. The organic matter is highly decomposed, and no cultural materials were recognizable. Upstream, this unit also disappears under slump and cannot be correlated with any units in the main excavation area. Downstream, this unit thins and terminates within 2 m of the profile, but it is nearly identical in composition to and is at approximately the same elevation as the artifact-bearing sediments of area C. We cannot determine whether the area C deposits are the same as or underlie or overlie this unit.

The sand layer is overlain by about 1.5 m of coarse sand and gravel. Bedding in this unit dips sharply downstream, and some beds include foreset series within them. Heat-fractured and angular gravels are very rare, but several boulders (up to 30 cm in length) of sandstone may be manuports,

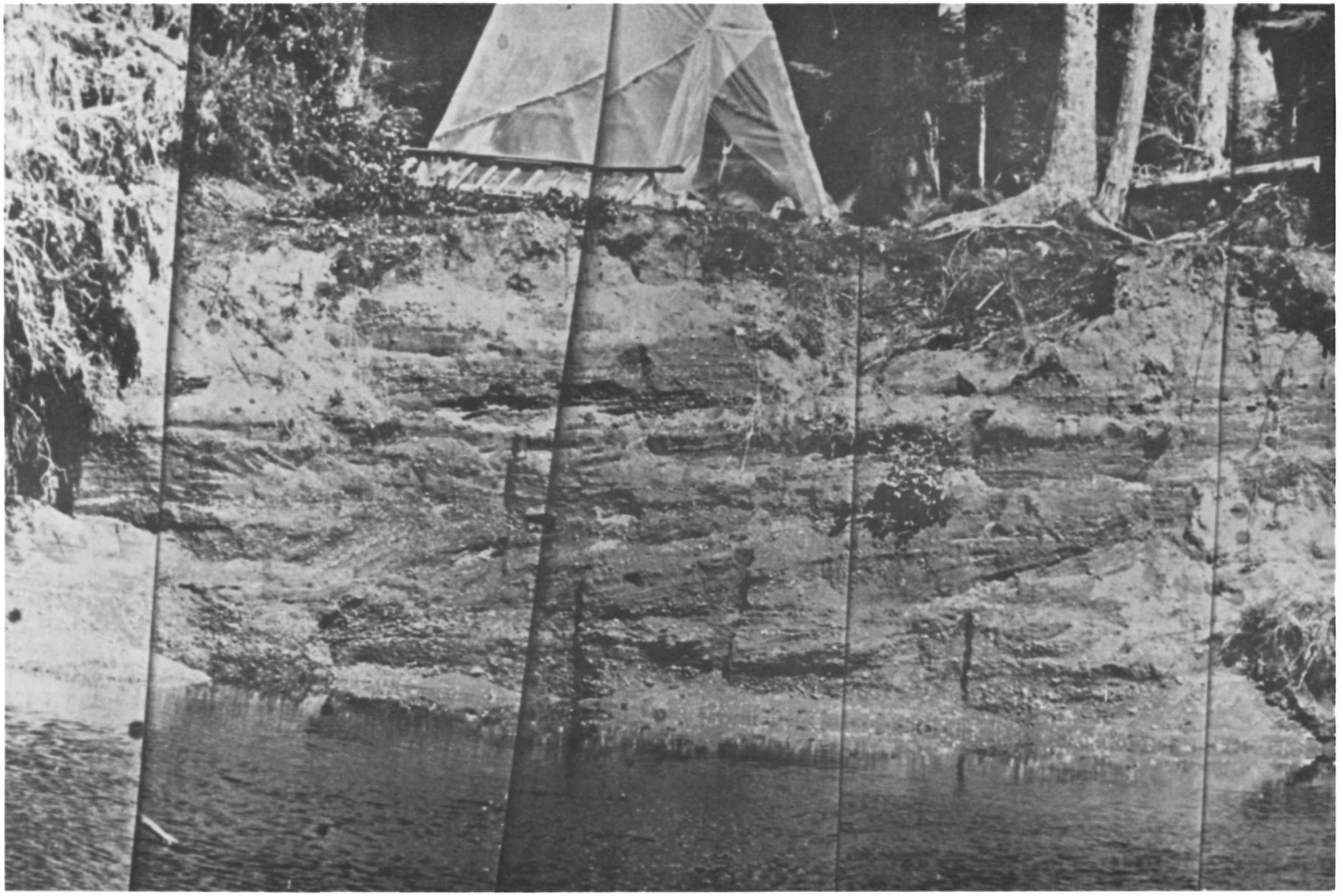


Figure 26. View of profile 1.

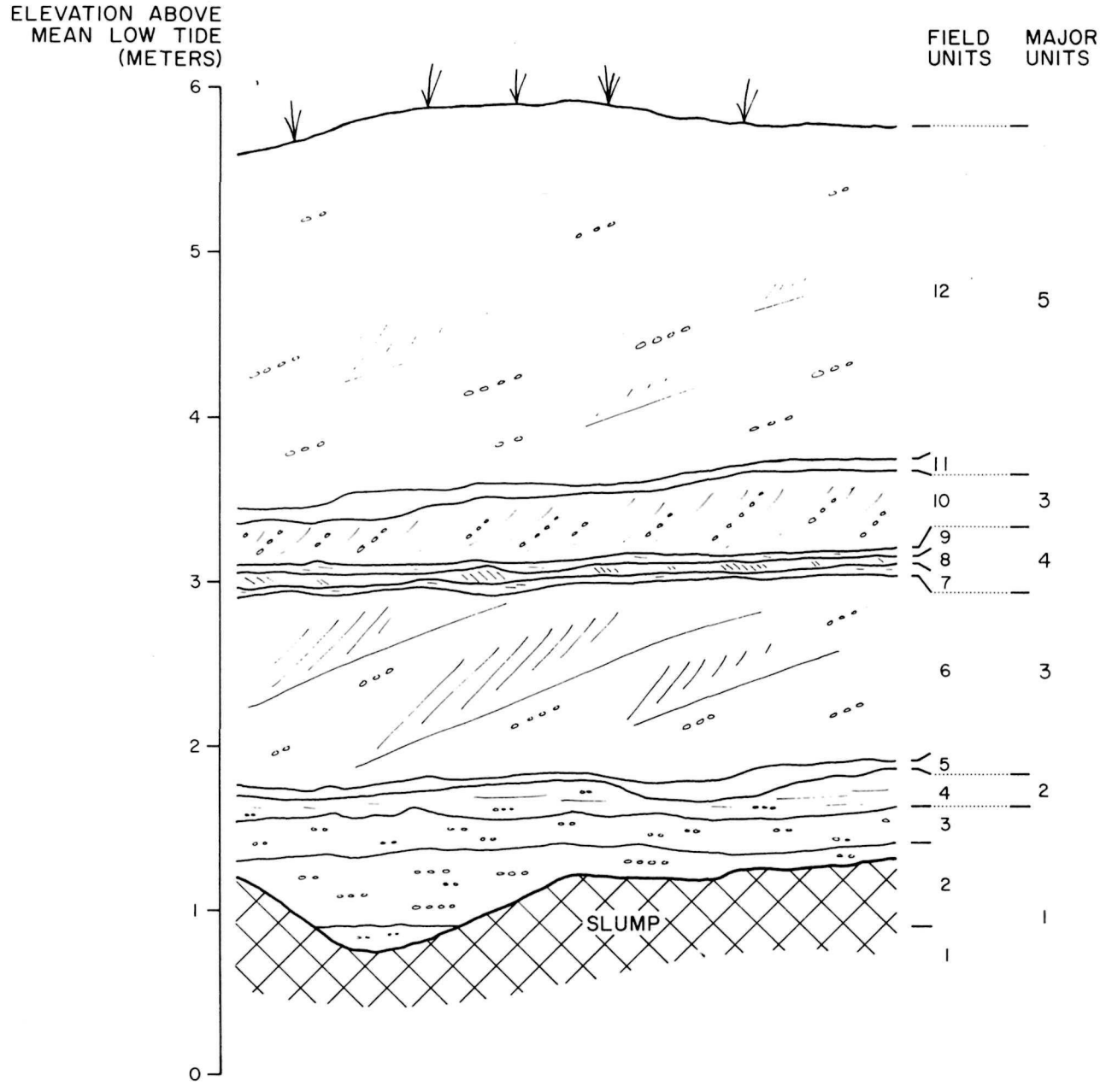


Figure 27. Stratigraphy of profile 1.

Table 6

Field descriptions of units at Profile 2

Major unit	Field unit	Elevation	Description
4	12	3.54-5.88 m	Downstream dipping foreset beds of sand and gravel (foresets dip 7°, azimuth 274°). gravel becomes less abundant upwards and tends to appear on discontinuous planes. Lateral coarsening of the deposits occurs upstream.
	11	3.40-3.54 m	Massive tabular bed of medium to coarse sand. No visible bedding. Grades into overlying unit 12 about 7 m upstream. Dip of the upper boundary is 2°, azimuth 240°.
	10	3.12-3.40 m	Downstream dipping foreset beds of gravel and some sand (foresets dip 15°, azimuth 130°). Unit 10 and unit 12 grade into each other 13 m upstream.
	9	3.05-3.12 m	Horizontally laminate medium and fine sand with occasional gravel. Rare scattered charcoal. Fining upwards within the unit, all of the gravel is on the lower boundary. Dip of the boundary is 2°, azimuth 288°. Unit terminates laterally 6-8 m upstream. Terminus is covered by slump.
	8	2.99-3.05 m	Upstream dipping foreset beds of medium sand, coarse sand and fine gravel (foresets dip 11°, azimuth 30°). Unit terminates laterally 6-8 m upstream. Terminus is covered by slump.
	7	2.94-2.99 m	Horizontal laminations of sand, fine sand and silt. Some ripple laminations. Sorting of each lamination is excellent. Upper boundary is an abrupt transition in texture and bedding.
3	6	1.88-2.94 m	Cross-laminated alternating inclined beds of coarse sand and fine gravel, some fine sand and possible silt beds are in the lower portion of the unit. Occasional foreset series are found between inclined beds. Dip of the inclined beds in 16°, azimuth 246°. The upperboundary is abrupt and dips 1°, azimuth 307°.

Table 6 (continued)

Major Unit	Field Unit	Elevation	Description
	5	1.71-1.88 m	Massive gravel and sand. Unit thins upstream and fines slightly. Rare fire-cracked rock. Upper boundary dips 6°, azimuth 284°.
2	4	1.61-1.71 m	Horizontally bedded fine sand with lenses of organic materials and charcoal. Some pockets of gravel. Upper boundary is smooth to wavy; dip is 6°, azimuth 279°.
1	3	1.38-1.61	Fine gravel with some gravel up to 5 cm. No bedding or apparent grain orientation. Possible fining upwards of coarser fraction. Upper boundary is smooth; dip is 4°, azimuth 118°.
	2	0.94-1.38 m	Horizontally bedded coarse sand and fine gravel up to 8 cm. Some heat-fractured and nonrolled rocks in the upper part of the unit. Dip of the upper boundary is 8°, azimuth 1°. There is one silt pebble in the unit.
	1	0.76-0.94 m	Moderately well sorted fine gravel, some gravel up to 4 cm, some coarse sand. No bedding or apparent imbrication. Dip of upper boundary is 9°, azimuth 71°.

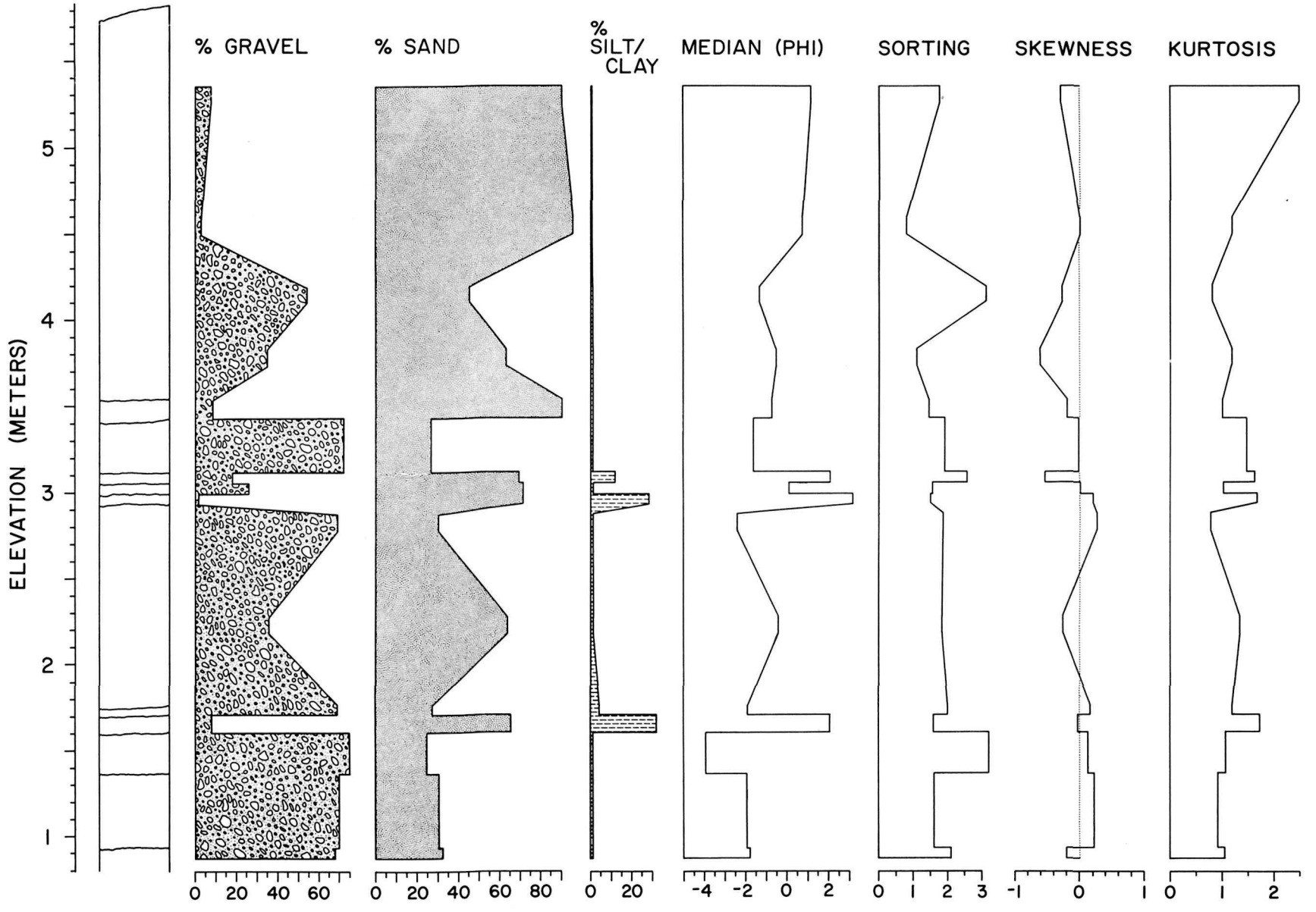


Figure 28. Grain size parameters for samples from profile 1.

given the lack of a natural explanation for their presence. Inclined beds and foreset series of sand and gravel can be traced at this elevation along most of the cutbank.

Within this coarse sand and gravel about 2.3 m above mean low tide is an 18 cm thick unit of sand. It consists of two sets of horizontal laminae separated by 6 cm of upstream-dipping foreset laminae. No cultural materials were found. The terminus of this unit lies under slump between 6 and 8 m upstream; downstream the unit is discernible for at least 12 m, and the upstream-dipping foresets coarsen and thicken.

The final unit forms the upper 2.66 m of sediment of profile 1 and can be traced along most of the cutbank. It is characterized by downstream-dipping bedding with occasional foreset series. Gravels are less abundant toward the top of the profile and tend to occur as single discontinuous layers. Within the upper 1 m of this unit are occasional cut and fill structures oriented perpendicular to the cutbank. Occasional fire-cracked rock and lithic artifacts were noted in this unit, and artifacts found in slumped material were probably derived from here.

Profile 2

Sediments and stratigraphy of profile 2 were described in the field by Maureen Brinck-Lund and Anna Lou Van Gijn. Over 25 sedimentary units were defined on the basis of grain size, bedding, and composition; but for the purposes of this discussion, they will be grouped into four major units (Figures 29,30). Laboratory samples were not taken from this profile due to the danger of bank collapse over the excavations.

The lowest unit (below approximately 2.30 m elevation) consists of alternating layers of water-logged vegetal materials and sand, gravel, or silt. The mats of organic material vary in thickness from a few millimeters to 20 cm and usually have a matrix of fine sand. Usually mats are discrete laterally, but they occasionally terminate or fuse with adjacent layers. Bedding surfaces tend to dip between 8 and 12 to the east/ southeast (azimuth 250). These layers include both perishable and nonperishable cultural material and were the focus of the excavations. This unit was described as deposit B in the initial report.

A wedge-shaped bed of inclined sand, gravel, and silt laminae overlies the organic mats. Where traceable, these laminae are continuous with those of the unit below, although instead of vegetal materials, some of the laminae include charcoal and occasional fish bones and lithic artifacts. Sediments tend to coarsen upward. Angle of dip within the bed decreases as elevation increases until the laminae



Figure 29. View of profile 2.

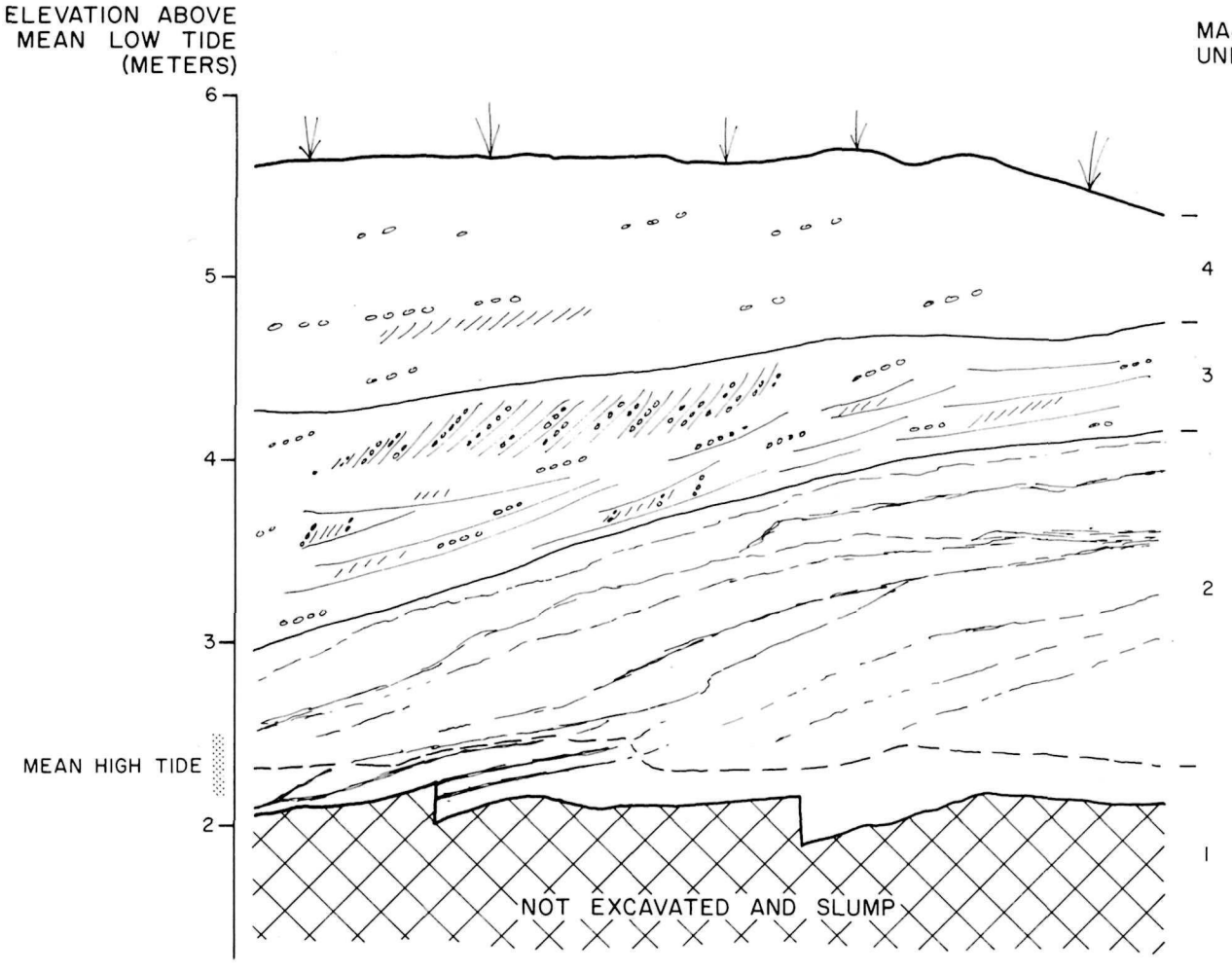


Figure 30. Stratigraphy of profile 2.

become nearly horizontal at about 4.2 m elevation. Direction of dip is the same as that of the organic mats below. Differences between this bed and the one below appear to result primarily from the loss of organic matter from the overlying bed. The coincidence of the organic mat upper boundary with the approximate elevation of mean high tide suggests that aerobic decay is responsible for the differences between the units. These dry laminae were defined as part of deposit A in the initial report.

The third unit consists of coarse sand and gravel with inclined bedding and occasional foreset series. Apparent dip of both the beds and the foresets is downstream, although no measurements were taken. Lithic artifacts and fire-cracked rock are present but rare. This unit can be traced laterally downstream along the cutbank and is the same as unit 3 of profile 1. Gravel decreases in abundance in the uppermost unit, which is composed of inclined layers of sand, rare foreset series, and occasional single discontinuous layers of gravel. Apparent dips are all downstream, and this unit can be directly correlated with unit 5 of profile 1. This unit (unit 4) and the underlying gravelly sand form the upper portion of deposit A as defined in the initial report.

Cores 10 and 11

Cores 10 and 11 were taken 15 cm apart, approximately 16 m back from the cutbank in area B. Core 10 included sediments from the top of the terrace (5.94 m elevation) down to 2.53 m elevation. Core 11 began at 3.28 m elevation and included sediments to -0.34 m elevation. Sediments above 3.19 m elevation were recovered with a 10 cm diameter auger and considerable mixing occurred. Below 3.19 m elevation a 6 cm diameter split-barrel core was used, which caused only minor disturbance. Samples from cores 10 and 11 were chosen for analysis because they were taken in close proximity to the cutbank at area B, because of the total depth of the cores, and because of the number of samples available for study.

During coring, water saturation was encountered at about 3.40 m elevation. Above this level sediments were oxidized (dark brown to dark yellowish brown; 10YR3/3 to 10YR3/6), and no organics were observed. Below 3.40 m elevation sediments were gleyed (color variable; hues yellow, green yellow, blue green), with occasional oxidized layers. Organic materials were common, and several distinct organic mats were encountered, including some cultural material. One fire-cracked rock was found at about 2.84 m elevation; a wood chip was found at 2.76 m; and a split stick was found at 2.52 m. The results of the laboratory analysis of these cores are constrained by the disturbance of the sediments during recovery. Samples are assumed to be reasonable

approximations of the stratigraphic sequence, but mixing and some contamination from above has undoubtedly taken place, especially for the auger samples. Several samples may also have been affected by an accidental exposure to high heat (150 C) during drying. High temperatures may cause alteration and aggregation of clay minerals, decreasing their apparent proportion in the sediment. I do not feel that this has had any significant effect on either the data or the conclusions.

Grain size data and indices of sorting, skewness, and kurtosis are presented in Figure 31. Sediments below 2.15 m elevation are dominated by silts (median greater than 4 phi). Grain size, organic content, and elevation correlate well with the excavated sediments of area B. Immediately above the silts, the proportion of gravel increases sharply (median less than 0 phi) but then declines gradually with increasing elevation to about 3.50 m elevation. This portion of the core corresponds in elevation to unit 2, profile 2, and although the proportion of gravel seems high, the presence of cultural material, organics, and a moderate percentage of silt/clay supports a tentative correlation. The upper 2.3 m of core are characterized by sand and a decreasing percentage of gravel. These data parallel the grain size data for unit 5, profile 1, and the field descriptions of unit 4, profile 2.

Other cores show the same general stratigraphic sequence. Silt/clay and abundant organic materials are found below about 2 m elevation. Overlying these are about 2 m of silt, sand, and gravel with some scattered organic matter. At the top of the sequence are about 2 m of sand and gravel with little or no silt/clay. Coarser sediments between 2 and 4 m of elevation tend to be oxidized and to lack organic matter, whereas the finer sediments (fine sand and silt) tend to be reduced and to include sparse to abundant plant debris. Overlying sand and gravel are usually oxidized, and underlying silt/clay is reduced. The core stratigraphies correlate with all of profile 2, but they only correlate with the upper 2 m of profile 1. In no instance was a basal gravel layer encountered. Cultural materials were relatively rare but had a wide vertical and horizontal distribution.

Depositional Environment

Depositional context can be very important to an understanding of the archaeological record. This is especially true at the Hoko River site, where deposition appears to be controlled by natural rather than cultural factors. Goals of the stratigraphic study included determining the mode of

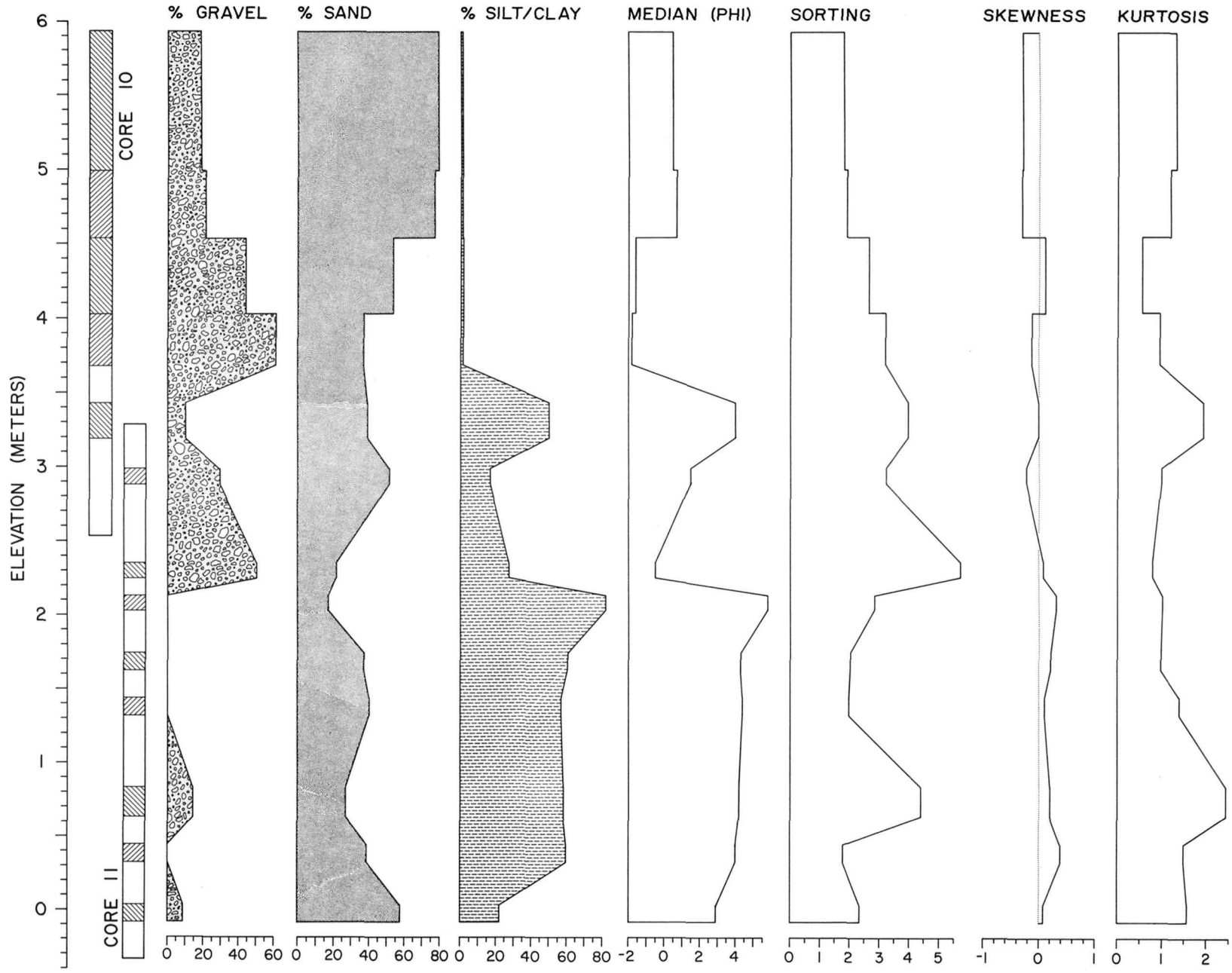


Figure 31. Grain size parameters for samples from core # 10/11.

deposition, the geomorphic setting of the site, and effects of depositional processes on the cultural record. We do not as yet have strong sedimentological data to support specific conclusions (Folk 1966:75), but field observations and the preliminary laboratory studies have contributed to the following hypotheses and discussions of site development.

All sediments at the site are waterlaid with little or no cultural modification. Sand and gravel are well rounded from moderate to long-distance transport. The few exceptions are heat-fractured rocks, which show little if any rounding on the edges of the fractures, and the flaked and ground stone artifacts, which do not show signs of abrasion following discard. Two postmolds were exposed in unit 3, profile 2, by flood erosion of the cutbank during the winter of 1977-1978, but no cultural stratigraphic features were encountered during the 1977 excavations. Bed form, sedimentary structures, grading, sorting, and size characteristics of the sediments are all consistent with deposition from flowing water rather than colluvial, aeolian, or cultural deposition.

Site sediments were initially interpreted as being beach sand and gravel overlying river (fluvial) deposits. Modern beach sand tends to be moderately sorted to well sorted and to have characteristic bed forms (Reineck and Singh 1975:Table 8, 299-305). Sorting of the upper sand at the Hoko River site is poor to very poor, however, and bed forms and structures show more variety than those reported for beaches. In comparison, stratigraphic features do fall within the range of modern fluvial deposits, and I interpret the entire sequence to be a product of fluvial processes.

Fluvial deposits can be divided into three major groups: channel deposits, bank deposits, and flood basin deposits (Reineck and Singh 1975:230). Rivers that actively meander within their valleys tend to reduce the contrast between flood basin and bank deposits, leaving only two groups: flood plain and channel deposits. Flood plain sediments in this context tend to be slightly coarser than flood basin deposits (a result of higher velocity flow) and to include sand as well as silt and clay. Horizontal bedding, climbing ripple lamination, and cross-bedding can be found in any combination or relative abundance (Reineck and Singh 1975:252-253).

Channel sediments include lag deposits of gravel and point bars that are usually dominated by sand (Reineck and Singh 1975:231-238). Point bars are deposited as a meandering river moves laterally through its flood plain. Deposition keeps pace with erosion of the opposite bank (cutbank) to maintain a constant channel width, and most deposition occurs during flow subsidence following floods or high

water. Sand and gravel are cross-bedded, and both unit size and particle size can decrease upwards. Fine sand, silt, and clay can be found in upper strata of bar development or in swales in the bar surface; these fine sediments can be accompanied by accumulations of drifted plant material. Longitudinal cross-bedding is common in intertidal point bars and in the bars of small rivers (Reineck and Singh 1975:90).

Gravel at the base of profile 1 (unit 1) was probably deposited as channel lag. Bedding is indistinct, and no current direction can be inferred. In the lower sand and silt of profile 2, gravel is present as lenses or thin layers and represents short periods of higher velocity flow within a context of much lower energy (sand and silt) deposition. Within unit 3 of each profile, gravel occurs with sand as foreset series, more indicative of flood-related bar development than of channel-lag deposition.

Periodic deposition of sand, silt, vegetal materials, and gravel characterizes the lower two units at profile 1 and appears to have resulted from a relatively stable period of bar development. Successive depositions on the sloping bar surface occurred as the river channel migrated to the southeast (Figure 32; direction inferred from the dip of the excavated vegetal mats below profile 2). These sediments are finer than would be expected for most bar environments, but they could have resulted from deposition in a bar swale or, more likely, from the interaction of tidal and river flow (Reineck and Singh 1975:90). Without evidence of sedimentary structures, the fine sediments at the base of core 10 could be interpreted as flood basin sediments, but their elevation and proximity to the fine bar sediments of profile 2 lead me to believe that they are also part of an intertidal bar deposit.

The coarser sediments of unit 3 in both profiles mark a transition from periodic to sporadic sedimentation. Cross-bedding and foreset series reflect short periods of rapid deposition, and the particle sizes (sand and gravel) would indicate relatively higher energy flows. These conditions can occur on higher surfaces of point bars which are above normal tranquil flow but are within the flood channel.

Above this unit, gravel becomes less abundant and is restricted to occasional discontinuous horizontal layers. Median particle size decreases in both the core and profile 1, but it is dominated by sand rather than silt/clay. Foreset series are rare, and the deposits fall within the range of modern flood plain sediments.

These interpretations can be summarized in a hypothetical model of site development. Initial deposition took place

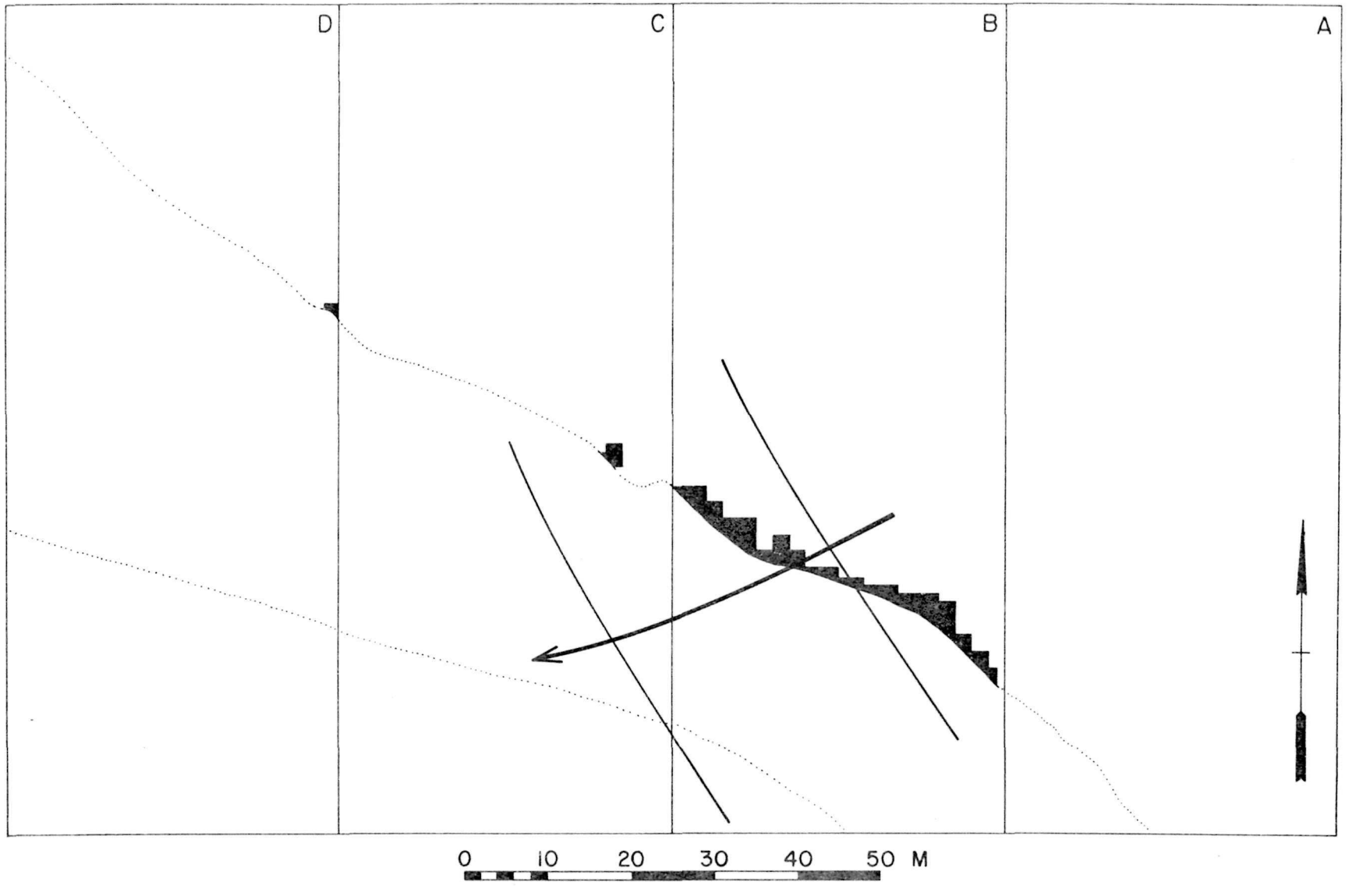


Figure 32. Hypothesized location and lateral migration of the Hoko River channel during site formation.

when the Hoko River occupied a channel in the eastern side of the valley near its present location. The channel was oriented more to the north than it is presently and was steadily meandering to the west (Figure 32). Tidal influence on the river was relatively great, slowing the flow and allowing the accumulation of sand, silt, and organic materials on the lower surfaces of point bars. Periodically, higher energy flows covered the organic layers with sterile sand and gravel, building up the bar surface (Figure 33). As the channel moved farther west and the bar surface rose, deposition became less regular and was more dependent on floods than on river-tide interaction. At first, occasional high waters deposited quantities of sand and gravel, but as the distance from the channel increased, flood velocity decreased, and lesser amounts of deposits (predominantly sand) were added to the site.

If the laminae of unit 2, profile 2, represent the upper surfaces of an intertidal bar, then the model of site development must also include a major change in river hydrology. Modern counterparts of this surface lie approximately 1.5 m lower in elevation, although they are apparently identical to the laminae in all other respects. A major change in river discharge could conceivably account for the elevation difference, but it is unlikely that the sedimentological resemblances would be maintained. A more parsimonious explanation is that the base level of the river (sea level) has fallen approximately 1.5 m since the site was formed. Independent evidence of recent relative sea level change (probably tectonic uplift) has been accumulated by Dr. Parke Snaveley, Jr., U.S.G.S., at Clallam Bay, approximately 8 km to the east of the Hoko River mouth (personal communication). His preliminary estimate of 2 m of change in the past 2000 years is in reasonable agreement with the Hoko River model.

The hypothetical model can be extended to include the relationship of the site area to the river mouth and the Strait of Juan de Fuca. A massive "hogback" of sandstone and conglomerate rises abruptly behind the site and extends into the strait, forming Kydaka Point. Despite the hypothesized change in relative sea level, this point would tend to keep the coastline near its present position by retaining sediment discharged by the river and transported along the coast by wave action. About 500 m of tidal river would have protected the site area from the full force of storms in the strait. Further protection would have been provided by a sand spit at the river mouth, which probably was maintained by wave action for most of the river's existence (Wright 1977:867).

The most important implications of the hypothesized depositional environment are those that relate to the cultural

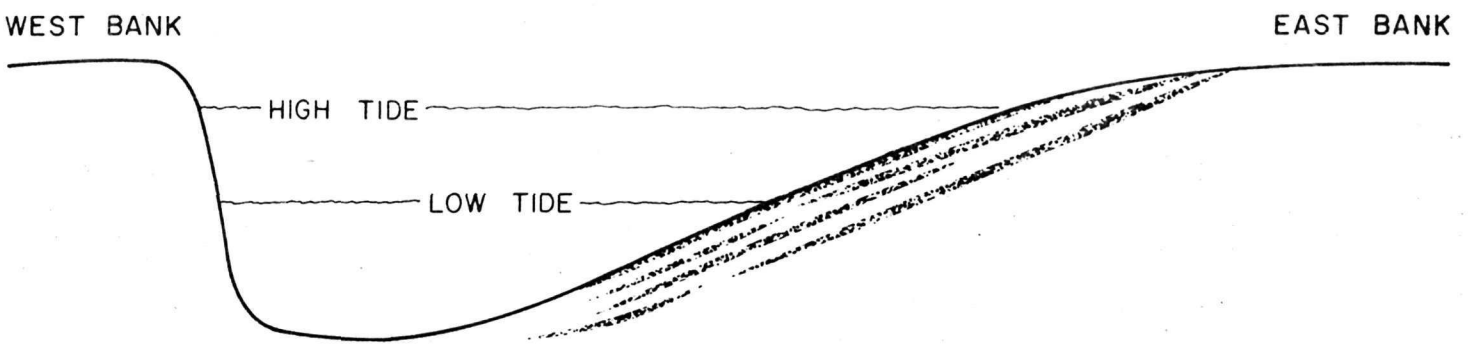


Figure 33. Hypothetical cross-section of the Hoko River channel during site formation.

record at the Hoko River site. Foremost is the obvious factor of preservation. Aerobic decay of vegetal materials has been prevented in the lower portion of the site by the interaction of the ground water level and the elevation of mean high tide. The upper limit of preservation slopes upward from the cutbank to the valley wall to the east, and above this level only stone, charcoal, and rare bone survive. In the water-saturated deposits, most vegetal materials are well preserved (can be recovered intact by careful excavation) as are the stone artifacts. Bone is usually extremely fragile (with the exception of rare but relatively solid terrestrial and aquatic mammal bone), and shell is present only as periostraca. Bone and shell have been affected by the acid soil conditions and ground water, and the sample of shell periostraca from the site probably represents only a fraction of the numbers and varieties of mollusks originally deposited.

The model also points out potential biases about the source of the cultural material and about its representativeness as a reflection of prehistoric activities. We assume that the layers of organic matter that have been the focus of excavation accumulated on the lower surface of an intertidal point bar. Studies of modern bar development include references to accumulations of vegetal drift, but their provenance (origin, source) is not discussed. It is conceivable that such deposits include debris derived from the entire course of the contributing river. If this were the case at the Hoko site, interpretation of the cultural material would be seriously constrained by a lack of an interpretable spatial and temporal context. Cultural material could have been derived from anywhere along the course of the river, and erosion of older cultural deposits upstream could mix temporally distinct assemblages.

Although much of the material in the vegetal mats (leaves, sticks, twigs, etc.) probably has an upstream origin, we believe that most of the cultural material has a local provenance and that some represents in situ deposition. These assumptions are based primarily on the nature and distribution of lithic artifacts in the site. Fire-cracked rock, flaked and ground stone, and abundant quartz debitage show no evidence of rounding of fractured edges. In a fluvial system gravel is usually well rounded after only a few kilometers of transport (Reineck and Singh 1975:120), and visible rounding would be expected after a few tens or hundreds of meters. Also, the size of the lithic artifacts is often (although not always) significantly larger than the particle size of their matrix. This is difficult to explain in the context of fluvial deposition without recourse to a human agent. In addition, fluvial deposition cannot account for the concentration of quartz debitage at higher elevations in the site. If the quartz were carried by the river

from an upstream source, debitage would be more randomly distributed on the sloping bar surface, rather than being concentrated on higher (presumably more subaerially exposed) bar surfaces.

Extension of this argument to the wooden artifacts is less secure. In some instances, the close functional association between certain lithic and vegetal artifacts (quartz debitage with hafted microliths; weights with nets and lines, for example) supports a common (local) provenance. Other artifacts and faunal material are associated with exploitation of resources in the strait rather than in the river, making an upstream source unlikely. For the remainder, their proximity to the source of the lithic artifacts is the only basis for assuming a local origin. It is significant that other (younger, both prehistoric and historic) vegetal mat deposits along the lower course of the river contain very little cultural material. If cultural drift from upstream were deposited at the river mouth, the same mechanism should have introduced cultural material into all mats forming near the mouth for as long as people were living on the river. I believe that drift from upstream is an insignificant source of cultural material at the Hoko River site and that the density of artifacts reflects the intensity of local human activity.

Regardless of the source, the artifacts do represent a somewhat skewed picture of prehistoric activities along the river. Depositional surfaces were tidally inundated and do not represent occupation surfaces (although specialized activities could have occurred there during periods of subaerial exposure). Instead of midden debris, the artifacts are materials discarded into the water, on the beach, or near enough to the river's edge for them to eventually fall into the water. Given these conditions, the wet-site deposits may be skewed toward marine and riverine extractive technology and away from consumptive activities. Thus, the preponderance of fishing equipment in the recovered material represents depositional context as well as the prehistoric subsistence pattern at the site. Further, skewing may have occurred if the periodic mat deposition resulted from seasonal changes in river flow. Correlation of the sterile sand layers with greater river discharge during winter and spring means that cultural materials, if present, would have been flushed out the river mouth during these months. Thus, the wet-site deposits could also be biased in their reflection of seasonal site occupation.

Biases of the water-saturated deposits may be offset by the archaeological potential of the upper 2 m of terrace sediment. A corollary of the depositional model and the hypothesized local origin of the artifacts is that the prehistoric occupation surface would have been on the contemporary flood

plain and upper river bar. Preservation of vegetal material and shell midden is unlikely due to the oxidation and soil acidity of these upper sediments, but hearths and structural features (such as the postmolds revealed by the 1977-1978 floods) may be present. Excavation in this part of the terrace will permit evaluation of the preceding hypotheses and broaden our understanding of prehistoric activity at the Hoko River site.

Time Relationships

Relative dating within the site is based on the stratigraphic sequence of the artifact-bearing vegetal mats. These relationships are relatively clear in area B, where there are only occasional ambiguities caused by layers that fuse or terminate. A single mat (about 10 cm thick) was excavated in area C and includes several discontinuous but extensive lenses of sterile sand. These lenses may or may not have the same temporal significance as those in area B. Unfortunately the broader stratigraphic, and therefore temporal, relationship between areas B and C is not known. Near the boundary between areas A and B, sediments with large quantities of quartz detritus were excavated above the level of organic preservation. Erosion of intervening sediment and the lack of distinctive vegetal mats limit correlation with area B, but the detritus layers are both contemporary with and younger than mat AX (the oldest mat excavated in area B).

Depositional hypotheses presented in the initial report (Croes 1976b:205-206) and in the preceding pages include the possibility that the vegetal mats are seasonal (i.e., annual) deposits. Pollen samples were taken from a sequence of mats in an effort to detect seasonal differences, but the results were inconclusive (see Pollen analysis and seasonal deposition below). If annual deposition was responsible for site development, the vegetal mats in area B represent a time span of about 30 years. Even if the mats are not annual, it is likely that they accumulated in a relatively short time (less than 100 years), due to the normally rapid rate of bar development. (A modern bar near the mouth of the river has grown about 30 m in the past 30 years.)

Radiocarbon dates on material from the site lend support to the interpretation of relatively rapid site development. Two samples submitted in 1974 from the preliminary excavations in area B yielded dates of 2210±70 (WSU-1442) and 2750±90 (WSU-1443) years B.P. (Croes 1976b:206). These dates were stratigraphically reversed, and their provenience cannot be correlated with the levels excavated in

1977, so three samples from the 1977 excavations were submitted. The results are presented in Table 7. Samples of twigs and spruce cones were chosen to represent, at most, several years growth, in an effort to obtain more precise dates of the mats. Although the new dates from area B are also stratigraphically reversed, their standard deviations overlap, and they are essentially contemporaneous. Deposition at area C also appears to be contemporaneous, and all the dates provide a strong argument for rapid site development.

LAB PROCEDURES

by Karen Dohm

The working premise of the Hoko River laboratory was twofold. We wanted, as does every lab, to insure adequate labeling and preservation of the artifacts. We also wanted to maintain a methodology comparable with other Northwest Coast wet sites in order to facilitate comparisons with those sites. In particular, we wanted to maintain comparability with the near by Ozette site, and therefore many of the Hoko River procedures were derived and adapted from the Ozette Project.

The Hoko River lab was staffed by a full-time technician with the assistance of field school students who worked in the lab on a rotating basis as part of the summer school program. The field laboratory cleaned and labeled artifacts and catalogued them on triplicate field catalogue forms. Ring tags were attached to the artifacts in the field and were labeled in waterproof ink with the site number, artifact number, square and unit designation, provenience, date, and the excavator's initials.

Most conservation and preservation of perishable materials was done in the Neah Bay laboratory under the direction of Gerald H. Grosso. At Hoko, artifacts were cleaned, then stored in a freshwater holding tank until they could be taken to Neah Bay for preservation.

Breakage, rather than disintegration, was the major cause of artifact damage, so artifacts were sandwiched between layers of plastic window screening which held them rigid while they were cleaned with running water. Cleaned artifacts were, when possible, placed in individual net bags to guard against breakage in transport or storage and against tag loss.

Table 7

Radiocarbon dates from the Hoko River site

Excavation season	Site area	Level designation	Lab number	Date
1973	B	II	WSU-1443	2750 ± 90
1973	B	III	WSU-1442	2210 ± 70
1977	B	264-265/AN	WSU-2015	2610 ± 100
1977	B	215/AS	WSU-2014	2530 ± 60
1977	C	174/CF	WSU-2016	2580 ± 80

Storage of materials at the camp did present some problems. Water for the holding tank was taken from a spring above the camp and was untreated. Sometime after the first month of excavation, a type of small red worm began to infest the tank and to subsist on artifact tags. Apparently the worms came from the water supply and grew in the cool, dark, stagnant water of the holding tank. The worms ate through the ink on the tags to the paper underneath, rendering some of the labels unreadable. This caused a frantic, and in some ways humorous, retagging and recovery episode just before the end of field school. As a preventative measure, we recommend water exchange on a bi-weekly basis and a clear covering for the holding tank. Worm infestation was not a problem in the Neah Bay conservation lab since no organisms survive immersion in the polyethelene glycol solution.

At the Neah Bay lab, the Hoko materials were routinely preserved in a 70 percent Carbowax 540 solution. Initially, level-bags as well as artifactual materials were preserved, but the process of level-bag preservation was deemed too costly and time consuming. Materials must be well-cleaned prior to carbowaxing, but this is not necessary if the materials are simply dried for analysis. Therefore, later level-bags were stored in the holding tank and then returned to Washington State University, where they were mechanically air dried. These materials, of course, did shrink, warp, and crack to varying degrees, but not to a point where they would be useless for analysis. That is, the desiccation caused by drying seems to have been of a standard nature, and the materials themselves remained comparable. Therefore field drying in special drying equipment will be the preferred treatment of future Hoko level-bag materials.

As previously noted, an effort was made to keep labeling and cataloguing of level-bags and artifacts similar to the practices at the near by Ozette site. Hoko used the forms which were designed for Ozette and which permit artifact attributes to be recorded onto data sheets in preparation for computer loading. The attributes include provenience, functional class, and material(s). Several additional columns on the computer sheets were reserved for student projects in progress. This computer cataloguing will allow much better control of the data being processed from the site.

For additional discussion of problems and for information concerning artifact labeling and preservation procedures, the reader is referred to the recent symposium publication, Pacific Northwest Wet Site Wood Conservation Conference (Grosso 1976).

CHAPTER III ANALYSIS OF FLORAL AND FAUNAL REMAINS

FLORAL REMAINS

Macroflora Analysis

by Debra J. Ecklund

In addition to numerous artifacts, the Hoko River archaeological site contained a vast amount of drift material, including bark, twigs, wood, moss, leaves, and arboreal cones. The frequency of cones is used here to interpret the past vegetation at the site locale. Cone condition was noted as a possible seasonal indicator for the vegetal mats. Arboreal cones were chosen as fossil flora indicators as they are easier to identify than bark or twigs, easier to classify to the species level, and preserve better than leaves. In an early study, Chaney (1925) used the frequency of plant remains to reconstruct past vegetation:

> The correlation values . . . are sufficiently high to indicate a relationship between the numbers of leaves in the stream deposits and the numbers of adjacent trees. These correlations make possible a series of predictions as to the numbers of trees of the various species which were present at the Bridge Creek Forest (1925:138).

In this work I have attempted to apply the same principle, using cones instead of leaves.

Method

Organic materials including cones were collected by field school students and placed into level-bags for further study. There is, of course, a degree of error in the cone sample. My presupposition is that every excavator collected every cone in his/her square; however, many factors may have interfered with this process. The cones might not have been recognizable as cones (e.g., western red cedar cones are

very small and hard to identify), or the cones could have been accidently washed away before collection. But the majority of the cones present in the deposits were recovered and have been used in this research. My strategy was to sort through every level-bag, counting and determining the species of the cones in each bag. I recorded 1411 cones and used modern samples and drawings in books as guides for identification.

Species Collected

Five species of cones are found in the site: western red cedar (Thuja plicata), red alder (Alnus rubra), Douglas-fir (Pseudotsuga menziesii), western hemlock (Tsuga heterophylla), and Sitka spruce (Picea sitchensis). Sitka spruce cones were most abundant (n=945), followed by western hemlock (n=406), with minor occurrences of red alder (n=22), Douglas-fir (n=35), and western red cedar (n=3).

The results of my analysis are displayed in Figures 34 through 37. Figures 34 through 36 plot the absolute frequency of cones per square meter. Some clustering of species is detectable, especially in the eastern end of the site. Sitka spruce (Figure 35) and western hemlock (Figure 36) are both concentrated in this area. I use Sitka spruce and western hemlock in my discussion more than the other three species because they account for 67.0 percent and 28.8 percent, respectively, of all cones, and red alder, Douglas-fir, and western red cedar contribute only 4.3 percent of the total collection.

Table 8 shows the occurrence of cones per unit (level). I have divided the units according to the area of the site in which they were located: B-west, B-east, or C.

Figure 37 is a graph of cones per unit. Only those units with a total frequency of ten or more were used. The numbers listed on the horizontal axis are the relative frequencies of cones per unit since "it is these relative numbers that are most important in the reconstruction of the fossil forest" (Chaney 1925:139). In most cases the percentage of Sitka spruce exceeds 45 percent (averaging 65.8 percent) while the percentage of western hemlock varies from 15 to 45 percent, averaging 30 percent. There is an almost consistent relationship between the two dominant species. The other three species contribute minimally to the figures.

Results

The table and figures illustrate the spatial and temporal distribution of each species throughout the site. The result is almost always the same. Sitka spruce is the dominant species, with western hemlock a not-too-close second,

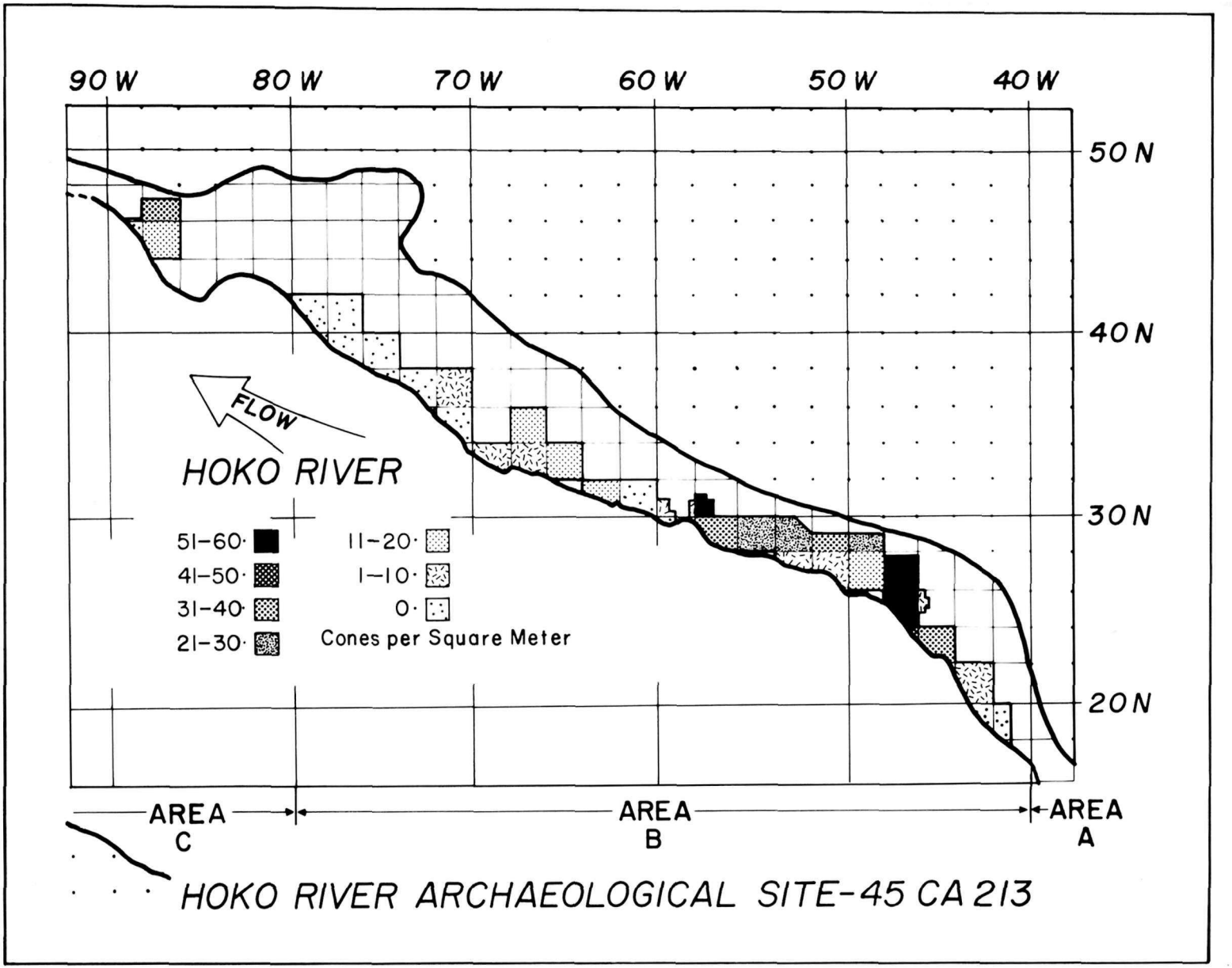


Figure 34. Frequency distribution of all cone species recovered from the Hoko River site.

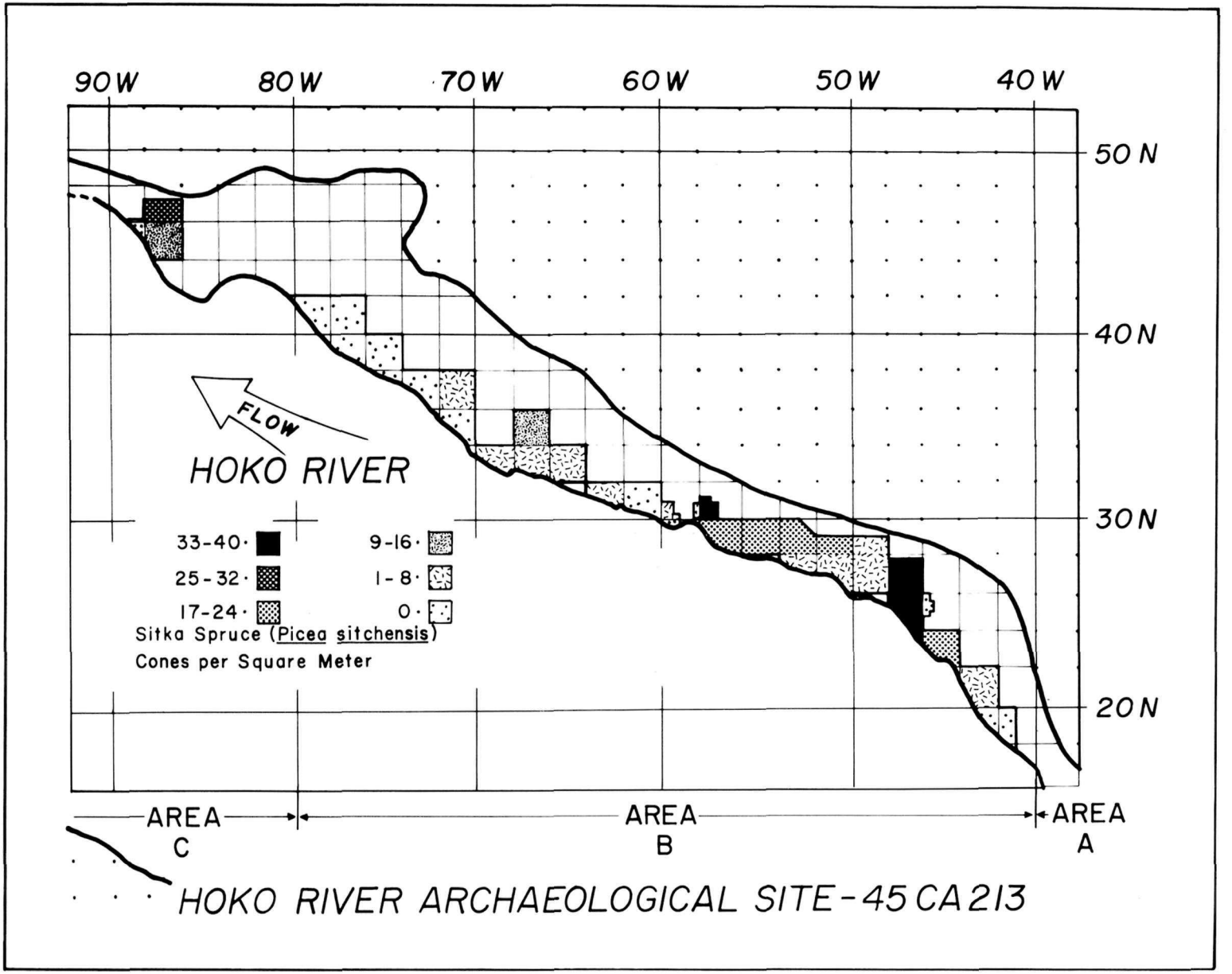


Figure 35. Frequency Distribution of Sitka Spruce cones recovered from the Hoko River site.

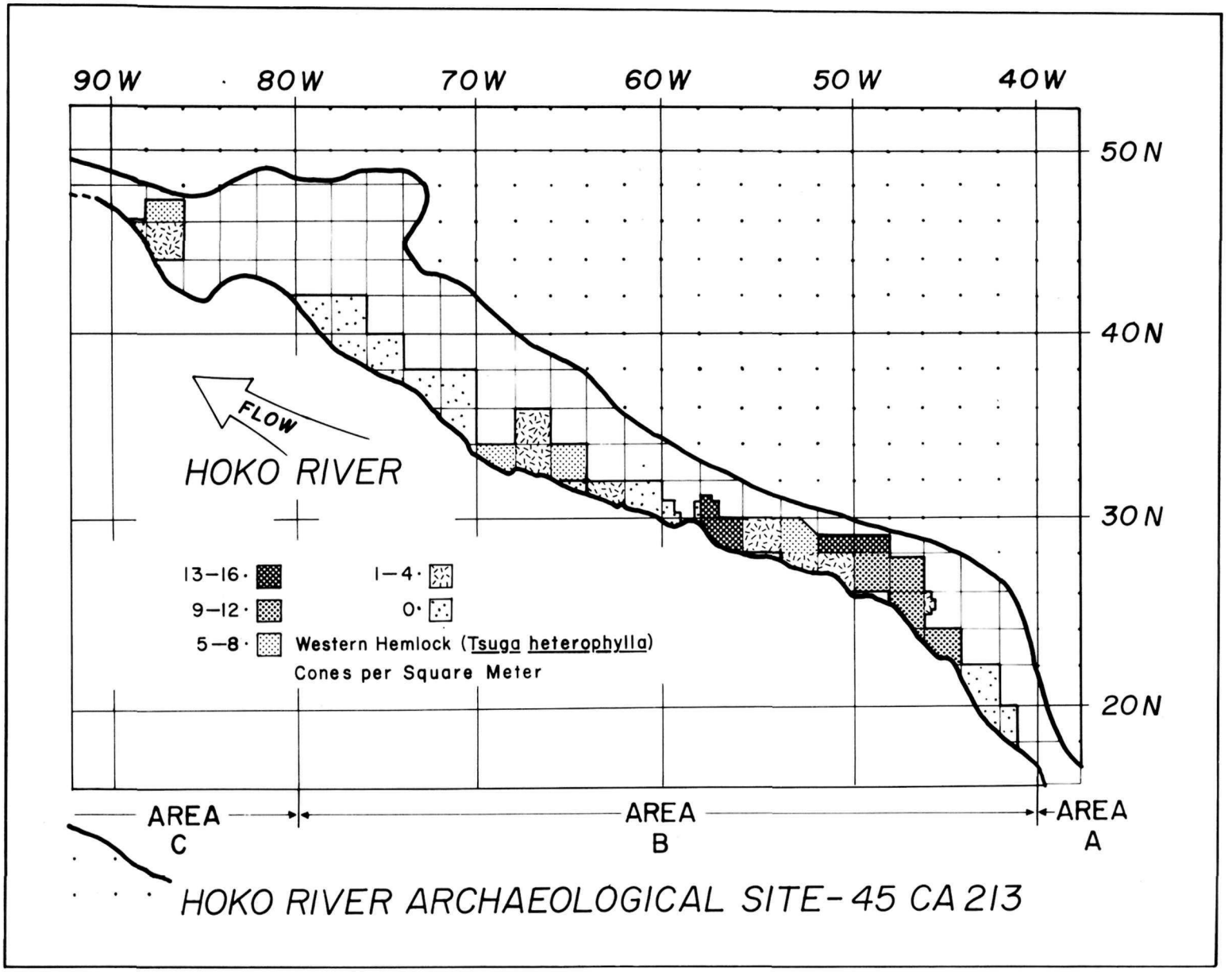


Figure 36. Frequency distribution of Western Hemlock cones recovered from the Hoko River site.

Table 8

Distribution of cones by unit[1]

Unit	*Picea sitchensis* Number	Percent	*Tsuga heterophylla* Number	Percent	Other Number	Percent	Total number
Area B, east							
AD	4	50	3	38	1	12	8
AE	37	61	19	31	5	8	61
AF	35	55	25	40	3	5	63
AG	5	71	1	14	1	14	7
AH	52	70	18	24	4	5	74
AI	17	77	5	23			22
AJ	66	80	11	13	5	6	82
AK	7	87	1	12			8
AK-AL			3	100			3
AL	3	60	2	40			5
AM	39	70	14	25	3	5	56
AN	49	56	37	43	1	1	87
AP	4	67	2	33			6
AQ	2	22	7	78			9
AS	26	44	32	54	1	2	59
AX	340	72	120	26	10	2	470
AY	2	66			1	34	3
AYB	1	100					1
Total number	689		300		35		1024
Area B, west							
H	36	73	8	16	5	11	49
I	58	62	33	36	2	2	93
J	9	70	3	23	1	7	13
JJ	2	100					2
JL	3	100					3
KJ	1	100					1
KK	5	83	1	17			6
KL	4	66			2	34	6
Total number	118		45		10		173
Area C							
C	93	76	24	19	6	5	123
CE	5	84			1	16	6
CF	15	88	2	12			17
Total number	113		26		7		146

[1]Not all cones discussed in the text appear in this table. Some cones were not recovered in situ.

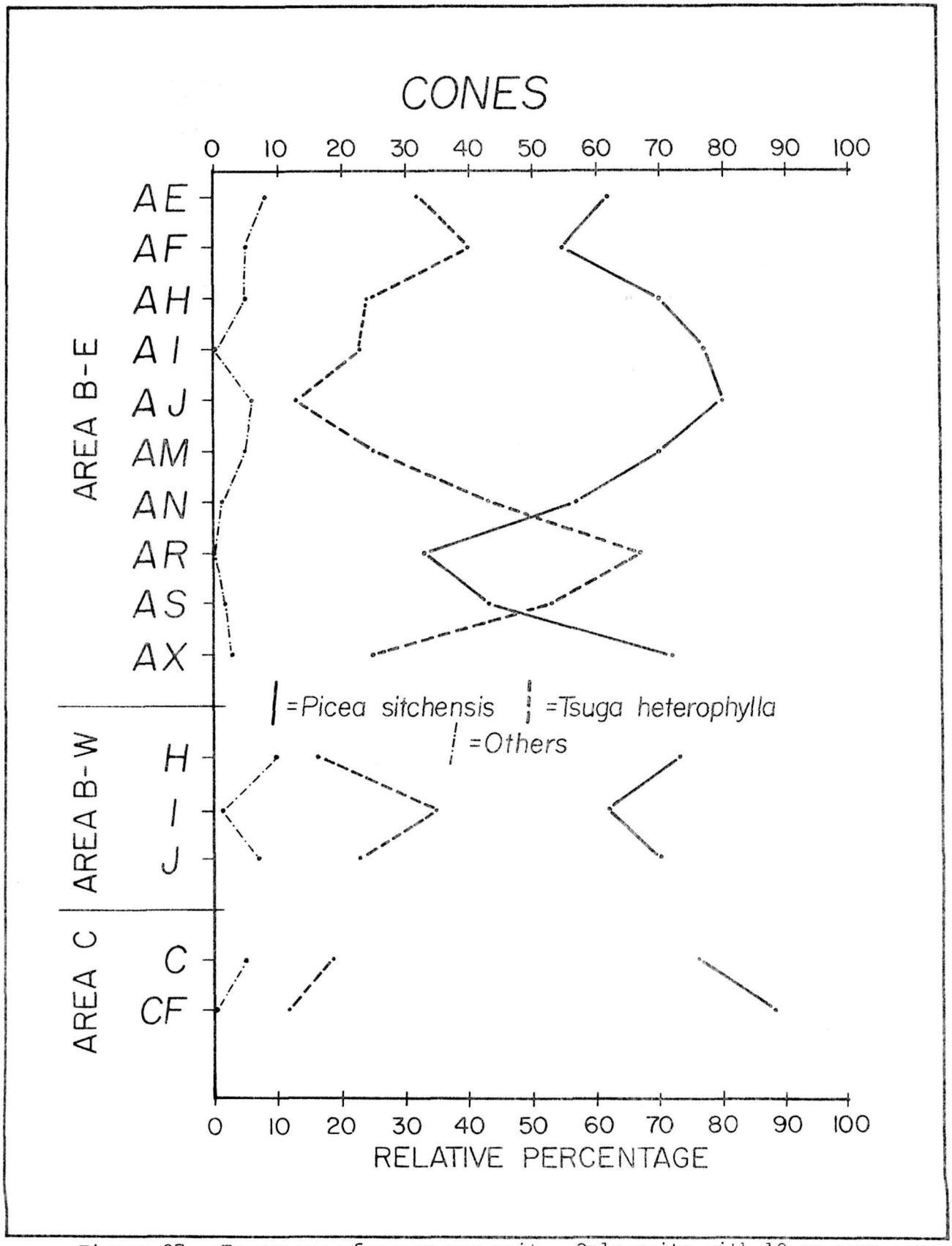


Figure 37. Frequency of cones per unit. Only units with 10 or more cones are included.

and with Douglas-fir, red alder, and western red cedar trailing far behind. I postulate from the data that Sitka spruce and western hemlock were the most numerous trees in the site region at the time of deposition, with a possible smattering of red alder, Douglas-fir, and western red cedar trees.

Conditions of Cones

One other factor I looked for while identifying and counting the cones was the "condition" of the cone, i.e., whether the scales were open, partly open (in western hemlock), closed, or too worn to tell, and whether (in Douglas-fir) bracts were present. In Table 9 I have recorded the absolute and relative frequencies of cone conditions by species. Taking the average of all species' relative percentages of condition, I calculated that 40.5 percent of all the cones were open and 26.2 percent were closed. A total of 22.7 percent of all the western hemlock cones were partly open.

There may be a correlation of these data with seasonality of the vegetal mats. According to Sudworth (1908) and Mosher and Lunnum (1977) most of these species drop their cones in autumn; the exception is western red cedar, which sheds cones in spring or summer, but only three cedar cones were collected from the site. No definite conclusions about seasonality are possible, however, since trees may drop their cones at any time due to wind, animal activities, etc.

Present Vegetation

Crown Zellerbach Corporation provides the following information on percentages of trees now in the Hoko River mouth area: Sitka spruce constitutes 81 percent of the arboreal vegetation, and western hemlock constitutes 19 percent (Figure 38). Since no figures for other species were given, I performed a walk-through survey of the site area which revealed no other tree species than these two. The immediate area of the site is in a recently undisturbed locale. Surrounding the spruce and hemlock zone is a logged and cut zone, with numerous secondary-vegetation alder trees. Only a few western red cedar and Douglas-fir trees are recorded for the area.

In the summer of 1977, Dean Pedersen (1977) recorded the constituents of two modern vegetal mats in the proximity of the site. He found that the two vegetal mats consisted mostly of red alder leaves, with only a small amount of cones and other vegetal materials. Though alder leaves are present in the prehistoric vegetal mats, they are not nearly so numerous as in the tested present-day mats. This fits in with the environmental reconstruction model proposed here, since the vegetation occurring today in the area of the tested mats is mostly secondary growth red alder trees.

Table 9

Condition of cones

Species	Condition									
	Open		Partly Open		Closed		Worn		Open bracts	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Picea sitchensis	283	29.9			216	22.9	446	47.2		
Pseudotsuga menziesii	6	17.1			8	22.9	12	34.3	9	25.7
Thuja plicata					1	33.3	2	66.7		
Tsuga heterophylla	208	51.2	92	22.7	103	25.4	3	0.7		
Alnus rubra	14	63.6					8	36.4		

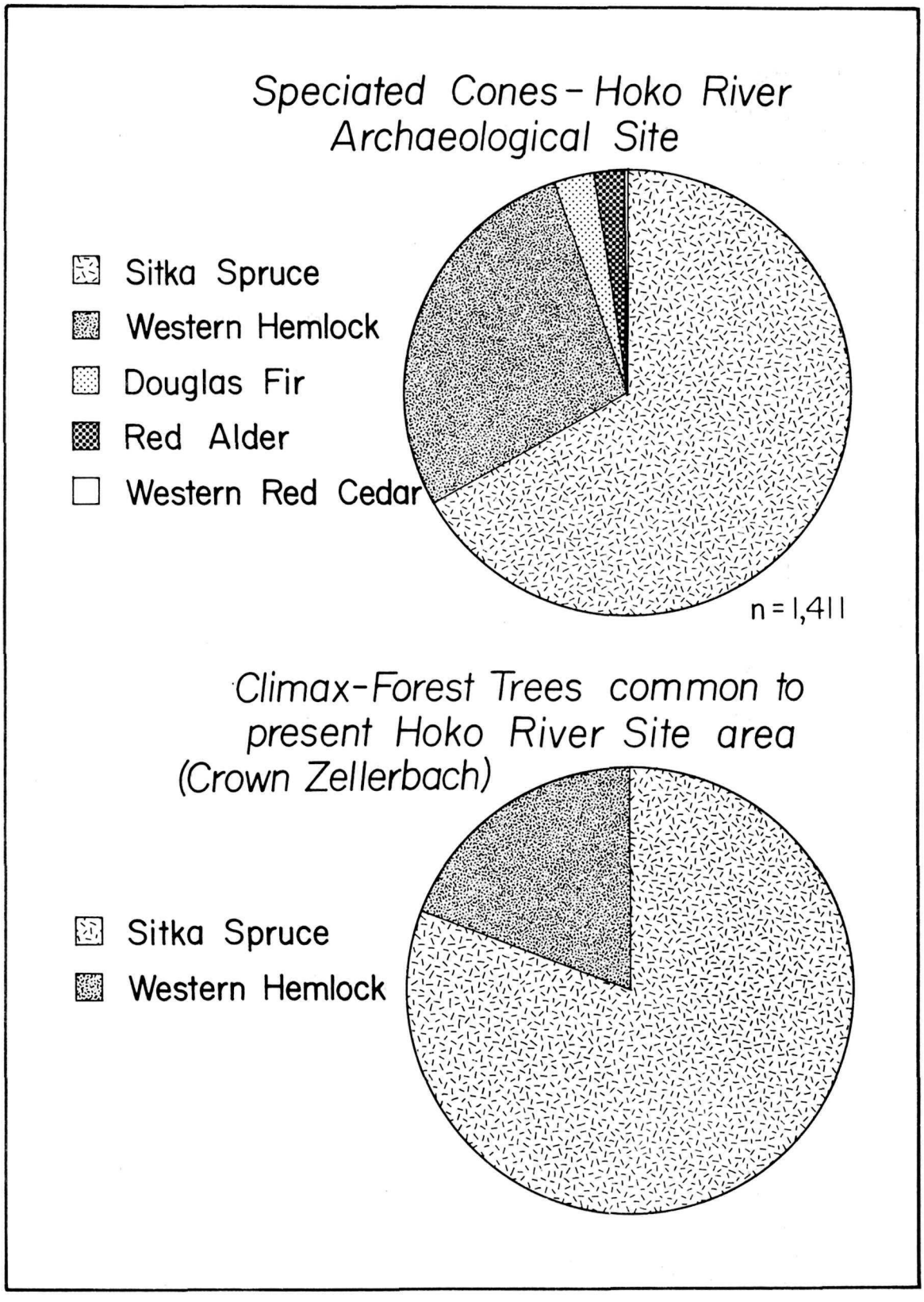


Figure 38. Frequency of Hoko River cones and present-day trees common to the vicinity.

Conclusion

From these data--the fossil cones and tree distributions of the present--I conclude that the vegetation in the immediate area of the site is essentially the same now as it was 2500 to 3000 years ago. Therefore, the prehistoric site area probably was a *Picea sitchensis-Tsuga heterophylla* plant community.

Pollen Analysis of an Organic Mat Sequence

by Eric Blinman and Kenneth Petersen

Excavations at the Hoko River site have focused on a series of thin vegetal mats that are separated by culturally sterile layers of sand, silt, or gravel. Possible explanations for the periodicity of these deposits include the hypothesis that they are varved (annually laminated), the vegetal portions of the couplet accumulating during low water discharge (summer and fall) and the sterile sediment accumulating during higher velocity river flow (winter and spring) (Croes 1976b:205-206; see Stratigraphy and depositional environment, above). Differential pollen content has been noted in studies of varved and rapidly deposited sediment laminae in lakes (Terasmae 1963; Tippett 1964:Figs. 2,3,4; Mehringer et al. 1977) and can be used as an indicator of seasonal deposition. We hoped that seasonal differences in pollen content could also be used to test the possible annual nature of the fluvial sediments at the Hoko River site.

Immediately prior to the 1977 excavations, a series of pollen samples were taken from the cutbank about 53 m west and 28 m north of the datum. The cutbank was faced at low tide, exposing a series of vegetal mats and intervening sediments. A 22.8 cm high column of sediment with a 1 sq cm cross-section was isolated and divided into 12 samples based on changes in natural stratigraphy. Where possible, samples were defined to include only vegetal mat or sterile sediment, but much of the column consisted of diffuse organic lenses rather than discrete mats. After collection, the samples were shipped to the Paleoenvironmental Laboratory at Washington State University for extraction and analysis.

Tablets containing 50,000 Lycopodium spore tracers (Stockmarr 1971, 1973) were added to each sample as the first step in extraction. Pollen and spores were then isolated by removing silica with hydrofluoric acid and removing organic matter by acetolysis (Mehringer 1967:136-137). The microfossils were stained and mounted in silicone oil, and the slides were counted at a magnification of 400x. Identifica-

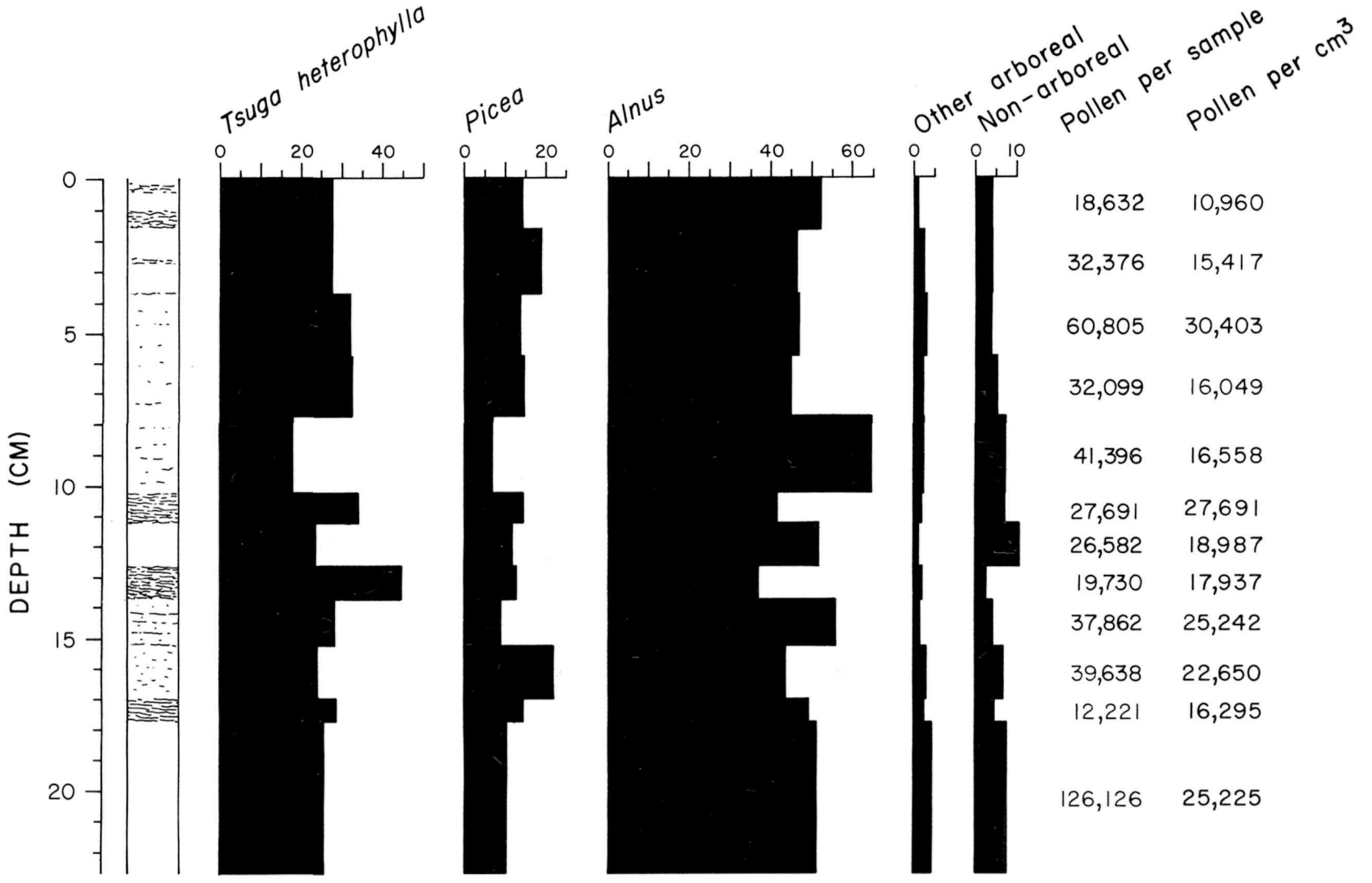


Figure 39. Percentages of major pollen types, pollen per sample, and pollen per cu. cm. for samples from a sediment column with a 1 cu. cm. cross-section, Hoko River site.

tions were checked against standard keys and the pollen reference collection at Washington State University. Counts were considered complete after at least 200 pollen were identified. Percentages of each pollen type, numbers of pollen per sample, and numbers of pollen per cubic centimeter were calculated; these data are summarized in Figure 39.

Pollen spectra in all samples are dominated by Alnus (40-65 percent), with lesser amounts of Picea and Tsuga heterophylla pollen. Other arboreal pollen types and nonarboreal pollen rarely amount to more than 10 percent of the pollen sum. Estimates of pollen concentration vary widely from sample to sample, ranging between 10,000 and 30,000 pollen per cubic centimeter. Variation in pollen content does not appear to correlate with the presence or absence of macroscopic organic matter. These pollen data are not directly comparable with the published lake and bog pollen records for this part of the Olympic Peninsula (Heusser 1973) due to the difference in depositional environment and the overrepresentation of Alnus (a member of the successional vegetation on the active flood plain).

Seasonal interpretations of pollen data depend on the contrast created by early and late flowering times of components of the vegetation. These contrasts are reduced as pollen is blown, bounced, and washed around the landscape before deposition. In the ideal situation, the contrast between spring and fall bloomers remains sufficient to be detectable in the sedimentary record. On the Olympic Peninsula this contrast would be between arboreal (Alnus and the conifers) and numerous nonarboreal pollen types.

Unfortunately, three arboreal pollen taxa so completely dominate the Hoko samples that nonarboreal pollen content is effectively masked. There is, however, a potential contrast between the spring and early summer flowering seasons. In the modern vegetation, Alnus rubra flowers in March and April, whereas Picea sitchensis and Tsuga heterophylla release pollen in May and in May and June respectively (Taylor and MacBryde 1977). This minimal contrast is not clearly reflected in the column samples where variations in the relative abundances of the three pollen types do not consistently correlate with the presence of lenses of vegetal material. However, the vegetal mats in the column that are stratigraphically most distinct (those between the 10 and 14 cm depths, see Figure 39) do show a consistent variation in pollen content: a relatively higher proportion of Tsuga heterophylla pollen in the samples of the mats, and a relatively higher Alnus pollen percentage in intervening and adjacent sediment.

If this correlation were consistent throughout the column, it could support an argument of spring deposition for the

culturally sterile sediment and of summer deposition for the vegetal mats. However, data from the column as a whole are inconclusive, and it would not be unreasonable to attribute the coincidence of the pollen frequencies between the 10 and 14 cm depths to chance. Alternately, future pollen studies may reveal that each discrete layer does represent a seasonal deposit, but that deposition is not strictly periodic or continuous. The majority of the column would there by represent partial layers resulting from intermittent deposition and would contain a more "average" pollen content.

FAUNAL REMAINS

Analysis of the Fish Remains

by David R. Huelsbeck

The Sample

The sample of fish remains recovered during 1977 from the Hoko River site is made up of bones and scales. The scales were recovered during the processing of bulk soil samples and have not yet been analyzed. A total of 814 fish bones and fish bone fragments were recovered during excavation, and of these, 460 pieces of bone were too fragmentary to be identifiable. The remaining 361 bones were compared with skeletal material from fish identified to species; 334 bones were positively identified, and 27 bones were deemed complete enough to be identifiable, but identification was not possible using the comparative collection available.

Although the sample was collected from fluvial or estuarine sediments, this does not reflect natural mortality of fish. Only a minority of the fish represented in the sample live in estuaries; a large number of artifacts were found in the same sediments as the fish bones; and some of the fish bones were burned. Thus, this sample of fish remains is at least in part a reflection of cultural activity.

The bones in this sample are fragile, and there were a large number of bones which could not be identified because they were too fragmentary. A few bones from very small (approximately herring-sized) fish were recovered but disintegrated before they could be identified. It is likely that the sample is biased in favor of large fish and fish with sturdy bones. Although some species which were originally deposited at the site may be missing entirely, the effects of

this bias are probably limited to an underrepresentation of small fish and possibly of salmonids, since their cranial bones are fragile.

While the bias due to the fragile condition of the bones is probably not serious, the small size of the total sample poses several problems. Too few bones were recovered from most units to permit statistical comparison of individual units, and comparisons can only be drawn between general areas of the site. Minimum numbers of individuals (MNI) represented in the sample are no more than two individuals for each genus or species. This suggests that approximately the same number of each kind of fish were caught and consumed by the people living at the site. However, there are distinct differences in the total number of bones from different kinds of fish in the sample, and the use of MNI as a basis of comparison within a sample this small may obscure differences that do exist. Thus, the number of identified bones from each genus or species, rather than MNI, is used as a basis of comparison within the remainder of this report.

This sample of fish remains is thought to be a product of at least some of the activities of the people living at the site. However, the small sample size places restrictions on the method of analysis and lessens the reliability of any conclusions. The results of the following analysis are best regarded as hypotheses which should be tested.

Fishing Activity

A brief examination of Table 10 and Figure 40 shows that flatfish are the most common kind of fish in the sample and that halibut is the most common species. Round fish, especially Pacific cod, are the next most common, followed by rockfish, the dogfish, salmonids, and sculpins. The obvious interpretation is that the fish whose bones are most common were most frequently captured and possibly most commonly sought after.

Although dogfish is as common as Pacific cod and rockfish, this may not have resulted from equal preference. A variety of techniques for catching dogfish are reported in the literature, whereas this is not the case for flatfish, rockfish, and Pacific cod. Dogfish were taken on bentwood hooks, on the type of hook used for catching Pacific cod and trolling for salmon, or by spearing (Drucker 1951:22; Koppert 1930:72; Suttles 1951:130). The dogfish in this sample may have been accidentally included in catches of other kinds of fish and may not have been intentionally sought after. Supporting this possibility is Swan's statement that the Makah rarely ate dogfish because of its "nauseous taste" (1870:29). Those dogfish which were captured may have been kept for nonfood uses, such as use of the skin as sandpaper.

Table 10

Identified fish bones from the Hoko River site

Species	Number of bones	Percent of total
Flatfish		
Halibut *(Hippoglossus stenolepis)*	73	20.2
Petrale sole *(Eopsetta jordani)*	49	13.6
Starry flounder *(Platichthys stellatus)*	4	1.1
English sole *(Parophys vetulus)*	1	0.3
Other flatfish	4	1.1
Total flatfish	131	36.3
Roundfish		
Pacific cod *(Gadus macrocephalus)*	56	15.5
Lingcod *(Ophiodon elongatus)*	12	3.3
Total roundfish	68	18.8
Rockfish (*Sebastes* sp.)	55	15.3
Cartilaginous fish		
Dogfish (*Squalus acanthias*)	44	12.2
Salmonids	29	8.0
Sculpins	7	1.9
Identifiable*	27	7.5
Total	361	

*"Identifiable"=bones which were suffuciently complete for potential identification, but which were not identifiable from the comparative collections at our disposal.

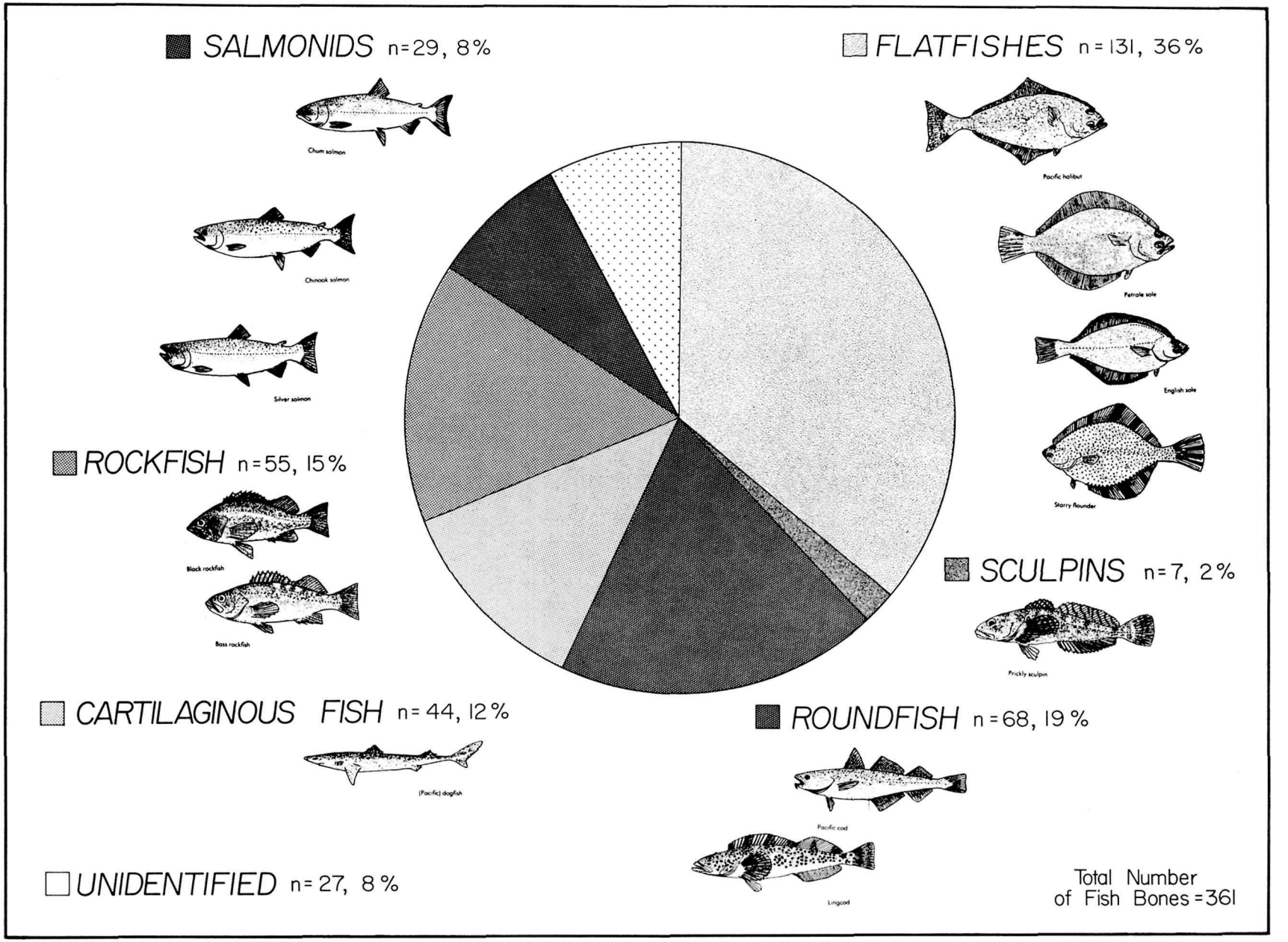


Figure 40. Frequency of identified fish bones recovered from the Hoko River site. Because of the low sample size, this data may only be suggestive of the frequencies of fish types procured.

The unexpectedly small number of salmonid bones suggests that either salmon were not frequently captured and consumed at the site or seasonal variation in river flow prevented deposition when salmonids were being exploited. Historically, salmon were trapped or netted up-river from the Hoko River site and were transported downriver to the site area for processing (see Ethnohistory section). This may not have happened prehistorically. The salmonid remains that were recovered may be from fish which were caught in the strait during the summer, and there may be another camp farther up-river which served as a base for salmon fishing in the fall. Another possibility is that during the salmon fishing season, fish bones did not accumulate as they may have in the summer.

Given the large number of flatfish bones recovered, it is probable that fishing for flatfish was a common activity. Fishing for Pacific cod and rockfish was probably somewhat less common, and the frequency of fishing for salmon is unclear. The large number of bentwood hooks recovered and the testimony of informants also indicate that fishing for flatfish was an important activity at this site.

Seasonality

Table 11 lists the kinds of fish represented by the Hoko fish remains and the time of year when they were available in the vicinity of the Hoko River. Pacific cod and flatfish (excluding the starry flounder) make up just over 50 percent of the sample and are only available during the summer (both fish winter in waters deeper than 100 fathoms). All of the salmonid remains in this sample are of a size to suggest they are from salmon or ocean-run trout, probably salmon. Salmon are more abundant during the summer and fall, and although they can be caught in the winter, these remains probably represent summer and fall captures.

Thus, on the basis of the fish remains, it would appear that the Hoko River site was occupied during summer, was probably occupied during the fall, and was possibly occupied during the rest of the year. Because salmonids could be caught in the strait during the summer, it is possible that the site was occupied only during the summer. On the other hand, over 30 percent of the bones analyzed are from fish that could have been available during the winter. Since fish bones from several strata were lumped in this study, a few winter occupations may be masked by the bulk of the data indicating summer occupation.

Utilization of Habitat Zones

Except for the starry flounder, all of the flatfish listed in Table 10 inhabit the Neritic Habitat Zone (see Fish habi-

Table 11

Seasonal availability of fish[1]

Type of fish	Season available
Halibut	Summer
Petrale sole	Summer
English sole	Summer
Pacific cod	Spring-Summer
Salmon in the river	Fall
in the strait	all
Other salmonids	all
Rockfish	all
Dogfish	all
Lingcod	all
Starry flounder	all
Sculpins	all

[1]Based on Hart (1973).

Table 12

Intrasite distribution of fish remains

Type of fish	Area B[1]		Area C[2]		Miscellaneous units[3]	
	Number of bones	Percent of total	Number of bones	Percent of total	Number of bones	Percent of total
Salmonid	27	20.4	0		0	4.3
Halibut	24	18.2	29	15.9	20	43.5
Petrale	17	12.9	28	15.3	4	8.7
Starry flounder			3	1.6	1	2.2
English sole			1	0.6	0	
Other flatfish	1	0.8	2	1.1	1	2.2
Pacific cod	6	4.5	47	25.7	3	6.5
Rockfish	7	5.3	41	22.4	7	15.2
Dogfish	32	24.2	5	2.7	7	15.2
Lingcod	5	3.8	7	3.8	0	
Sculpin	7	5.3	0		0	
Identifiable[4]	6	4.6	20	10.9	1	2.2
Total bones	132		183		46	

[1]Area B: A series of units; squares 61, 112, 162, 163, 164, 264, 265, 415, 416.
[2]Area C: Squares 17,3 174, 223, 224.
[3]Miscellaneous units: Squares 566, 616, 617.
[4]See note on Table 10.

tat zones, above). This is also true of the Pacific cod, lingcod, and rockfish. Dogfish could be captured in the Estuarine or Intertidal Habitat zones but historically were most frequently captured in the Neritic Zone. Between 70 percent and 90 percent of the fish bones in this sample are from fish which were captured in the Neritic Habitat Zone, suggesting strongly that this area was the focus of fishing activity, at least during the summer. During the fall, the Riverine Habitat Zone with its rich salmon resources should have been the focus of fishing activity, but this activity may have been carried on from a different base camp.

Intrasite Variation

Due to the small sample size it was not possible to directly examine the vertical distribution of different kinds of fish. However, grouping the fish remains by area does permit a more general examination of variation through time because different areas of the excavation have different stratigraphic ages. Table 12 lists the fish bones recovered from three different areas of the site.

Table 12 reveals a major difference in the number of bones of different kinds of fish that were recovered from the A series units and Area C. In the A series units rockfish constitute 5.3 percent of the sample, Pacific cod 4.5 percent, dogfish 24.2 percent, and salmonids 20.4 percent. In Area C rockfish constitute 22.4 percent of the sample, Pacific cod 25.7 percent, dogfish 2.7 percent, and salmonids are absent. In both areas flatfish constitute slightly over 30 percent of the sample.

Differences between the two areas may be accounted for by (1) changes in the nature of fishing activities at the site, (2) changes in the depositional situation, or (3) differential use of space--different fishing activities may have been prepared for at different points along the river, creating a spatial segregation of activities and their refuse. Similarly, seasonal variation in river flow may have prevented deposition at Area C during the period of salmonid fishing. Evidence from cultural remains supports neither the temporal, spatial, or depositional explanations; the proportions of fishhooks of various styles (ethnographically different hook styles are associated with different types of fish) are the same in the two site areas. These cultural materials suggest that there was little difference in fishing activity between the A series units and Area C and that differences in the number of bones may be due to sample error. At this point, too little is known about the site to satisfactorily account for the differences between the two areas.

Summary

Analysis of the fish remains from the Hoko River site indicates that the site was occupied during the summer and probably during the fall. The Neritic Habitat Zone was the locus of much of the fishing activity, and flatfish were the kind of fish most frequently exploited. Because of the small size of the sample, these conclusions are best regarded as hypotheses which should be tested against data other than fish remains and refined by the collection of a larger sample of fish remains.

Analysis of the Bird and Mammal Bone

by Edward Friedman

Bird and mammal faunal remains from the Hoko River site are limited in several ways: (1) the paucity of identifiable bones recovered (Table 13), (2) the dearth of species and seasonal variability represented in the sample (Tables 14 and 15), and (3) the wide spatial distribution of bones.

The majority of the faunal remains consist of bird bones. The data upon which this section is based are derived from several ornithological texts for the Northwest: Gabrielson and Jewett (1970); Godfrey (1966); and Guiguet (1962, 1964, 1967a, 1967b, 1970a, 1970b, 1971, and 1973). Five bird species were identified in the Hoko faunal remains: western grebe (Aechmophorus occidentalis), common tern (Sterna hirundo), white-winged scoter (Melanitta deglandi), surf scoter (M. perspicillata), and common murre (Uria aalge). The recovered bones of the bird species are listed in Table 15. Two additional bones are too fragmentary to be identified beyond family; both are ducks (Anatidae).

Of the five bird species recovered from Hoko, two--the western grebe and the common tern--are present in the area only seasonally (Table 16). The western grebe, represented by one bone (the left tarsometatarsus), is abundant in the area from mid-September to early May. While the period of availibility is restricted, that information by itself is not sufficient to substantiate the season of human occupation. The common tern, represented by a left humerus, also is limited in its occcurrence. A migrant, it is found in the vicinity from July to early October.

Three species represented in the archaeological remains are year-round residents. The white-winged scoter and the surf scoter exhibit periods of maximum density from mid-September to mid-May and from early August to mid-July respectively. The common murre generally is abundant throughout the year.

Table 13

Total mammal and bird bones and bone fragments recovered

	Number recovered	Number identified	Percent of identifiable bone
Mammal	34		
Land mammal		3	10.0
Sea mammal		6	20.0
Bird	28	21[1]	70.0
Total	62	30	

[1]Two bones identified only to family.

Table 14

Birds and mammal species recovered from the Hoko River site

Species	Common name	Number of bones
Birds		
Aechomophorus occidentalis	Western grebe	1
Melanitta deglandi	White-winged scoter	10
Melanitta perspicillata	Surf scoter	4
Sterna hirunda	Common tern	1
Uria aalge	Common murre	3
Anatidae sp.	Duck	2
Mammals		
Eschrichtius robustus	Gray whale	2
Callorhinus ursinus	Fur seal	2
Phoca vitulina	Harbor seal	1
Phocaena phocaena	Harbor porpoise	1
Castor canadensis	Beaver	1
Odocoileus hemionus	Black-tailed deer	2
Total bones		30

Table 15

Bones of bird species recovered from the Hoko River site

Species	Square	Bone identified
White-winged scoter	B/415/AH	Frontal
	B/415/AH	Left quadrate
	B/415/AH	Right quadrate
	B/415/AH	Right pterygoid
	B/415/AH	Cranium
	C/224/C	Right humerus
	B/617/J	Right coracoid
	B/617/J	Right scapula
	B/61/AY	Right ulna
	C/174/C	Left femur
Surf scoter	B/617/J	Right coracoid
	B/617/J	Right tibia
	B/617/KK	Left humerus
	B/415/AA	Left metacarpal
Common murre	B/617/KL	Left humerus
	C/174/CF	Left humerus
	B/265/AN	Right coracoid
Common tern	B/164/AX	Left humerus
Western grebe	B/224/C	Left tarsiometatarsus
Anatidae (ducks, geese, and swans)	C/174/CF	Right ulna

Table 16

Seasonal availability of birds in the Hoko River area

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Western grebe	×	×	×	×	+				+	×	×	×
White-winged scoter	×	×	×	×		o[2]	o	o	o/×	×	×	×
Surf scoter	×	×	×	×	×/o	o	o	o	×	×	×	×
Common tern				[3]			+	×	×	+		
Common murre	×	×	×	×	×	×	×	×	×	×	×	×

[1]Key × = common; + = common, part of month only; o = present.
[2]Only nonbreeding individuals present June to early September.
[3]Occasional migrant individuals appear in April and May.

The nature of the sample limits interpretations regarding seasonal occupation, resource utilization, or scheduling. The remains are widespread, both horizontally and stratigraphically. The 19 bird bones recovered came from seven different squares and 11 stratigraphic levels. This distribution does not allow for any more detailed analysis.

Nine mammal bones have been recovered from the excavation to date. Of these, three bones are of two terrestrial species: beaver (Castor canadensis) and black-tailed deer (Odocoileus hemoinus). The six remaining bones are sea mammal: gray whale (Eschrichtius robustus see Figure 41, next section), fur seal (Callorhinus ursinus), harbor porpoise (Phocaena phocaena), and harbor seal (Phoca vitulina). Terminology regarding mammalian remains used here is based on Banfield (1974).

The assemblage of mammal remains other than those of the gray whale and fur seal comprises species which are common to the Hoko River area year round. The fur seal would be classed as an "occasional straggler" (Fiscus 1972:11), as this species generally is found in the open sea and is seldom seen "within 10 or 15 miles of shore" (Fiscus 1972:7). Fur seals are abundant along the Washington coast, well offshore, from late November to June (Fiscus 1972:11). Gray whales may be seen closer to shore and would be most abundant from March to May (Miller 1975).

The faunal data are rather inconclusive as evidence relating to the season of occupation at the Hoko site. They tend to suggest a period of occupation from early fall through spring, but since remains of species that are year-round residents are represented in the deposits, the issue will remain unresolved pending the recovery of additional faunal remains from future excavations.

Analysis of the Whale Bone

by Marian Fisken

An analysis of the whale bones from the Hoko site resolves little in determining seasonal occupation at the site or the extent to which sea mammals were exploited from the mouth of the Hoko River. This is due to the small number of whale bones recovered and to their fragmentary nature and state of preservation. However, as nothing has been found at Hoko that can be identified as belonging to a whaling technology, some explanation for the presence of whale bones in the Hoko deposits should be explored.

Two identifiable whale bones have been recovered from the Hoko site. The largest, most complete bone is the left ulna of a gray whale (Eschrichtius robustus). The other is a 14 cm long fragment from the end of a transverse process of one of the last cervical vertebrae of a baleen whale. There is not enough of this bone left to make a species identification. Several additional fragments of whale bone have been recovered from the same stratigraphic level as the ulna and vertebra fragment, but they are much too small and fragmented to be identifiable. Two of these are from the same square as the ulna, and they are probably pieces of that bone. One is from the same square and level as the vertebra fragment, and one is from a neighboring square at the same level. Since no whale bones have been found in any other stratigraphic level, and because of the close proximity of the fragments, they probably belong either to the ulna or to the vertebra.

The ulna (Figure 41) was removed from the site in the block of river sediments in which it was found because of its fragile condition. The surface of bone exposed is the medial surface with the medial foramen in the proximal one-third. It is approximately 61 cm long, which is in the range of a medium-sized gray whale. It has been slightly crushed, probably by the weight of overlying deposits, and much of the dense surface is in fragments. The distal end is missing, and what is left of the distal one-quarter consists only of cancellous bone. The dorsal process on the olecranon is missing on the proximal end, which is also badly deteriorated to cancellous material. There are some charred surfaces or organic stains on the proximal end. Butchering marks found on whale ulnae recovered from the Ozette site occur most frequently on the lateral surface at the very end of the distal area. This surface is not visible on the Hoko specimen, and even if it were, the distal end is too far deteriorated to exhibit any butchering marks. The same is true of the vertebra fragment. The hard, exterior bone is almost entirely disintegrated except for the very end of the process.

Twice annually pods of gray whales pass the entrance to the Strait of Juan de Fuca on their migration route from the Bering Sea to Baja California. Most gray whales pass the Washington coast between November and the end of December on their way south and can be seen again around late March or April headed north. Single animals, however, will occasionally enter the strait and stay several days or even weeks. Some of these whales are "stragglers" and may appear long after most other whales have left the Northwest Coast. At least some of the "stragglers" are believed to be yearlings migrating on their own for the first time (Walker 1975:34). Gray whales have also been known to spend the entire summer in this area (Rice 1978:57). They spend much of the time

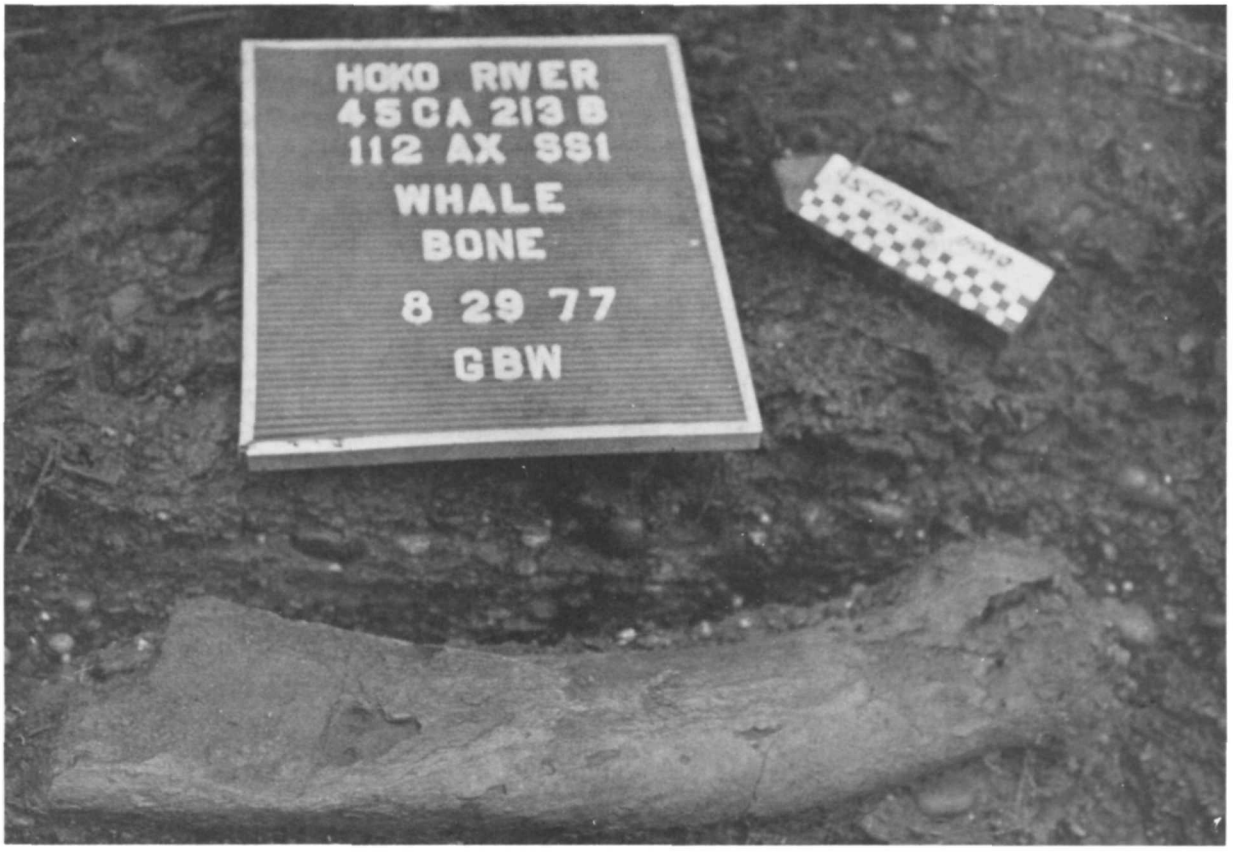


Figure 41. Left ulna from a medium sized gray whale.

close to shore, feeding along the bottom or rubbing off the parasitic barnacles (Cryptolepas rhachianecti) which grow on their skin. A gray whale was observed off and on for a week at the end of January, 1979, rolling in the surf several miles east of the Hoko site. Since the Hoko is not on the main migration path of the gray whale, and since gray whales have been observed year round in the Hoko area, the whale bones recovered to date are not particularly useful in any determinations concerning seasonality.

Since only two whale bones have been recovered at Hoko, and since these two bones were found at the same stratigraphic level and in close proximity to one another, it can be assumed that they are from the same individual. In the absence of a whaling technology, the presence of whale bones in an archaelogical site on the Northwest Coast can be explained by a drift carcass or beached whale. Even today, in spite of their greatly reduced numbers, it is not uncommon to find whale carcasses on Washington beaches. After a decay period of at least a year or more, the remainder of the carcass is broken up by and scattered along the beach. As a result, single whale bones are found occasionally along the Strait of Juan de Fuca when they are washed out with the movement of sand and gravel or they appear after bank erosion. The extent to which the animal represented by the bones recovered at Hoko was utilized must remain a question unless additional and better preserved gray whale bones are recovered from the same deposits.

Analysis of Mollusk Remains

by G. Timothy Gross

The aboriginal use of mollusks on the northern Olympic Peninsula is documented both ethnographically (Singh 1956:39-40) and archaeologically (Drake 1963; Friedman 1976:148-161). Singh reports the use of "clams and mussel shells" as well as "other tidal animals such as rock oysters, crabs, sea cucumbers and china slippers" (Singh 1956:39) and says that clams and mussels were the most important. Of the clams, butter clams were most plentiful in the area exploited by the Makah.

Mollusks may be gathered at any time of the year, but ethnographically they were collected primarily in the summer (Singh 1956:39). Croes and Hassan (1977) present a resource scheduling model for the area which also suggests summer utilization of mollusks.

Friedman (1976) has reported the excavation of two middens on the coast of the Strait of Juan de Fuca, both within about 30 km of the Hoko site. These two sites provide a basis of comparison for the material from Hoko. Table 17 lists the mollusks identified from these midden samples.

Mollusks provided not only food, but also raw materials. Singh (1956:40) reports the use of shell knives. Such knives have been found archaeologically at sites in the Northwestern Olympic Peninsula (Guinn 1963:14). Mussel shells have also been recorded as raw material for blades in harpoons.

There are no sandy beaches of the type that would support large populations of clams within a reasonable distance of the site. The only significant habitat type present near the site is exposed rock east of the river mouth (Kydaka Point; Figure 3) suitable for colonies of California mussel (Mytilus californianus). Fresh water mollusks are known to occur in the Hoko River (Croes, personal communication).

Mollusk Remains from Hoko

The only evidence of mollusks recovered from the Hoko excavations is fragments of periostracum, the organic layer which forms an outer covering for the shells of many mollusks. This organic covering is more resistant to corrosion by humic acids than are the calcareous inner layers of the shell. The thickness of the periostracum varies from species to species; it is thin in many of the marine mollusks and absent in some, while it is usually relatively thick in nonmarine mollusks (Salem 1974:10-11). Mytilus californianus are known to have a periostracum (Allen 1969:87).

Recognizing small fragments of periostracum in the dense organic mats of the Hoko River site posed some problems. While the larger fragments of periostracum retain the general shape and some of the surface morphology of the original shell, smaller fragments can easily be mistaken for bits of plant leaf, bark, or root or overlooked altogether. Another problem arises from the fragile nature of the wet periostracum. Even when a fragment was recognized in the midden, the fragile nature of the wet periostracum made cleaning and successful recovery very difficult; the finest spray of water would often cause the fragment to disintegrate as the sediments were washed from it.

More than 60 fragments of periostracum were recovered from the organic mats at Hoko. The fragments from each unit were accessioned together and form the individual samples. Table 18 presents a summary of the locational information, number of fragments per sample, and estimates of minimum number of individuals represented per sample. Figure 42 maps the locations of the samples.

Table 17

Shellfish species reported from two archaeological sites located near the Hoko River site[1]

Species	Common name	Present Neah Bay (45Ca22)	Warmhouse (45Ca204)
Balanus glandual	Acorn barnacle		×
Balanus nubilus	Giant barnacle	×	
Cryptochiton stelleri	Giant chiton	×	
Ketherina tunicata	Black katy	×	×
Hinnites multirugosus	Purple hinged rock scallop	×	×
Pectin caurinus	Giant Pacific scallop	×	
Mytilus californianus	California mussel	×	×
Clinocarsium nuttalli	Cockle	×	×
Macoma nausata	Bent-nose macoma	×	
Macoma secta	Sand clam		×
Saxidomus giganteus	Butter clam	×	×
Tresus capax	Horse clam	×	
Protothaca staminea	Native littleneck	×	×
Polinices lewisii	Lewis moon snail	×	
Olivella biplicata	Purple olive	×	
Neptuna lirator	Lyre whelk		×
Scarlesia dira	Dire whelk	×	
Thais tanaliculata	Channeled purple	×	×
Thais emarginata	Short channelled purple	×	
Thais lamellosa	Wrinkled purple snail	×	×
Diodora aspera	Rough keyhole	×	×
Acmea instabilis	Rocking chair limpet	×	
Acmea mitra	White cap limpet	×	×
Notoacmea scutum	Plate limpet	×	×

Table 17 (continued)

Species	Common name	Present Neah Bay (45Ca22)	Present Warmhouse (45Ca204)
Littorina sitkana	Sitka littorine	×	×
Crepidula adunca	Hooked slipper shell		×
Strongylocentrotus purpuratus	Purple sea urchin	×	×
Total number of species		23	18

[1]Data from E. Friedman (1976:156-157).

Table 18

The occurrence of periostracum fragments at the Hoko River site

Number of fragments	Grid unit	Accession number
8	N44/W86	173C
6	N30/W62	566/I
5	N26/W46	164/AX
4	N30/W62	566/JL
6+[1]	N32/W66	566/I
7+	N32/W64	617/J
2	N30/W57	416/AD
7	N30/W60	516/SG
4	N29/W56	415/AH
10+	N32/W64	617/KJ
Total 59+		

[1]A "+" following the number of fragments indicates that the samples contained many small fragments in addition to those which were counted.

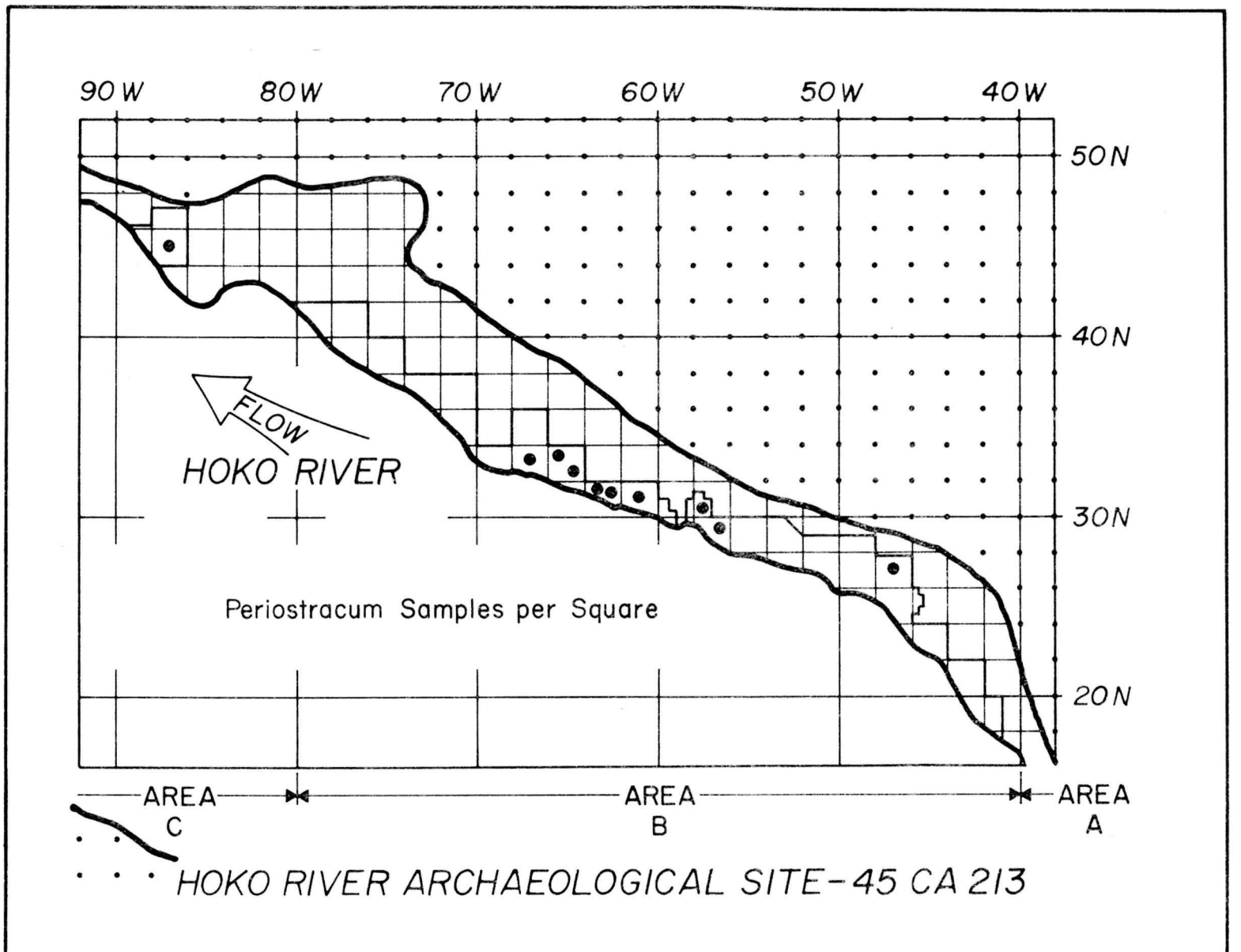


Figure 42. Distribution of periostracum samples recovered at the Hoko River site.

Tentative identifications of the periostraca have been made by comparing the preserved morphology of the periostracum fragments to the surface morphology of reference specimens collected in the vicinity of the site and from Cape Alava, Washington (at the Ozette Village archaeological site). Descriptions and illustrations provided in Morris (1952), Allen (1969), Pennak (1953), and Henderson (1929) were also used. Based on these comparisons, the periostraca appear to be from Mytilus californianus (Figure 43). This identification is, however, tentative.

Discussion

Since the archaeological sediments at the Hoko River site are waterlaid, it is necessary to consider the possibility that the shells whose periostraca survived to be collected in the excavations may have been incorporated into the sediments by natural rather than cultural means. If the identification of the shell as the marine species Mytilus californianus is correct, then it is unlikely that even the tidal current could have transported the shells upstream from the rocky areas at the mouth of the river to the site. If the identification is wrong, and the fragments of periostracum are from nonmarine species, then downstream transport could have played a role in their deposition in the Hoko archaeological deposits. Such a mechanism would not account for their concentrations (Figure 42) or their co-occurrence with artifactual materials, however. It seems most likely that the presence of the remains of mollusks is a result of cultural processes. It is important to note, however, that the distribution of shell remains at the site is quite different from that of the classic shell middens described for this area of the Olympic Peninsula by Friedman (1976).

There are several factors which may affect our interpretation of shellfish utilization at Hoko: the situation of the exposures at the Hoko River site, the acidic nature of the sediments, the fragmentary state and general fragility of the periostraca recovered, the difficulty of recognizing periostracum in situ, and the fact that not all marine mollusks have a durable periostracum, for example. The concentrations of humic acids in the sediments are probably responsible for dissolving the calcarious parts of the shells whose periostraca were recovered, and they would have destroyed all of the shells that did not have durable periostraca. It would seem, then, that mollusks may well be underrepresented in any sample from Hoko, and in consideration of diet and manufacturing processes, it will be necessary to take this fact into account.

It is also interesting to note that artifacts such as shell knives and shell harpoon blades might not be recovered even if they were at one time incorporated into the sediments.

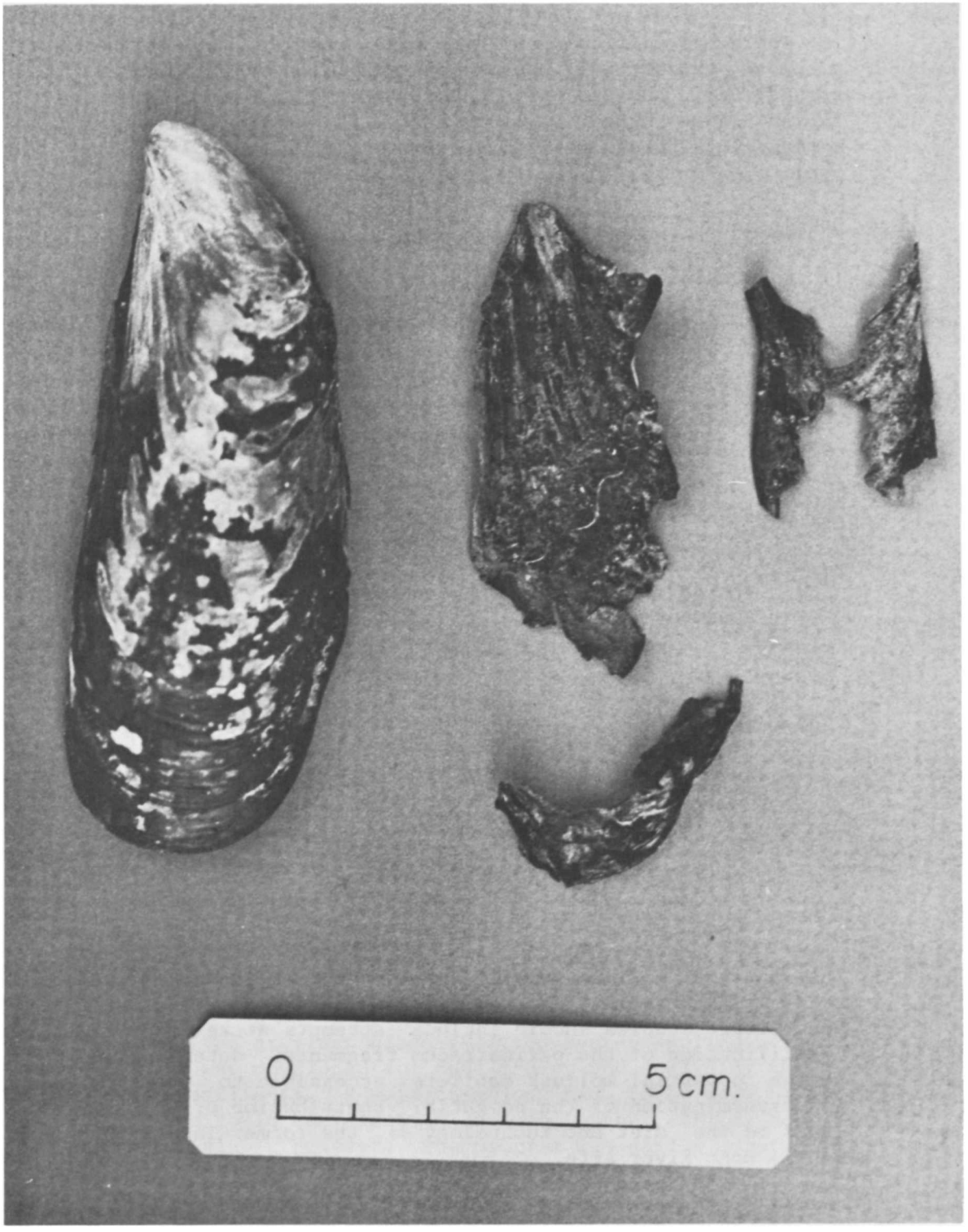


Figure 43. California mussel (Mytilus californianus) shell from present-day beach (left) and periostracum from Hoko River (right). Note banding and preserved barnacles on periostracum.

It would be difficult to determine whether a particular piece of periostracum had been attached to an implement of ground shell, and it would appear that the process of grinding and edge formation on at least the knives would have removed large areas of periostracum, leaving little of the tool to be preserved (Paul Gleeson, personal communication).

Conclusions

It is possible to make the following statements about the occurrence of mollusk remains at the Hoko River site:

1. Shells which had a durable periostracum were incorporated into the archaeological sediments.

2. The pieces of periostracum found at the site are tentatively identified as Mytilus californianus.

3. The shells were probably incorporated into the site sediments as a result of human activity.

4. As a result of the humic acid percolation, the amount and variety of shell originally deposited in the site sediments may not be accurately reflected in the recoverable archaeological remains.

5. The sediments at the Hoko River site do not represent the kind of shell midden typically described for the Northwest Coast (cf. Friedman 1976; Guinn 1963).

The fact that mollusk remains are present at the Hoko River site is interesting and should be investigated further. Such future studies should include attempts at refining the identification of the periostracum fragments, determination of the potential mollusk habitats accessible to the site, and determination of the potential contribution of the mollusks to the diet and technology of the former inhabitants of the Hoko River site.

The operation of a specific N-transform (Schiffer 1976:15-16), humic acid corrosion of mollusk shells, has been suggested as an explanation for the absence of calcarous shell remains. This hypothesis should be tested. Future work at the Hoko River site should help to document the process of this particular transformation and the degree to which it might be expected to have operated on other Northwest Coast sites.

CHAPTER IV THE ANALYSIS OF ARTIFACTS

COMPUTER SUMMARY OF THE HOKO RIVER ARTIFACTS

by Jennifer Ayers

At the present time, 1,129 artifacts have been attributed to the Hoko River archaeological site. This total represents the artifacts obtained in the initial test excavation (1973) and from the 1977 field season's excavations, and those artifacts donated by various collectors who live in the Hoko area. These artifacts have been analyzed using an artifact classification system originally devised for the Ozette site (45Ca24) artifacts by Paul Gleeson. The computer has proved to be an important tool for discerning the significance of the Hoko artifacts in terms of frequencies and spatial distributions within the site. By compiling these data, we are better prepared to make inferences concerning the major activities that took place at the site 2,500 years ago. Furthermore, the use of a common system of artifact classification allows for a general comparison to be made between the Ozette Village and Hoko River sites. This is especially true when comparing the frequencies of major artifact categories occurring at the two sites.

The Artifact Classification System

Since the artifact classification system applied here originally was developed for cataloguing and analyzing the Ozette site artifacts, some alterations had to be made before the system could be directly applied to the earlier Hoko River materials. However, the program was easily adapted to the Hoko materials since a high degree of similarity exists between the artifact inventories of the two sites. This similarity is probably due to both sites being wet sites, being located within the same general environment, and being generally the locales of similar activities. Although the Hoko site is estimated to be at least 2,000 years older than the Ozette House I time period, both groups were exploiting similar natural resources, and this is reflected in the high degree of similarity between the artifact categories of the two locations.

The arrangement of the Ozette system of artifact classification is based on the assignment of each artifact to a major category. These major categories are determined on the basis of artifact attributes, function, and material composition--e.g., woven materials, cordage, fishhooks, stone artifacts, etc. The major categories are further divided into more specific subcategories. All major categories are assigned a numerical designation; each subcategory is assigned a number that is a derivative of the major category number. For example, major category 1.00 (woven material) includes subcategory 1.10 (baskets), 1.20 (mats), 1.30 (hats), etc.(Table 19). The assignment of numerical designations to artifact categories translates them into a form that is easily read and analysed by a computer.

Although there is a high degree of similarity between the artifact inventories found at the Hoko and Ozette sites, the two inventories are not identical. In order for the Ozette classification system to be applied to the Hoko artifacts, it had to be expanded to include artifact categories that are found only at Hoko.

Frequency and Distribution of Artifacts

For the purpose of simplifying this discussion, I will deal mainly with the artifact categories that are predominant: major categories 1.00 (woven material), 2.00 (cordage), 5.00 (points), 8.00 (fishhooks), 10.00 (woodworking tools), 13.00 (miscellaneous), 14.00 (stone artifacts), and 17.00 (raw materials). The frequencies for all the artifact categories are presented in Table 19; the predominant categories will be discussed below in the order of their frequency of occurrence.

Major Category 2.00 (Cordage)

This is by far the most frequently encountered major artifact category at the Hoko site (n=625, 55.5 percent). This is due primarily to the large amount of two-strand spruce/cedar rootlet string (subcategory 2.30) (n=460, 40.7 percent). These strings are found used as double-strand fishhook leaders, as twining elements in making shredded cedar-bark skirts, and as sewing elements in sewn "tule" mats (see Cordage, below). One-strand withe (subcategory 2.20, n=116) also has a high relative frequency, constituting 10.3 percent of the total artifact inventory. Multi-strand rope (subcategory 2.10, n=11), on the other hand, has a low relative frequency and constitutes only 1.0 percent of the total Hoko artifacts. Cedar-bark braid (subcategory 2.40, n=9) and knotted cedar-bark strips (subcategory 2.70,

Table 19

Frequencies of various classes of material remains, Hoko River and Ozette Village sites (1977)

Material Type	Hoko 1973		Hoko 1977		Hoko Private Collections		Hoko Total		Ozette Total	
	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
Category 0 No Provenience Artifacts									101	0.4
Category 1 Woven Material	4	3.3	2	0.2	7	5.2	13	1.2	190	0.7
1.10 Basket	2	1.9	23	2.6	16	11.9	41	3.6	1062	4.0
1.11 Cedar-bark doughnut									21	0.1
1.12 Bound twigs and bone									104	0.4
1.13 Garment			9	1.0	3	2.2	12	1.1	99	0.4
1.14 Blanket									2	0.0
1.15 Shredded bark			2	0.2			2	0.2	1	0.0
1.16 Binding binding coil	10	8.3	2	0.2	1	0.7	13	1.2		
1.17 Cedar bark split with stick			1	0.1	2	1.5	3	0.3		
1.18 Skirt										
1.19 Textile material										
1.20 Mat			4	0.5			4	0.4	1209	4.5
1.30 Hat			1	0.1	2	1.5	3	0.3	92	0.3
1.40 Cradle									58	0.2
1.50 Net			3	0.3			3	0.3	21	0.1
1.60 Tumpline									92	0.3
1.70 Harpoon sheath									46	0.2
1.80 Cedar-bark bundle									113	0.4
1.90 Sheath with harpoon									10	0.0
Total	16	13.5	47	5.4	31	23.0	94	8.3	3120	11.6

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
Category 2 Cordage			4	0.5			4	0.4	88	0.3
2.10 Multi-strand rope			11	1.3			11	1.0	508	1.9
2.11 Wrapped brush									1	0.0
2.12 Wrapped stick										
2.13 Leaders										
2.14 Strap cordage										
2.15 Knotted strap cordage										
2.20 Withe	10	8.4	106	12.1			116	10.3	1140	4.2
2.21 Multi-strand withe loop										
2.22 Wrapped multi-strand withe loop										
2.23 Knotted withe										
2.30 String	43	36.1	342	39.0	75	55.6	460	40.7	294	1.1
2.31 Cordage, knotted										
2.32 Cordage, spliced										
2.33 Knotted splice										
2.34 Wrapped cordage										
2.35 Knotted wrapped cordage										
2.40 Braid	3	2.5	6	0.7			9	0.8	1014	3.8
2.50 Cherry bark			4	0.4			4	0.4	81	0.3
2.51 Cherry bark, knotted										

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
2.52 Cherry bark, coiled										
2.60 Cordage tied to wood			2	0.2			2	0.2	62	0.2
2.70 Knotted cedar bark	1	0.8	11	1.3			7	0.7	105	0.4
2.71 Knotted cedar bark and cordage										
2.80 Wrapped cedar bark									15	0.1
2.90 Coiled bark	1	0.8	6	0.7			7	0.7	16	0.1
Total	58	48.7	492	56.2	75	55.6	625	55.5	3324	12.4
Category 3 Weaving tools									4	0.0
3.10 Loom upright									13	0.1
3.20 Loom beam									14	0.1
3.30 Weaver's sword			1	0.1			1	0.1	18	0.1
3.40 Spindle whorl									35	0.1
3.50 Spool									4	0.0
3.60 Shredder									32	0.1
3.70 Beater									10	0.0
3.80 Mat creaser									7	0.0
3.90 Spindle whorl shaft									2	0.0
Total	0		1	0.1	0		1	0.1	139	0.5
Category 4 Shafts									746	2.8
4.10 Arrow shaft									997	3.7

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
4.11 Shaft with wood point									12	0.0
4.12			1	0.1			1	0.1		
4.20 Bound shaft									400	1.5
4.30 Harpoon shaft			1	0.1			1	0.1	103	0.4
4.40 Roasting stick									9	0.0
4.50 Mortiсed stick									35	0.1
4.60 Finger rest									13	0.0
4.70 Shaft with scarf joint									24	0.1
4.80 Arrow shaft blank (?)									6	0.0
4.90 Arrow shaft preform									4	0.0
Total	0		2	0.2	0		2	0.2	2349	8.6
Category 5 Points									464	1.7
5.10 Unipoint	2	1.7	16	1.8	3	2.2	21	1.9	3513	13.0
5.20 Bipoint			1	0.1			1	0.1	742	2.8
5.30 Barbed point	1	0.8	1	0.1	2	1.5	4	0.4	481	1.8
5.31 Bilaterally barbed point										
5.40 Ulna awl									18	0.1
5.50 Needle									19	0.1
5.60 Bound point									67	0.2
5.70 Point preform									53	0.2
5.80 Awls other than ulnar									20	0.1
Total	3	2.5	18	2.1	5	3.7	26	2.3	5377	20.0

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
Category 6 Harpoon heads									20	0.1
6.10 Harpoon valve, point inset									20	0.1
6.20 Harpoon valve, blade inset									53	0.2
6.30 Harpoon valve, no inset									45	0.2
6.40 Lance valve									85	0.3
6.50 Composite harpoon, point inset									25	0.1
6.60 Composite harpoon, blade inset									15	0.1
6.70 Composite harpoon, no inset									6	0.0
6.80									6	0.0
6.90 Harpoon valve blank									16	0.1
Total	0		0		0		0		291	1.2
Category 7 Floats			1	0.1			1	0.1	15	0.1
7.10 Float plug									111	0.4
7.20 Float tube									19	0.1
Total	0		1	0.1	0		1	0.1	145	0.6
Category 8 Fishhooks									11	0.0
8.01 Bentwood hook			22	2.5	4	3.0	26	2.3		
8.02 Bentwood hook with leader	2	1.7	4	0.5	1	0.7	7	0.6		
8.08 Bentwood hook preform			9	1.0	4	3.0	13	1.1		

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
8.10 Halibut hook	5	4.2					5	0.4	115	0.4
8.20 Halibut hook shank			1	0.1			1	0.1	464	1.7
8.30 Halibut hook shank blank									55	0.2
8.40 Single barb composite hook			20	2.3			20	1.8	56	0.2
8.41 Single barb composite hook with leader			1	0.1			1	0.1		
8.42 Base wrap of composite hook										
8.50 Double barb composite hook									14	0.1
8.60 Composite hook shank	6	**5.0**	22	2.5	1	0.7	29	2.6	25	0.1
8.61 Composite hook shank with leader										
8.62 Composite hook shank with barb										
8.70 Herring rake									8	0.0
8.80 Hook preform									11	0.0
8.90 Fishhook shanks tied together									36	0.1
Total	13	10.9	79	9.0	10	7.5	102	9.0	795	2.8
Category 9 Clubs									1	0.0
9.10 Whalebone clubs									15	0.1
9.20 Heavy wood clubs									27	0.1

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
9.30 Light wood clubs									20	0.1
9.40 Club preform									3	0.0
Total	0		0		0		0		66	0.3
Category 10 Woodworking tools									5	0.0
10.10 Wedges	5	4.2	6	0.7	2	1.5	13	1.1	1006	3.7
10.11 Wedge preform										
10.20 Collars (grommets)	1	0.8	3	0.3	3	2.2	7	0.7	117	0.4
10.30 Tool handles									81	0.3
10.40 Metal-bladed composite tools									26	0.1
10.50 Shell-bladed composite tools									5	0.0
10.60 Bone- or tooth-bladed composite tools									3	0.0
10.70 Sheath with harpoon point									5	0.0
10.80 Chisels									13	0.1
Total	6	5.0	9	1.0	5	3.7	20	1.8	1261	4.6
Category 11 Canoes, etc.									10	0.0
11.10 Paddle									436	1.6
11.20 Bailer									13	0.1
11.30 Cross-grain fragments									44	0.2
Total	0		0		0		0		503	1.9

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
Category 12 Non-woven containers									5	0.0
12.10 Boxes									1207	4.5
12.20 Bowls									207	0.8
12.30 Trays									95	0.4
12.40 Bucket									3	0.0
12.50 Keg									35	0.1
Total	0		0		0		0		1552	5.8
Category 13 Miscellaneous wood and bone artifacts									200	0.7
13.01 Game paddle									36	0.1
13.02 Comb									88	0.3
13.03 Bow			1	0.1			1	0.1	106	0.4
13.04 Fire drill base									6	0.0
13.05 Carved	13	10.9	13	1.5	5	3.7	31	2.7	465	1.7
13.06 Worked	2	1.7	32	3.6			34	3.0	2911	10.8
13.07 Pointed wood (stakes)			3	0.3			3	0.3	295	1.1
13.08 Handle (not woodworking)									81	0.3
13.09 Miniature									39	0.2
13.10 Stick with braided end									15	0.1
13.11 Sculptured									53	0.2
13.12 Worked tooth									19	0.1
13.13 Peg									64	0.4
13.14 Bark			8	0.9			8	0.9	9	0.0

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
13.15 Whale saddle									1	0.0
13.16 Bark beater									3	0.0
13.17 Hoop									16	0.1
13.18 Plank			5	0.6			5	0.4	54	0.3
13.19 Sewn plank									2	0.0
13.20 Ochre paint brush									7	0.0
13.21 Pendant									18	0.1
13.22 Pin									73	0.3
13.23 Wrapped sticks	1	0.8	4	0.5			5	0.4	39	0.1
13.24 Clothes pin									3	0.0
13.25 Blanket pin									37	0.1
13.26 Drilled wood									6	0.0
13.27 Whistle									3	0.0
13.28 Wall support post									7	0.0
13.29 Decorated									3	0.0
13.30 Spoon									3	0.0
13.31 Rock tongs									7	0.0
13.32 Bone splinter bundle									55	0.2
13.33 Knife									3	0.0
13.34 Cedar broom									2	0.0
13.35 Hafted stone tool			6	0.7			6	0.5	105	0.4
13.36 Split board			13	1.5			13	1.1		
13.37 Trapezoidal split-cedar objects	1	0.8	6	0.7			7	0.6		
13.38 Bilenticular split-cedar objects			4	0.5			4	0.4		

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
13.39 Bilenticular blank										
13.40 Spatulate object										
13.41 Wrapped bone										
Total	17	14.2	95	10.4	5	3.7	117	10.4	4834	18.0
Category 14 Stone artifacts			3	0.3			3	0.3	105	0.4
14.01 Whetstone			2	0.2			2	0.2	740	2.8
14.02 Maul									18	0.1
14.03 Net sinker			6	0.7			6	0.5	153	0.6
14.04 Hammerstone			8	0.9			8	0.7	97	0.4
14.05 Hook shank									28	0.1
14.06 Ground slate			1	0.1			1	0.1	65	0.2
14.07 Chipped slate			4	0.5			4	0.4	22	0.1
14.08 Chipped stone	3	2.5	11	1.3	2	1.5	16	1.4	28	0.1
14.09 Worked stone			19	2.2			19	1.7	112	0.4
14.10 Pigment grinder stone									31	0.1
14.11 Worked sandstone			3	0.3			3	0.3	43	0.2
14.12 Fire-cracked rock									8	0.0
14.13 Mudstone									1	0.0
14.14 Chipped stone point									4	0.0
14.15 Flake/chip			41	4.7			41	3.6	3	0.0
14.16 Stone pendant									3	0.0
14.17 Abrader	1	0.8	1	0.1			2	0.2	49	0.2
14.18 Boiling stone			1	0.1			1	0.1		
14.19 Maul preform									1	0.0

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
14.20 Anvil stone			1	0.1			1	0.1		
14.21 Ground serpentine (adze)			1	0.1			1	0.1		
14.22 Core										
14.23 Hand wedge										
14.24 Coral										
14.25 Blade										
14.26 Spall-tool										
Total	4	3.3	102	11.7	2	1.5	108	9.6	1511	5.7
Category 15 Shell									22	0.1
15.10 Harpoon blade									18	0.1
15.20 Shell blade									70	0.3
15.30 Ground shell fragment									431	1.6
15.40 Pectin shell									12	0.0
15.50 Worked clamshell									1	0.0
15.60 Dentalia									5	0.0
15.70 Worked abalone shell									1	0.0
15.80 Olivella shell bead									1	0.0
15.90 Shell blade with whale bone									1	0.0
Total	0		0		0		0		562	2.1
Category 16 Pigment									5	0.0
16.10 Red ocher									9	0.1
16.20 Yellow ochre										
Total	0		0		0		0		14	0.1

Table 19 (continued)

Material Type	Hoko 1973 Absolute frequency	Hoko 1973 Relative frequency	Hoko 1977 Absolute frequency	Hoko 1977 Relative frequency	Hoko Private Collections Absolute frequency	Hoko Private Collections Relative frequency	Hoko Total Absolute frequency	Hoko Total Relative frequency	Ozette Total Absolute frequency	Ozette Total Relative frequency
Category 17 Raw materials			2	0.2			2	0.2	66	0.2
17.10 Cut antler									177	0.7
17.11 Cut wood			19	2.2	2	1.5	21	1.8	79	0.3
17.12 Sinew									3	0.0
17.13 Vegetal sea materials									1	0.0
17.20 Cut bone									168	0.6
17.30 Cut whalebone									380	1.4
17.40 Cedar bark bundle	2	1.7	5	0.6			7	0.6	20	0.1
17.50 Baleen			1	0.1			1	0.1	8	0.0
17.60 Tooth									12	0.0
17.70 Weaving raw materials			2	0.2			2	0.2	33	0.1
17.80 Moss mass									3	0.0
17.90 Bamboo									1	0.0
Total	2	1.7	29	3.3	2	1.5	33	2.9	951	3.4

n=7) are also represented within this major artifact category and constitute 0.8 percent and 0.7 percent of the artifacts, respectively. In distribution, cordage artifacts grade in density from east to west in area B, with the highest density to the east. Stratigraphically the eastern section of area B is closest to a known onshore area (Figure 44; for further discussion of the Hoko cordage, see Cordage, below).

Major Category 14.00 (Stone Artifacts)

This major category has been rated second in terms of its relative frequency within the site, but it should be noted that the relative frequency as discussed in this section does not reflect all of the lithic material recovered from the site. A few weeks into the 1977 excavation, a lithics workshop area was discovered in the eastern portion of the site (area B, squares 10, 60, 61), and 100 percent samples were taken from the affected squares. These samples were submitted to Jeff Flenniken for analysis (see Systems analysis of the lithic artifacts, below). The relative frequency of stone artifacts discussed below does not take into account any of the artifacts retrieved from these 100 percent samples. The following statistics only apply to the stone artifacts which were obtained from other areas of the site.

Stone artifacts from areas other than the lithics workshop constitute 9.6 percent of the total Hoko artifact inventory. The most frequently occurring subcategories within this category are stone flakes (subcategory 14.15, n=41, 3.6 percent), worked stone (subcategory 14.09, n=19, 1.7 percent), and chipped stone (subcategory 14.08, n=16, 1.4 percent). The major raw material is vein quartz, and a bipolar technique of cobble reduction is indicated (see Systems analysis of the lithic artifacts below). Also included within this major category are hammerstones (subcategory 14.04, n=8, 0.7 percent), net sinkers (subcategory 14.03, n=6, 0.5 percent), and a single stone adze blade (subcategory 14.20) recovered in 1977. This adze blade was found in "slump" before excavation began, so we are unable to assign it to any specific provenience within the site.

Major Category 8.00 (Fishhooks)

This category is third in relative frequency (n=102, 9.0 percent). The subcategories within this major category are basically concerned with differentiating between two types of fishhooks: composite and bentwood (see Fishhooks, below). Single-barb composite hooks (subcategory 8.40, n=20, 1.8 percent) and composite hook shanks (subcategory 8.60, n=29, 2.6 percent) constitute a total of 4.4 percent of the total Hoko artifact inventory. On the other hand,

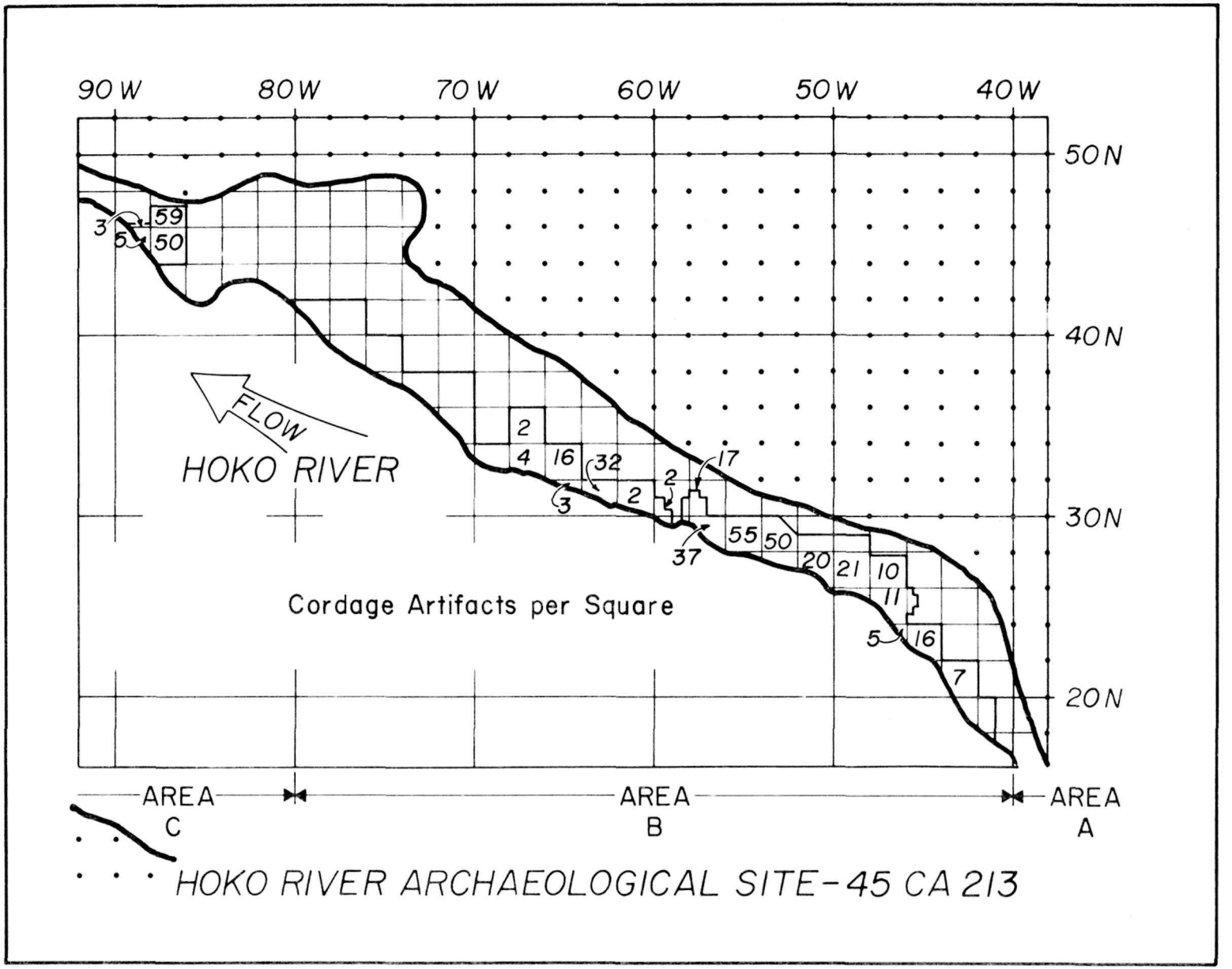


Figure 44. Distribution of cordage at the Hoko River project.

bentwood fishhooks (subcategory 8.01, n=26, 2.3 percent), bentwood fishooks with leaders (subcategory 8.02, n=7, 0.6 percent), and bentwood fishhook preforms (subcategory 8.08, n=13, 1.1 percent) constitute 4.0 percent of the total Hoko artifact inventory. The two basic "types" of fishhooks are almost equally represented within the site, with composite fishooks exhibiting only a slightly higher relative frequency than that of bentwoods. The two Hoko fishhook "types" differ on the basis of their raw material (see Microscopic identification of artifactual plant materials, below), the composites being hardwood, and the bentwoods identified as spruce limb. The high relative frequency of fishhooks reflects an emphasis upon fishing activities at the Hoko River site. The fact that both "types" are well represented within the site is indicative of a specialized hook-and-line deep-sea fishing technology (see Fishhooks, below). In distribution, fishhooks also grade in frequency from west to east with a higher frequency in the east end of area B or the on-bank direction (Figure 45). Analysis of the fish remains recovered from the site indicates that mainly neritic fish and especially flatfish were being exploited with these hooks (see Analysis of the fish remains, above).

Major Category 1.00 (Woven Materials)

This category is rated as fourth in terms of its relative frequency within the Hoko artifact inventory (n=94, 8.3 percent). The subcategories within this major category are diverse, consisting of such artifacts as baskets and basket fragments (subcategory 1.10, n=41, 3.6 percent),garment fragments (subcategory 1.13, n=12, 1.1 percent), mats (subcategory 1.20, n=4, 0.4 percent), hats (subcategory 1.30, n=3, 0.3 percent), and nets (subcategory 1.50, n=3, 0.3 percent). The majority of the baskets recovered from the site are burden baskets, with some smaller basketry bags. The emphasis on burden baskets reflects a need to transport some product, probably fish. A few sewn tule mats were also recovered from the site. (For further information concerning the woven materials found at the site, see Basketry artifacts, below).

Major Category 17.00 (Raw Materials)

This category is rated as fifth in terms of its relative frequency within the site. Included within this major category are those raw materials that are suspected of having been in some way influenced or altered by the actions of man. The predominant subcategory is cut wood (subcategory 17.11, n=21, 1.8 percent), followed by cedar-bark bundles (subcategory 17.40, n=7, 0.6 percent) and weaving raw materials (subcategory 17.70, n=2, 0.2 percent). The relative frequencies that are presented here are not indicative of

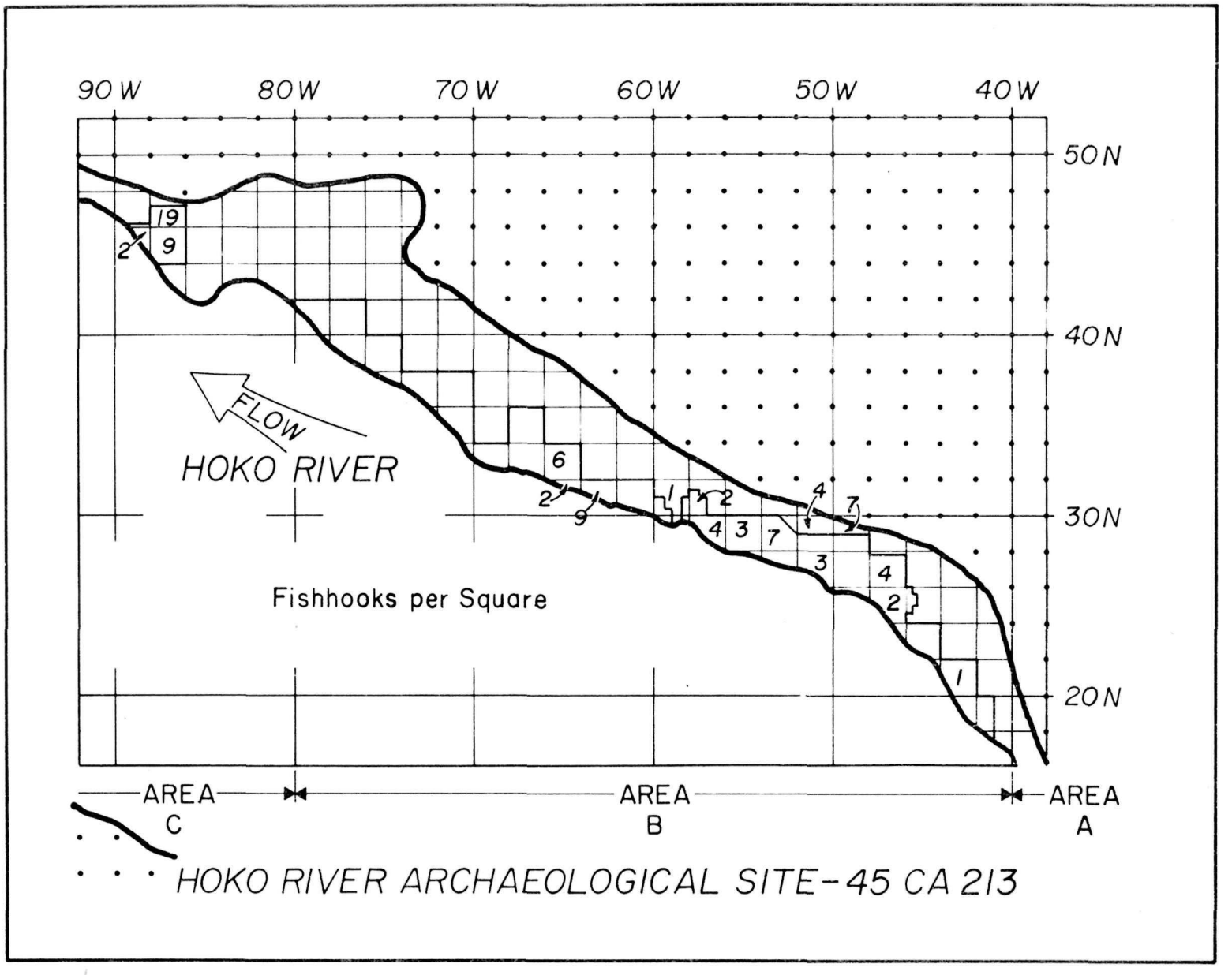


Figure 45. Distribution of fishhooks at the Hoko River site.

what was in actuality found at the site; both wood chips and weaving raw materials were collected in level-bags instead of being fully recorded as artifacts (see Basketry waste materials and Woodchip debitage, below). Also it should be noted that large bark strips appear in subcategory 13.14 (see Major Category 13.00, below); for this reason the total amount of bark recovered from the site is not indicated by the statistics given for subcategory 17.40. The high frequencey of raw materials at the site probably reflects the use of this location to manufacture equipment, clothing, and other items. This would imply that the site was occupied for a longer period than the time necessary to obtain a resource and move elsewhere. They not only fished, hunted, and gathered here; they made equipment as well.

Major Category 5.00 (Points)

Wooden points constitute 2.3 percent of the total artifact inventory and are rated as sixth in terms of their relative frequency within the site. The subdivisions within this major category are determined on the basis of morphology. Only three distinct morphological point "types" have been attributed to the Hoko site: unipoints (subcategory 5.10, n=21, 1.9 percent), unilaterally and bilaterally barbed points (subcategory 5.30, n=4, 0.4 percent), and bipoints (subcategory 5.20, n=1, 0.1 percent). These points are similar morphologically to points found at other Northwest Coast sites, except that they are composed solely of wood rather than of bone or antler. The bilaterally and unilaterally barbed points often are composed of Sitka spruce (see Microscopic identification of artifactual plant materials, below). These points formed part of the procurement equipment used in fishing and for hunting activities carried out from the Hoko River location. They represent some of the finest decorative woodcarving at the site (Figures 46 and 47, see also Croes 1976b:227-229).

Major Category 10.00 (Woodworking Tools)

Within this major category only wood wedges and their associated cordage collars (grommets) are recorded (Figure 48). Wood wedges (subcategory 10.10, n=13), with or without their associated cordage collars, constitute 1.1 percent of the total artifact inventory (see Wood wedges, below). The cordage collars (subcategory 10.20, n=7) found independently of the wedges constitute 0.7 percent of the total Hoko artifacts (see Cordage, below). The Hoko wood wedges are composed of yew wood and are similar to those found at other Northwest Coast wet sites and recorded ethnographically. They reflect a wood-splitting technology that was established at least 3,000 years ago (see Croes 1976c:293-294).

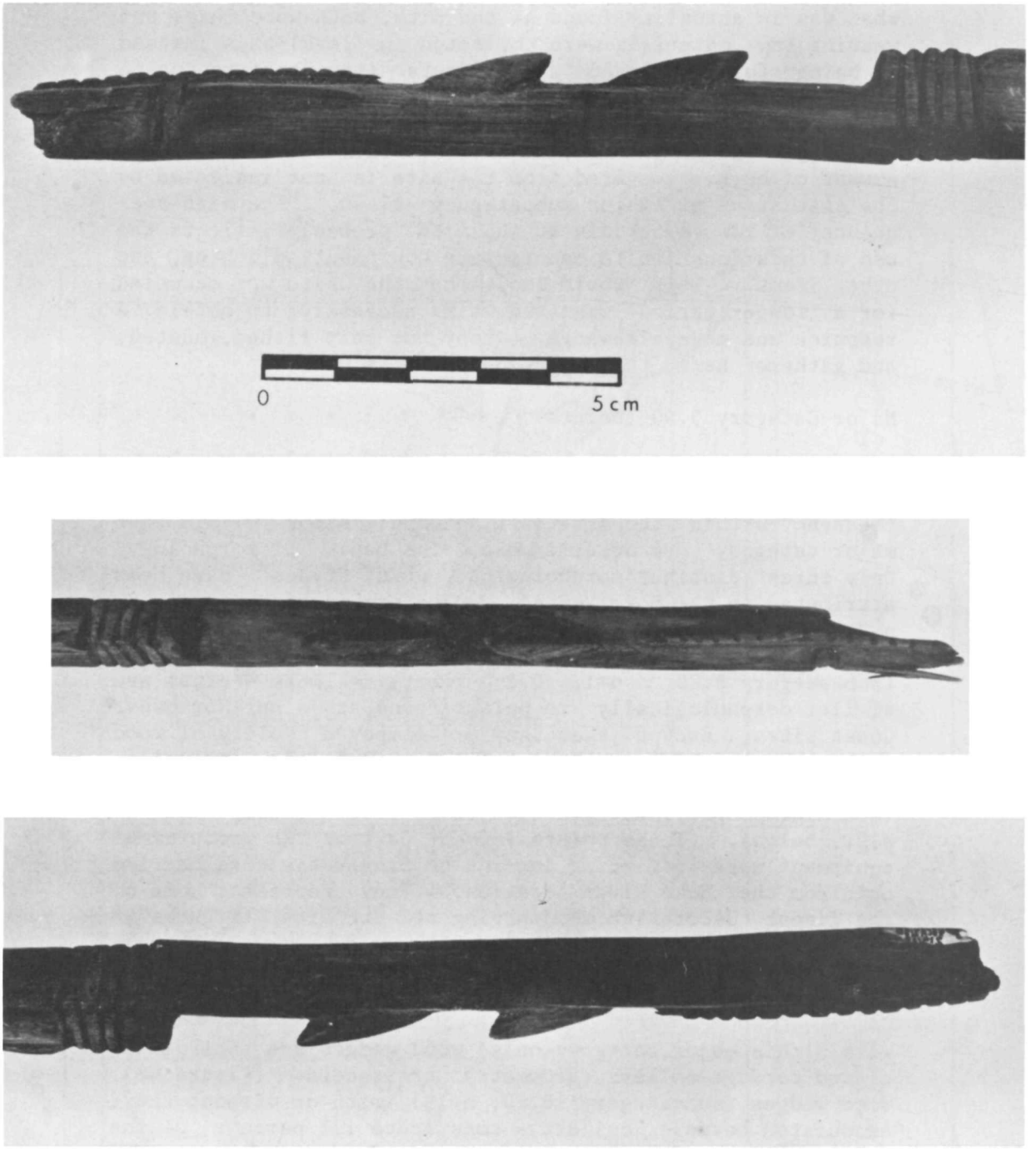


Figure 46. Unilaterally barked and elaborately carved wooden projectile point.

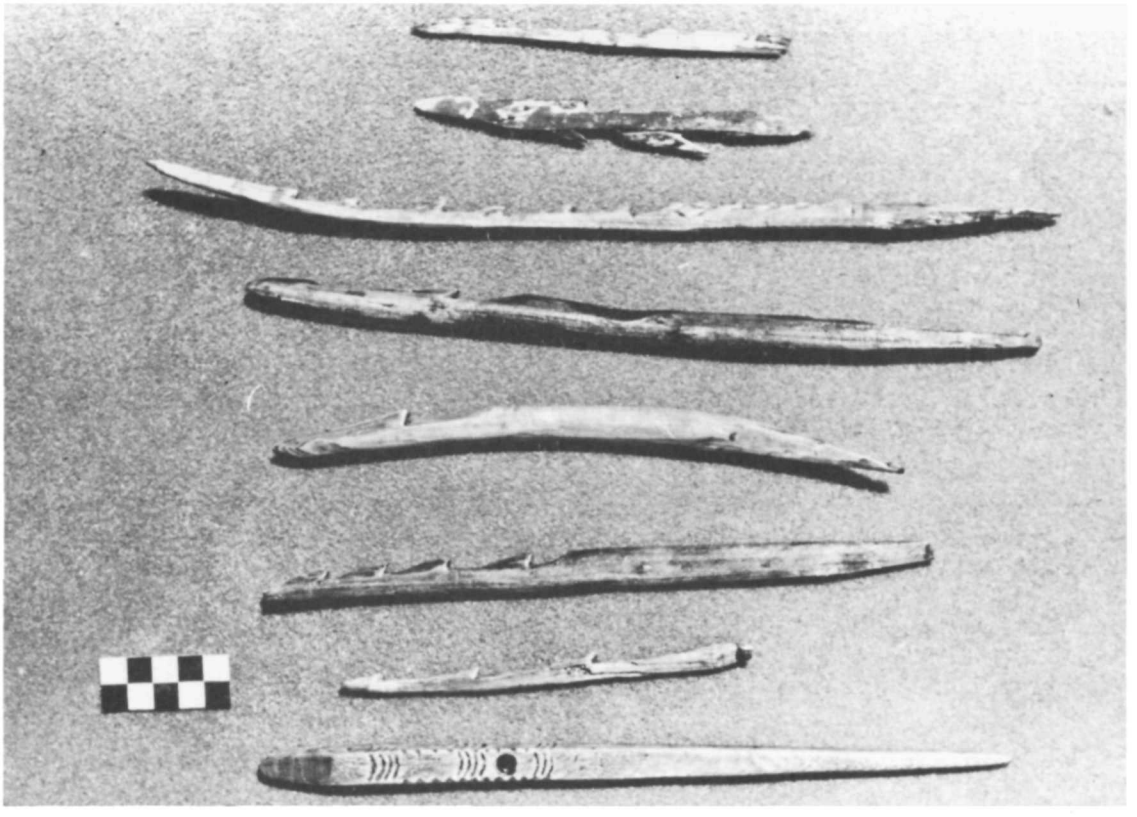


Figure 47. Several unilateral points, one bilateral point, and a decorated point from the Hoko River site.



Figure 48. Example of a wooden wedge with a cordage collar from the Hoko River site.

Although it is a woodworking tool, the single green-stone adze blade recovered from the Hoko site is assigned to a subcategory under the major category of stone artifacts (see Major Category 14.00 above, and Systems analysis of the lithic artifacts, below) in order to correlate with the Ozette system.

Major Category 13.00 (Miscellaneous Wood, Stone, and Bone Artifacts)

Included within this artifact category are all of the artifacts that could not, on the basis of function or material composition, easily be assigned to any of the other major categories. The relative frequency of this major category is high (n=117, 10.4 percent), but because the artifacts that can potentially be assigned to it are very diverse, their combined rating is inconsequential and left for this concluding section. Many of the subcategory members, however, are very significant artifacts; these are discussed individually below.

Some general inferences can be drawn from the relative frequencies of the individual subcategories included within this lumped category. The majority of these artifacts are the result of a woodworking or wood-splitting technology. Carved wood (subcategory 13.05, n=31) and worked wood (subcategory 13.06, n=34) constitute 2.7 percent and 3.0 percent of the total Hoko artifact inventory, respectively. Split boards (subcategory 13.36, n=13, 1.1 percent) and planks (subcategory 13.18, n=5, 0.4 percent) are also represented within this major category and may reflect the materials used to construct dwellings at the site.

Artifacts that are questionable in terms of their function are included within this miscellaneous category. Hafted microlith tools (subcategory 13.35, n=6, 0.5 percent; Figure 49) were recovered from the Hoko site in 1977. Tests have been performed with replications of these stone tools to determine their intended function, and the results are recorded in detail below (see Systems analysis of the lithic artifacts). Also of questionable function are those artifacts described as trapezoidal, split-cedar objects with protruding ears (subcategory 13.37, n=7, 0.6 percent; Figure 50). The four complete examples measure an average of 15.5 cm long (S.D.=1.5), 4.6 cm wide (S.D=1.5), and 0.9 cm thick (S.D.=0.2). They are similar in shape and size to historical fishnet floats (Stewart 1977:60) and to mat creasers found both historically and at the Ozette Village site (Croes 1976b:218-219). The "ears" of some are impressed with grooves that may be from line attachments (Figure 50) as in floats, but the sewn tule mats recovered may indicate a use of these as mat creasers. Bilenticularly carved split-cedar artifacts (subcategory 13.38) also are typical

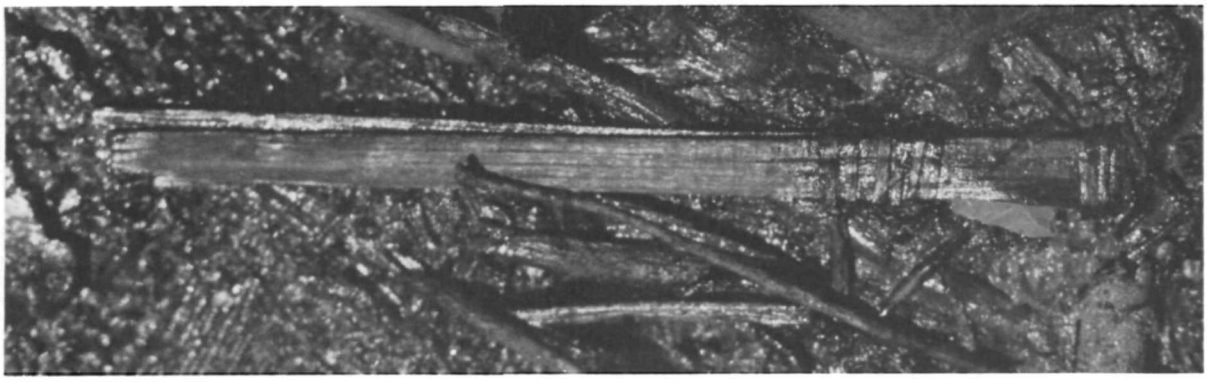


Figure 49. Hafted microlith tool. The handle is made from split cedar sticks, the binding of cedar bark, and the microlith of green chert.

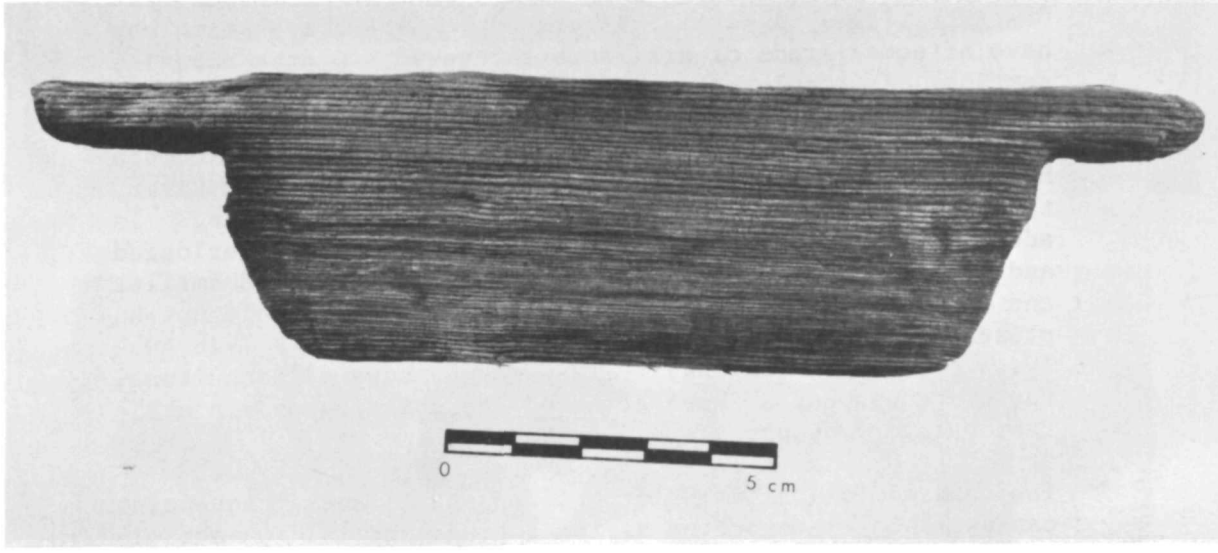


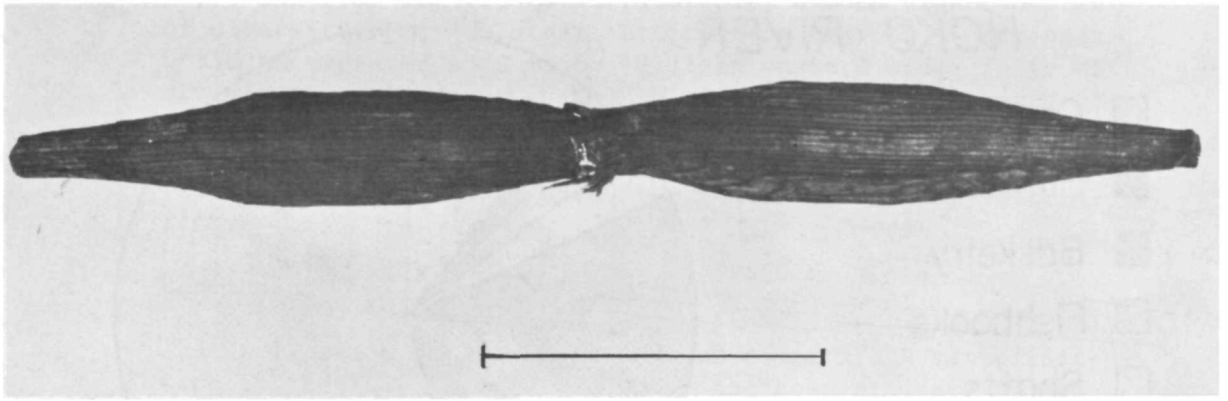
Figure 50. Trapezoidal split-cedar object with protruding "ears".

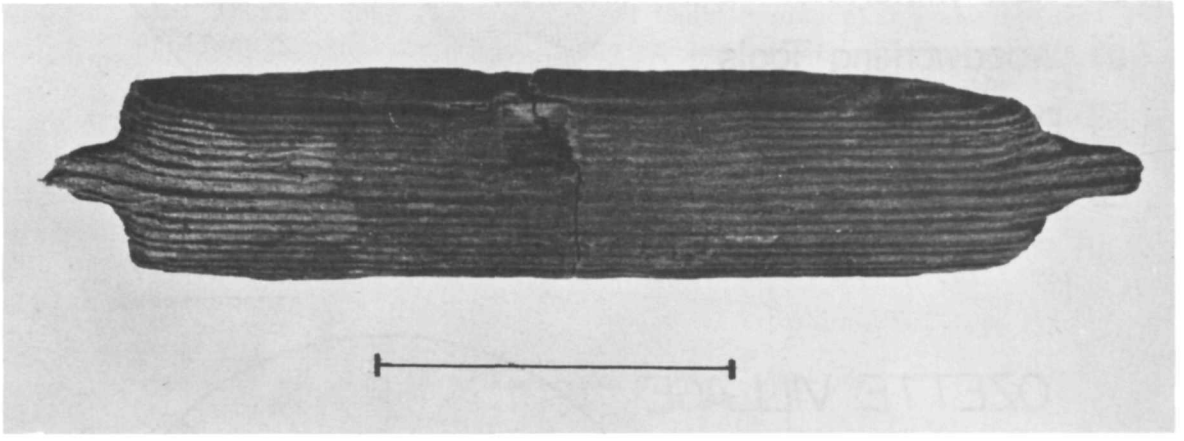
of the Hoko River site (n=4, 0.4 percent; Figure 51). They have a mean length of 14.6 cm (S.D.=2.0), width of 2.8 cm (S.D.=0.7), and thickness of 0.7 cm (S.D.=0.3). These may have been floats, hand fish-reels, or net-making tools. They are a distinct artifact with no exact functional assignment at present.

Comparison of Major Artifact Categories--Hoko River and Ozette Village

Figure 52 illustrates the frequencies of the major artifact categories attributed to both the Hoko River site (n=1129) and the Ozette Village site (n=26,895). This comparison serves to illustrate the differences between the two artifact inventories. The Ozette inventory is more diverse in content and includes several major artifact categories (bentwood boxes, worked shell, canoe paddles, and harpoon heads) that are not found within the Hoko artifact inventory. This could be due in part to sampling error since only one summer excavation season has been completed at the Hoko wet site compared with seven year-round seasons at Ozette Village. Also the difference in site composition may have affected kinds of artifacts recovered. Ozette contains sections of complete houses and their contents that were covered and encased under a mudslide. Hoko River is a refuse deposit offshore from the campsite; Even though boxes, paddles, etc., probably were used at Hoko River, these may not have been discarded offshore when broken. In addition, larger items that float may not have waterlogged and ended up in the immediate offshore area as did smaller and lighter items. Finally, shell artifacts would not be present at Hoko due to the poor shell preservation (see Analysis of mollusk remains). Therefore, several noncultural factors could could have affected the differences in artifact category occurrence and frequency.

The general distribution of relative artifact frequencies can still be interpreted as reflecting some of the activities taking place at the two sites. The major artifact categories of cordage, fishhooks, and woven material are well represented within both inventories (Hoko: 55.5 percent,9.0 percent,8.3 percent; Ozette: 12.4 percent,2.8 percent,11.6 percent), but they occur relatively more frequently at Hoko River. Within these categories, cordage at Hoko is mainly of string gauge and is often associated with fishhooks as leader elements. The Hoko basketry is mainly burden baskets; this probably reflects the need to carry some product from the beach, most likely fish, and certainly fishhooks reflect fishing activities. At Hoko River the predominance of these artifacts (and of some others)





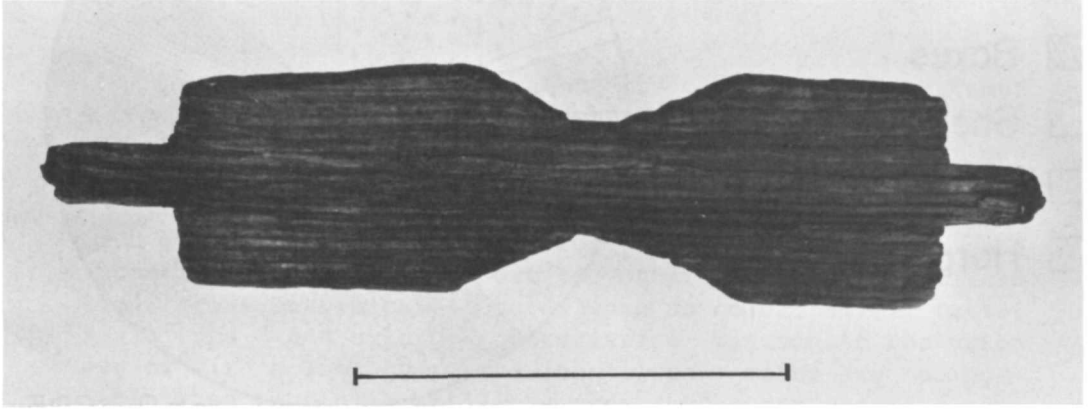


Figure 51. Bilenticularly carved split-cedar artifacts. These may have functioned as floats, fishline handreels or net making tools. Scale equals 5 cm.

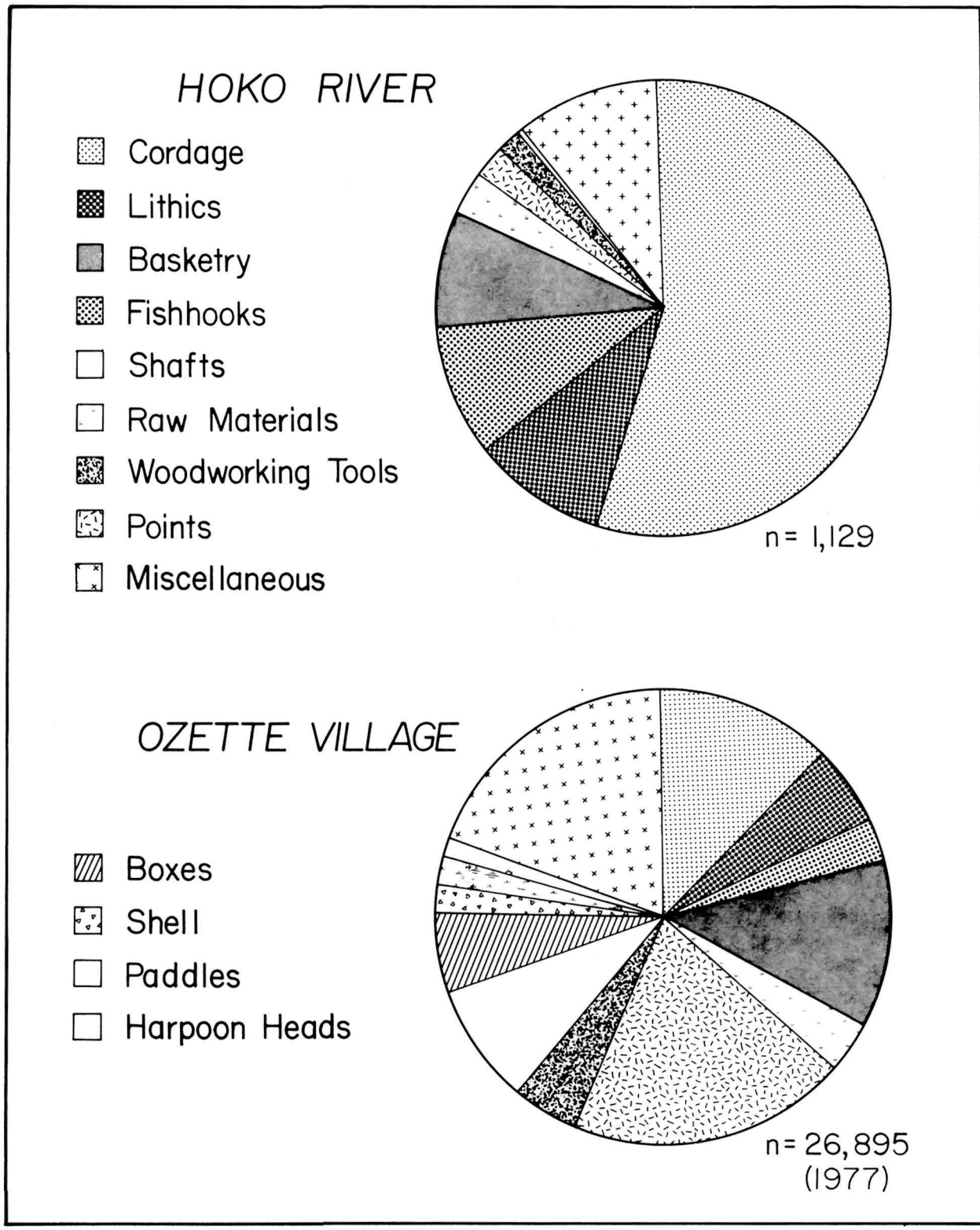


Figure 52. Frequency of major artifact categories at the Hoko River and at Ozette Village.

reflects the importance of fishing activities at this "fishing station." At Ozette Village the cordage (Croes 1979) and basketry (Croes 1977) display a much higher degree of diversity, as do other artifact categories, and that would be expected at a major village where a wider range of activities would occur. Though site-use differences can be suggested from these data, a more detailed comparison at a much finer level of analysis is required before better results can be produced with the general inventory information.

Conclusion

The application of the Ozette system of artifact classification to the Hoko artifacts adapts the Hoko artifact to computer inventory and summary. The inventory suggests that there was an emphasis on fishing and fishing-related equipment at the Hoko River site and that woodworking and other artifact production took place at the site. The use of a common artifact classification system also allows the two sites to be compared on the basis of their artifact content. On a general level, many similar kinds of activities took place at Hoko River and Ozette Village, though the relative frequencies tend to characterize Hoko River as an important fishing station and Ozette Village as a diversified "winter" village. More detailed comparisons are necessary for finer assessments.

MICROSCOPIC IDENTIFICATION OF ARTIFACTUAL PLANT MATERIALS

by R. James Barbour

Until Janet Friedman's work at Ozette, virtually no attempt had been made to positively identify wood used in preserved wooden artifacts from wet sites. Friedman developed her own techniques (1975a, 1976) from those traditionally used by wood technologists. Minute anatomical features are often used in industry to identify wood by species. While wood technologists may also resort to other modes of identification (gross anatomical features such as color, smell, taste, grain type, and other characteristics visable to the naked eye or with a low-power hand lens), these means are not possible when examining artifacts preserved under wet-site conditions. Such artifacts have begun to deteriorate, and many gross features have been lost or are obscured by soil particles and by preservation methods. Thus most gross features are not of value in archaeological identification; grain type is often noted, but it is not normally used for identification because surfaces have often been smoothed either in production or in use.

Information generated by this study will be used in an attempt to better understand the relationship that existed between the early people who occupied the Hoko River and the environment in which they lived. Additionally, a comparision will be made between the types of materials used at Hoko River (ca. 2,500 years B.P.) and those used at the Ozette Village (ca. 400 years B.P.).

Methods

Artifacts were divided into two major categories: (1) structurally sound artifacts which have been carved or split from larger pieces of wood without distortion of the original cellular organization of the wood and (2) structurally altered or distorted artifacts such as cordage, in which the original cellular organization of the wood has been distorted by twisting, splitting, and/or pounding. The second category includes basketry materials in which the wood has been split so thin that standard methods of identification are not satisfactory. Friedman's methods of identification were employed for the first category; new methods for identification of the second category are being developed and will be described below.

Structurally Sound Artifacts

Methods used for the structurally sound artifacts in this study are similar to, but slightly different from, those developed by Friedman for use at Ozette. A double-edged razor is used to slice thin sections from an artifact. Under ideal conditions three orientations are obtained: cross, radial, and tangential sections (see Figure 53). A cross section is a section cut perpendicular to the direction of growth. A radial section is a section parallel to the direction of growth and along a ray. Rays are common groups of cells which extend from the center of the stem and are perpendicular to the growth rings, somewhat analagous to the spokes of a wheel. A tangential section is a section parallel to the direction of growth and perpendicular to the rays.

After sectioning is completed, the sections are dehydrated by passing them through a series of ethanol solutions, from 50 percent to absolute; they are then placed in xylene and mounted on microscopic slides in Picolite (a commercial mounting media used for light microscopes). The sections are arranged with the cross section closest to the label, followed by the radial and then the tangential sections. In many cases, no cross sections are obtained since the artifacts had been worked on from both ends. Since the cross

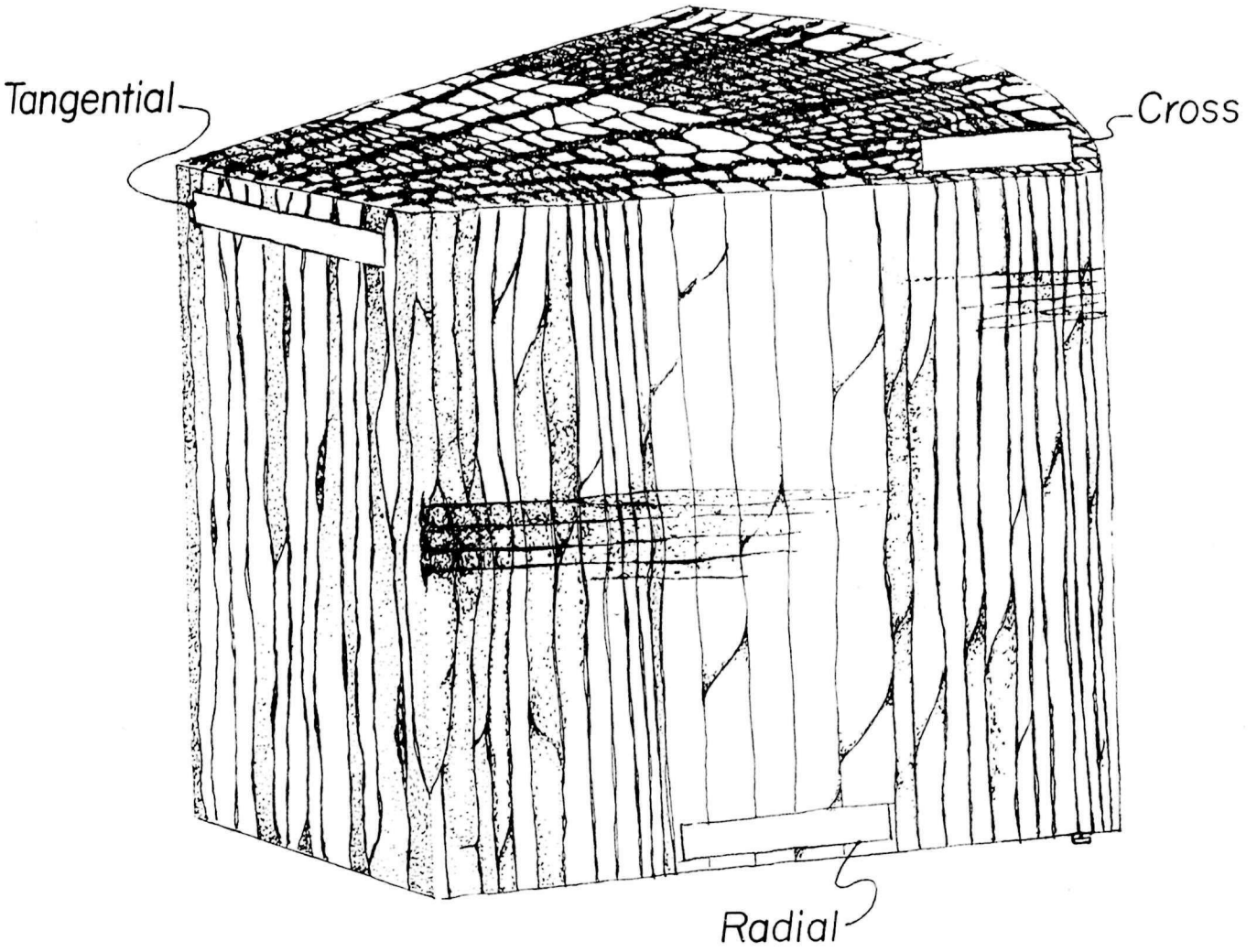


Figure 53. Locations of the tangential cross, and radial sections on a cut of wood.

sections are of limited value, and since obtaining them from artifacts worked on both ends would damage the artifact, they were forfeited in these cases to minimize damage.

Each section is examined with a light microscope as it is prepared. If the contrast between cellular components does not seem great enough for identification, the sections are stained. For softwoods (conifers), the stain consists of 1 percent safranin for five minutes then crystal violet for five to 15 seconds. For hardwoods (angiosperms), the stain used is 0.1 percent Fast Green for five to 15 seconds, then Orange II saturated in clove oil is used until a high degee of contrast is reached. In both cases the sections are dehydrated after staining and then mounted in picolite.

After they are mounted, the sections are examined under a light microscope and identified using characteristic anatomical features. Two keys were used for this purpose. One was developed by Friedman for her work at Ozette (1975a) and the other is from the text of Panshin and De Zeeuw (1970).

Structurally Distorted Artifacts

Although only a few artifacts in which the cellular organization was disturbed during manufacturing have been identified, it seems reasonable to include a description of the methods being developed for this purpose, as well as an explanation of how such identifications are made. Two methods are used jointly for the identification: (1) material is embedded in Aquax and thin sections are made using a microtome (Aquax is similar to the polyethylene glycol used at the Neah Bay lab for artifact preservation); and (2) after sections are taken, the Aquax is removed from the remaining tissue and it is macerated with Jeffery's maceration fluid. Maceration is a process by which the middle lamella (an area between cells composed mainly of lignin and pectic compounds) is disolved. When teased with a needle, the cells fall apart and can be observed with a light microscope. This method is less corrosive than other techniques, making it suitable for use with structurally distorted artifacts.

There are presently two problems with this technique. First, for both types of preparation, a method of washing must be perfected. The distortion of stem organization that occurs during the production of cordage allows mud to impregnate the materials. Such materials also are more degraded than structurally sound artifacts. The mud must be removed before the materials can be properly identified, and this has proved to be the major drawback in working with the distorted materials. The second problem area with the technique is one involving macerations only: a proper time schedule needs to be developed. Some tissues will macerate

in eight to ten hours, while others may take up to 24 hours. It is difficult to monitor the tissue constantly for these lengths of time. If the tissue is allowed to stay in the macerating solution for too long, it will almost completely disintegrate and become useless for identification.

After methods are perfected for producing usable thin sections and macerations, identification should be possible. Information needed to classify the artifacts into groups with common characteristics will be obtained from thin sections. The macerations will be used to identify the wood to genus or species. This should be possible because individual cells are visible, and those cells which characterize each species become apparent.

Results and Discussion

All of the wooden artifacts recovered at Hoko were softwoods except the composite fishhooks. Of these, two were softwoods, the rest were hardwoods. Three major varieties of softwood were identified, and these are listed below along with a brief description of their identifying characteristics:

1. Picea sitchensis (Bong.) Carr., Sitka spruce. This species has resin canals, but no spiral thickening on the longitudinal tracheids (Figures 54 and 55).

2. Thuja plicata Donn., western red cedar. This species has no resin canals; has no radial tracheids; has no spiral thickenings; has smooth end walls on the ray parenchyma, with indentures; and has relatively high rays (Figure 56).

3. Taxus brevifolia Nutt., Pacific yew. This species has no resin canals and has spiral thickenings on the longitudinal tracheids (Figure 57).

Table 20 compares the materials used in artifact production at Hoko with those from Ozette. As can be seen from the data, there are both differences and similarities in the types of wood chosen for specific tasks at the two sites.

Fishhooks

Bentwood hooks found at Hoko were made almost exclusively from Sitka spruce (Figure 55), while only four (0.3 percent) of the 192 hooks examined at Ozette were Sitka spruce. At Ozette 115, or 60 percent, of the hooks were made from western hemlock. This difference may reflect a change in preference from spruce to hemlock. Both types of wood were



Figure 54. A thin section of cordage embedded with Aqwax and cut on a microtome at 20 micrometers. A resin canal is visible on the left.

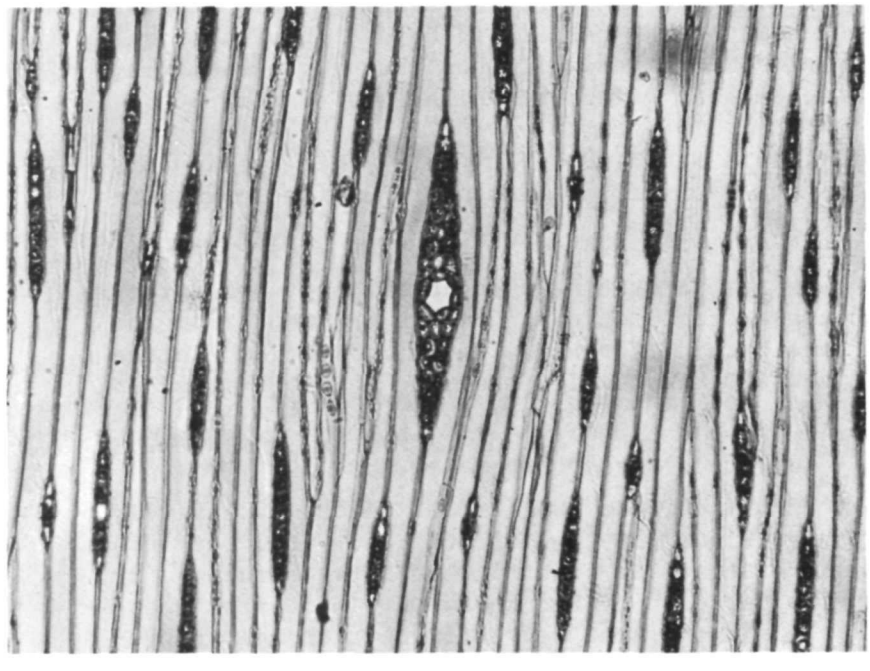


Figure 55. Sitka spruce from a bentwood fishhook, showing resin canal (center) which is characteristic of this species.

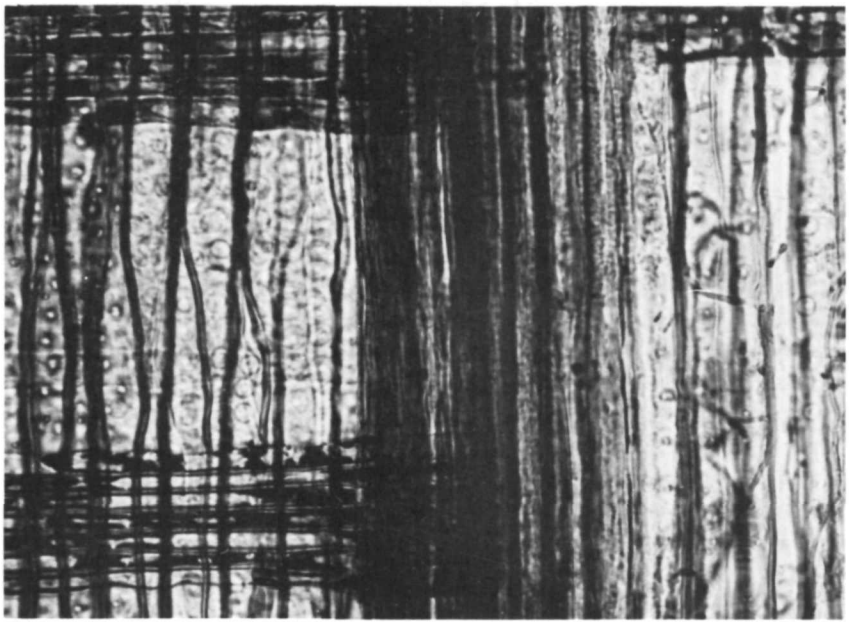


Figure 56. Western red cedar from a microlithic tool handle.

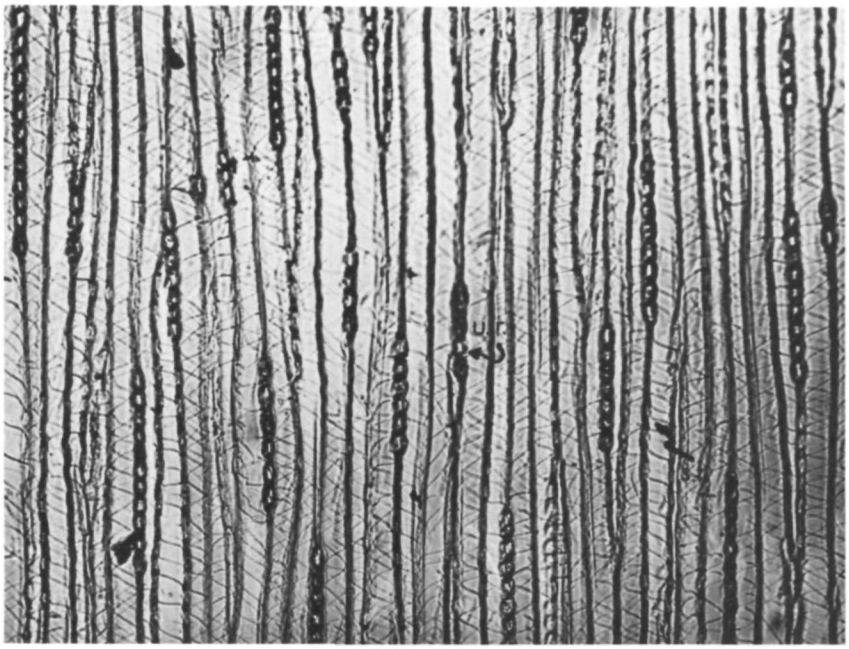


Figure 57. Pacific yew from a wood wedge. Note spiral thickenings and uniserate rays which are characteristic of this species.

Table 20

Identification of plants used in manufacturing artifacts at the Hoko River and Ozette Village sites

Plant types	Bentwood fishhooks		Composite fishhooks		Wood wedges		Bilenticular carved wood		Wooden points		Stakes		Digging sticks		Wooden preform		Tool handles[1]	
	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette	Hoko	Ozette
Pacific yew																		
Number					5	42				2								9
Percent					83	10				-								45
Western red cedar																		
Number						2	9			45							3	4
Percent						-	100			9							100	20
Sitka spruce																		
Number	13	4	2		1	384			4	279	1		1					4
Percent	86	2	14		17	88			100	54	100		50					20
Douglas-fir																		
Number	1	73				1				1			1					1
Percent	7	38				-				-			50					5
True fir																		
Number										63								
Percent										12								
Western white pine																		
Number	1																	
Percent	7																	
Western hemlock																		
Number		115								120					1			
Percent		60								23					100			
Hardwoods																		
Number			13			9				7								2
Percent			86			2				2								10
Total Number	15	192	15		6	438	9		4	517	1		2		1		3	20

[1]Tool handles at Hoko = microlith tool handles, at Ozette = carved woodworking and knife handles.

available at Hoko (see Macroflora analysis, above), but spruce was the more abundant taxa. In general, the hooks examined at Ozette are larger than those found at Hoko; this makes it seem likely that different sized fish were being exploited at the two sites.

Wood Wedges

Again, there is no consistency of material type between the wedges found at Hoko and those from Ozette, but only six wedges were examined from Hoko. Five of them were Pacific yew (Figure 57); the other was Sitka spruce. At Ozette 438 wedges were examined, and of these 384 or 88 percent are Sitka spruce while only 42 or 10 percent are Pacific yew. Friedman (1976) points out that yew is not a common tree on the Olympic Peninsula, and that the yew that are available are small with gnarled trunks. She also notes that the people at Ozette preferred to use spruce compression wood for wedges, saving the yew for more important uses. If it were more available, yew would be an obvious choice for wooden wedges, given its greater strength. Croes (1976c:293-294) states that the type of wood used in wedge production varies greatly between groups. Yew was preferred at the approximately 3,000-year-old sites of Hoko River and Musqueam Northeast; western fir was preferred at the 2,000-year-old Lachane site; and Sitka spruce was the choice 400 years ago in Ozette Village. There must have been some special reason why yew was chosen over the more abundant spruce at Hoko River.

Tool Handles

Microlithic tool handles from Hoko were compared with carved tool handles (knives) used to hold small pieces of stone, shell, or metal from Ozette. The three handles tested from Hoko are western red cedar (Figure 56); the other handles recovered from the site appear to be made of the same material. Of the knives examined at Ozette, four are western red cedar, nine are Pacific yew, four are Sitka spruce, one is Douglas-fir (Pseudotsuga menziesii (mirb.) Fronco), and two are bigleaf maple (Acer macrophyllum Pursh).

Projectile Points

Wooden projectile points are the only other items found at Hoko that can be easily compared with those found at Ozette. Four points were examined from Hoko, all of which are made from Sitka spruce. From Ozette, 517 were examined of which 279 or 54 percent are Sitka spruce, 120 or 23 percent are western hemlock, 63 or 12 percent are true fir, 45 or 9 percent are western red cedar, 7 or 2 percent are various hardwood types, two are yew, and one is Douglas-fir. A more or less consistent use of spruce can be seen between the two sites.

The remaining wooden artifacts found at Hoko are not compared here with those found at Ozette because no direct counterparts exist. It is important to note that the sample obtained at Hoko at this point is small, especially when compared with Ozette, and this lessens the weight that can be given to the above comparisons. When more data become available from Hoko River and other Northwest Coast wet sites, more meaningful comparisons can be made, and perhaps trends in wood usage can be recognized and compared. Potentially, it could be determined what types of wood were used to produce certain classes of artifacts by different prehistoric groups along the Northwest Coast.

FISHHOOKS

by Ricky Hoff

People living on the banks of the Hoko River 2,500 years ago left behind remnants of their material culture which express their dependence upon the local aquatic environment. These Hoko River people were undoubtedly hunting, gathering, and fishing in many habitats. In the vicinity of the Hoko River mouth the intertidal, riverine, estuarine, and neritic habitats played a vital role in Indian food-gathering methods. The resources of these habitats are represented by the remains of various species of marine fauna, mainly fish. The artifacts also reflect a corresponding emphasis on an elaborate fishing technology. Several techniques for fish procurement are evident at the site; the form of fishing best represented, however, is line fishing with wooden fishhooks.

The Hoko River people's fishing technology may have been similar to that employed historically on the Northwest Coast. The fishing methods used by these people are actually a reflection of generations of technological adaptation to the local environmental setting. This adaptation is demonstrated by the remains of fishing gear found at the site, such as a possible fish weir fragment, nets, spears, harpoons, and wooden fishhooks. These fishhooks are the most abundant form of fishing gear so far recovered.

The development of sophisticated gear for line fishing would have been dependent upon an important prerequisite--suitable watercraft. Reinman's statement referring to prehistoric Oceania, supports this:

> Greater exploitation of the sea required the use of two further relatively complicated technological devices: some form of a boat or raft, and the invention of the fishhook. With the first, man was no longer confined to the beaches and the shallow inshore waters, but was able to effectively exploit the offshore waters either for new foods or in pursuit of a quarry that used the sea as a means of escape. With the second implement, the fishhook, man was no longer confined in his exploitation to the surface waters of the sea, but was now able to effectively explore and utilize the sub-surface regions and successfully capture mid- and deep-water fish (1967:104).

For the Hoko River people to have been able to exploit deep-sea fish in the nearshore and offshore zones, a form of watercraft was a necessity. Also without the development of specialized angling implements the advantage of being able to harvest the "subsurface" habitats would never have been realized.

The different fishhook types found ethnographically on the Northwest Coast were designed for specific functions. For example, the shape and size of individual hooks from the Hoko River site were technological adaptations best suited to selectively catching certain species of fish from particular habitats. In addition, the length variations of each hook type also imply attempts to secure different sizes of fish. The manner of manufacture and the methods of use were advancements that must have taken many generations to evolve. This evolution could possibly be the result of local development, but may also include elements introduced from neighboring areas.

The fishing-oriented societies on the Northwest Coast used a wide variety of methods for collecting fish. In reference to the salmon fishery implements, Drucker comments that "variants of each of the devices were made in different parts of the coast. Some of the variation depended on cultural preferences, and some on adaptation to local conditions, such as depth of water, speed of current, rocky or sandy bottom" (1965:11). Moreover, Barnett makes the statement that "...all or most of these people were familiar with the techniques of their neighbors, but because of local geographical conditions or cultural inertia, found their own practices better adapted to their requirements" (1955:78-79). The relatively large fishhook assemblage recovered from the Hoko River site implies that the form of line fishing used was apparently technologically efficient and must have satisfied the cultural needs of the people using it.

The fish bone sample from the site indicates the effectiveness of hook and line fishing. Fish remains are mostly those of bottom fish, indicating a dominant use of the neritic habitats. Fish from the near- and offshore zones represented in the site include: cod, rockfish, dogfish, flounder, and other flatfish, with emphasis on halibut. Salmon bones also occur in the samples. Due to their anadromous habits, salmon could have been caught both nearshore and offshore, as well as in the estuary and up river. However, greater numbers of salmon would have been harvested farther up the Hoko River during the spawning runs. Given the abundance of fishhooks at the Hoko River site and the abundance of neritic fish remains, we may assume that line fishing played a vital role in the subsistence pattern of these people 2,500 years ago.

Fishhooks as a class of artifacts are defined functionally here as implements which catch fish by having the fish voluntarily take at least part of the hook into its mouth. A preliminary description of the attributes of the two basic types of fishhooks represented in the 1977 excavations of the site will be given, accompanied by a discussion of probable manufacturing techniques.

The two hook types found in the site are bentwood fishhooks (Figures 58-62) and composite fishhooks (Figures 63-66). Composite fishhooks can be additionally subdivided into the two-piece (Figures 65,66) and the three-piece (Figures 63,64) subtypes. The sample also includes bentwood preforms, some of which have been completely formed but not yet bent into the desired shape. Lastly, there are a few fragments which have been classified as "indeterminates." These are small pieces of broken fishhooks that share characteristics of both hook types and cannot be assigned with certainty to either category.

It should be noted that in the future, replications of these fishhooks and related fishing gear will be be tested in the neritic habitats. There are a number of reasons for undertaking this project. To adequately understand possible techniques and steps taken in manufacturing these fishhooks, it will first be necessary to reconstruct them. Secondly, it will be necessary to determine the reasons why certain materials were preferred. Finally, it is important to learn how these hooks actually perform when they are being used to catch a fish. Because there is very little information from the site indicating how the fishhooks were rigged, it will be necessary to look at historically recorded methods for insight on hook use. Unfortunately, the ethnographic literature provides only a minimal amount of data on the construction and function of Northwest Coast fishhooks. Additionally, because different kinds of hooks are represented in the site, it will be interesting to see how hook type and

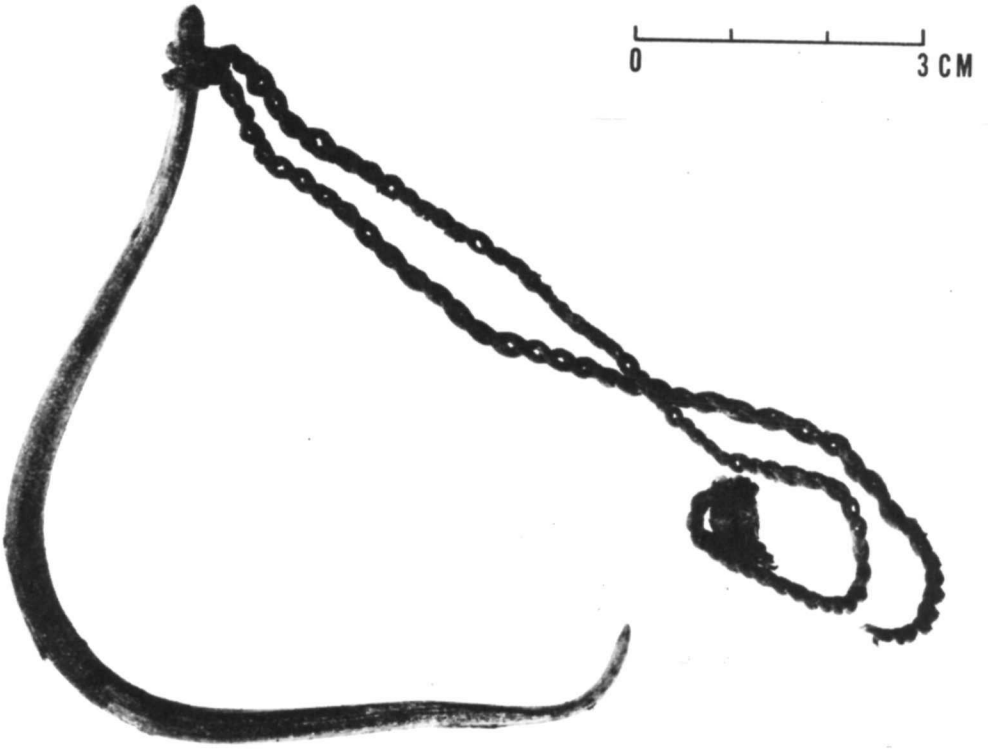


Figure 58. Bentwood fishhook.

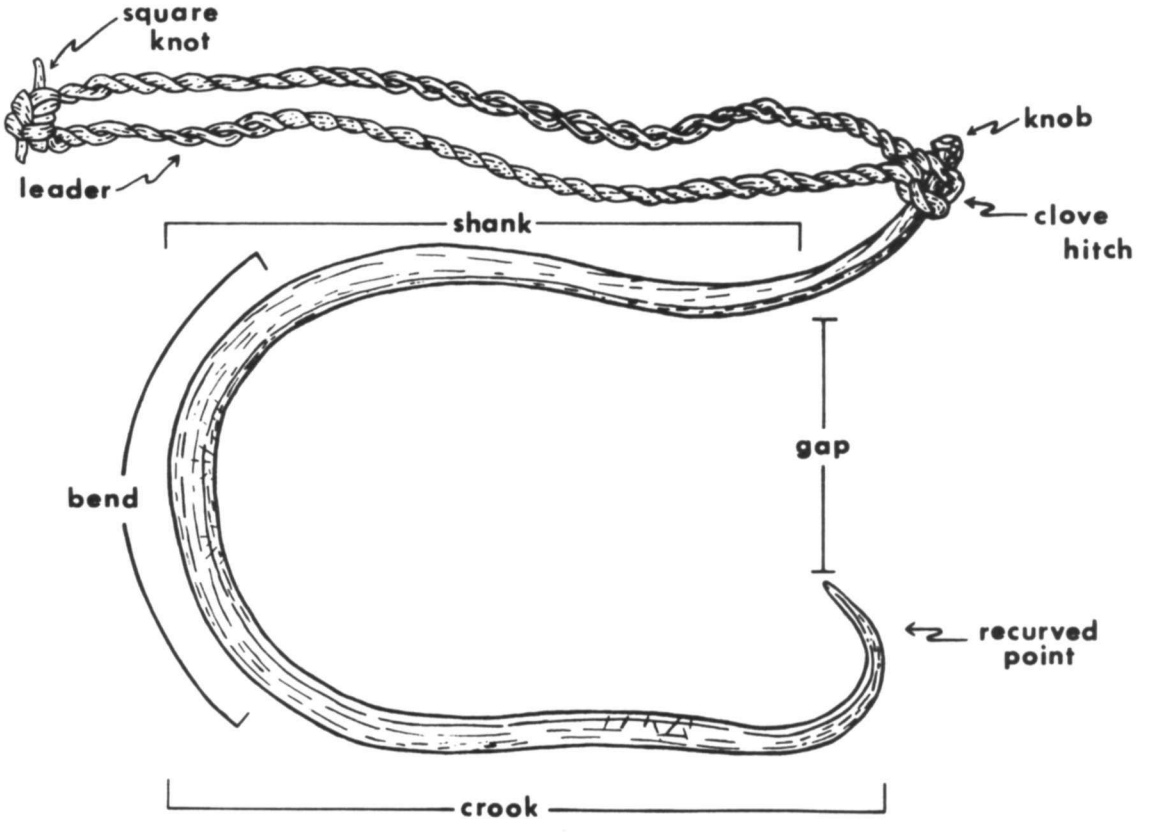


Figure 59. Bentwood fishhook diagram.

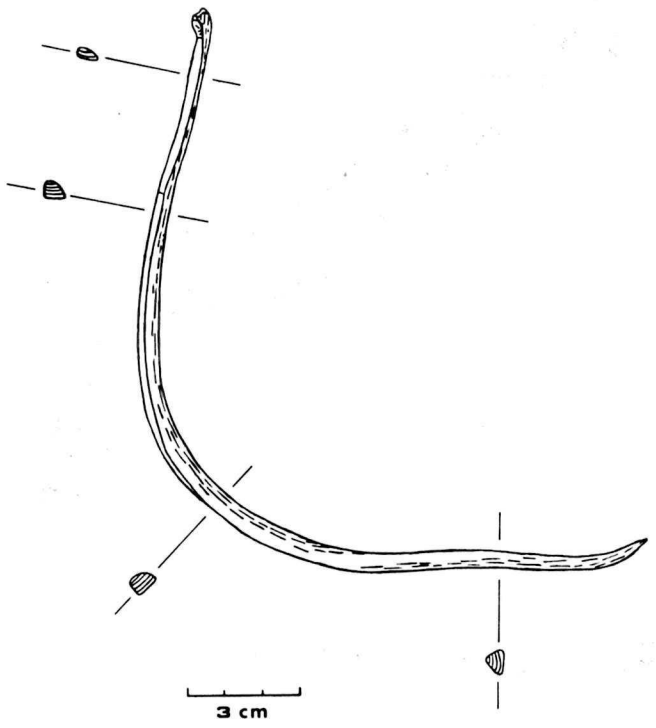


Figure 60. Cross-section at various points along a bentwood fishhook.

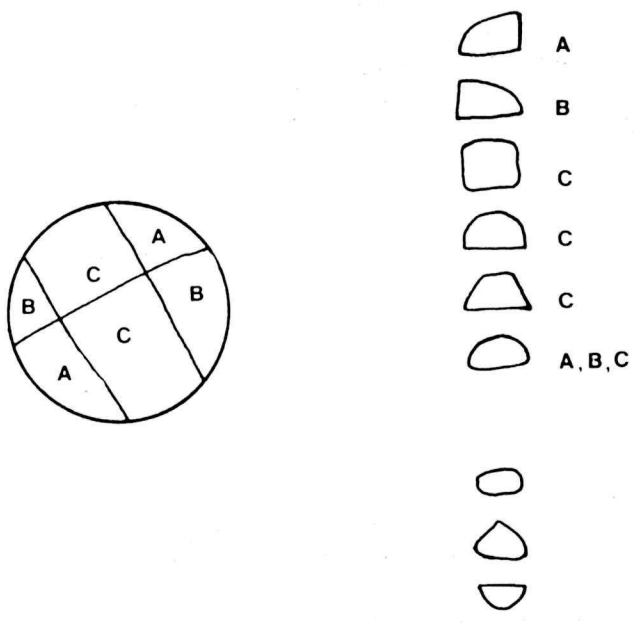


Figure 61. Potential (left) and actual (right) bentwood fishhook cross-sections from a split limb.

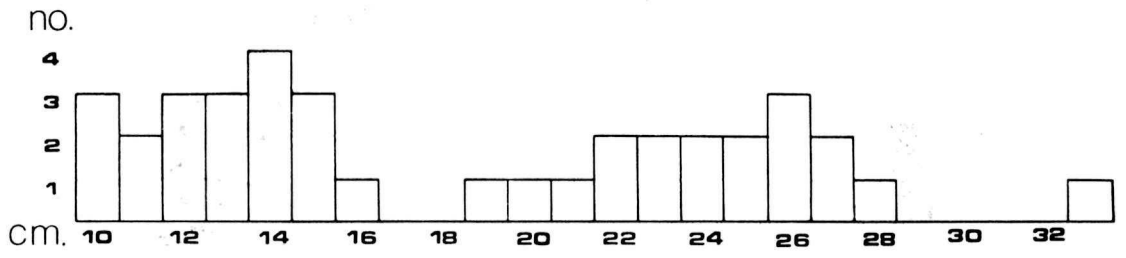


Figure 62. Size-range classes of bentwood fishhook recovered at the Hoko River site.

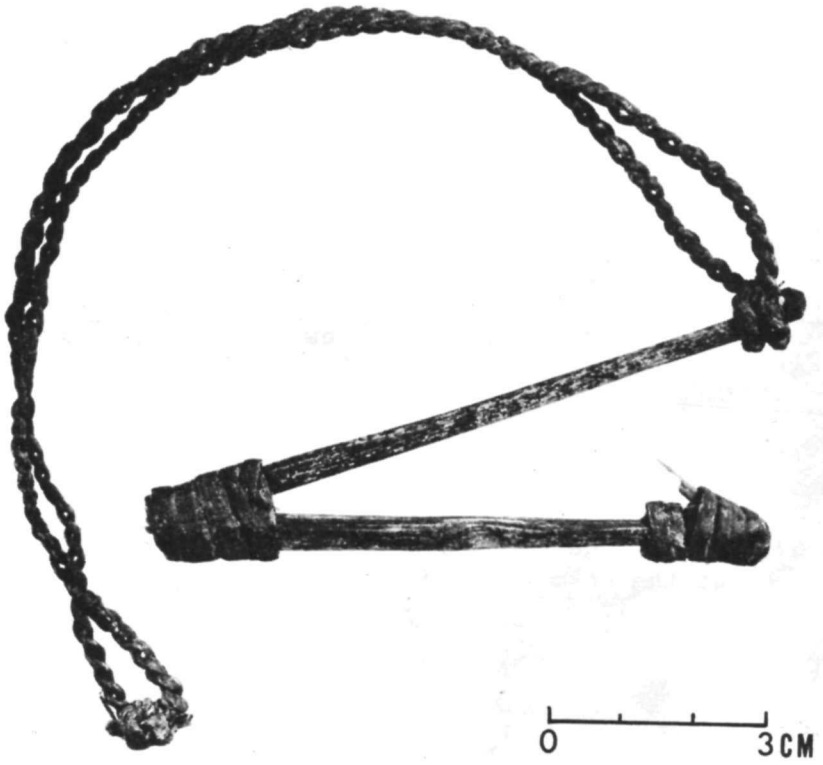


Figure 63. Three-piece composite fishhook.

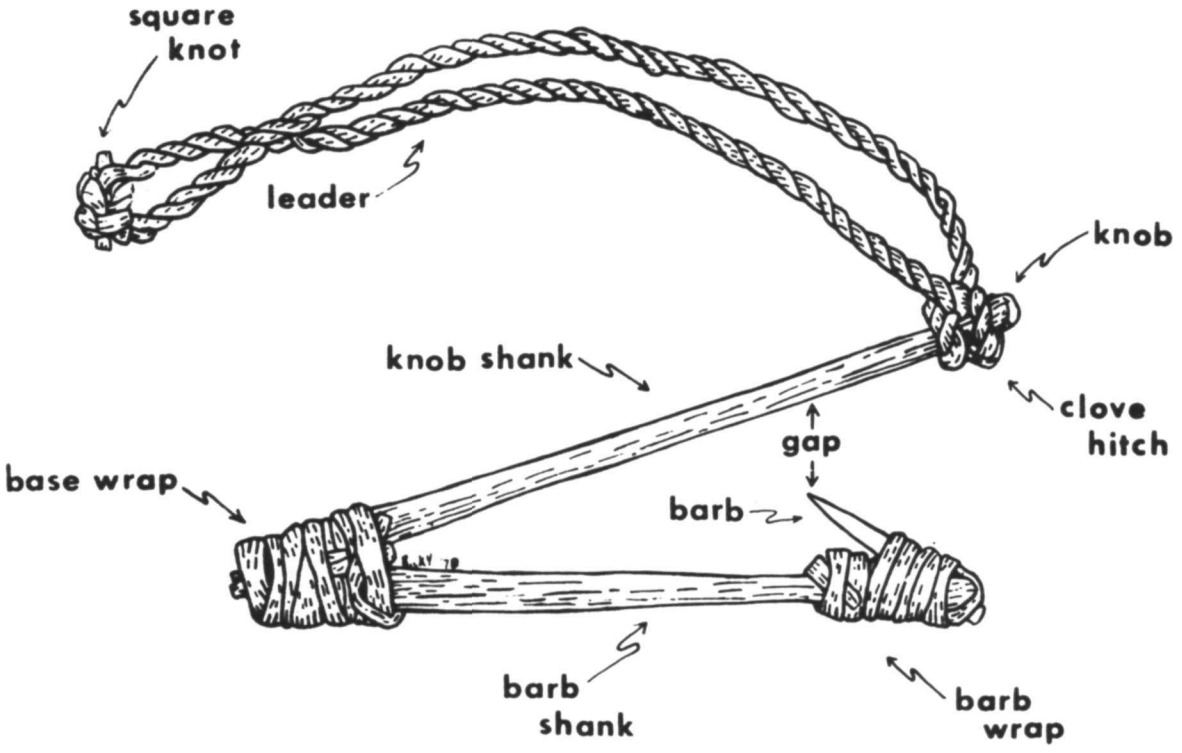


Figure 64. Three-piece composite fishhook diagram.

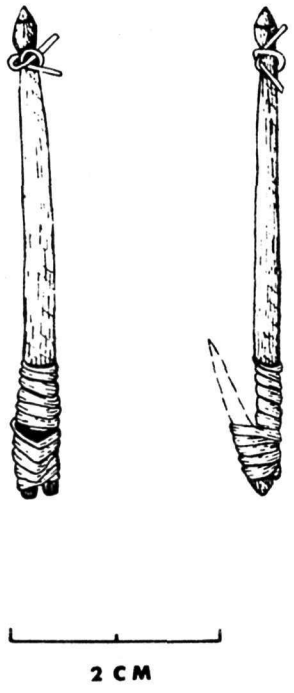


Figure 65. A two-piece composite fishhook.

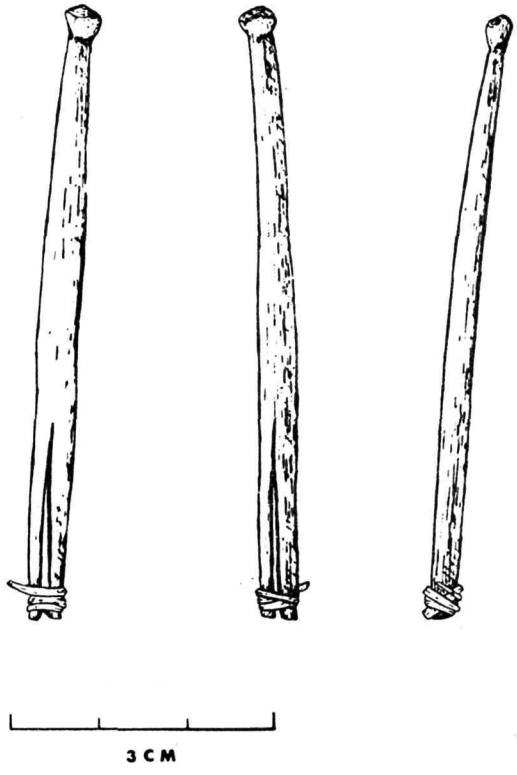


Figure 66. A two-piece composite fishhook.

size affect the kind and size of fish caught. From this replication and experimentation it is hoped that a good deal of information will be gained and that new questions will be generated as some of the current questions are answered.

Bentwood Fishhooks

The bentwood fishhook is constructed from a single piece of wood that has been bent into a "U" shape. The material used to manufacture these hooks at Hoko River has been identified as spruce (see Microscopic identification of artifactual plant materials, above). So far, however, it has not been possible to verify from what part of the tree the material was taken. Due to the pattern of relatively tight annual rings as seen from the cross section of fishhook fragments, it is probable that the material may have been taken from a limb. On the other hand, Drucker (1951:22) notes that the Nootka used "tough spruce root" in making bentwood halibut hooks. This question of exact material origin is one of those to be addressed in replication experiments.

From a split piece of spruce the fishhook blank is fashioned into a preform, a shape which facilitates bending and the maintenance of the resulting "U" shape. The body of a complete bentwood fishhook may be subdivided into five general descriptive areas: the knob, shank, bend, crook and the recurved point (Figure 59). Apparently, for proper construction, the grain of the wood must run horizontal to the length of the fishhook (Figures 59,60). This may allow the fishhook preforms to stretch more easily at the stress points during the bending process; if the grain were vertical to the hook's length there might be a tendency for the grain laminations to pull apart. Only one specimen was recovered which had been constructed across the grain, and at its bend the wood grains had separated from each other.

Another constructional feature important to the bending procedure is the flat back surface as opposed to the more rounded inside area of the preform (Figure 60). This rounding may vary at different positions on an individual fishhook, and also to some degree from hook to hook. These variations, as seen from the cross-sectional view, could hypothetically be the result of selecting different sections of a split limb, as represented on the left side of Figure 61. The right side of the illustration shows six of the common cross-sections found among the total sample; the lower three happen to be examples from three individual hooks. On a number of fishhooks the crook area has a triangular cross-section which tapers towards the point (Figure 60). This portion of the hook is probably designed to maintain the crook and to enhance bending of the recurved point.

It is not entirely clear how these bentwood fishhook preforms were made. The only evidence of carving or whittling on the finished fishhook is on the knob. The construction of the knob appears to consist of removing or thinning part of the shank's back- side while leaving a small remnant of the knob. The hook illustrated in Figure 60 shows this more prominently than any other specimen so far excavated. Except for this knob construction, evidence of whittling has been noted on only one other sample--on the point of a preform. It is possible that the hook bodies were first partially carved into their general shape and then given a smoothed finish by the use of an abrader. Sandstone is easily collected in the site area, and some of the sandstone abraders found in the site may have been used for this purpose. Dogfish skin was also used ethnographically as an abrasional tool. Either of these tools could have removed any evidence of whittling on the hook surface, but both would be expected to leave striations. Unfortunately there are few signs of striations on the hooks, and the ones that do exist may actually be marks produced by fish teeth. Still, as part of replication experiments, such abraders will be tested to demonstrate their utility so that we can better understand the technological and cultural aspects of the fishhooks and their production.

Once the bentwood fishhook preform has been prepared, it then must be bent into the required shape, probably by means of steaming. One method noted historically for steaming bentwood hooks was to place the preform into a kelp tube or stem (Drucker 1951:22; Swan 1870:41). The open ends were stuffed with sea weed or kelp leaves, and the tube was placed near or under the hot ashes of a fire. Stewart (1977:34) states that the kelp was then left in the "hot ashes of a dying fire" overnight. Another method, which was used primarily to steam small bentwood hooks, was to place hot rocks in the bottom of a pit and then cover them with moist seaweed. The preforms were placed over the steaming seaweed and covered with leaves or mats. Finally, water was percolated down to the hot rocks to produce larger amounts of steam; this method would make the preforms pliable for bending in only about 15 minutes (Stewart 1977:35). Both of these steaming processes will be reproduced to test their effectiveness for replicating the bentwood U-shaped forms.

After the bentwood shape has cooled, it should retain its shape. The Kwakiutl Indians historically placed bentwood fishhooks in molds for cooling (Stewart 1977:32-35; Boas 1909:332-333). However, this does not seem to be a step taken in constructing the Hoko River fishhooks, as the use of molds would tend to result in uniform sizes, and the hooks from the Hoko River site do not show any distinct size standardization. The final step before rigging the hook for fishing is to tie a leader on snugly against the knob.

The length of the complete bentwood fishhook bodies ranges from 10 cm to 33 cm. Figure 62 clearly demonstrates that the hooks fall into three size-groups, only two of which are commonly recovered. The largest size-group is represented by only one specimen, and this specimen is distinctly larger than any of the other fishhooks. This size-range variation may reflect predation on different sizes, or even different species, of fish.

Composite Fishhooks

The three-piece, V-shaped composite fishhook (Figures 63,64) is made by securing two wooden shanks, the knob and barb shanks, together at their bases by the "base wrap." At the opposite end of one shank a barb, which serves as a hooking device, is set in place by a "barb wrap"; the opposing end of the second shank has a knob which is similar to the bentwood fishhook's knob. The two-piece composite fishhook subtype has only one shank which has both the knob and the barb, one on each end (Figures 65,66). The material used for the composite fishhook shanks is believed to be a hardwood, but it has yet to be identified to species (see Microscopic identification of artifactual plant materials, above). The binding material used to join the shanks resembles split spruce root in most cases, although two specimens from Hoko River have base wraps that appear to be wild cherry bark. Ethnographically, the people of the Northwest Coast considered this latter material to be a very desirable binding for use underwater. Barnett (1955:86) attributes this to its being "thin, tough, resistant to decay, and [making] a smooth union." These same characteristics can also be generally attributed to split spruce root, and today this material is far more abundant in the Hoko area than is wild cherry. The identifications of the binding materials from the composite fishhooks are currently being verified, since it will be important to replications of the Hoko River fishhooks that proper materials be used. Aspects such as the fishhook's strength, function, and balance while submerged would be affected by the choice of binding material.

The cross-sections of the composite fishhook shanks are, for the most part, triangular and oval (Figure 67). Some of the shanks, however, have one or more of the edges rounded off, thus producing some variation in the cross-sectional views. It is possible that the oval shanks may be triangular shanks with all the edges rounded off. Triangular shanks appear to be simply pieces of split wood. The arc of the annual rings observed on a number of broken fragments suggests the material was a small limb or the trunk of a shrub or very small tree. Like the bentwood hooks, the composite fishhooks show

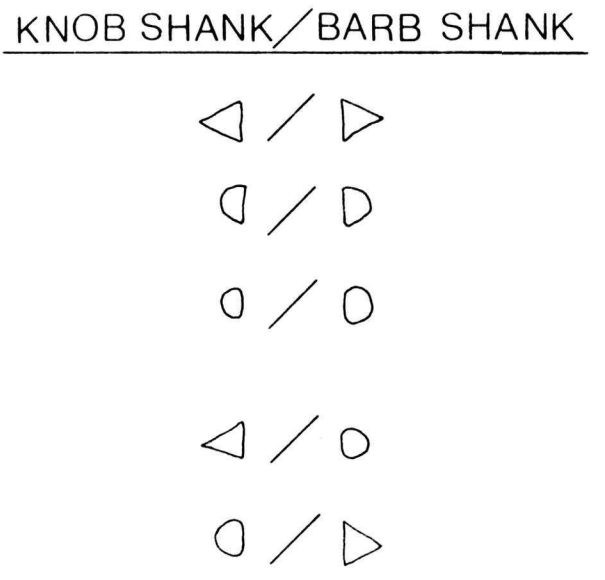


Figure 67. Paired cross-sections of composite fishhook shanks.

no clear indications of the mechanism(s) by which the shanks have been modified. The triangular shanks appear to have been minimally modified before construction; modification of the oval shanks is more extensive and is possibly due to whittling or abrasion. The triangular shank perhaps represents a hook style that could be made quickly and with the least amount of effort. When a stronger and more durable fishhook was desired, more time and effort were put into making the oval shanks. Commonly both shanks of a composite fishhook are the same shape, but there are, nevertheless, a few specimens with mixed shank types (Figure 67). This mixing may have been done initially, but is probably a secondary construction where functional parts from broken hooks were reused to make a new hook.

The bases of both shank styles are beveled to assist in their being bound together as in a mitered joint. Beveling on some triangular shanks is a short, concave groove that may have been produced by scraping out or depressing the wood, thus leaving no cut marks (Figure 68). In contrast, beveled bases of the oval shanks are more flat and often, but not always, show cut marks (Figure 69).

As on the bentwood fishhooks, the knobs on the composite hooks show some evidence of carving, and a remnant portion of the knob projects to the back of the fishhook. Both of the two-piece composite fishhooks have distinct grooves around the base of the knob (Figures 65,66). One three-piece composite hook possibly shares this characteristic, but this is not certain because the clove hitch of the leader conceals the base of the knob. In addition, one bentwood fishhook also has this girdled feature with its knob still projecting toward the back, and there is a possible bentwood preform that is girdled too. The latter specimen may actually be a garment pin. Only ten of the 62 composite fishhooks still retain their knobs, while 35 of the 43 bentwoods have their knobs intact. In order to get a clearer picture of knob stylistic features between the hook types, it will be necessary to work with a larger sample.

The composite fishhooks, like the bentwood hooks, can be grouped into three size ranges. And again like the bentwoods, the largest category includes only one hook. The remaining fishhooks fall into one of the two smaller size-categories as shown in Figure 70. The barb shank is characteristically slightly shorter and thicker than the knob shank. A stronger barb shank may have been required to absorb the stress once the fish had taken the hook. The angle of the two shanks may also have been chosen to compensate for the amount of stress applied to the hook. The 22 composite hooks whose angles could be measured fall into two categories: one group averages about 15 degrees while the other averages about 21 degrees (Figure 71). The range in

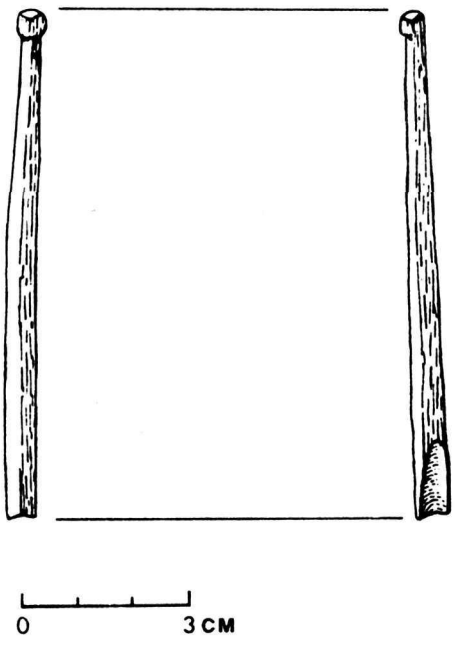


Figure 68. Triangular composite fishhook shank with a depressed beveled base.

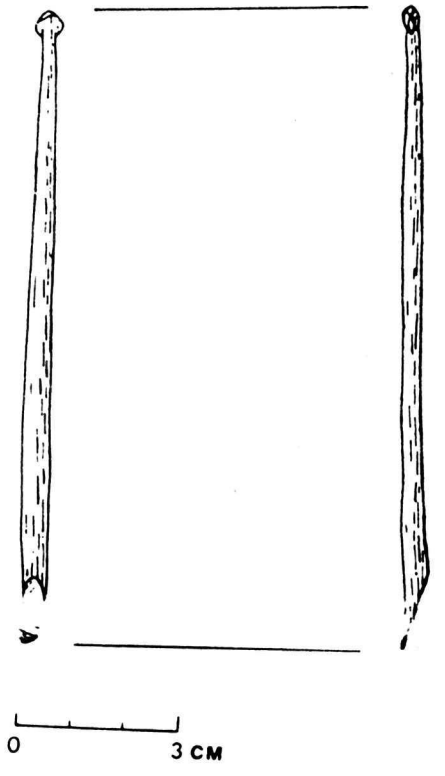


Figure 69. Oval composite fishhook shank with a flat beveled base.

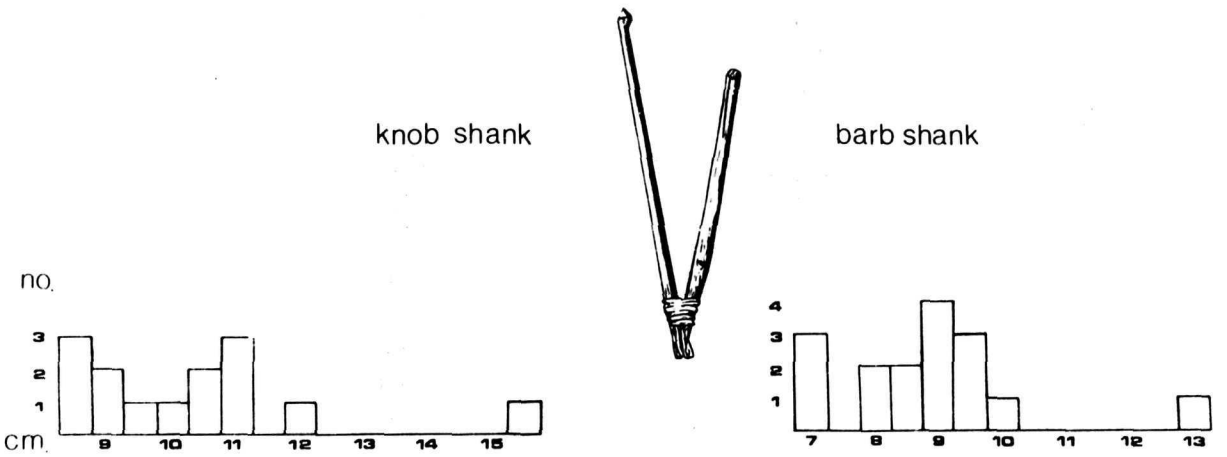


Figure 70. Size-range classes of composite fishhook shanks recovered from the Hoko River site.

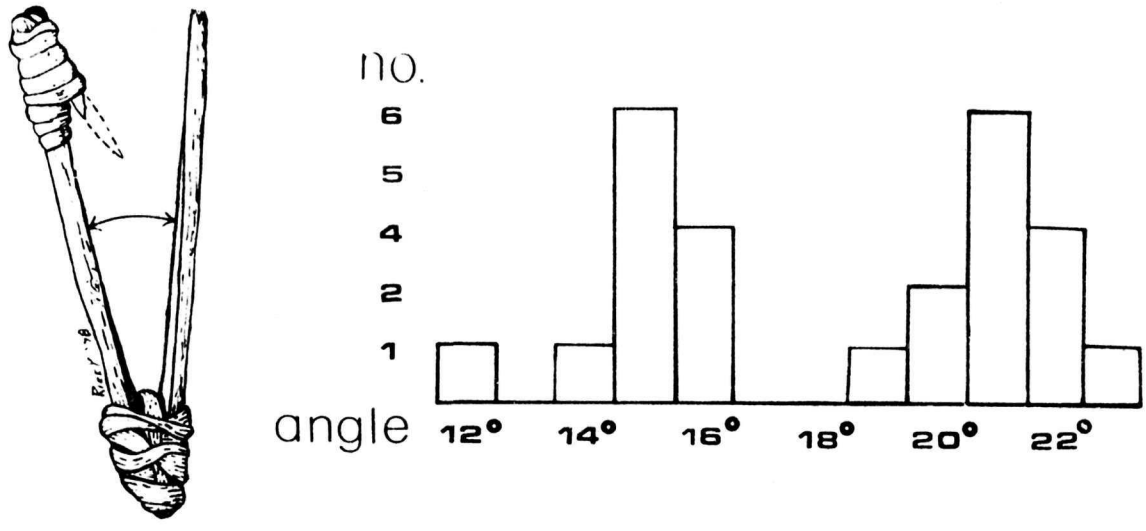


Figure 71. Composite fishhook shank angles.

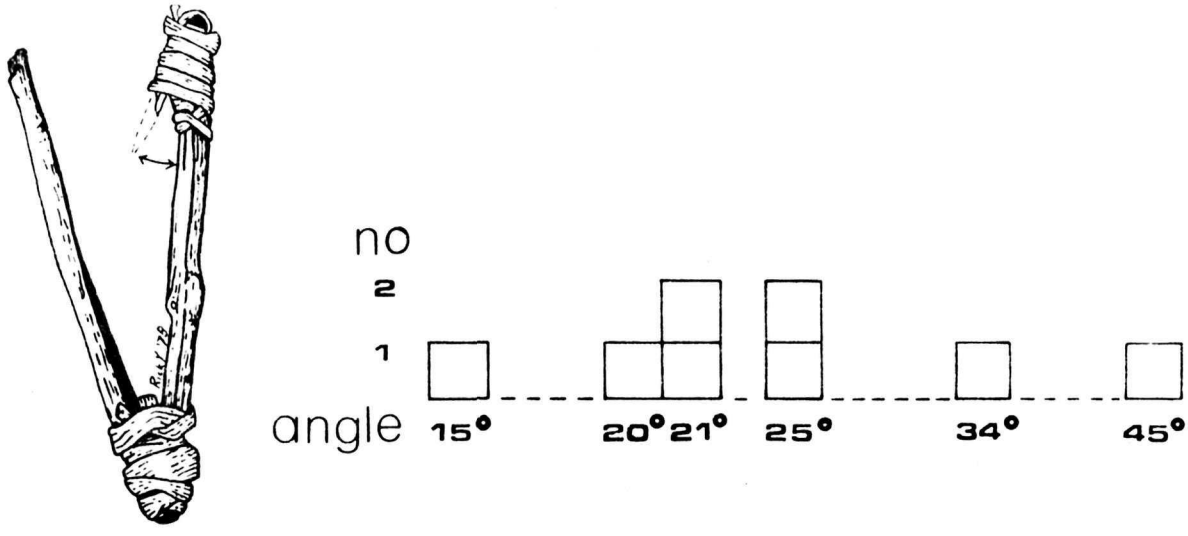


Figure 72. Composite fishhook barb angles.

the group with smaller angles was from 12 to 16 degrees, and the hooks appear to have undergone some postdepositional deformation, making it difficult to obtain accurate angle measurements. The fishhooks with angles ranging from 19 to 23 degrees have generally remained in better condition, thus allowing for a more precise measurement. This angle size is possibly a functional adjustment to both strengthen the hook and enable the fish to take it.

There are so few hooks with any evidence of barbs or barb wraps in good condition that length measurements of the barbs and angle measurements between the barbs and shanks are not dependable (Figure 72). In fact, at this time it can only be assumed that the barbs were made from bone, since most evidence of any barb remains is concealed under the binding material. Of the entire collection, only eight hooks provided any information on the barb angles; of these, five grouped together with angles ranging from 20 to 25 degrees. Here too, the angle must have been adjusted to provide the appropriate gap to allow a fish to take the hook. Obviously, more data are needed. Hopefully, further excavation of the Hoko River site along with the proposed replication experiments will provide the additional information.

The pattern used in putting together the parts of the composite fishhooks appears to be uniform among all the specimens so far excavated, though there are some cases where the pattern is unclear due to the condition of the hook. The following description will be a reconstruction of the sequence and the arrangement used in joining the parts of the composite fishhooks that seems to best fit the presently available data. This is the sequence that will be used to replicate these fishhooks.

The shanks are first prepared to the desired shape, then the beveled ends are butted together (Figure 73a) and positioned to be secured by a base wrap. The next step is to anchor one end of the binding by wrapping it back around the base of the shanks and then overlapping itself (Figure 73b). The wrapping material ranges from 1.5 mm to 5.0 mm in width; the average is about 3.0 mm. Of the 43 specimens that still had the base wraps, all except one had the binding going from right to left (when the hook is observed with the base wrap down and the barb shank to the right). How many times the binding material is wrapped around the shanks varies from hook to hook, depending on the size of the shanks and the width of the binding. In most cases it is wrapped five to eight times, but it may be wrapped as many as 13 times. Once the number of wraps required to adequately support the shanks is completed, the binding is run vertically between the shanks at least once, but usually twice (Figure 73c). This helps to further secure the shanks and serves as a spa-

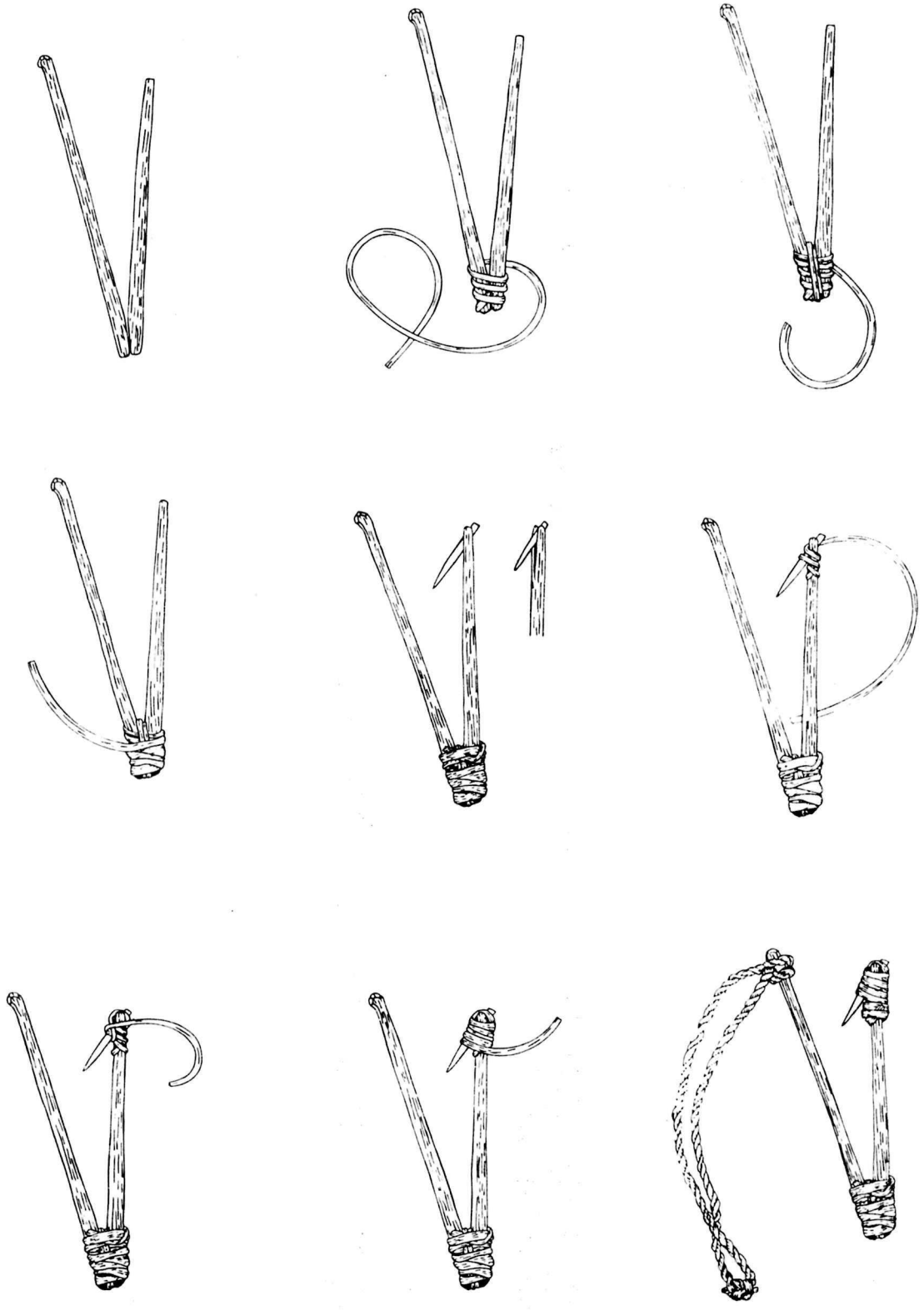


Figure 73. Construction sequence of the three-piece composite fishhook.

cer to keep them separated at the appropriate distance. The binding material is then brought to the base of the shanks again, and a second wrapping is applied from right to left (Figure 73d), completely covering the previous wrapping. Finally, the end of the binding material is tucked under the last wrap (Figure 73e). Generally the binding, as shown in the illustration, is taken down over the previous wrap, tucked under it, and pulled upwards; a few hooks do not have the binding crossing over the previous wrap, but rather have it tucked under and pulled down.

The next procedure is to add the barb. To set the barb in position, it is first necessary to make a slit in the end of the shank (Figure 73e); when the barb is positioned at the proper angle, it is made secure by a binding material with an average width of 2.5 mm to 3.0 mm. Of the total composite fishhook sample, only 11 specimens had barb wrap remains. In most cases it is not possible to tell from which direction the wrap runs because it is concealed by the overlying wrapping of the finished hook. Two hooks with only fragmented remains of the binding material show the wrapping going from the right to the left (Figure 73f). In order to position the barb and to hold it in place, the binding makes a "figure eight" around both ends of the barb (Figure 73g). The binding then continues around the shank and barb, but in a left to right direction (Figure 73h). After two to five wraps below the barb, the binding is terminated in a fashion similar to that of the base wrap (Figure 73i).

The final step for a completed composite fishhook is the addition of a leader to the end of the knob shank (Figure 73i).

Leaders

Thirteen fishhooks were recovered with either complete or partial remains of double leaders. These leaders were found connected to six bentwood hooks, four three-piece composite hooks, one two-piece composite hook, and to two unclassifiable fishhook fragments. These two-strand leaders are made from spruce rootlets which have been twisted to the left and then wound back on themselves to form a right twist or Z lay (see Cordage, below). The twists vary from four to eight twists per 2 cm, with an average of six; the diameters range from 1.5 mm to 3.0 mm with an average of 2 mm. In contrast, possibly due to its much smaller size, a two-piece composite fishhook has the remains of a single-strand double leader. The material used for this particular hook leader is probably split spruce root or cedar bark. Its small diameter, a

little less than 1 mm, would suggest that the fish procured with this hook was small and may have been used for bait. The bentwood and three-piece composite fishhook leaders employ a clove hitch to secure them to the end of the knob shank (Figures 58,63); the two-piece composite hook differs here also in that a single overhand knot was used to attach it to the shank (Figure 65).

A large inventory of spruce rootlet cordage was recovered from the Hoko River site (see Cordage, below), including four complete leaders that were not attached to fishhooks. A number of fragments with either clove-hitch or square knots were also collected, and these may be leader fragments, although cordage was used for other purposes as well. Ethnographically, spruce root cordage and cedar bark are noted by Niblack (1890:292) as having been used for fishing line. It is not possible to state that spruce root or any other type of vegetal material was used at Hoko River for fishing line because there are no long strands of string, nor are there any fishing lines connected to any of the hooks or leaders. Since there are no indications of fishing lines from the excavations, it is suggested that kelp stems were used. Kelp, commonly used on the Northwest Coast as fishing line, is an algae which decays very rapidly except under exceptionally dry conditions. In a short trip by canoe the people occupying Hoko River could have paddled to a number of kelp beds (see Figure 9) to gather large quantities of kelp stems. Other materials noted ethnographically as having been used in at least some areas of the Northwest Coast--gut and plaited hide (Drucker 1950:169) and sinew (Stewart 1977:26)--would also not normally preserve well in an archaeological context. The lack of preservation of the fishing line is a critical factor limiting our understanding of how the Hoko River fishhooks and possibly related gear were used.

Anchor Stones and Line Floats

Not only is there no fishing line in the site, there is also little evidence for other cultural material that might have been associated with line fishing gear. Artifacts which might have been part of this "hand line" technology include some wrapped anchor stones and possible split cedar line floats. The anchor stones (see Systems analysis of lithic artifacts, below; Figure 142) are simply made by wrapping small cobbles with spruce root strips, and it is not known how, or if, they were used with the line fishing gear. The original shapes of these stone implements have not been altered, so that many well- rounded cobbles found during the excavations may also have been used in this way; with the wrappings gone, there would be no indications of their having been so used.

The split cedar objects (Figure 51) could have acted either as surface or subsurface line floats. On the other hand they could also have functioned as net floats, net gauges, or even as mat creasers. There are no lines attached to either the possible line floats or the anchor stones.

By comparing the numerous styles of hand line fishing recorded for the Northwest Coast, it is possible to hypothesize some ways in which the Hoko fishing equipment may have been utilized. Ethnographic accounts illustrate various line fishing methods such as set lines using spreaders, trolling, and jigging. The high percentage of bottom fish remains found in the site, plus the similarity of the bentwood and composite fishhooks to the bottom fish fishhooks noted in the historic record, suggest that the hooks from Hoko River were used for this same purpose. Common methods that could have been used are rigging with set lines or with spreader devices for drift fishing.

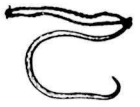
Anchor stones found in the site may have been used (Stewart 1977:43) to hold the line stationary while the possible line floats would mark the fishing gear's position on the surface of the water. Except for one possible specimen, there are no artifacts that suggest the use of spreaders. This possible exception is a small limb with its distal end tied in a loop which may have served to secure a leader and fishhook so as to prevent them from slipping off (see Stewart 1977:39). It is unfortunate that, although a significant number of fishhooks were recovered, the method for rigging them and the possible use of anchor stones and line floats can only be speculated about.

Total Fishhook Sample and Fishhook Distribution

After the 1977 field season, a total of 116 fishhook specimens were available for analysis (Figure 74). There are 109 hooks which could be categorized into one of the two fishhook types. These include 60 three-piece composite fishhooks, 43 bentwood fishhooks, four bentwood preforms, and two two-piece composite fishhooks. An additional seven indeterminate fragments could not be designated into a type category due to their small size and lack of identifiable characteristics. Most of these indeterminates are parts of fishhook shanks or the knob end of a shank. Of the total sample examined, 74 percent were recovered from the archaeological excavations and 26 percent were from the collections of local residents.

Within the excavated materials, three-piece composite fishhooks made up 63 percent of the sample, whereas the bentwood







	3 piece composite	2 piece composite	bentwood	b.w. preform	indeterminate
Excavations	54	1	21	4	6
Schostak collection	6	1	21		1
Riedel collection			1		
	6	2	43	4	7

total sample: 116

Figure 74. Total fishhook sample from local collectors and the 1977 excavations.

fishhooks and preforms represented only 29 percent. The two-piece composite fishhook subtype constituted 1 percent of the fishhook sample, and the remaining 7 percent consisted of indeterminates. The local collectors selectively gather artifacts from the erosional surface of the site, thus skewing the percentage relationships. Of the collectors' finds, the three-piece composites represent only 20 percent of the sample, whereas the bentwood fishhooks constitute a much higher percentage, 73 percent. The two-piece composite fishhook and the one indeterminate type each contribute only 1 percent of this sample. Thus, in the controlled excavations, three-piece composites outnumber the bentwood hooks by two to one, whereas the bentwoods outnumber the composite fishhooks in the collectors' sample by three to one.

The distribution of the wooden fishhooks in the site is partially due to secondary deposition. The materials were deposited in the water or directly on the beach within the intertidal zone and later were washed away by the tide to settle in an offshore locality. Because of this secondary and possibly tertiary deposition, the fishhooks appear to have a random distribution (Figure 75) except for a higher concentration of composite fishhooks in area C. The reason for this exception has not been determined, but this high concentration may suggest an emphasis on a particular species of fish during a particular period of deposition. Huelsbeck (see Analysis of fish remains, above) notes a higher frequencey of bone in association with these particular hooks.

Stratigraphically, area C has not been correlated with area B; the radiocarbon dates for both areas do, however, fall within the same time range (see Table 7). Fishhooks and other cultural materials from area B are found intermixed within the inclined water-saturated vegetal layers. Figure 76, which illustrates the vertical distribution of the fishhooks in the main portion of area B, demonstrates that distribution is not totally random. There appears to be a certain amount of sorting between the levels. For example, level AN includes bentwood fishhooks and levels AD/AE include preforms. This suggests a correlation between various activities and different depositional periods.

Breakage and Preservation

Both types of fishhooks demonstrate a clear difference in breakage patterns, both at the time of excavation and after. Just a few complete or near complete fishhooks are represented in the Hoko River cultural remains. From the total

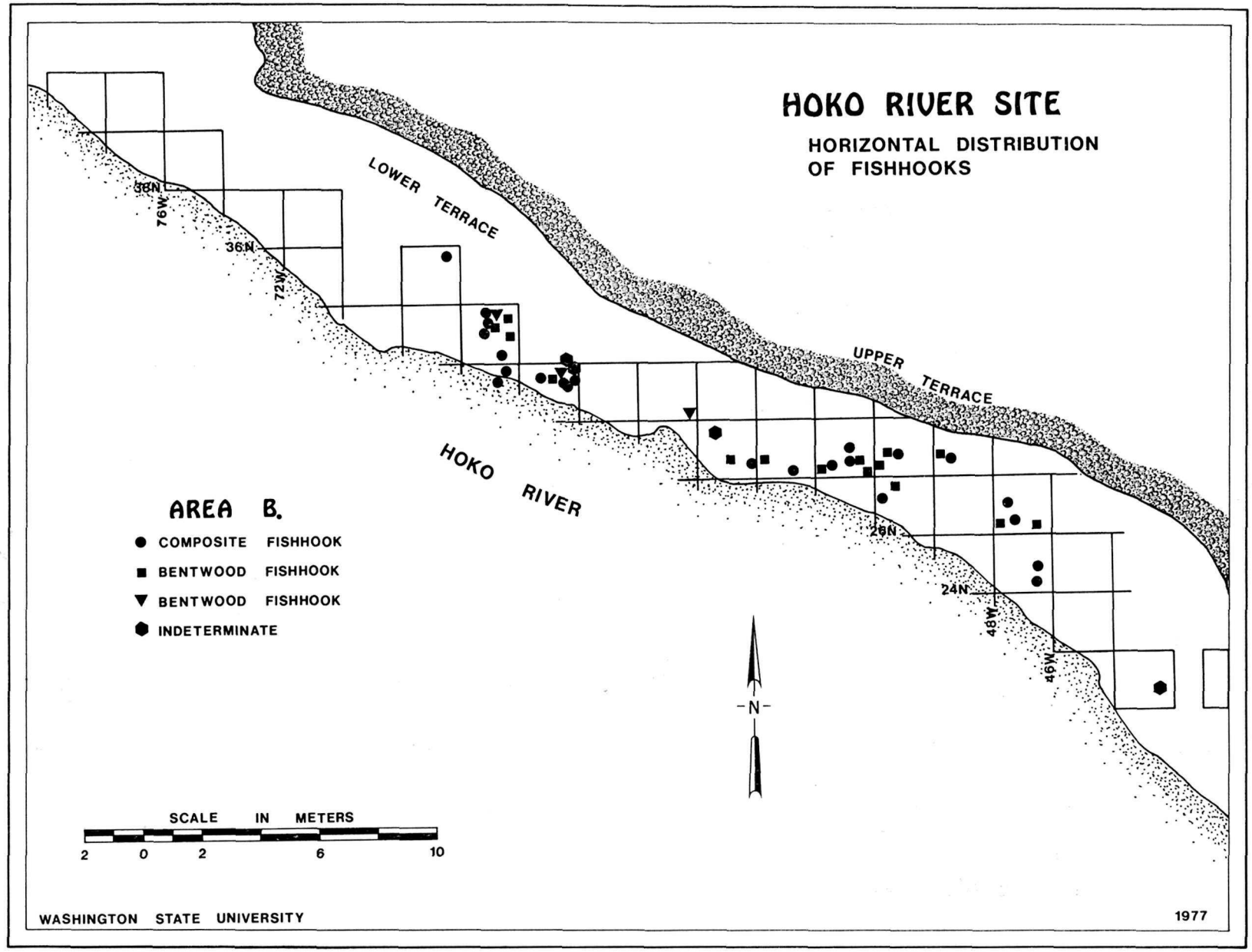


Figure 75. Fishhook distribution within the 1977 excavation areas.

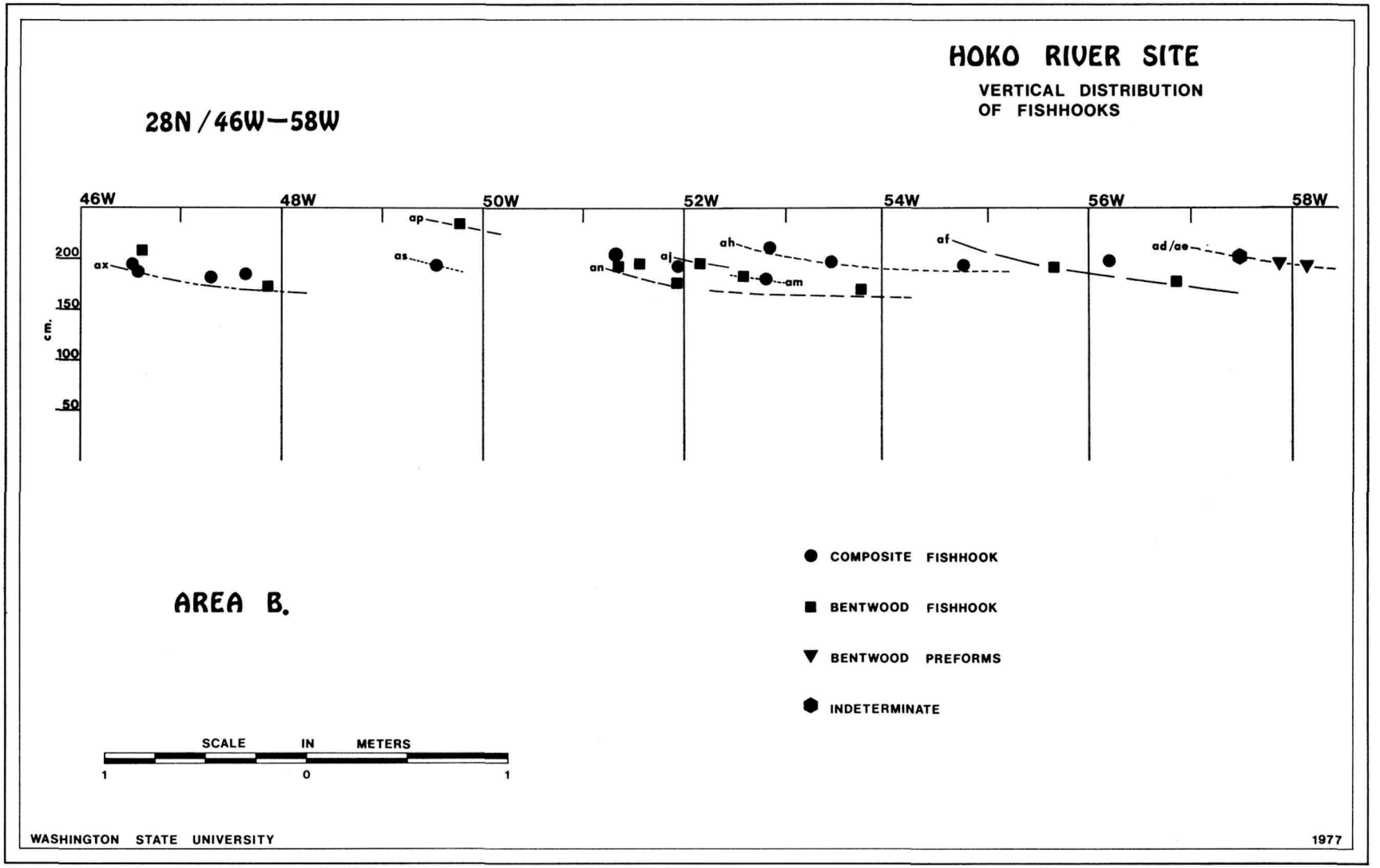


Figure 76. Vertical distribution of fishhooks within the A series strata.

sample of 43 bentwood fishhooks, only 21 (49 percent) are unbroken. It appears that most of the bentwood hooks were broken during use and then discarded or lost. Figure 77 illustrates the nature of the total sample of breaks found on the bentwood fishhooks; a few of the specimens had multiple breaks. The majority of fractures occur at the base of the knob, at the bend, and at the curve of the point. Logically, it would seem that a fish taking one of these hooks would tend to apply the most stress in these areas, particularly at the bend.

In contrast to the bentwood hooks, the 62 three-piece and two-piece composite fishhooks include only four hooks (6 percent) that are unbroken except for having complete bone barbs. The few barbs that have been recovered occur as fragmentary remains within the barb wrapping; no bone barbs or points that could possibly be barbs have been found at the site. This may be due to a preservation factor, or it is possible that the Hoko River people removed any salvageable barbs to be used on new hooks.

Even with the careful technique of using a fine mist spray for excavation, the very delicate composite fishhooks are sometimes unavoidably damaged. Possibly because of some postdepositional conditions, the structure of the wood used to make them has been altered and weakened, allowing the shanks to snap very easily.

Most of the breaks on the composite hooks are a characteristic postdepositional snap. This is a clean break without splintering. The composite fishhook breakage pattern (Figure 78), consequently, shows a skewed distribution. A break due to usage would more likely result in a splinter, most often at the base of the barb shank. The large number of postdepositional breaks is probably the result of stress due to the weight of the overburden or, if the hooks have been redeposited, to breakage during transport. That is, after a hook was initially deposited for a period of time, long enough for it to become structurally weakened, an erosional episode could have removed it, causing it to break, and dispersing the fragments, which would have been deposited farther downstream. This assumption of at least some tertiary deposition is supported by the data. Many of the fragments have the characteristic snap, but their matching pieces are missing.

A number of the composite shanks were made from some kind of hardwood, and the bentwood fishhooks appear to be made from a softwood (see Microscopic identification of plant materials, above). This results in the composite hooks being very fragile, while the bentwood hooks are more durable and easily handled. A few composite fishhook specimens share the durable features of the bentwood hooks, suggesting that they too are made from softwood.

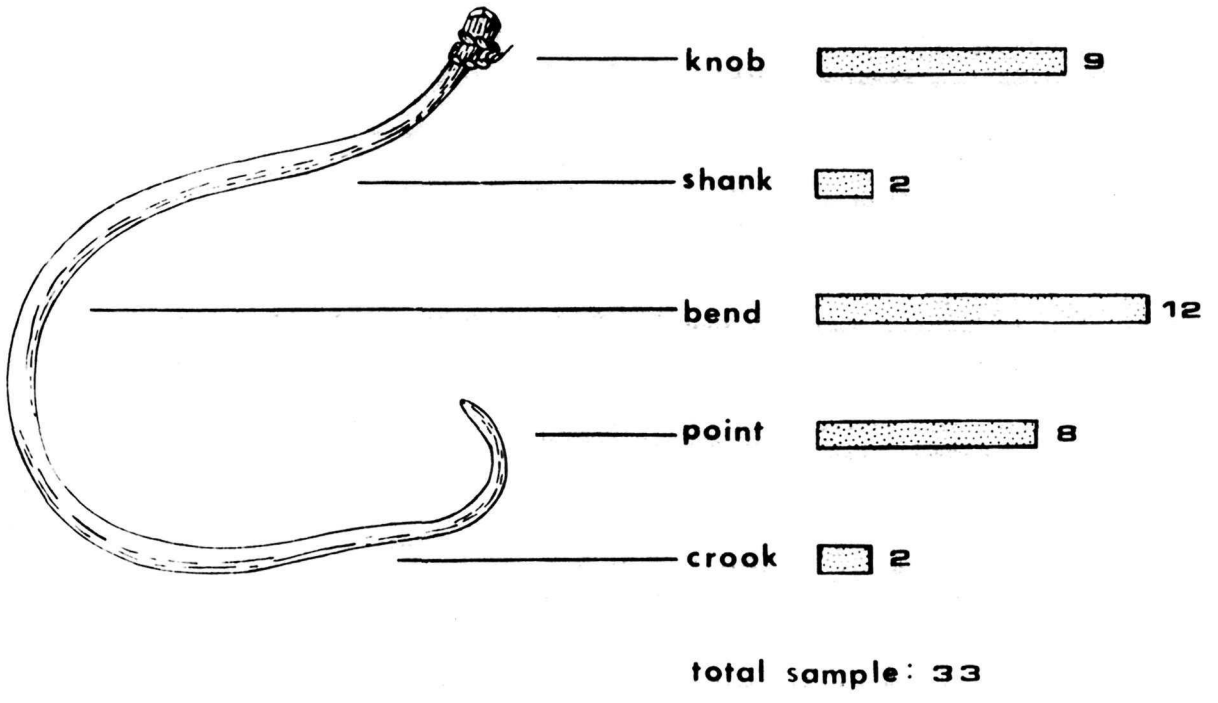


Figure 77. Bentwood fishhook breakage points.

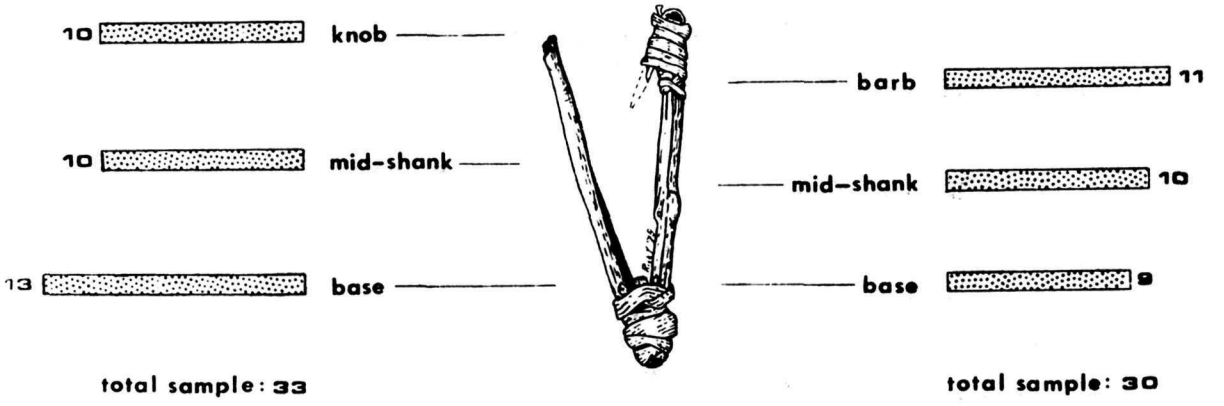


Figure 78. Composite fishhook breakage points.

There are a couple of other notable differences between the composite and bentwood fishhooks, or rather between the hardwood and softwood specimens. One is the preservation of color. Many of the softwood hooks, when first exposed have a very light, natural wood color. This original, or near original color is lost, however, within a few minutes upon exposure to air and light. In contrast, the hardwood composite fishhooks had already changed to a darker color before being uncovered by the archaeological excavations.

Another characteristic of the wood types is their reaction to being air-dried without following proper conservation methods. The composite fishhooks made from hardwood tend to undergo extensive deformation when allowed to dry. That is, the structure of the wood seems to collapse and wither up much like dried fruit. This was observed on specimens in the Scholstack collection where the only method of preservation was to soak the hooks in a water/white glue solution. The softwood hooks preserved their original shape much better when treated in the same way, but there were still some problems with checking.

Proposed future research

Over a hundred wooden fishhooks were recovered from the Hoko River archaeological site during the 1977 excavations, demonstrating a specific utilization of the aquatic environment. This paper has presented a discussion of the construction methods of the different fishhook forms recovered. An experimental design will be established to make replicated copies of the bentwood and three-piece and two-piece composite fishhooks, and then an attempt will be made to actually fish with them in the vicinity of the Hoko River. In addition, it will be important for understanding the proper function of these fishhooks to test other elements of the fishing technology, such as the line floats, line weights, and spruce-root leaders. Since no fishing line remains were found in the site, kelp line may have been employed. Therefore, this project will include studies of how to properly prepare and use kelp line.

These replication experiments are expected to yield detailed information on the construction techniques involved in making the various classes of hooks recovered at Hoko. A second area of study will concern the techniques by which these hooks were actually used in fishing. A third area of study will involve several questions about the effectiveness of the hooks: What kinds of fish can be caught with the hooks? Were the different hook types intended to catch different species? How does a fish take one of these hooks? How do the hooks function in the water? Regarding the last question, it is known from ethnographic data that some of the bentwood hooks used for halibut fishing on the Northwest

Coast were made from hemlock knot wood which sinks. Did the Hoko hooks have to sink in order to work properly? The final step in the replication experiments will consist of a comparison between the modern catch and the archaeological remains of the prehistoric catch. This will involve questions of relative proportions of fish species and of the location of various fish habitats in relation to the Hoko River mouth.

The result of these experiments will be a more complete understanding of one aspect of the subsistence patterns at Hoko River 2,500 years ago. Information about the technological and cultural attributes of these fishhooks will create a greater appreciation for the ways of the "old-time fishermen" and increase our knowledge about the role of this fishing complex in the development of the Northwest Coast cultures.

BASKETRY ARTIFACTS

by Dale R. Croes

Basketry, including baskets, mats, hats, and shredded bark clothing, is common and well-preserved at the Hoko River site. These are complex artifacts with several diagnostic characteristics (modes) that were combined into different basketry forms (types). This study examines the numerous materials, techniques, shapes, and forms used at Hoko River and compares them with those used at other Northwest Coast wet sites. Since basketry is complex, it is ideal for comparative studies, often revealing degrees of stylistic similarity between sites through time and across space. This information is particularly useful in constructing hypotheses about cultural interrelationships between sites, since distinctive basketry techniques and styles of a group undoubtedly are passed on from one generation to the next, changing but retaining a degree of similarity in one area that is measurably different from basketry styles and techniques developed in other areas. In addition to this test of the similarities in basketry between Hoko River and all other Northwest Coast wet sites, the functional interpretation of the basketry objects from Hoko River is considered here, and an attempt is made to delineate the role of these artifacts in the activities of the prehistoric Hoko River people.

Basketry Construction Materials

Hoko River basketry is constructed from split inner bark, conifer roots and boughs, and whole rush stems. The exact identification of the plant species used is being accomplished through microanalysis of cell structure (see Microscopic analysis of artifactual plant materials, above). From ethnographic data and macrofeatures, preliminary and tentative identifications can be suggested.

Inner cedar bark (Thuja plicata n=34, 41 percent) is a common material at Hoko River for basketry bags, matting, and twined hats, and it is shredded to form skirts or capes. Cedar trees are not common in the Hoko River vicinity presently and may not have been common prehistorically (see Flora and Macroflora analysis, above), necessitating collection upriver at higher elevations. (For more information concerning the gathering and preparation of this material and those considered below see Basketry waste materials, below; Croes 1977:21-25; Boas 1909:371-372, 1913:120-134.)

Splint basketry material of split cedar boughs and/or roots is also common at Hoko River (n=33, 40 percent). Sturdy burden baskets from the site are constructed with splints, and one hat is constructed of thinly split root materials. A few baskets from Hoko also are constructed with a combination of splint materials and cedar bark (n=4, 4 percent). The splints are the support material, and cedar bark is used as a secondary weft element.

Tule stems (?) (n=13, 16 percent) were used to make sewn mats. The stems are placed one next to the other and sewn through their centers with a two-strand spruce rootlet string.

Construction Techniques

Several different basketry construction techniques are recorded from Hoko River (Figure 79). These techniques have been divided into four main categories: plaiting, twining, wrapping, and piercing techniques (for detailed definitions of these terms and weave techniques see Croes 1977:49-64).

Plaiting

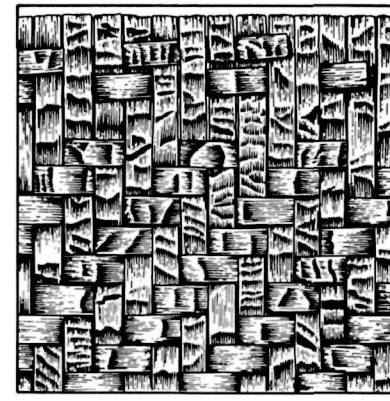
Checker.--This simple one-over-one-under plaiting technique occurs as cedar bark matting fragments (n=6) and as the body weave technique on two cedar splint baskets.

PLAITING

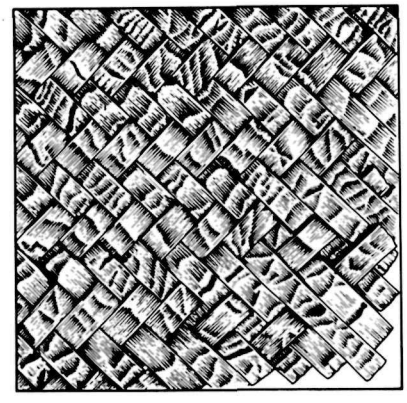
Checker



Twill

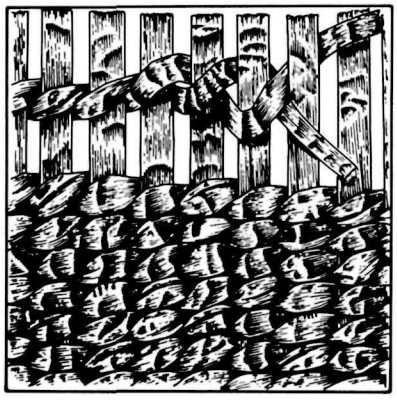


Twill on Bias



TWINING

Plain Twining



Open Twining

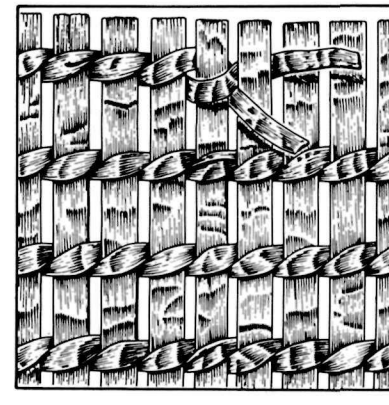
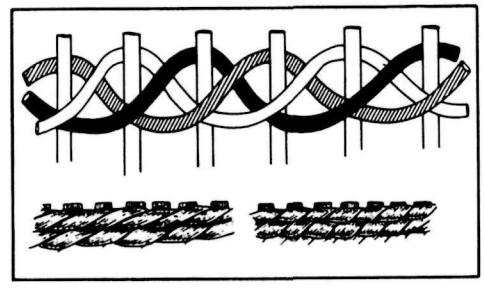


Figure 79. Hoko River basketry construction techniques.

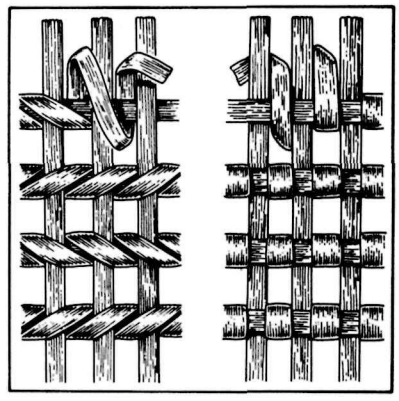
TWINING (cont.)

3 Strand Twining

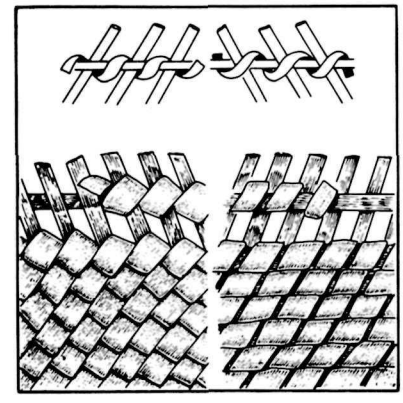


WRAPPING

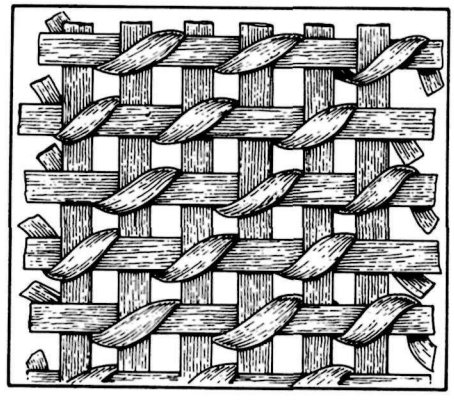
Open Wrapping



Wrapped Twining



Wrap Around Plaiting



PIERCING

Sewn Stem

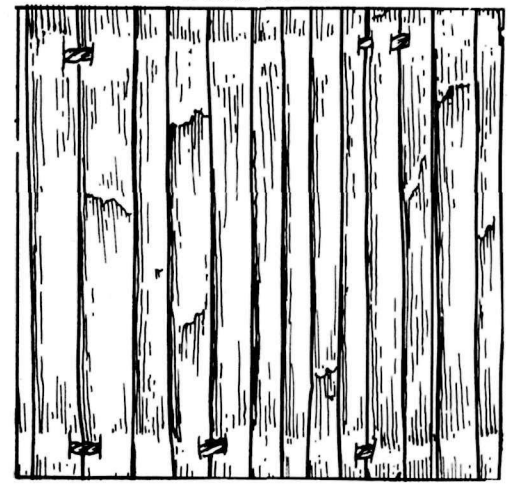


Figure 79-continued. Hoko basketry construction techniques.

Twill.-- A form of twill is recorded forming the start of splint bough/root burden baskets (Figure 80). This base technique is anchored and developed using a spiraling wrap twining technique (below).

Twill on Bias.--This technique is recorded on four cedar-bark bands, and though the ends are fragmented, these bands originally may have been belts or tumplines for carrying baskets.

Twining

Plain Twining.--Four cedar-bark basket bodies, three hats (two cedar bark and one split root), one spiral basket base, one flat bag base, and two basketry fragments are recorded with plain twined weave. This provides a strong, flexible weave, appropriate for bags and hats (Figure 81).

Open twining.--One example of this technique is recorded on an open-work shredded cedar bark artifact which is loosely open twined and may be a bag or skirt/cape fragment.

Three-strand Twining.--One basket bag is recorded with a single row of three-strand twining along its base.

Wrapping

Open wrapping.--By far the most common single technique, open wrapping is the major body weave for splint burden baskets (Figures 82,83). It is a distinctive wrapping technique because the lean of the wrap alternates between rows. This is a common burden basket body weave at Hoko River and Ozette Village and, historically, in this south-central region of the Northwest Coast. The weave is particularly typical of Wakashans and adjacent groups. Evidently it has at least 2750 years of continuity in this region, but it is not recorded as a burden basket weave at sites contemporary to Hoko River in the Puget Sound/Gulf of Georgia region (i.e., Biederbost, English Camp, and Musqueam Northeast; Croes 1977:78, 404-405).

Wrapped Twining.--One small cone-shaped basket is constructed with wrapped twining. This small bag is made with split root materials. Other examples of this technique (n=7) occur on burden basket bases. This technique is spiraled around the twill base, forming a small, strong center before the open-wrapped body weave begins. Wrapped twining historically is restricted to Nootkan and adjacent groups on the Northwest Coast (Jones 1976).

Wrap-Around-Plaiting.--This technique is a combination of rigid checker plaiting with a more flexible wrapping element binding the weave. It is similar to open twining except

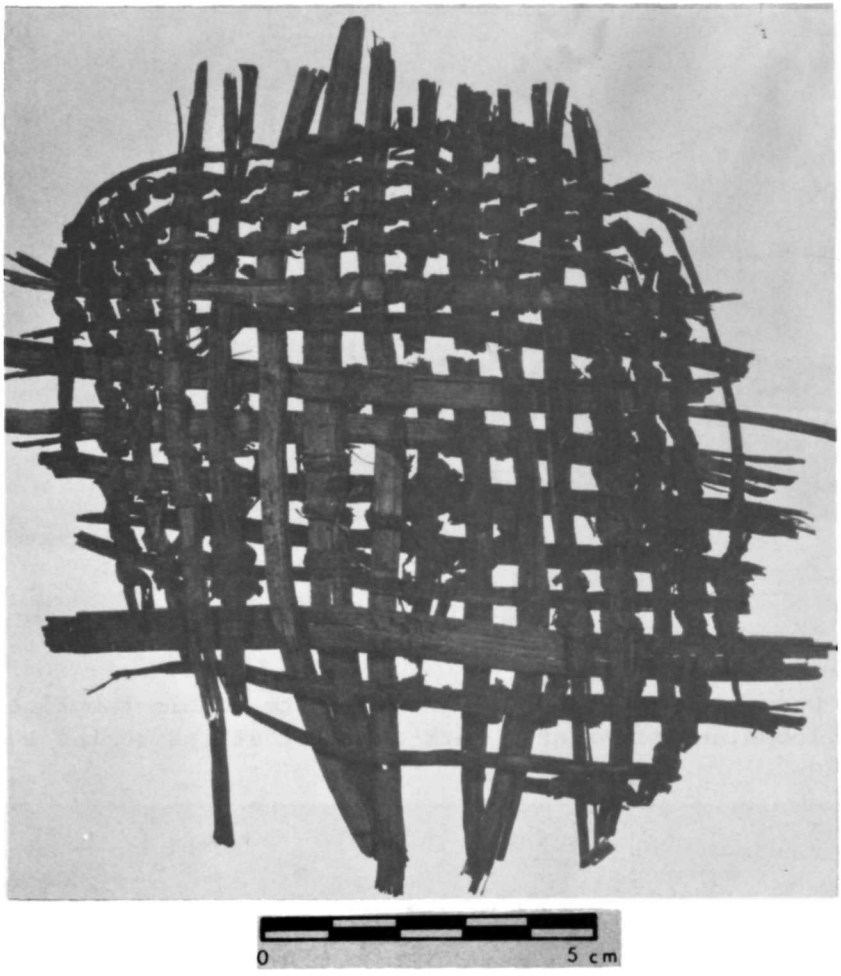


Figure 80. Example of twill plaiting forming a burden basket base. Note wrap twining as the binding and transition technique between base and open-wrap body.

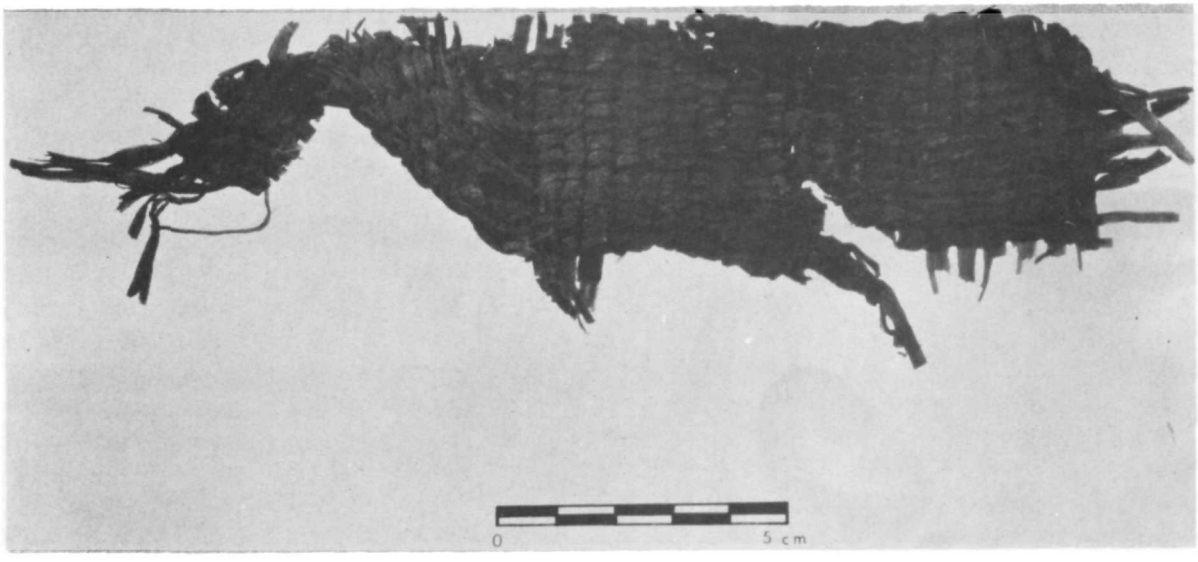


Figure 81. Example of a plain twined, split root, basketry fragment.

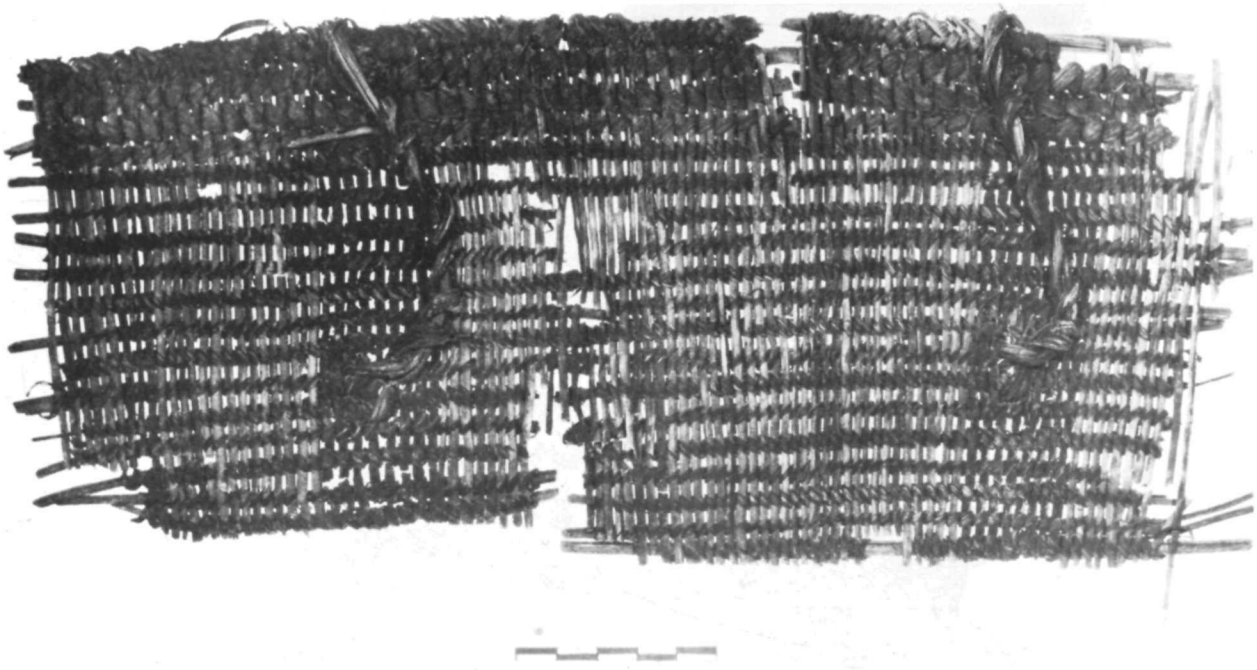


Figure 82. Open-wrapped basket fragment. Note double tumpline loops and ornamental dark contrast strips behind tumpline.

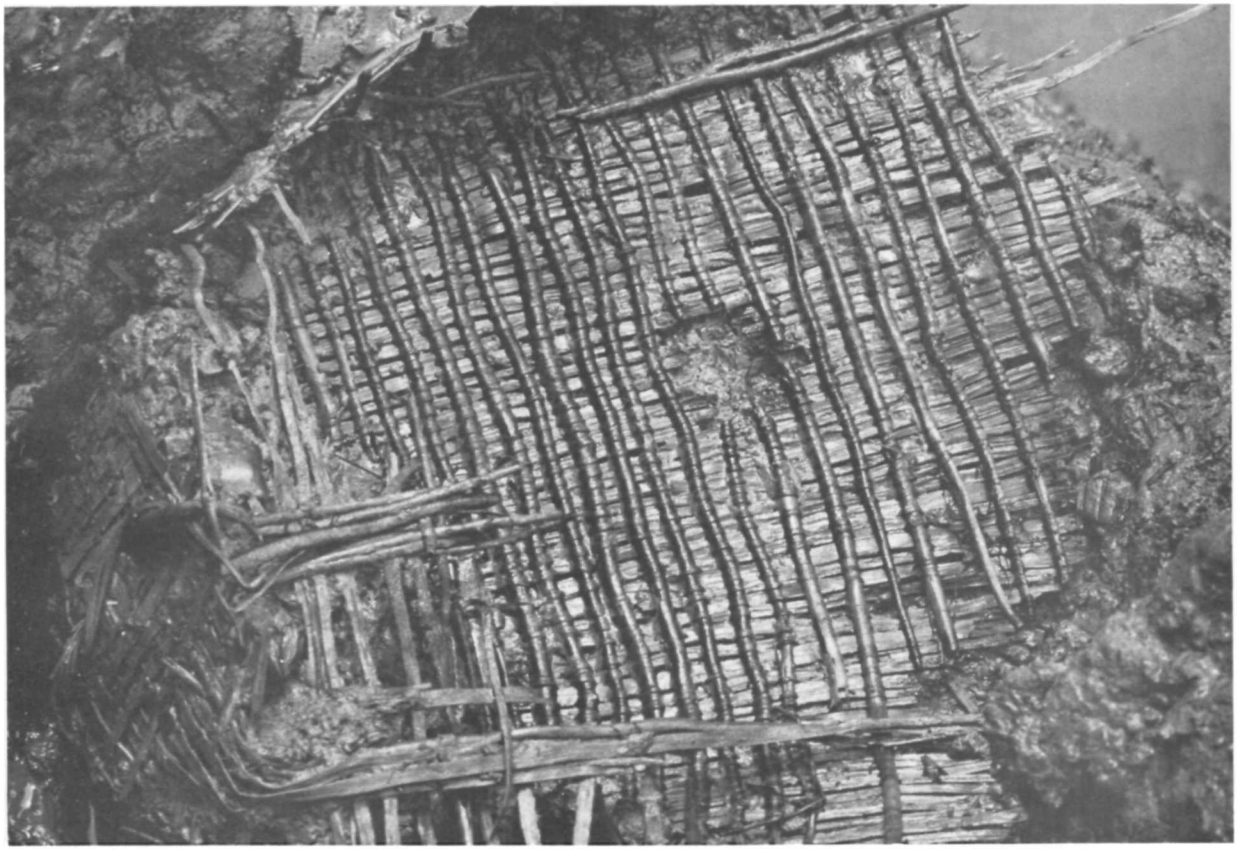


Figure 83. Inside surface of an open-wrapped burden basket with base preserved (left).

that only one weft element is flexible. Because of the wrapping characteristic, it is considered a wrap technique here. The wrapping element is advanced one warp element in each row, creating a diagonal appearance to the surface. Apparently this helps to stabilize rows and also gives a decorative appearance to the basket surface. Two examples are recorded as basket bodies. This technique is recorded in greatest frequency at the Musqueam Northeast site, where it is by far the dominant burden basket technique (Croes 1977:77-78).

Piercing (Sewn)

Five examples of sewn "tule" mat fragments are recorded from Hoko River. The stems are sewn together with twisted two-strand spruce root strings. The only other wet site where sewn tule mats are preserved is Ozette Village. However this technique was widespread ethnographically throughout the south-central and interior Northwest region. The examples from Hoko River give considerable time depth to the use of sewn tule matting on the coast (see discussion below).

Gauge of Weave

The range, mean, and standard deviation of Hoko River plaiting, twining, wrapping, and piercing techniques are recorded in Figure 84. As can be seen, plaiting and twining techniques have a wide range of gauge variation. One example of very fine twining (14 stitches/2.5 cm) is recorded on a basketry bag fragment. Wrapping and piercing techniques are much more concentrated in gauge distributions. The examples of open wrapping with 10 stitches per 2.5 cm have the finest gauge of this technique recorded from a Northwest Coast wet site. The piercing techniques range between 2 and 3 stitches per 2.5 cm, and this probably reflects either the natural or selected diameter of tules used.

Selvage Techniques

The basketry from Hoko includes several techniques for finishing basket rims and mat edges (Figure 85; for detailed definitions of each selvage technique see Croes 1977:125-131). The cut-off (n=1) and turned-in (n=3) techniques are recorded on cedar-bark basket rims. Mock-braid rims (n=12) are the most common basket rims recorded and are typically found finishing splint burden baskets, though some cedar-bark baskets (n=4) also have this rim. Besides plain

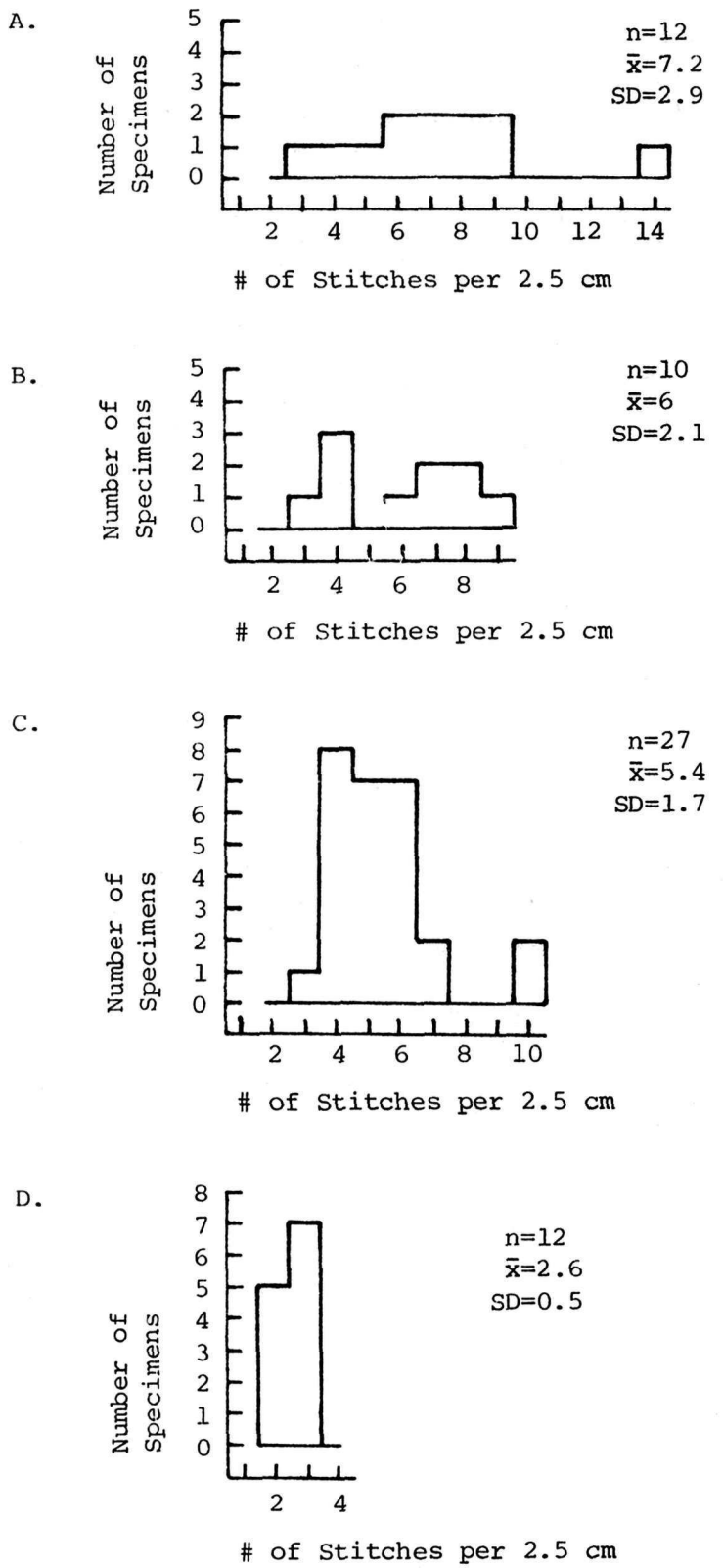
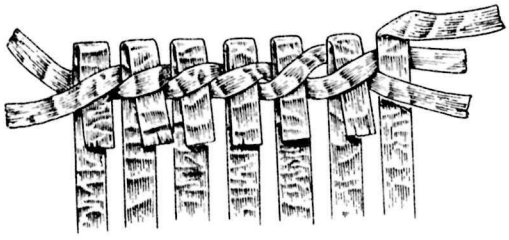
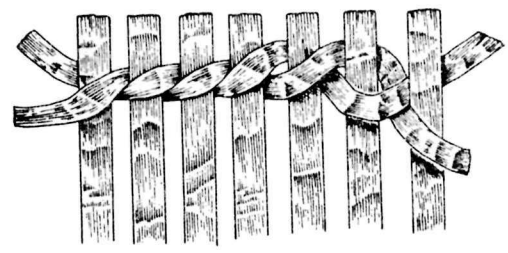


Figure 84. Gauges of weave of Hoko River basketry construction techniques.

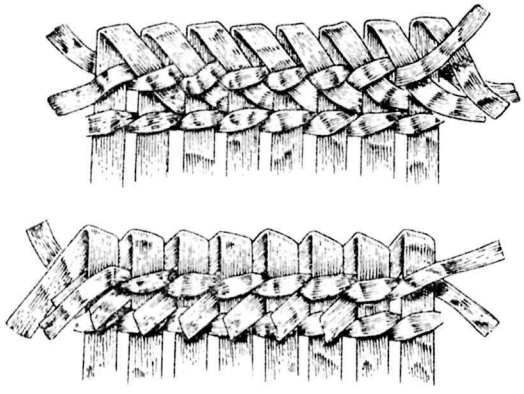
CUT OFF



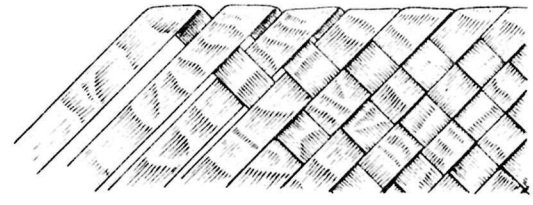
BENT DOWN



TURNED IN



BENT BACK



MOCK BRAID

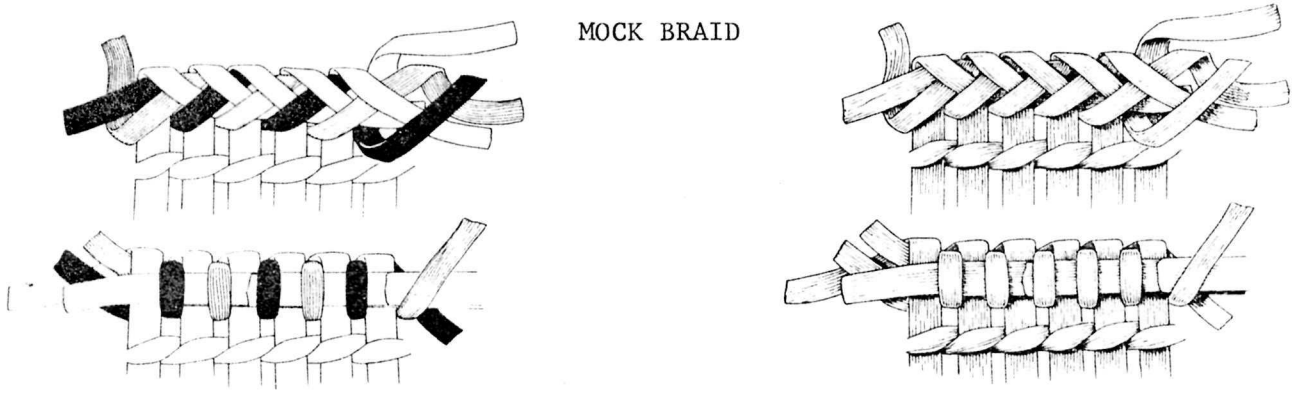
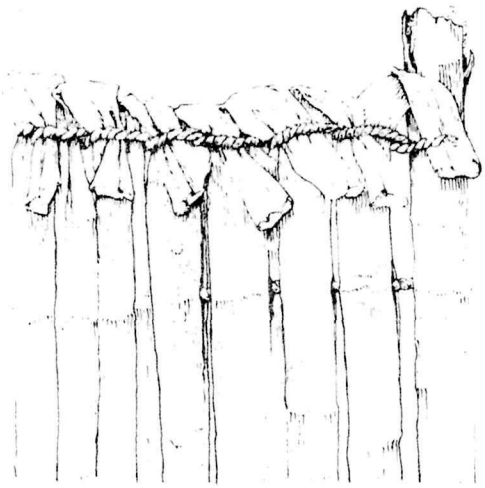
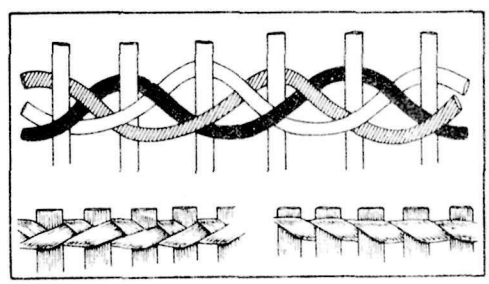


Figure 85. Hoko River basketry selvage techniques.

TURN-TO-SIDE AND TWINED



3 STRAND BRAID



DOUBLE WRAP RIM REINFORCEMENT

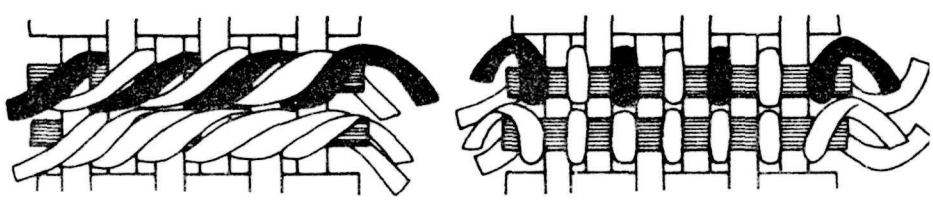


Figure 85-continued. Hoko River basketry selvage techniques.

mock-braid rims, two varieties of this finish are recorded: one has two to three rows of double wrapping directly below the rim (n=5; Figures 85,86), and the other has two rows of three-strand braid (n=3; Figure 85). These transition techniques between body weave and rim finish may be decorative, but they probably also served in a strengthening capacity.

Bent-back edges are found on narrow cedar-bark bands with twill-on-bias weave. This creates a smooth flat edge, typical of braiding techniques. These bands may have functioned as belts or tumplines.

Bent-down edges are recorded on shredded cedar-bark "skirts" (n=7). In this technique the ends are folded down over a two-strand spruce root string and then twined into place. This creates a sturdy, flexible edge.

Turn-to-side and twined edges are found on selvages of sewn "tule" mats (n=13). In this technique a considerable length of the end is folded down and twined alongside the adjacent warp. This technique of finishing edges of tule mats also is observed on historic examples.

Attachments on Basketry Items

Some Hoko River burden baskets have attachments such as cordage lines tied to their bases (n=2, Figure 87) and tumpline loops along the rims (Figures 82,86). The cordage lines tied to burden basket bases probably are for attaching carrying straps to aid in balancing and holding a load.

The vertical cordage tumpline loops occur on the rim of one burden basket (Figures 82,86). Two loops are attached, probably at corners, and these undoubtedly were used to guide the carrying strap around the basket. Ozette Village is the only other wet site to have produced basketry with vertically attached tumpline loops, but ethnographically these loops are common on burden baskets of the region.

Basketry Shapes

The shapes of basketry items are often diagnostic of functional characteristics. Basket, hat, and mat shapes from Hoko River will be considered.

Baskets

Four basket shapes are recorded from the site (Figure 88; see Croes 1977:34-35 for detailed definitions): flat rectangular, trapezoid, inverted cone bags, and the subrec-

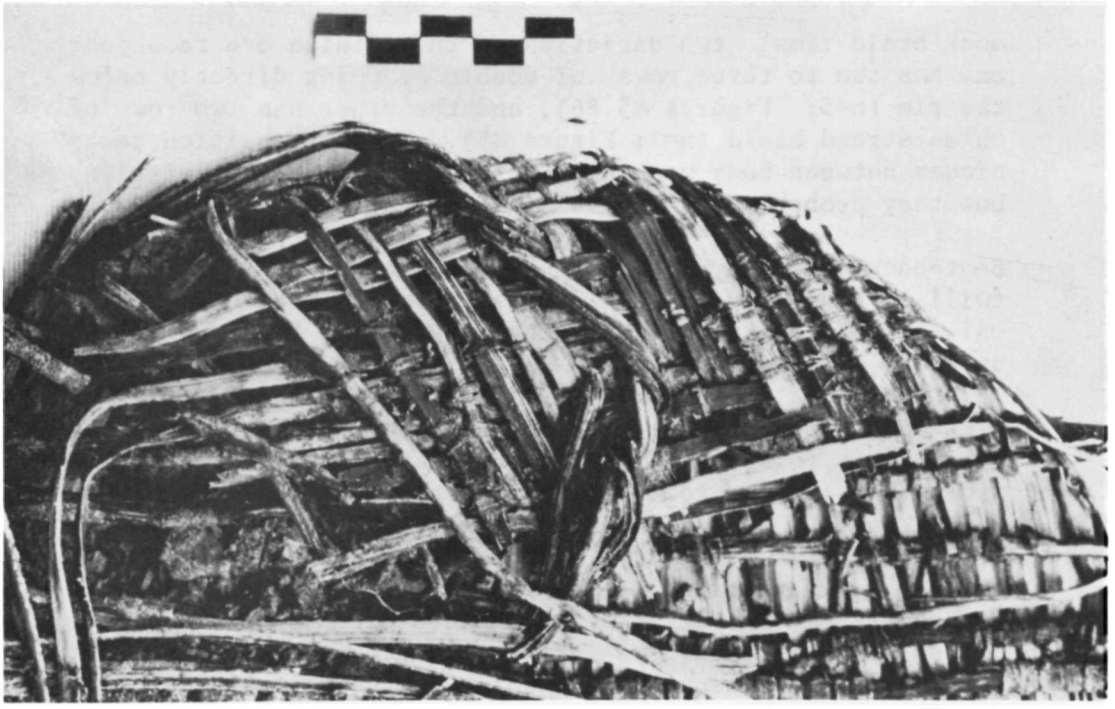


Figure 86. Open-wrap burden basket edge; mock-braid rim technique with two rows of double wrap. Two-strand cordage tumpline loop is attached to edge.

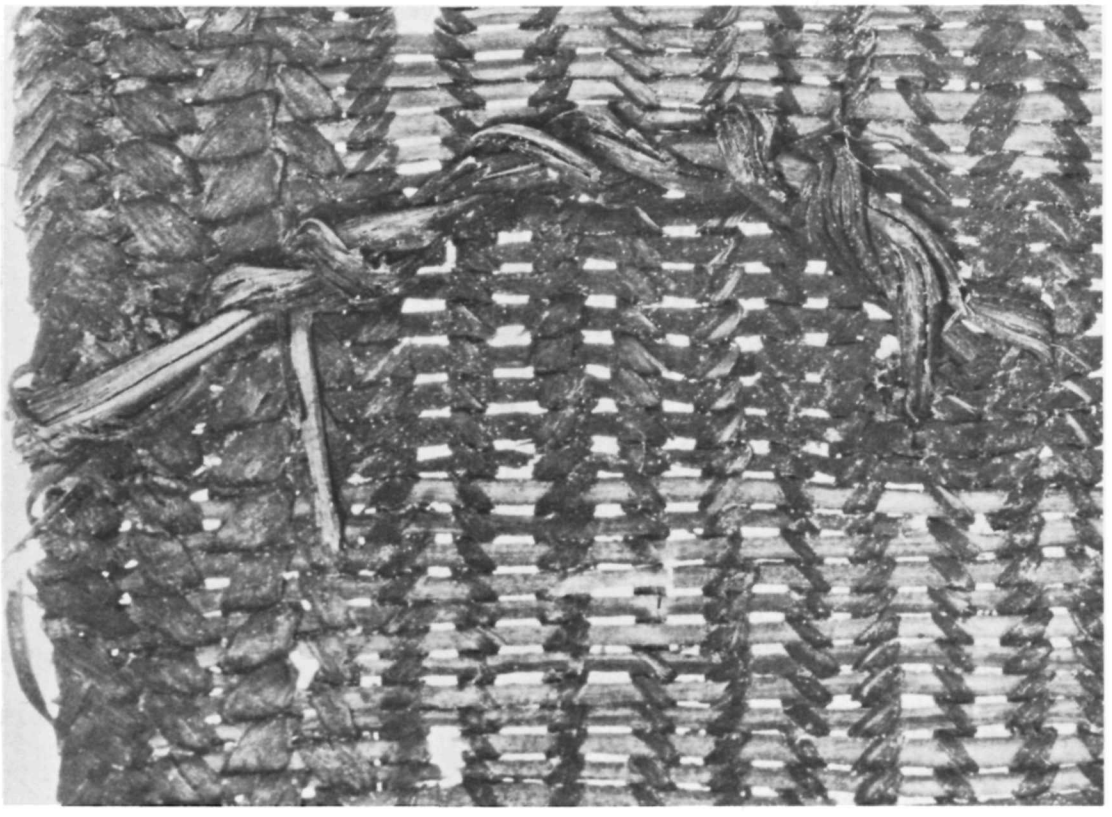


Figure 87. Rope loop attached to the base of a burden basket.

I. Baskets



Flat Rectangle



Flat Trapezoid

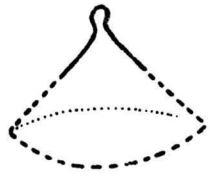


Sub-rectangular, Inverted, Truncated Cone

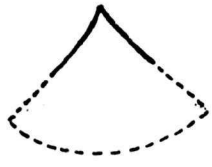


Inverted (Truncated) Cone

II. Hats

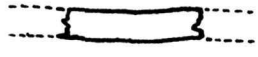


"Small" Knob-top Cone



"Pointed" Cone

III. Mats



Band

Figure 88. Hoko River basketry shapes.

tangular inverted (truncated) cone shaped burden baskets which are the most common form. These latter baskets have a narrow squarish base and rounded corners. This shape would distribute the weight higher on the back of the carrier, since the basket expands from bottom to top. This general shape is characteristic of historic burden baskets in this area of the Northwest Coast as well.

Hats

Two hat shapes are recorded (Figure 88): "small" knob-top cones (n=2) and "pointed" cones (n=1). The knob-top hats stylistically are intriguing since this form is also common at Ozette Village (though the knobs there are larger) and is considered symbolic of high status for the owners (Croes 1977:417-427). Some symbolic meaning may also have been associated with the Hoko River knob-top hats (see discussion below).

Mats

No complete mats were recovered so that it is not possible to identify actual shapes. However, four narrow cedar-bark bands are recorded with incomplete ends (below). These may be remnants of belts or tumplines.

Comparison of Hoko River Basketry Modes

The discussed basketry materials, techniques, and shapes can now be compared with those recovered from other Northwest Coast wet sites. These comparisons measure the degree of similarity of basketry modes occurring among different sites and potentially reflect cultural relationships between sites through time and across space.

With the addition of new basketry modes recovered during the 1977 summer field season, it was possible to update the presence/absence chart which appeared in Croes (1977:192-194). This updated chart appears as Table 21. These data were introduced into a computer program provided by R. G. Matson using an average linkage cluster analysis on a matrix of Jaccard coefficient, a dendrogram was produced which illustrates the degree of similarity among the eight major Northwest Coast wet sites (Figure 89). The test illustrates a closer degree of similarity between Hoko River and Ozette Village than did the test which was run before the 1977 data were obtained. These data add to the previous hypothesis that a form of techno-cultural continuity exists between Hoko River and Ozette Village and suggest some form of cultural continuity in this south-central coast region

Table 21

Occurrence of basketry modes (attributes) recorded at Northwest Coast wet sites[1]

Attributes	Occurrences							
	Ozette Village	Hoko River	Axeti	Lachane	Musqueam Northeast	Biederbost	Conway	Fishtown
Basket base construction techniques								
Checker	+	+	+	+	-	-	+	-
Twill 2/2	+	+	-	-	+	+	+	+
Twill 3/3	-	-	-	-	+	+	-	-
Spiral based plain twining	+	+	-	-	-	-	-	-
1-row plain twining	+	+	-	-	-	-	-	-
1-row three-strand twining	+	-	-	-	-	-	-	-
Open wrapping	+	-	+	-	-	-	-	-
Wrap twining	-	+	-	-	-	-	-	-
Coiling (spiral and meander based)	+	-	-	-	-	-	-	-
Basket body construction techniques								
Checker	+	+	+	+	+	+	+	-
Twill 2/2	+	-	-	+	+	-	+	+
Checker IIA	+	-	-	-	-	-	-	-
Checker IIB	+	-	+	+	-	-	-	-
Checker II plaid	+	-	-	-	-	-	-	-
Twill on bias (2/2 and 2/1/1)	+	-	-	-	-	-	-	-
Cross-warp plaiting	-	-	+	-	-	-	-	-
Plain twining	+	+	-	+	-	-	-	-
Open twining	+	-	-	+	+	+	+	+
Diagonal twining	-	-	-	-	+[2]	-	-	-
Cross-warp twining	+	-	-	-	-	-	-	-
Alternate plain twining/checker (and/checker II in two's)	+	-	-	-	-	-	-	-
Alternate open twining/cross-warp twining	-	-	-	+	-	-	-	-
Open two-rows twining	-	-	-	+	-	-	-	-
Wrap twining	-	+	-	-	-	-	-	-
Open wrapping	+	+	+	-	-	-	-	-
Wrap-around plaiting	-	+	-	-	+	-	-	-
Unidirectional open wrapping	-	-	-	-	+[3]	-	-	-
Coiling	+	-	-	-	-	-	-	-
Basket body reinforcement techniques								
Single-wrap reinforcement	-	-	-	-	+	+	-	-
Double-wrap reinforcement	-	-	-	-	+	+	-	-

Table 21 (continued)

Attributes	Occurrences							
	Ozette Village	Hoko River	Axeti	Lachane	Musqueam Northeast	Biederbost	Conway	Fishtown
Hat construction techniques								
Plain twining	+	+	-	-	-	-	-	-
Ozette combination #2	+	-	+	-	-	-	-	-
Ozette combination #3	+	-	-	-	-	-	-	-
Ozette combination #4	+	-	-	-	-	-	-	-
Ozette combination #5	+	-	-	-	-	-	-	-
Axeti combination #1	-	-	+	-	-	-	-	-
Mat construction techniques								
Checker	+	-	+	+	-	-	-	-
Twill 2/2	+	-	-	-	-	-	-	-
Checker on bias	+	-	-	-	-	-	-	-
Twill on bias	+	-	-	-	-	-	-	-
Construction techniques recorded on basketry fragments								
Checker	+	+	+	+	+	+	+	+
Twill 2/2	+	-	+	-	+	-	+	+
Twill 3/3	+	-	-	-	-	-	-	-
Checker IIA	+	-	-	-	-	-	-	-
Checker IIB	+	-	-	-	-	-	-	-
Checker IIC	+	-	-	-	-	-	-	-
Checker II plaid	+	-	-	-	-	-	-	-
Checker on bias	+	-	+	-	-	-	-	-
Cross-warp plaiting	-	-	+	-	-	-	-	-
Plain twining	+	+	-	-	+	-	-	+
Open twining	+	+	-	+	+	-	+	+
Diagonal twining	-	-	-	-	+	-	-	-
Cross-warp twining	+	-	-	-	-	-	-	-
Open two-rows twining	+	-	-	-	-	-	-	-
Alternate plain twining/checker	+	-	-	-	-	-	-	-
Open wrapping	+	+	-	-	-	-	-	-
Wrap twining	+	+	-	-	-	-	-	-
Unidirectional open wrapping	-	-	-	-	+	-	-	-
Wrap-around plaiting	-	+	-	-	+	-	-	-
Coiling	+	-	-	-	-	-	-	+
Twill on bias	+	+	-	-	-	-	-	-
Sewn	+	+	-	-	-	-	-	-

Table 21 (continued)

Attributes	Occurrences							
	Ozette Village	Hoko River	Axeti	Lachane	Musqueam Northeast	Biederbost	Conway	Fishtown
Handle attachment techniques								
Continuous, one-strand attached, looped handles	+	-	-	-	-	-	-	-
Single handles in a staggered series around rim	-	-	-	-	+	+	-	-
Single handles attached to body reinforcement rows	-	-	-	-	-	+	-	-
Single (opposing) handles	+	-	-	-	+	+	+	+
Continuous, two-strands attached, looped handles	+	-	-	-	-	-	-	-
Across-the-mouth braid handles	+	-	-	-	-	-	-	-
Double looped (opposing) handles	+	-	-	-	-	-	+	+
Single handles attached on weft rows below rim	-	-	-	-	-	-	-	-
Tumpline loops	+	+	-	-	-	-	-	-
Basket rim construction techniques								
Mock braid	+	+	-	-	+	+	-	-
Double mock braid	-	-	-	-	+	-	-	-
Criss-cross /braid/mock braid	-	-	-	-	-	+	-	-
Criss-cross braid	-	-	-	-	-	+	-	-
Single-strand wrap	-	-	-	-	+	-	-	-
Tuck and wrap (B)	-	-	-	-	-	-	+	-
Looped	+	-	-	-	-	-	+	+
Top hitch	-	-	-	-	-	-	+	+
Turned in	+	+	+	+	-	-	-	+
Tuck and wrap	+	-	+	-	-	-	-	-
Cut off	+	-	-	+	-	-	-	-
Hitched	+	-	-	-	-	-	-	-
Tuck and wrap covered with coiling	+	-	+	-	-	-	-	-
Bent down	+	-	-	+	-	-	-	-
Coiled	+	-	-	-	-	-	-	-
Open braid	+	-	-	-	-	-	-	-

[1]Adapted from Croes (1977:192-194)
[2]Recorded on Musqueam Northeast Combination Body Weave C
[3]Recorded on Musqueam Northeast Combination Body Weave A

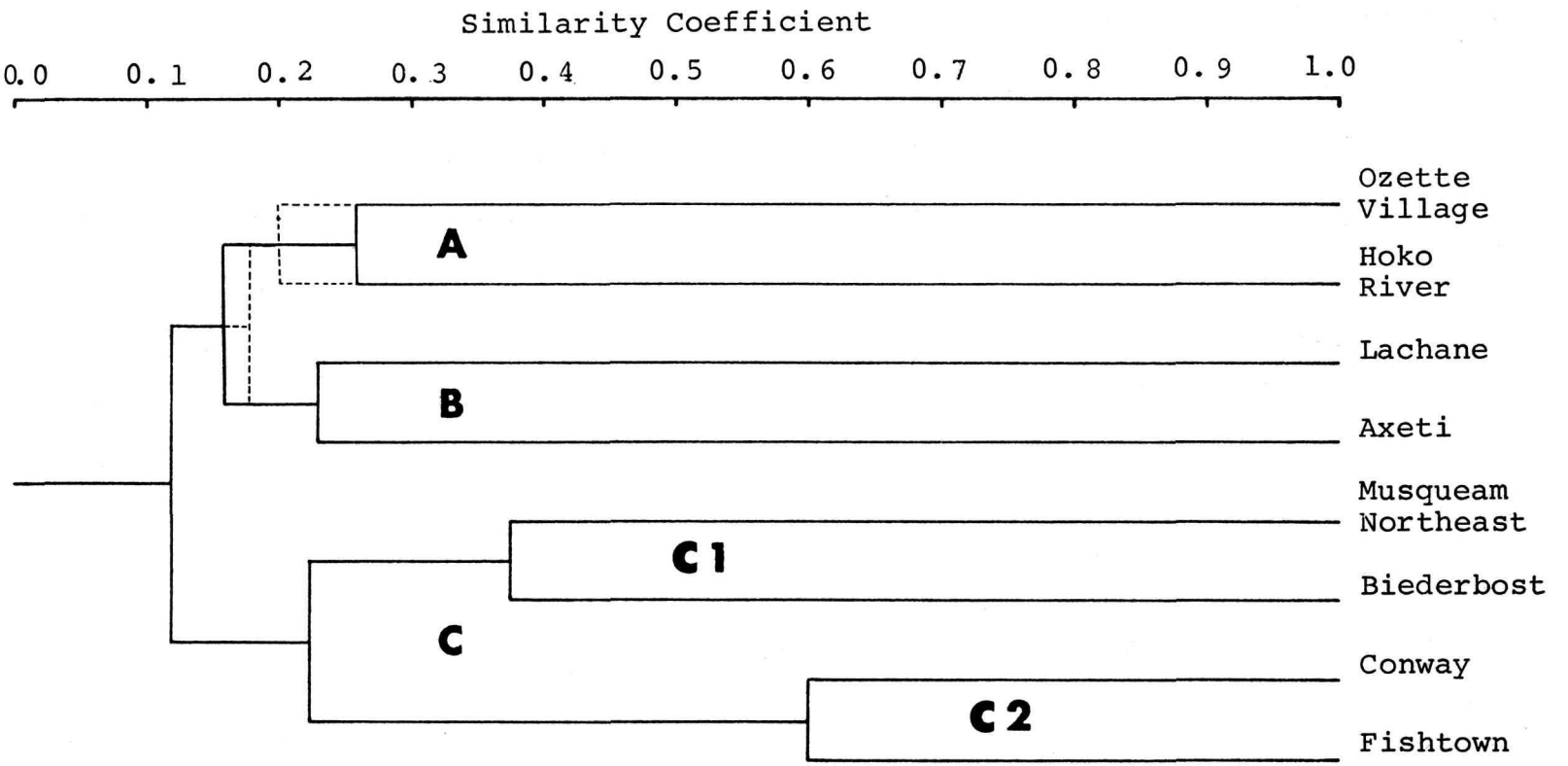


Figure 89. Dendrogram representing an average linkage cluster analysis of Northwest Coast wet site basketry modes on a matrix of Jaccard's coefficients. Degrees of similarity: 1 = complete similarity to 0 = no similarity. Dashed lines represent test results with previous data (Croes 1977:195).

(Croes 1977:191-198; see Figure 90). This is further discussed below with the consideration of basketry classes (types) from Hoko River.

Reconstructed Hoko River Basketry Classes

Whole basketry objects are infrequent at the Hoko River site. In order to reconstruct the original basketry classes, therefore, it was necessary to carefully consider all the basketry fragments as well as complete or almost complete examples. The construction materials and techniques of most fragmentary specimens were recorded; the more complete specimens provided important data concerning base and body construction techniques, shapes, sizes, ornamentation techniques, rim construction techniques, and basketry attachments. The data on the fragmentary specimens and those from the complete specimens have been used to formulate Stylistic/Technological (S/T) basketry classes (Figure 91). These S/T classes are paradigmatically defined by a combination of: (1) construction material, (2) shape, (3) base-construction techniques, (4) body-construction techniques, and (5) basketry attachments. This framework is similar to that used to define basketry classes from other Northwest Coast wet sites (Croes 1977), and it was chosen so that direct class to class comparison could be made. Each class may have examples included which are missing certain characteristics since they are fragmented; several dimensions may have "or ?" statements since some examples were more incomplete than others. Though missing some characteristics, these examples best fit into their assigned classes, and it is hypothesized that they probably had the suggested modes in these categories when they were complete. That is why these classes are considered "reconstructions" or an "averaging" of the data and their redundancies. Basketry fragments without enough data to reconstruct total shapes are included at the end of the classification as basketry fragments.

Since these reconstructed basketry classes represent the combination of specific basketry modes, the occurrence of similar basketry classes at sites other than Hoko River might reflect relationship or interaction through time and across space. The presence/absence tables of reconstructed basketry classes from Northwest Coast wet sites have been previously compared in an average linkage cluster analysis, on a matrix of Jaccard coefficient (Croes 1977:257). The recovery at Hoko in 1977 of an additional mat class (HO-M1) which also occurs at Ozette Village slightly modified the dendrogram (Figure 92). As would be expected, the chart now shows an even stronger relationship between the spatially

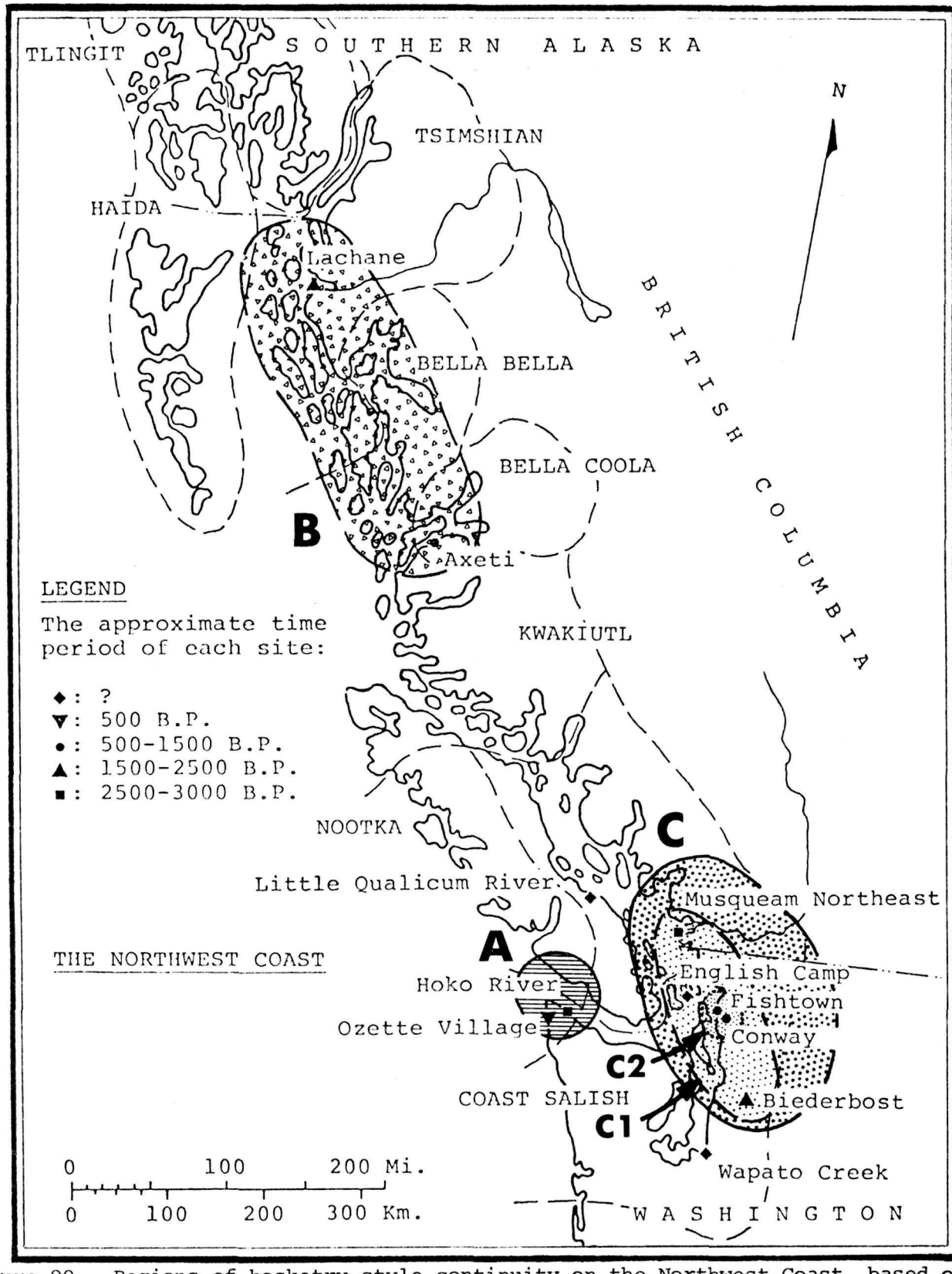


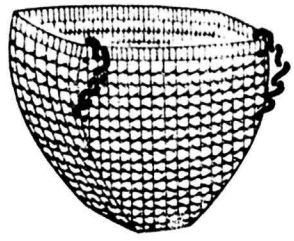
Figure 90. Regions of basketry style continuity on the Northwest Coast, based on average linkage cluster analysis. Region A, southcentral coast; Region B, northern coast; Region C, Puget Sound/Gulf of Georgia; subregion C1, sites dating 2000-3000 years B.P.; subregion C2, sites dating to about 1000 years B.P. (Reproduced from Croes 1977).

Definition

Illustrated Reconstruction and Frequency of Occurrence

A. BASKETS

HO-B1. MATERIAL: splints
SHAPE: inverted, sub-rectangular, truncated cone or ?
BASE CONSTRUCTION: wrap twining or ?
BODY CONSTRUCTION: open wrapping
EXTENSIONS: none or double tumpline loops



(n=25, 76%)

HO-B2. MATERIAL: cedar bark or splints
SHAPE: inverted, truncated cone
BASE CONSTRUCTION: spiral based twining
BODY CONSTRUCTION: plain twining
EXTENSIONS: none
(SIZE: small)



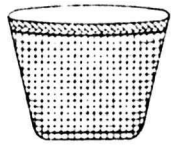
(n=3, 9%)

HO-B3. MATERIAL: splints (spruce root)
SHAPE: inverted, truncated cone
BASE CONSTRUCTION: wrap twining
BODY CONSTRUCTION: wrap twining
EXTENSIONS: none
(SIZE: small)



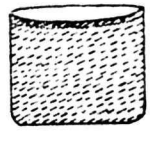
(n=1, 3%)

HO-B4. MATERIAL: cedar bark
SHAPE: flat trapezoid
BASE CONSTRUCTION: 1 row twining
BODY CONSTRUCTION: checker
EXTENSIONS: none
(SIZE: small)



(n=1, 3%)

HO-B5. MATERIAL: cedar bark (?)
SHAPE: flat rectangle
BASE CONSTRUCTION: 1 row twining
BODY CONSTRUCTION: plain twining
EXTENSIONS: none
(SIZE: small)



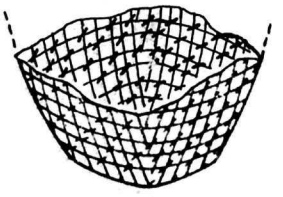
(n=1, 3%)

Figure 91. Reconstructions and frequencies of occurrence of Hoko River basketry stylistic/technological classes.

Definition

Illustrated Reconstruction and Frequency of Occurrence

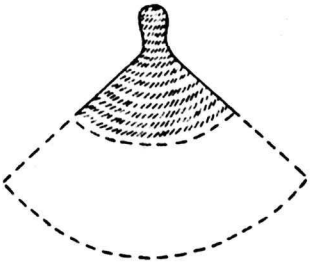
HO-B6. MATERIAL: splints (cedar)
SHAPE: inverted, sub-rectangular, truncated cone (?)
BASE CONSTRUCTION: twill
BODY CONSTRUCTION: wrap around plaiting
EXTENSIONS: ?



(n=2, 6%)

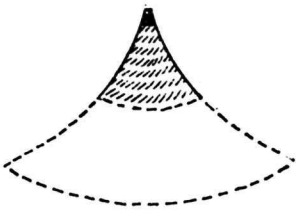
B. HATS

HO-H1. MATERIAL: cedar bark
SHAPE: small knob-top cone
BODY CONSTRUCTION: plain twining
INNER LAYER/HEADBAND: ?



(n=2)

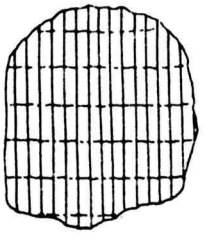
HO-H2. MATERIAL: splints (root)
SHAPE: pointed top cone
BODY CONSTRUCTION: plain twining
INNER LAYER/HEADBAND: ?



(n=1)

C. MATS

HO-M1. MATERIAL: tule (cattail ?)
SHAPE: indeterminate
BODY CONSTRUCTION: sewn through
EDGE/END CONSTRUCTION: indeterminate
SIZE: indeterminate



(n=14)

Figure 91-continued.

Definition

Illustrated Reconstruction and Frequency of Occurrence

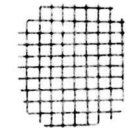
D. BASKETRY FRAGMENTS

HO-F1. MATERIAL: cedar bark
SHAPE: ?
BODY CONSTRUCTION: shredded bark
(RIM: bent down over cord and twined)



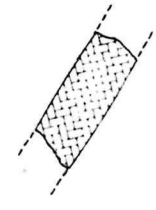
(n=7)

HO-F2. MATERIAL: cedar bark
SHAPE: ?
BODY CONSTRUCTION: checker
RIM: ?



(n=5)

HO-F3. MATERIAL: cedar bark
SHAPE: band
BODY CONSTRUCTION: twill on bias
RIM: bent back



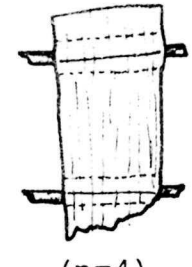
(n=4)

HO-F4. MATERIAL: splints (cedar)
SHAPE: ?
BODY CONSTRUCTION: checker
RIM: ?



(n=2)

HO-F5. MATERIAL: cedar bark
SHAPE: ?
BODY CONSTRUCTION: pierced together with sticks
RIM: ?



(n=4)

Figure 91-continued.

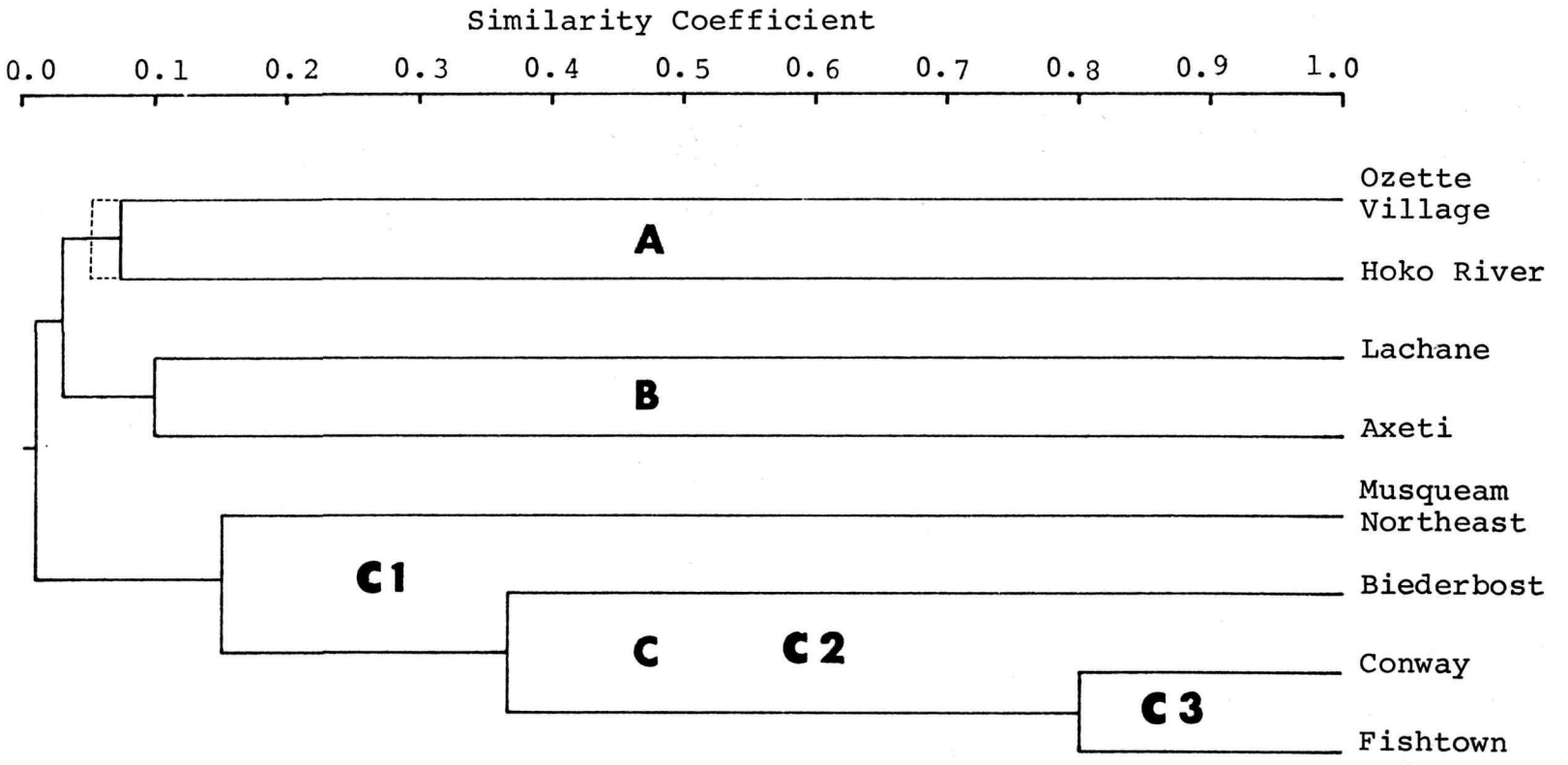


Figure 92. Dendrogram representing average linkage cluster analysis of Northwest Coast wet site basketry classes on a matrix of Jaccard's coefficient. Degrees of similarity: 0 = no similarity to 1 = complete similarity. Dashed lines represent test results with previous data (Croes 1977:257).

close Hoko River and Ozette Village sites. This again adds to a hypothesis of techno-cultural continuity and potential cultural continuity in this region.

Functional Analysis of Hoko River Basketry Classes

The reconstructed S/T classes will now be employed to discuss functional characteristics of basketry from Hoko River. The different classes are grouped into functional sets (see Croes 1977:261). These sets are constructed according to the way basketry classes appear to correlate (1) technologically and (2) in total site context in terms of both associated artifacts and the site functional context. When appropriate, general ethnographic analogies and comparisons with similar basket classes are made; though thousands of years old, the Hoko basketry is often very similar to historic examples.

Baskets

Functional Set I /HO-B1, HO-B6/

The S/T classes in this functional set (HO-B1, HO-B6) are the most common basket classes at Hoko (82 percent of all baskets recorded; n=25 and n=2 respectively). They are defined as large, open-weave, cedar-splint, burden/utility baskets with inverted, subrectangular, truncated cone shapes (Figure 93).

The most abundant class (HO-B1) is essentially equivalent to the Ozette Village specialized pack basket class OB44 in Ozette Basket Functional Set IX, even to the opposing tumpline loops (Croes 1977:337; Figures 82,83). This close S/T similarity between these specific classes suggests a considerable period of in situ technological continuity for this specific burden basket class in the south-central coast regional area (Croes 1976b; Croes 1977:404).

At the Ozette Village site these pack baskets are low in frequency (4 percent of all baskets). At Hoko River, however, this class was the most abundant (78 percent). The differential concentration at the two sites is perhaps best explained by functional contexts. Hoko River appears to have been an important fishing station, and at a fishing station only certain basketry items would be expected. Large numbers of utility/pack baskets would be necessary to transport the fish being caught and/or prepared. At Ozette Village, on the other hand, one finds a wide variety of functionally distinct baskets, as would be expected of a village. An unusual concentration of utility/burden baskets

A. Set I HO-B1, HO-B6



B. Set II HO-B2, HO-B3



C. Set III HO-B4, HO-B5



Figure 93. Hoko River basket functional sets. A. Set I: Large, open wrapped or wrap around plaited, cedar splint, carrying-utility baskets with an inverted, sub-rectangular, truncated conical (?) shape. B. Set II: Small, close weave, cedar bark or root, inverted truncated conical baskets. C. Set III: Small, twined or plaited, cedar bark flat bags.

also was noted at other Northwest Coast wet site fishing stations (Croes 1977:488-494). At these sites the S/T pack basket styles were often dissimilar from Hoko/Ozette, although functional efficiency was undoubtedly equivalent.

The two fragments of possible burden baskets of the class HO-B6 are technologically distinct in body weave (wrap around plaiting vs. open wrapping) from the HO-B1 basket class. These may be equivalent to the common burden/utility basket class MU-B1 recovered at the contemporary Musquean Northeast site. This rarer basket class may have been introduced to the site from the Puget Sound/Gulf of Georgia region where it was most common, and it may well have functioned in transporting fish at both sites (Croes 1977:404).

Functional Set II /HO-B2, HO-B3/

Hoko River baskets in this functional set are small, close weave, cedar bark or root, conical baskets (Figure 94). The weave techniques are either plain twined or wrap twined. The latter technique especially is characteristic and distinctive of historic Nootkan basketry (Jones 1976:158). Essentially small flexible pouches, they are somewhat similar to baskets in Ozette Village Functional Class Set XIIa (Croes 1977:365).

The specific use of these baskets at Hoko River is uncertain. One suggestion, based on their size and shape, is that they were used as tackle bags to hold the common bentwood and composite fishhooks and leaders recovered at the site (Croes 1976c). If so, it is expected that fishhooks might be recovered in baskets of this class in future excavations of this site.

Functional Set III /HO-B4, HO-B5/

The cedar-bark flat bags in this functional set are similar to the common cedar-bark flat bags from Ozette Village (Basket Functional Set II). The function of these small bags at Hoko River is uncertain. They may well have had several uses, or perhaps they were special containers used to hold and protect articles of importance, as were some cedar-bark flat bags (Set IIa) at Ozette Village (Croes 1977:274).

Hats

Functional Set I /HO-H1/

The two hats recorded in this functional set are of a knob-top conical style (Figure 95; see Croes 1976b:220, Fig. 14a). The general style is similar to Ozette knob-top hats (Hat Functional Set II; Croes 1977:417). It cannot be

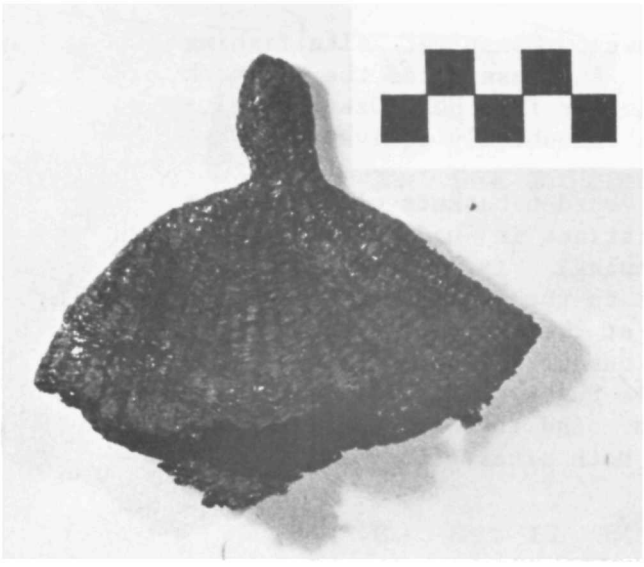
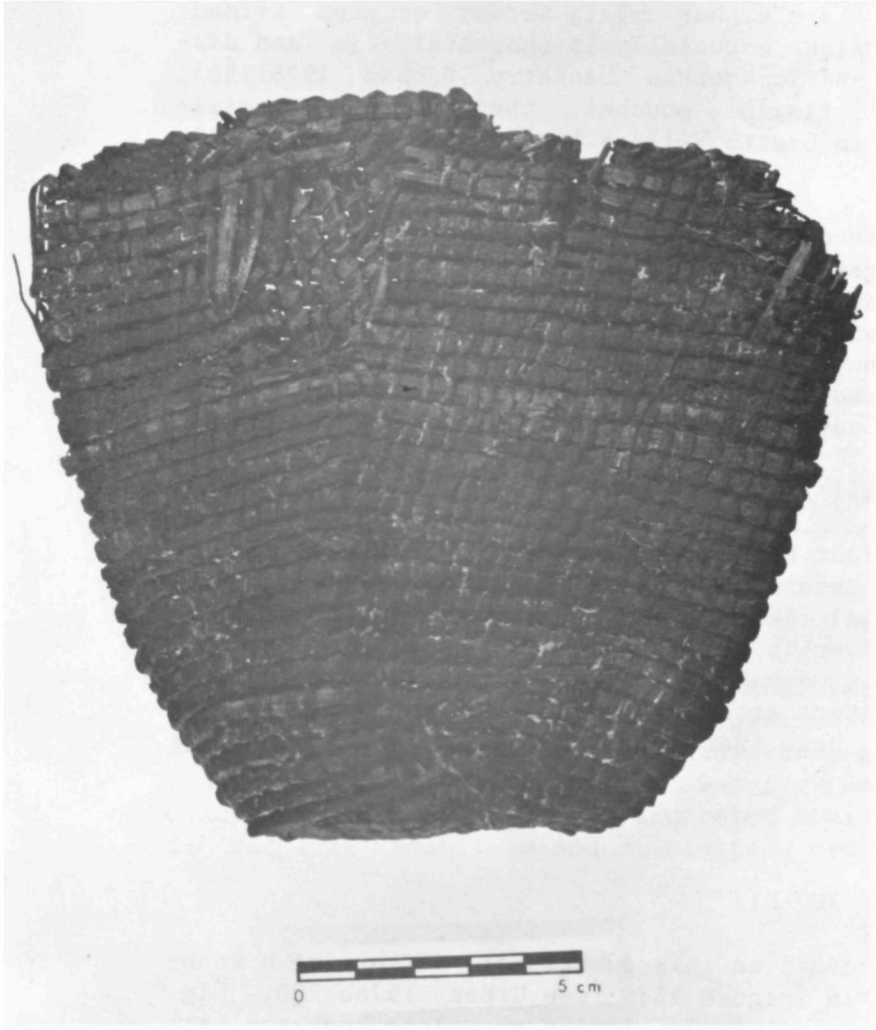


Figure 94.

Small conical basket of functional set II. Note the distinct wrap twined body weave.

Figure 95.

Plain twined cedar-bark hat from Hoko River. Note knob top.



demonstrated whether or not the knob-top hats from Hoko River had status-marking connotations; since, however, Hoko River is in the same area as Ozette Village and near other Nootkan territories, and since Hoko River basket technology appears to be interrelated with the later basket technologies of that area, a possible social status function may reasonably be suggested, even though its exact role cannot be specifically determined. If these knob-top hats did indeed have a status-marking function, this has been a culture trait in this area for approximately 2500 years. Further excavations at Hoko River should provide more hat examples and may possibly indicate other hat shapes occurring at the site, which might further support the possibility of hat shapes having had social connotations at the site.

Functional Set II /HO-H2/

The single hat in this class is made of plain twined root splints. It has a bound top without the distinct knob of those in set I. This hat may have been worn by someone of a status or sex different from the wearers of set I examples, or this may simply have been a different hat form. It is significant that this hat is made with root construction materials. Although some Ozette hats are made with root materials as well, historically this material was more commonly used in hat construction further to the north.

Mats

Functional Set I /HO-M1/

Hoko River has several examples (n=14) of sewn tule mat fragments (Figure 96). Despite their fragmented condition, many examples have selvage preserved, indicating a straight edging. Sewn tule mats also are recovered at the Ozette Village site (OM1; Croes 1977:468-473), which is the only other Northwest Coast wet site to produce these artifacts.

Ethnographically tule mats commonly were used as wall liners in plank dwellings, mattresses, and cushions for canoe paddlers. They were also used to construct temporary mat houses at camps or to cover beached canoes to protect them from the sun (Croes 1977:471). Since Hoko River is considered to have been a major fishing camp, the occurrence of sewn tule mats at the site may indicate either of these latter uses.

Gunther mentions that, "Makah get tule at Lake Ozette and use it for making mats" (1945:22). Possibly this also was the tule source for the early Hoko River people, since Lake Ozette is only approximately 30 miles up the Hoko River from the site and over a low pass.

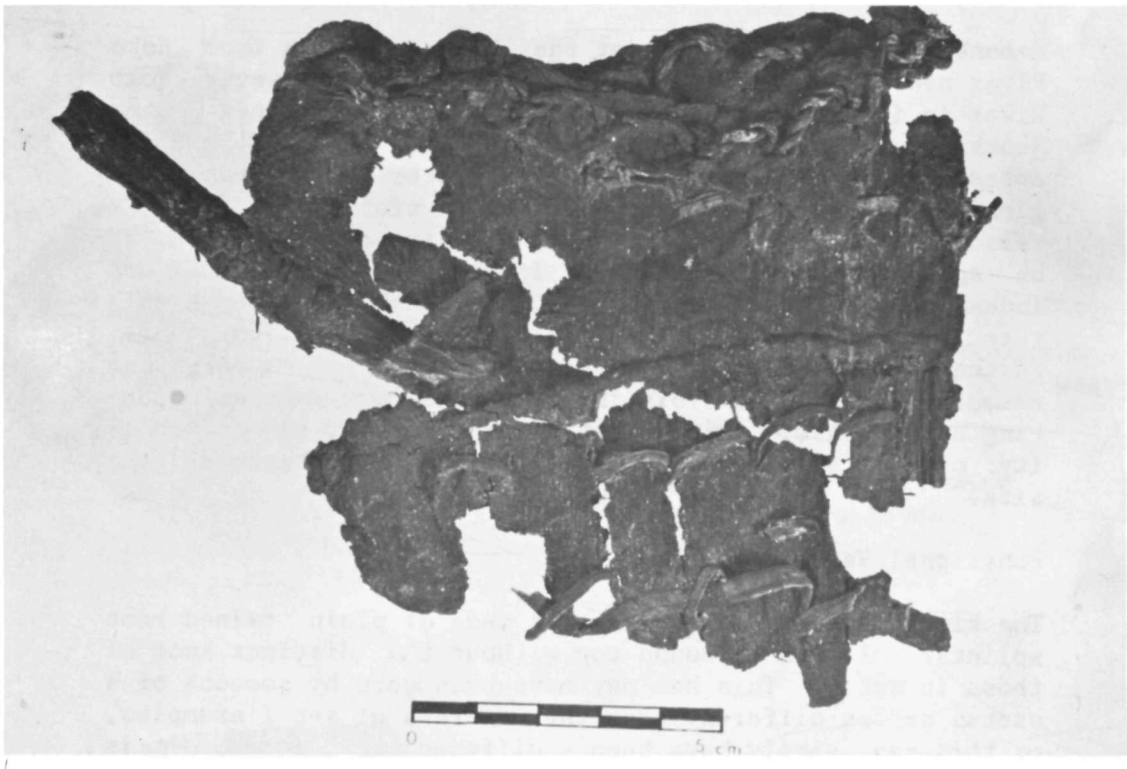


Figure 96. Tule mat Fragment. Note open twining in lower area.

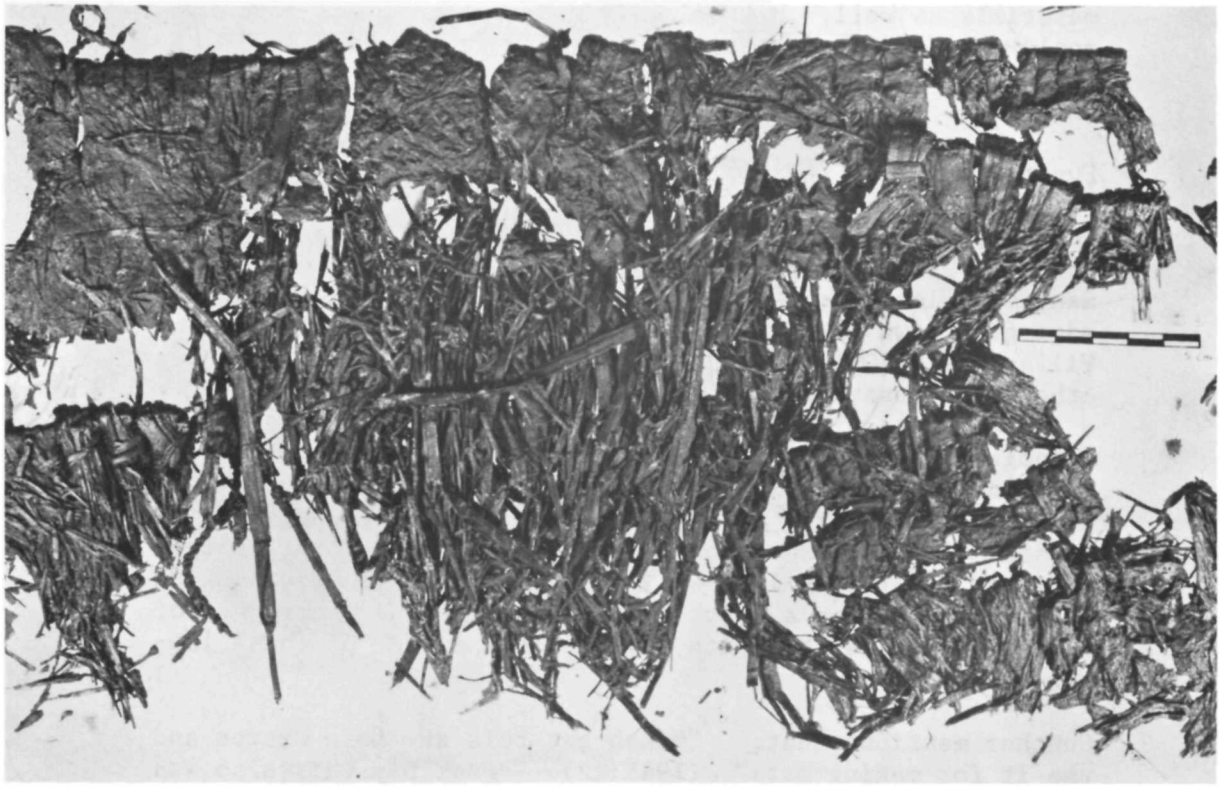


Figure 97. Example of the shredded cedar-bark "skirts" common to Hoko River. Note bent down selvage with spruce root cordage core.

Basketry Fragments

Shredded Cedar-bark "Skirts" /HO-F1/

These skirtlike basketry fragments are common at Hoko River (n=7) and probably represent a form of clothing (Figure 97). Similar shredded skirts also are recorded at Ozette Village (Croes 1977:250) and historically as clothing forms among several coastal groups. The examples from Hoko River demonstrate the antiquity of this form of clothing on the Northwest Coast. The material may be yellow cedar bark, a commonly used clothing material in historical time, but exact identifications have not been made.

Cedar-bark, Checker-weave Fragments /HO-F2/

Five examples of checker-weave cedar bark have been recovered (Figure 98). Since none have selvage remaining, it is difficult to assign these pieces to a mat or basket category.

Cedar-bark, Twill-on-bias Bands /HO-F3/

Four examples of these distinctive bands have been recovered (Figure 99). Since the ends are missing, their exact function can not be determined, though they probably represent fragmented burden basket tumplines or belts for clothing. Similar bands were used as tumplines at Ozette Village (Croes 1977:462).

Splint, Checker-weave Fragments /HO-F4/

Two fragments of this type have been recovered from Hoko River. Though no selvages are preserved, they probably represent body weaves from fragmented large utility baskets (Figure 100).

Wide Cedar Strips Pierced with Sticks /HO-F5/

Four carefully cut and pierced cedar strips are recorded at Hoko River (Figure 101). Their function is unclear. They may be part of a series of cedar-bark pieces that were pierced together forming a large flat surface, possibly to cover shelters. Speculation as to their use will remain open until more are recovered and examined. The sticks are carefully shaped, and the bark strips are creased on either side of the piercing stick (Figure 101).

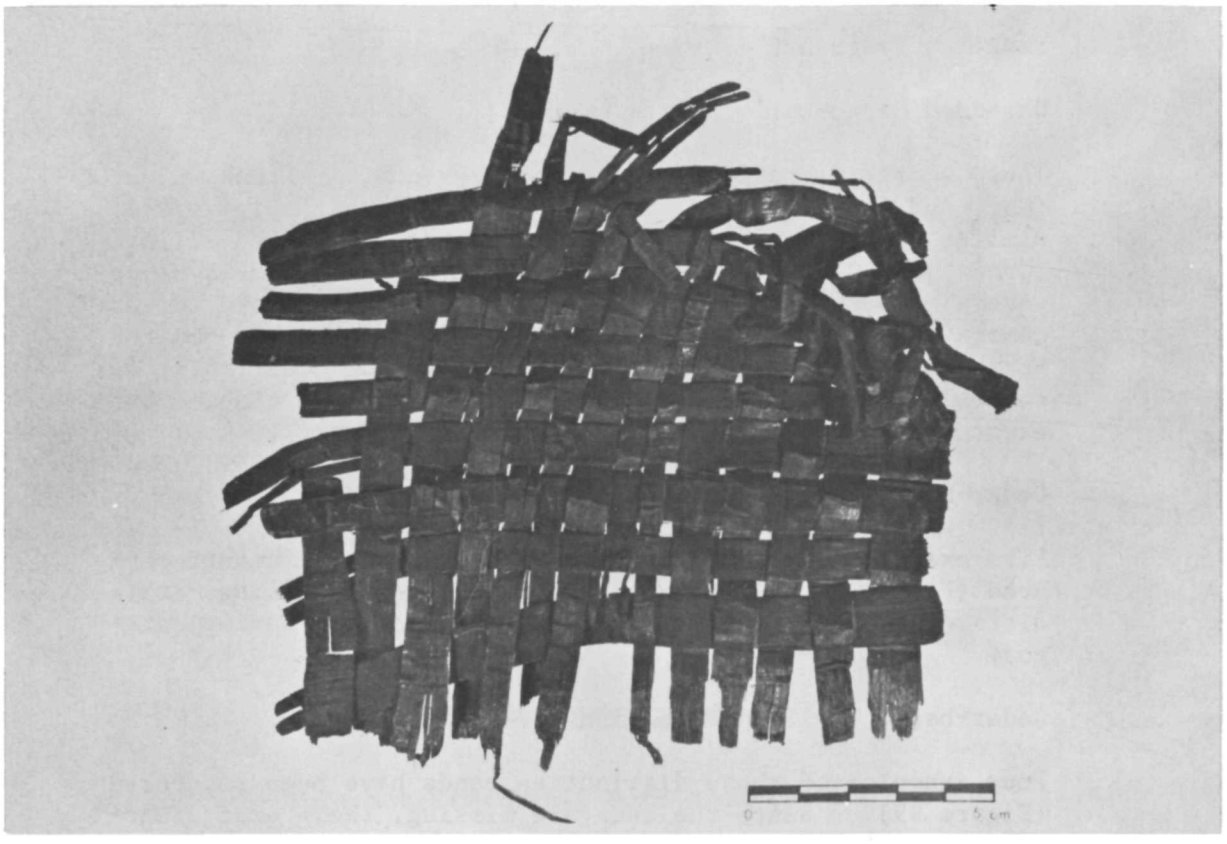


Figure 98. Cedar-bark, checker-weave fragment. This may be basket base/body or mat fragment.

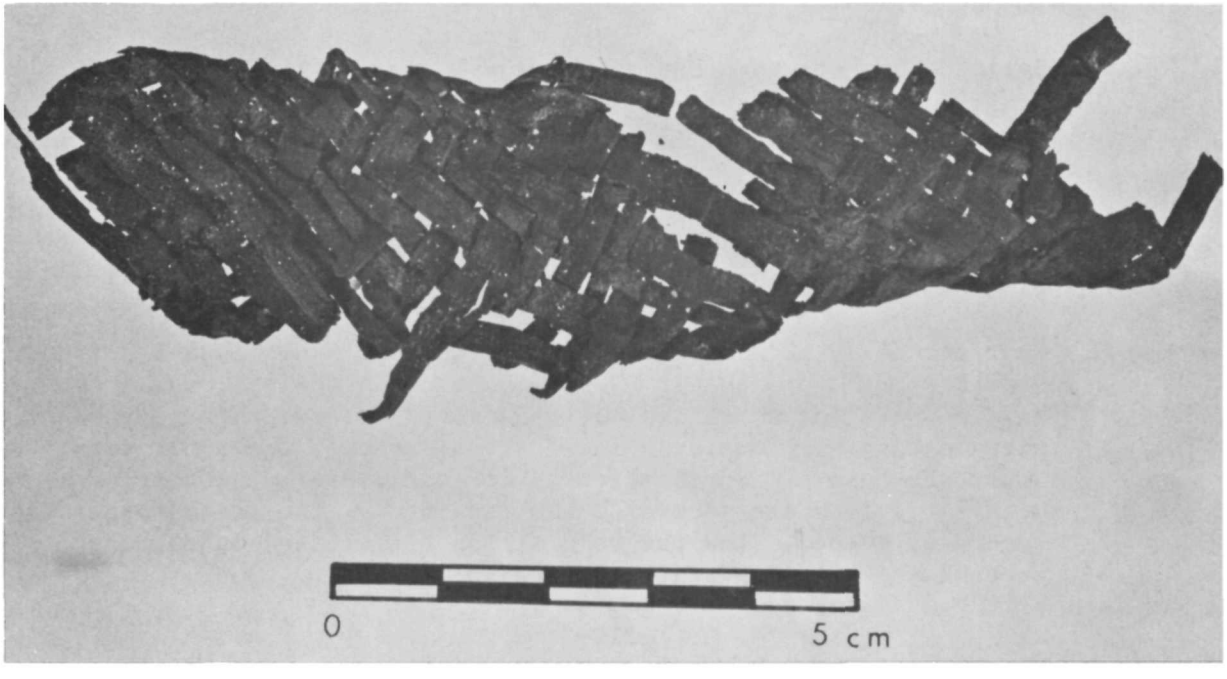


Figure 99. Cedar bark, twill on bias bands. These may be fragments from tumpline straps or belts.

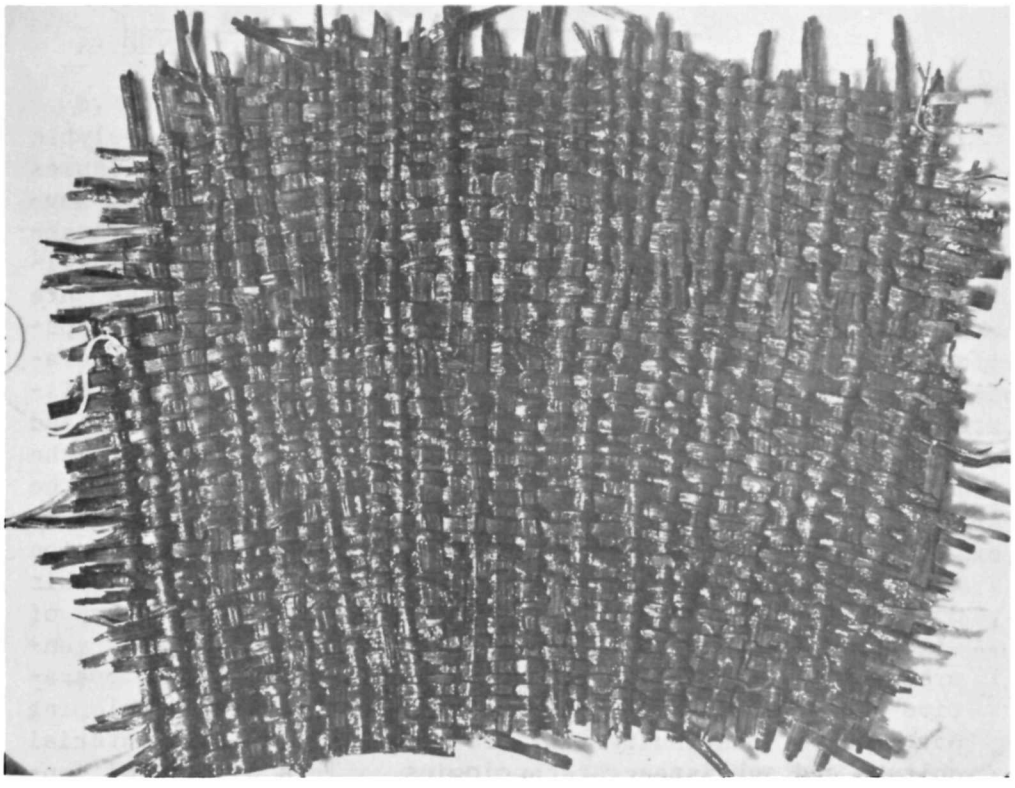


Figure 100. Splint, cedar(?) limb, checker-weave basketry fragment. Note expanding weave toward the top edge.



Figure 101. Example of a wide cedar-bark strip that is pierced with a stick. Note cross marks on either side of piercing and the carefully attached patch. The latter was probably intended to prevent splitting.

Summary and Conclusion

Hoko River basketry has been approached from three analytic levels: the basketry modes, stylistic/technological classes (types), and functional categories. On the first two levels, it becomes increasingly apparent that Hoko River basketry is most similar to basketry recovered from Ozette Village prehistoric House I (Croes 1977). These sites are spatially only 30 miles apart, but temporally they are separated by approximately 2000 years. Apparently the generations of basket weavers in this region passed down the distinctive technologies, so that Hoko basketry modes and classes remained common to this west coast region into the historic period. The S/T basketry data provide part of the support for an assumption of in situ cultural continuity in this south-central Northwest Coast region. The conclusion reached is that prehistoric human groups adapted to this distinctive west coast environment were the forerunners of similarly adapted ethnographically known groups in this general region. The significance of this particular comparative analysis lies in its contribution to the developing patterns of continuity that are emerging in both material culture and subsistence technologies. This pattern of continuity needs to be further tested with other categories of material culture and technology.

The functional categorization of Hoko River basketry reveals (1) an emphasis on large, open-wrapped burden baskets at the site, (2) the use of hats made of cedar bark and with knob-tops, and (3) the presence of sewn tule matting. The emphasis on burden baskets correlates with the proposed use of the site as a major fishing station. The baskets were undoubtedly used to transport the large quantities of fish being caught and processed. Knob-top hats may have had status-marking or other connotations for the wearers at Hoko River, though the exact meaning of these hat styles remains a question. And the sewn tule mats found at the site possibly represent matting used to construct temporary shelters or to cover beached canoes at the Hoko River fishing camp.

Hoko River basketry is sensitive for comparative and functional analyses. Further excavation at this site and future Northwest Coast wet sites will add substantially to the possibilities for comparison and functional interpretation.

BASKETRY WASTE MATERIALS

by Margaret Paden

Introduction

The Hoko River archaeological site contains numerous examples of basketry waste materials, i.e., the waste strips discarded in the preparation of basketry materials or the manufacture of basketry items. Cedar-bark baskets, mats, skirts, capes, and hats along with splint (root/limb) baskets and hats have been recovered from the site (see Basketry, above). The amount of basketry waste material (n=1495) indicates that in addition to being used at Hoko, many of these basketry items were probably being made there. This report deals with the Hoko River basketry waste materials and their measurements, cut ends, surface modifications, and distribution in the Hoko River site.

Analysis

All items from the Hoko River level-bags, including basketry waste materials, were washed, dipped in cytox (an antibiotic), and dried. After drying they were sorted, counted, and recorded into these categories: basketry waste materials, cones, woodchips, split wood, waterworn wood, burned wood, bark, twigs, and miscellaneous. The individual pieces of basketry waste from each level-bag were numbered sequentially in white ink. The pieces were then measured for width, thickness, and length in centimeters, and coded as to type of material, surface texture, and cut features.

Material Identification

Basketry construction materials recorded at Hoko are inner cedar bark (n=931, 62.4 percent), split root or limbs (probably cedar or spruce, and possibly black hemlock; n=545, 36.4 percent), and some unsplit root or limbs (n=19, 1.3 percent). As discussed in the Basketry section, cedar bark was used at Hoko to construct baskets, matting, hats, and skirts or capes, while split root or limb was used primarily for burden baskets. Both cedar-bark and split limb/root basketry waste materials are common to the site, indicating that both kinds of basketry were being made there.

To gain a better understanding of the gathering and preparation of cedar bark and split limb/root basketry material,

ethnographic information was gathered and techniques were replicated. I will discuss first the cedar bark and then split limbs and roots.

Inner cedar bark (the inner phloem layer) typically is gathered in the warmer spring-summer months when the sap is running and the bark can be removed easily. A horizontal cut is made at the bottom of the appropriate-sized cedar tree (typically a young, 40-60 cm in diameter tree), and a vertical cut is started from either end of this bottom cut. A very long strip (as long as 10 m), from 10 to 40 cm wide, is pulled up the tree until it narrows and breaks off at the top. The inner bark is carefully split from the outer and rolled into large bundles which are dried and stored for later use. When the material is needed for basketry work, it is soaked, and measured sections are cut from the long strip according to the size of the basketry object desired. These lengths of bark are further split into narrow ribbons of the desired width, and these ribbons are split through the center 2 to 4 times until the desired thickness of basketry weaving elements is acheived. These pieces may be further split into narrower strips and also thinned more. The cedar-bark basketry waste materials found at Hoko River typically are split and thinned as will be explained below.

Cedar limbs, usually green limbs, are typically gathered in warmer months and from young trees (Boas 1909). Long, straight, narrow limbs are desired. These may be heated over a fire and the bark removed. The limbs commonly are split through the center from the narrow end, and then additional splints are removed from each half as the thickness permits; the splints thus produced can be stored for later use (Boas 1909).

Spruce and cedar roots are also commonly gathered in the warmer months. Areas around appropriate groves of trees are dug up with a digging stick, and roots of small diameter ("finger-sized") and straight lengths are selected. These are pulled from the ground, heated over a fire, and run through a split-stick tong to remove the bark. These materials are also split through the center and can be stored for later use. When needed for basketry work, the roots are soaked and further split to make the thin basketry splints (Boas 1909).

The split basketry limb/root waste materials recovered from Hoko River commonly are thin splints prepared for basketry, but also half-split pieces are recorded.

Measurements

The width measurements of cedar-bark basketry waste materials reflect a narrowing of the wide cedar-bark strips into

basketry elements. For this reason the width was measured on all pieces to determine if any pattern of width-size selection was present (Table 22). The average (mean) width of cedar-bark basketry waste strips is 0.7 cm with a standard deviation of 0.5 cm. A strip of cedar bark of this mean width is certainly appropriate for most of the baskets and matting recovered from the site and seen in ethnographic collections. Therefore most of the cedar-bark waste detritus is within the size range of materials commonly used in making the recovered basketry at the site.

The mean overall width for split root/limbs is 0.7 cm with a standard deviation of 0.5 cm. This measurement generally reflects the diameter size of the roots/limbs selected for basketry. As was the case with cedar-bark detritus, the root/limb waste materials fall within the size-range of basketry elements recovered from split root/limb basketry at the site.

Thickness of cedar-bark and splint root/limb waste materials is an important measurement in determining the degree of thinning of these materials. Both materials are split through the center in making thin strips or splints for basketry. Thickness of a piece of basketry waste material may help to indicate whether it was unsplit or split once, whether it needed to be split again to be suitable for creating a final product or did not need further splitting before use.

The mean thickness for cedar-bark strips is 0.10 cm with a standard deviation of 0.06 (Table 23). Several unsplit strips were collected and measured, and it was determined that the average unsplit piece of cedar bark is approximately 0.22 cm thick, with an older tree having a thickness up to 0.31 cm (only 4 percent of the Hoko examples fell into this category). The majority of the Hoko River cedar bark (72.2 percent) is between 0.06 and 0.15 cm thick. This would be a little thick for fine basketry, although it would be appropriate for most basketry bags and matting. Another 16.6 percent of the cedar bark is in the thinnest division, between 0.01 and 0.05 cm thick. This thickness would be ideal for finer basketry because it is very flexible and easy to use. I conclude that most of the cedar bark was being prepared for baskets and matting, with lesser amounts being prepared for finer work such as twining. This conclusion would be in agreement with the generally wide width measurements of the basketry elements found.

Splint materials have about the same range of thickness as cedar-bark materials (Table 23). As might be expected, splints with the outside surface present on one side tend to be slightly thicker than splints split on both surfaces. The overall thickness of splints averages 0.11 cm with a

Table 22

Width of Hoko River basketry detritus

Width (cm)	Material			
	Cedar bark		Splints	
	Number	Percent	Number	Percent
0.1 - 0.3	142	15.5	114	21.0
0.4 - 0.6	393	13.0	204	37.6
0.7 - 0.9	224	24.5	109	20.1
1.0 - 1.2	79	8.7	46	8.5
1.3 - 1.5	32	3.5	37	6.8
1.6 - 1.8	22	2.5	17	3.1
1.9 - 2.1	9	1.0	5	0.9
2.2 - 2.4	5	0.5	4	0.8
2.5 - 2.7	1	0.1	3	0.6
2.8+	6	0.7	3	0.6
Total number	913		542	
Mean	0.7 cm		0.7 cm	
Standard deviation	0.5 cm		0.5 cm	

Table 23

Thickness of Hoko River basketry detritus

Thickness (mm)	Material			
	Cedar bark		Splints	
	Number	Percent	Number	Percent
.01 - .05	154	16.6	96	17.7
.06 - .10	442	47.7	231	42.6
.11 - .15	227	24.5	139	25.6
.16 - .20	65	7.0	40	7.4
.21 - .25	28	3.0	18	3.3
.26 - .30	7	0.8	10	1.9
.31+	4	0.4	8	1.5
Total number	927		542	
Mean	.10 mm		.11 mm	
Standard deviation	.06 mm		.06 mm	

standard deviation of 0.06 cm. Experimentation with preparing splint basketry materials from cedar and spruce roots indicates that the most usable elements are no thicker than 0.11 cm because thicker roots are less flexible and considerably harder to manipulate. The thinnest elements, 0.01-0.05 cm, make up 17.7 percent of the collection. As with cedar bark, the majority (68.2 percent) of the splint basketry materials are .06 to 0.15 cm thick (Table 23). Only 14.1 percent are thicker than 0.15 cm, but this is greater than the percent of thicker examples recorded for cedar-bark materials (11.2). Certainly splint materials can be thicker than cedar bark, but also thicker pieces of splint might be intentionally made for more rigid support elements in burden baskets.

The lengths of basketry waste materials may be the "left-overs" cut off from "usable" lengths of material, or they may be "usable" lengths that were discarded for some other reason. Cedar-bark pieces have a mean length of 9.1 cm with a standard deviation of 6.6 cm (Table 24). Only 12 percent of the cedar-bark pieces are over 15.0 cm long. This leaves the majority (88 percent) much too short to make a typical basket, mat, hat, or skirt. Therefore it appears that most of the cedar-bark basketry waste materials are pieces cut or trimmed from the ends of longer lengths of basketry materials.

The lengths of splint basketry waste materials have a mean of 5 cm and a standard deviation of 4.1 cm (Table 24). The average lengths are shorter than those of cedar-bark materials, but these pieces again were probably cut from longer pieces of splint elements that were used in basketry construction (e.g., in trimming a finished basketry item). Only 1.0 percent of all splints are over 25.1 cm long, the length which was determined by replication at Hoko to be the minimum useful length for general basketry. Some of the shorter lengths may be the result of breakage after discard, breakage caused, for example, by human trampling.

Cut Marks

Cut marks on basketry materials from Hoko might help to indicate whether the materials were broken off from baskets or were the left-overs cut from raw materials or from the edges of basketry items in finishing. Out of a total of 1495 basketry waste material pieces, 1112 or 74 percent are uncut; 193 (13 percent) are cut at one end; 43 (3 percent) are cut at both ends; and 29 (2 percent) are split up to about the center and cut at one end. The center split may be due to natural drying out of the materials. The remaining 7 percent are questionable cases whose "cut marks" may be due to the natural drying out of materials causing both vertical and horizontal splitting of the material.

Table 24

Length of Hoko River basketry detritus

Length (cm)	Material			
	Cedar bark		Splints	
	Number	Percent	Number	Percent
0.1 - 2.5	47	5	138	25
2.6 - 5.0	209	23	216	40
5.1 - 7.5	214	23	99	18
7.6 - 10.0	710	18	49	9
10.1 - 12.5	100	11	15	3
12.6 - 15.0	70	8	9	3
15.1 - 17.5	41	4	6	1
17.6 - 20.0	19	2	4	1
20.1 - 22.5	9	1	1	
22.6 - 25.0	10	1	1	
25.1 - 27.5	10	1	1	
27.6 - 30.0	8	1	1	
30.1 - 32.5	6	1	0	
32.6 - 35.0	3		1	
35.1 - 37.5	5	1	1	
37.6 - 40.0	2		0	
40.1 - 42.5	1		0	
42.6 - 45.0	2		0	
45.1+	1		0	
Total number	927		542	
Mean	9.1 cm		5.0 cm	
Standard deviation	6.6 cm		4.1 cm	

Of the cedar-bark examples 622 (67 percent) are uncut; 146 (16 percent) are cut at one end; and only 25 (3 percent) are cut to the center and one end. The remaining 15 percent are broken apart due to drying. A surprising number show no signs of being cut off, but it may be that the tools used to trim or cut the cedar were not sharp (at least not as sharp as a metal blade) and did not leave obvious cut marks.

Of the splint materials, 447 (87 percent) are uncut. This again may indicate that these materials were cut with something rather dull that did not leave distinct cut marks, or they may have been snapped and broken off. Those cut at one end (n=48) make up only 9 percent of the sample; those cut at both ends, 2 percent; and those with miscellaneous cuts on their surface, 2 percent.

Surface Texture

Surface textures may indicate whether the surface of the material was modified (e.g., beaten or shredded) in preparation. Of the cedar-bark pieces, 463 or 50 percent are totally smooth. This is the typical surface for weaving baskets, mats, and hats at Hoko River. Forty pieces (4 percent) are totally shredded, while 178 or 19 percent are shredded at one end. Cedar bark was shredded at Hoko to form the elements of skirts and possibly for towels or baby diapers (Boas 1913). Frayed cedar bark accounts for 203 (22 percent) of the examples and probably is the result of wear on the elements after discard. The remaining 5 percent is made up of various combinations of smooth, shredded, and fragmented examples. Splints, of course, do not shred, and therefore the majority of the splint materials (n=463, 86 percent) have a smooth surface. Only 14 percent have frayed surfaces, and this again may be from wear after discard.

Summary of Attribute Analyses

From this examination of the Hoko River basketry waste materials a number of conclusions can be reached:

1. Both cedar-bark and splint basketry are recovered at Hoko; the presence of detritus of both materials in the deposits suggest that both basketry types were actually manufactured at the site.

2. Cedar bark pieces recovered are well within the size-range of the elements of typical cedar-bark basketry at the site.

3. Cedar-bark and splint elements are intentionally thinned for use.

4. Almost all lengths of cedar-bark and splint basketry waste materials are too small to be usable for the manufacture of anything but unusually small basketry objects. Therefore most of the materials probably are pieces trimmed from the larger-sized elements that were used for basketry manufacture, or they are trimmings from the finished ends of basketry objects.

5. Most elements are uncut or do not show signs of clean cuts with a sharp tool at their ends.

6. Surfaces typically are smooth, though some shredded examples of cedar bark are recovered. Frayed surfaces most likely reflect wear after discard.

Distribution of Basketry Waste Materials

In examining the horizontal distribution of basketry waste materials, it becomes clear that the materials grade in frequency, with some exceptions, from the nearshore areas (east end of site) to the further offshore deposits (Figures 102 to 104). This general pattern would be expected, since the majority of the activities, including basketmaking, would be taking place, on the river bank. Certainly the differences in the volume of material excavated in different areas would affect the final distribution densities, but generally equal volumes of material were excavated in all areas. The separate cluster in the west end of the site (Area C) is part of a different depositional sequence.

To determine the vertical distribution of basketry waste materials, counts were made of occurrences of basketry detritus in each of the numerous stratigraphic units at Hoko River (Table 25). From this table and from Figure 105, it is clear that cedar bark is the most common material at the site. Cedar bark makes up approximately 65 percent of the examples in each unit; splints make up some 35 percent in each unit. These figures correlate closely with the percent of each material in the total count (62 percent and 38 percent respectively). A tentative hypothesis is suggested: during each of the time periods represented by individual stratigraphic units at Hoko River, whether they be one or 100 year intervals, a similar proportion of cedar-bark to

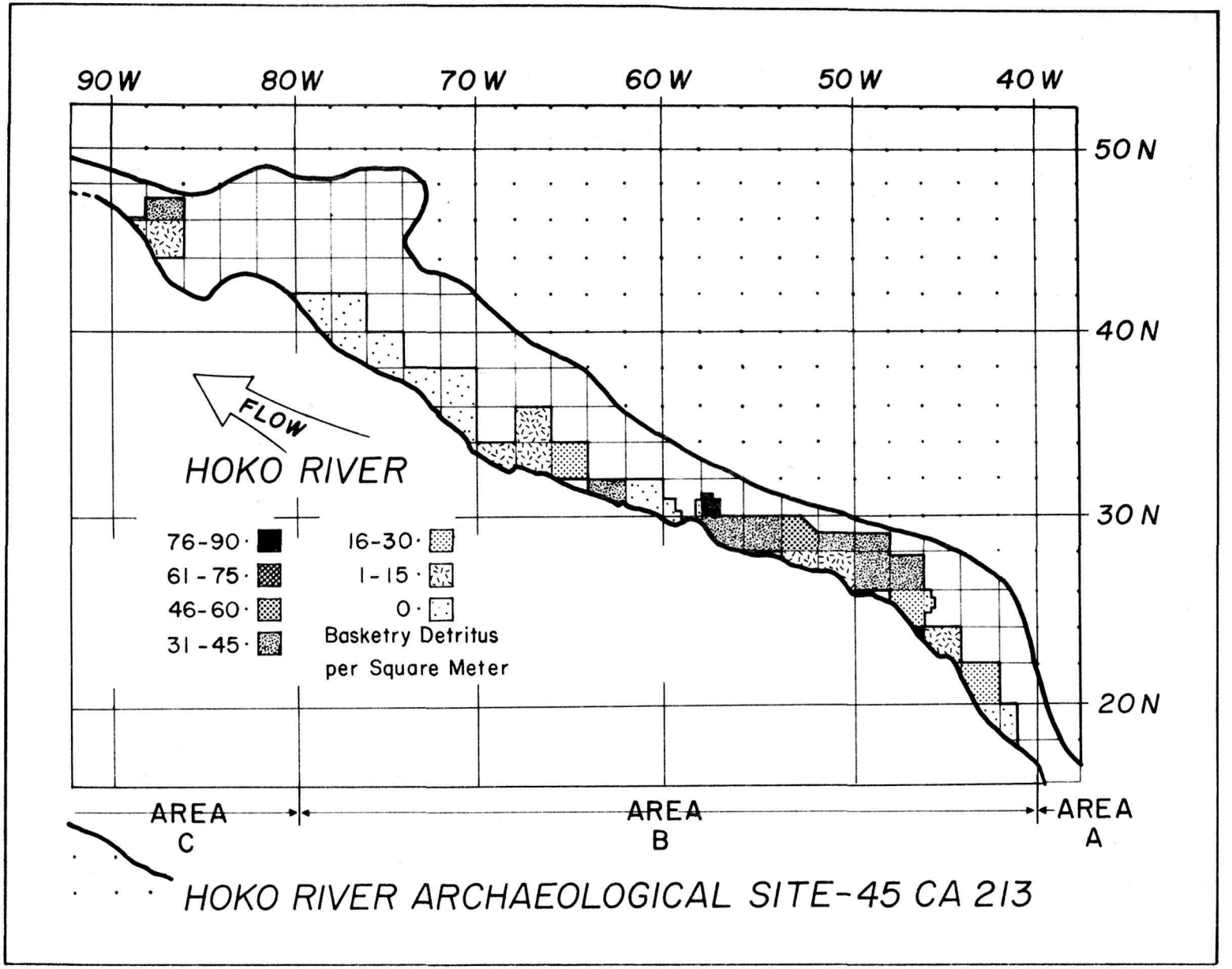


Figure 102. Frequency distribution of basketry detritus from the Hoko River site.

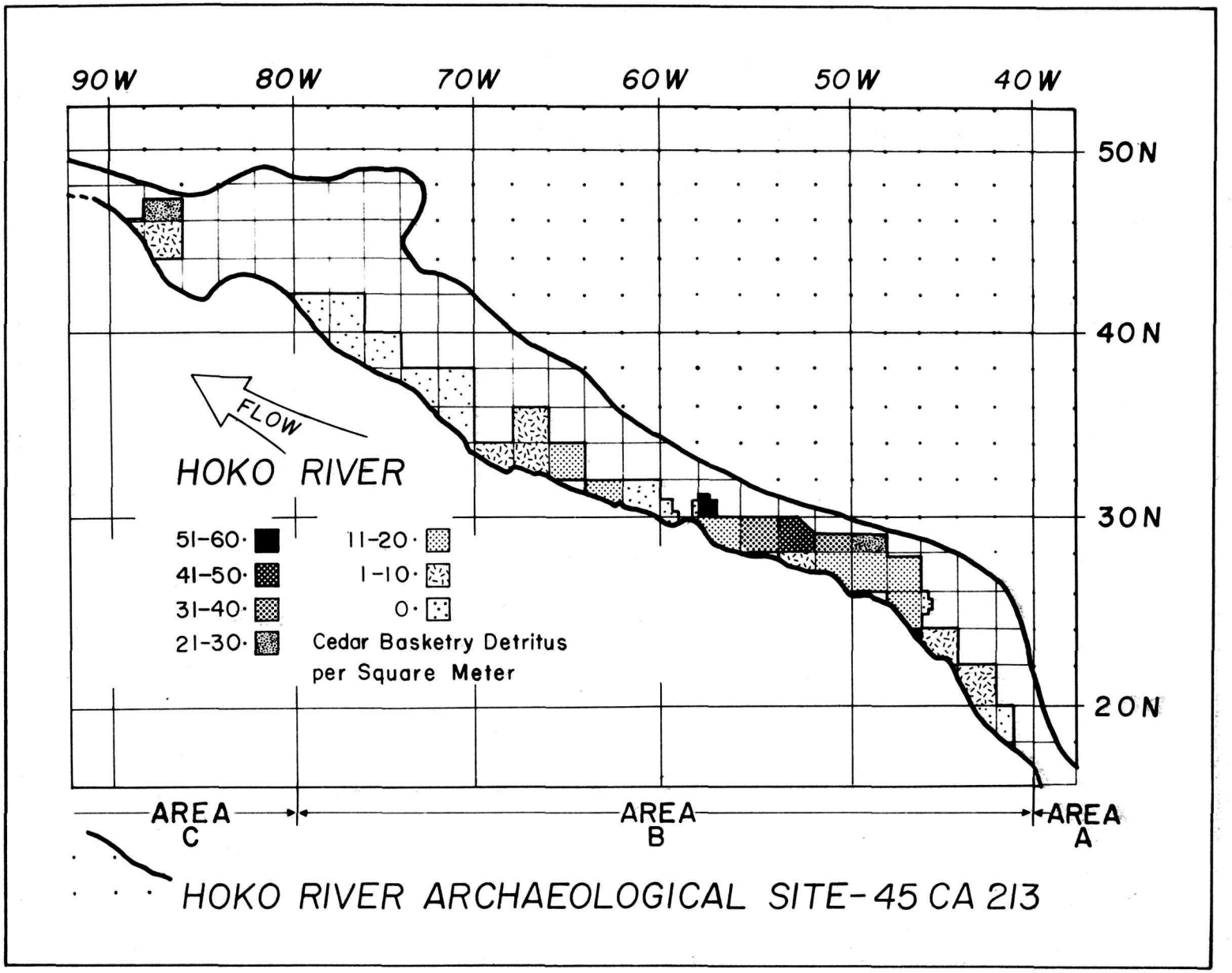


Figure 103. Frequency distribution of cedar bark basketry detritus from the Hoko River site.

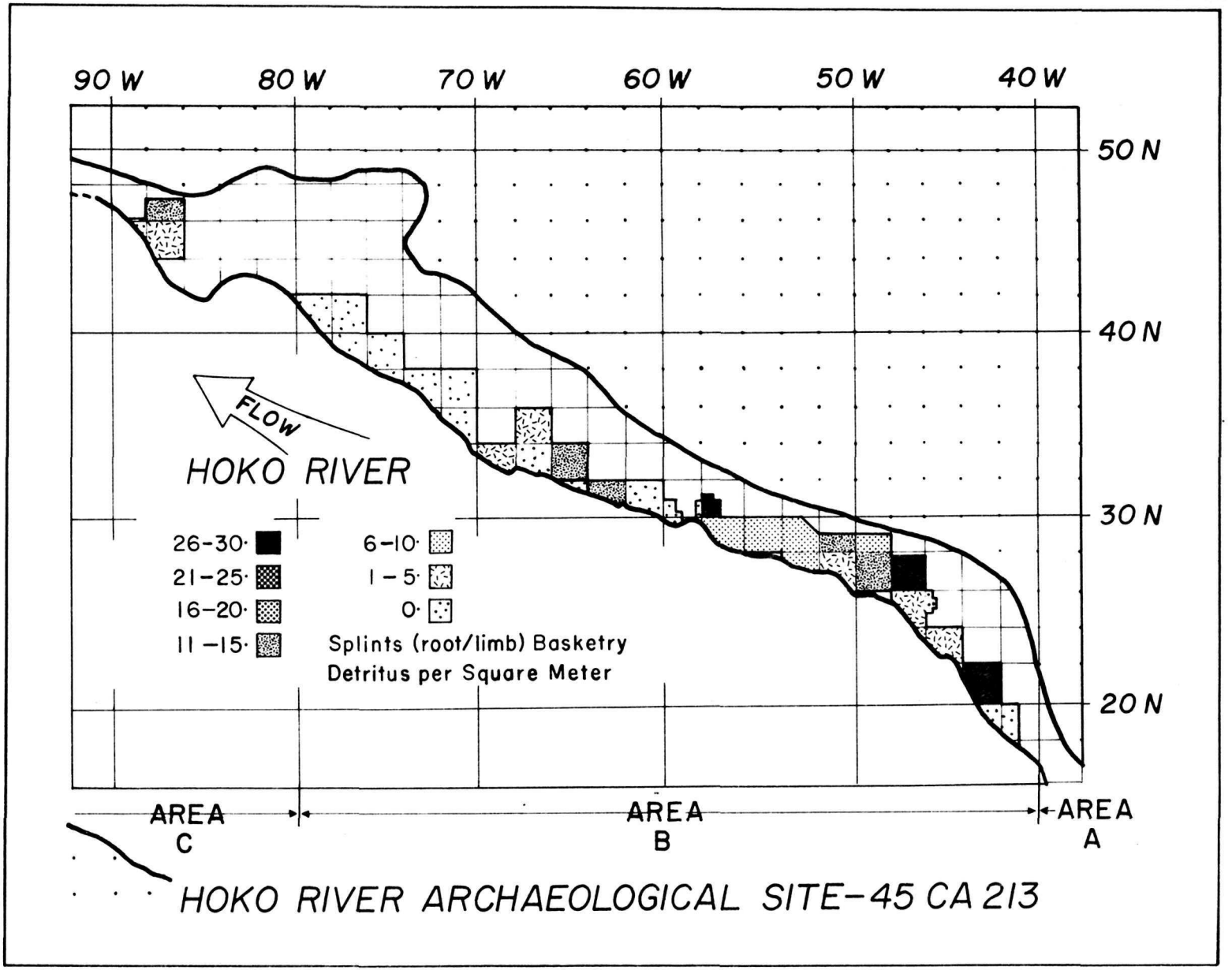


Figure 104. Frequency distribution of splits (roots/limb) basketry detritus from the Hoko River site.

Table 25

Distribution of basketry waste materials by unit

Unit	Material				Total number
	Cedar bark		Splints		
	Number	Percent	Number	Percent	
Area B, east					
AD			21	100	21
AE	87	92	8	8	95
AF	51	71	21	29	72
AG	12	75	4	25	16
AH	39	70	17	30	56
AI	3	100			3
AJ	60	67	30	33	90
AK	3	38	5	62	8
AL	18	86	3	14	21
AM	17	74	6	26	23
AN	110	80	27	20	137
AP	16	84	3	16	19
AR	27	69	12	31	39
AS	100	79	26	21	126
AX	105	48	112	52	217
AY	8	12	59	88	67
AYB	31	62	19	38	50
Total	687		373		1060
Area B, west					
H	4	18	18	82	22
I	63	66	33	34	96
J	17	41	24	59	41
JJ	1	20	4	80	5
JK	7	87	1	13	8
JL	8	36	14	64	22
KL	6	50	6	60	12
Total	106		100		206
Area C					
C	57	71	23	29	80
CE	13	72	5	29	80
CF	1	14	6	86	7
Total	71		34		105

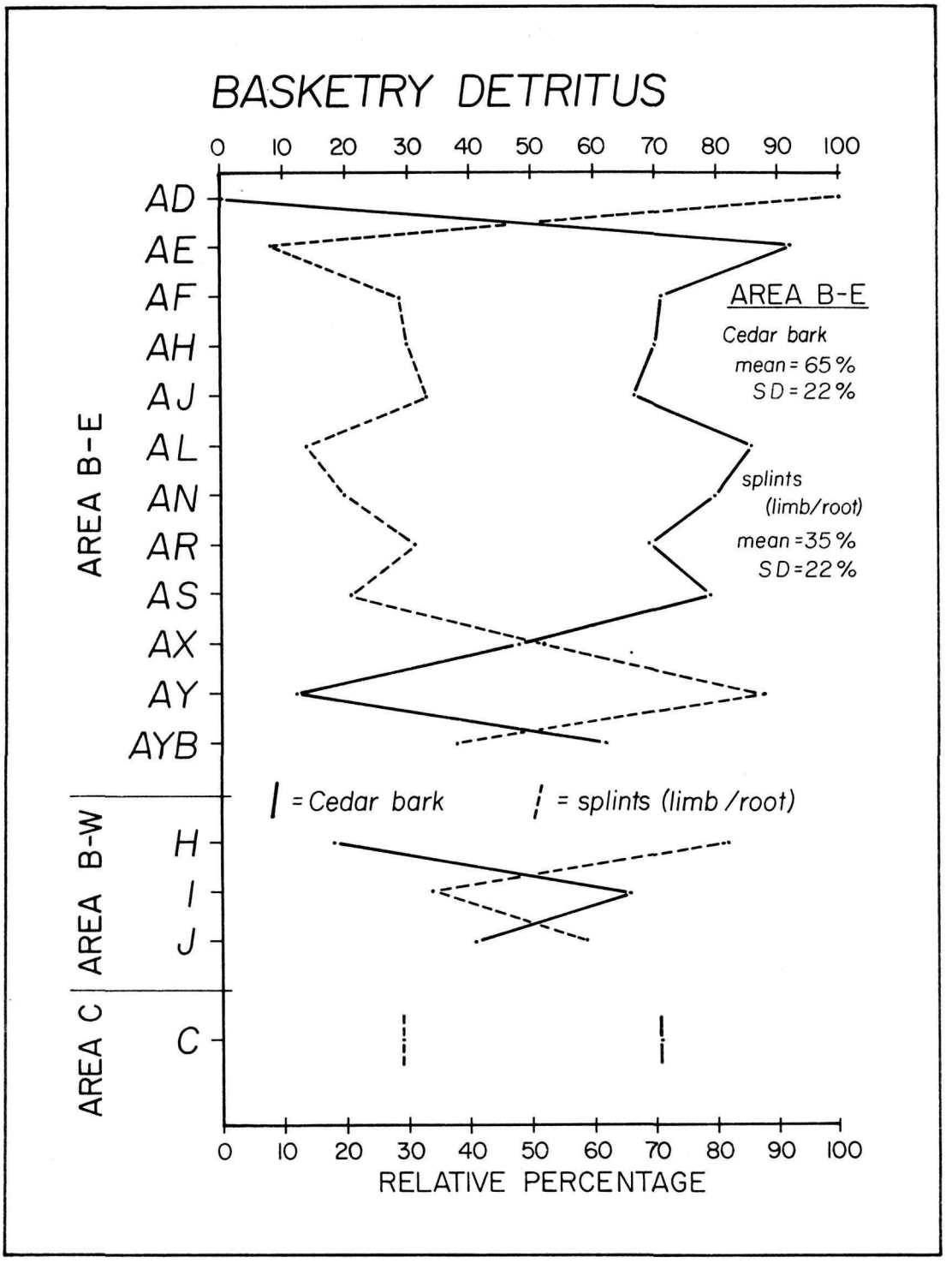


Figure 105. Frequency of basketry detritus per unit. Only units with 20 or more pieces are included.

splint basketry generally was being manufactured at the site.

Conclusions

From the above analysis, it appears that the people at Hoko were actively manufacturing basketry objects at that location. They were using both cedar-bark and splint basketry materials in similar proportions through the stratigraphic units, that is, through time. Evidence of the end product of these activities consists of the actual basketry objects discussed above, but the analysis described here expands our knowledge of the range of activities carried out at this location: basketry objects were not only used at the site, they were manufactured there as well. This would mean that Hoko was not just a fishing location were the people came for a brief period, where catching and preparing (preserving) fish took up everyone's time. Rather it would appear that this was a place where they spent a fair amount of time, permitting basketmaking and other equipment manufacturing activities to take place.

CORDAGE

by Dale R. Croes

Introduction

As has been the case at other wet sites on the Northwest Coast, the Hoko River site produced a large number of cordage artifacts (n=631). They are made with a number of different materials, techniques, numbers of strands, and gauges and are formed into lines, fishline leaders, nets, wood wedge collars, and binding elements. The Hoko River cordage characteristics (or modes) and their combinations into cordage classes (or types) are considered in this paper and compared with similar cordage modes and types from other Northwest Coast wet sites. The functional categorization of the cordage is discussed, placing these artifacts into the overall site-use context.

Construction Materials

Hoko River cordage was constructed from spruce/cedar rootlets (n=432; 68 percent), cedar boughs (n=161; 26 percent), cedar bark (n=23; 4 percent), and cherry bark (n=15; 2 percent). Cedar boughs and spruce rootlets are tightly twisted to form flexible cordage, whereas cedar and cherry bark are formed into long, narrow, thin strips to be used as cordage elements (for information concerning collecting and preparation of cedar bough, spruce root, cedar bark, and cherry bark, see Boas [1909]). These cordage construction materials are common to all Northwest Coast wet sites, but vary in frequency. Hoko River is distinctive because of its major emphasis on string gauge rootlet cordage (Figure 106;Croes 1979).

Construction Techniques

Hoko River cordage was produced by (1) twisting or plying, (2) braiding elements together, or (3) using strips as strap cordage. Twisted cordage elements (mostly cedar bough and spruce root) typically are twisted to the left (L) and plied together with a right (R) twist. This forms a Z lay. Only eight out of 611 twisted examples had an S lay--single elements twisted to the right and plied together to the left. Clearly Z-laid cordage is the main construction; Z lay also is the main direction recorded for twisted cordage from all Northwest Coast wet sites (Croes 1979).

Diameter Gauge

The proportions of different diameter measurements within the collection of twisted cordage from Hoko River is illustrated in Figure 106. As can be seen, a very high frequency (84 percent) fall into the string gauge range, and the remainder are in the cord to rope gauge. In comparison with other Northwest Coast wet sites, Hoko has the highest relative frequency of string-gauge cordage (see example comparison with Ozette Village in Figure 106). Most strings are the two-strand twisted rootlet lines characteristic of the site.

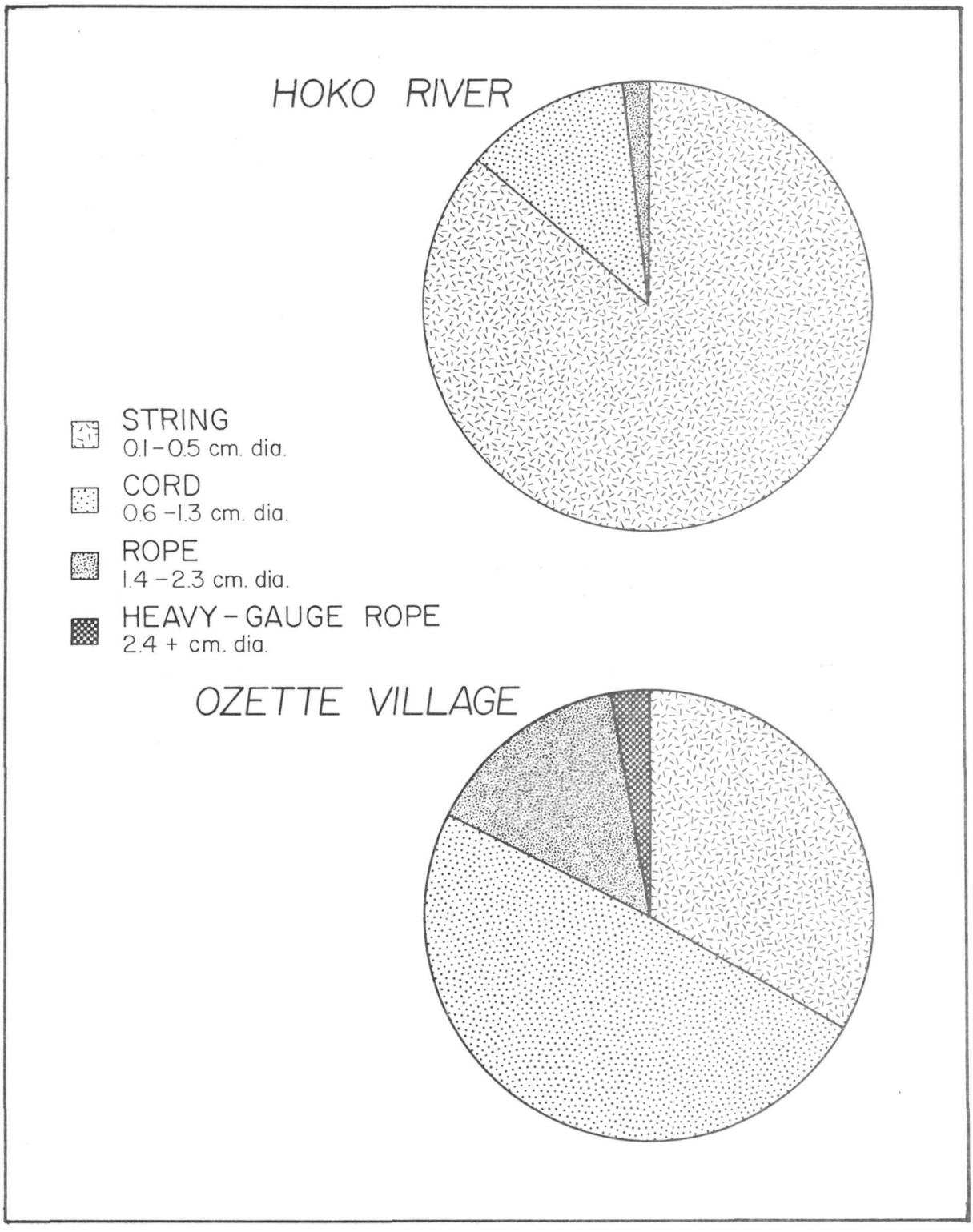


Figure 106. Frequency of cordage gauges recovered from Hoko River and Ozette Village.

Stylistic/Technological (S/T) Classification

The modes of Hoko River cordage discussed above--the construction materials, the construction techniques (including number of strands and lay/twist), and the gauge size--can be combined to form a paradigmatic classification of Hoko River cordage types. This is considered a stylistic/technological classification, and its main purpose is to demonstrate the range of cordage classes and also to create explicit class units for comparison with the same class units found at other Northwest Coast wet sites. This classification of Hoko River cordage types is shown in Figure 107.

As can be seen, several classes and subclasses (diameter gauge categories) of cordage occur. The frequencies of different classes vary greatly, with spruce root two-strand strings (HO-C9) being the most common (n=425; 67 percent). Different kinds of twisted bough and root cordage are present, and examples of braided cedar bark and strap cordage occur.

These classes and subclasses of cordage can now be compared with similar ones occurring at the ten other presently excavated Northwest Coast wet sites. The degree of similarity of S/T classes between sites can be measured. Since the relative frequency of occurring classes can reflect site-use, i.e., be indicative of the cordage used in particular activities common to the site, only the presence/absence of cordage S/T classes from each site is compared (Table 26). This is thought to be the most practical means of testing style similarities among sites. Twenty-six major cordage classes and 66 subclasses are compared, using an average-linkage cluster analysis on a matrix of Jaccard coefficient (Figures 108,109; definitions of classes are in Croes 1979:Fig. 7) and carrying out the computations by means of a computer program (developed by R. G. Matson from the University of Washington UWPGM program). The resulting dendrograms of (1) cordage class and (2) cordage subclass similarities are illustrated in Figures 108 and 109. As can be seen, both dendrograms are similar in arrangement. Unfortunately some sites (especially Fishtown and Conway) have too small a cordage sample size for serious consideration.

In the two dendrograms, the Hoko River cordage is consistently linked most closely with Ozette Village cordage. The sites share a wide variety of cordage classes, including cedar-bough withes (HO-C1), two- and three-strand cedar-bough cords (HO-C2, HO-C3 and HO-C4), two-strand cedar-bark strings and cords (HO-C5), cedar-bark braids (HO-C7), spruce-root strings (HO-C9), and cherry-bark strips (HO-C13). Since they are spatially close sites (Figure 110), and since other wet sites tend to cluster regionally also (i.e., the northern sites of Lachane and Axeti and the

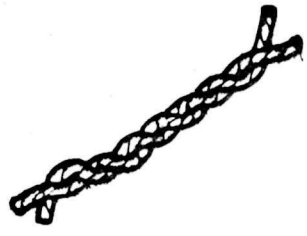
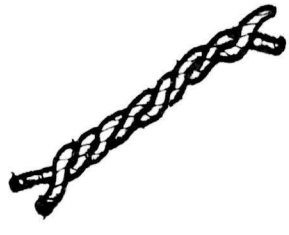
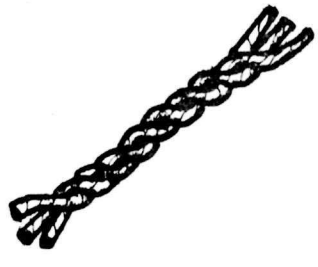
Definition	Illustration and Frequency of Occurrence
HO-C1. (OC1) MATERIAL: cedar bough CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 1 LAY/TWIST: -/L GAUGE SIZES (DIAMETER): a. String: n=96, 15% b. Cord: n=13, 2%	 (n=109, 17%)
HO-C2. (OC2) MATERIAL: cedar bough CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 2 LAY/TWIST: Z/R GAUGE SIZES (DIAMETER): a. String: n=12, 2% b. Cord: n=26, 4% c. Rope: n= 3, 1% d. Heavy-gauge Rope: n= 3, 1%	 (n= 42, 8%)
HO-C3. (OC3) MATERIAL: cedar bough CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 2 LAY/TWIST: S/L GAUGE SIZES (DIAMETER): a. String: n= 2, - b. Cord: n= 1, -	 (n= 3, 1%)
HO-C4. (OC4) MATERIAL: cedar bough CONSTRNQUE: twist NO. OF STRANDS: 3 LAY/TWIST: Z/R GAUGE SIZES (DIAMETER): b. Cord: n= 5, 1%	 (n= 5, 1%)

Figure 107. Stylistic/technological classification of Hoko River cordage. Ozette cordage class (OC) designations are recorded in parentheses under the Hoko River designations (see Croes [1979] for complete Ozette class listing).

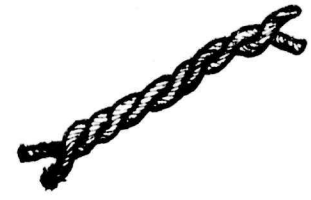
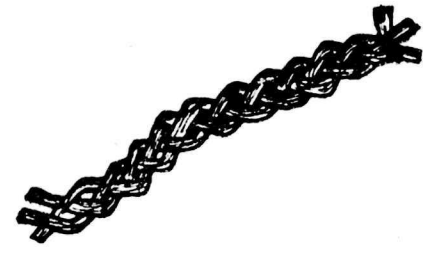
Definition	Illustration and Frequency of Occurrence
HO-C5. (OC9) MATERIAL: cedar bark CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 2 LAY/TWIST: Z/R GAUGE SIZES (DIAMETER): a. String: n= 1, - b. Cord: n= 3, 1% c. Rope: n= 2, -	 (n= 6, 1%)
HO-C6. (OC10) MATERIAL: cedar bark CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 2 LAY/TWIST: S/L GAUGE SIZES (DIAMETER): a. String: n= 1, -	 (n= 1, -)
HO-C7. (OC13) MATERIAL: cedar bark CONSTRUCTION TECHNIQUE: braid NO. OF STRANDS: 3 LAY/TWIST: not applicable GAUGE SIZES (WIDTH): a. String: n= 1, - b. Cord: n= 5, 1% c. Rope: n= 1, -	 (n= 7, 1%)
HO-C8. (OC15) MATERIAL: cedar bark CONSTRUCTION TECHNIQUE: strap cordage NO. OF STRANDS: 1 LAY/TWIST: not applicable GAUGE SIZES (WIDTH): a. String: n= 6, 1% b. Cord: n= 2, - c. Rope: n= 1, -	 (n= 9, 1%)

Figure 107. (continued)

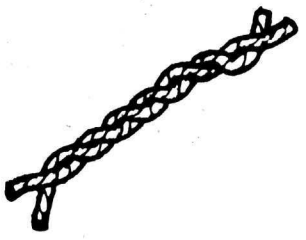
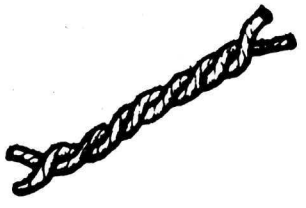
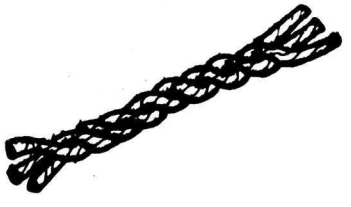
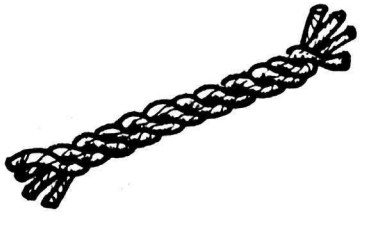
Definition	Illustration and Frequency of Occurrence
HO-C9. (OC20) MATERIAL: spruce/cedar root CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 2 LAY/TWIST: Z/R GAUGE SIZES (DIAMETER): a. String: n=406, 65% b. Cord: n= 16, 3% c. Rope: n= 1, -	 (n=425, 67%)
HO-C10. (OC21) MATERIAL: spruce/cedar root CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 2 LAY/TWIST: S/L GAUGE SIZES (DIAMETER): a. String: n= 2, -	 (n= 2, -)
HO-C11. (OC22) MATERIAL: spruce/cedar root CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 3 LAY/TWIST: Z/R GAUGE SIZES (DIAMETER): a. String: n= 1, - b. Cord: n= 2, -	 (n= 3, 1%)
HO-C12. (OC23) MATERIAL: spruce/cedar root CONSTRUCTION TECHNIQUE: twist NO. OF STRANDS: 4 LAY/TWIST: Z/R GAUGE SIZES (DIAMETER): a. String: n= 2, -	 (n= 2, -)

Figure 107. (continued)

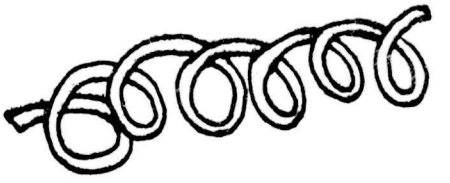
Definition	Illustration and Frequency of Occurrence
HO-C13. (OC25) MATERIAL: cherry bark CONSTRUCTION TECHNIQUE: strap cordage NO. OF STRANDS: 1 LAY/TWIST: not applicable GAUGE SIZES (WIDTHS) a. String: n= 9, 1% b. Cord: n= 5, 1% c. Rope: n= 1 -	 (n= 15, 2%)
HO-C14. (OC26) MATERIAL: root or limb splint CONSTRUCTION TECHNIQUE: strap cordage NO. OF STRANDS: 1 LAY/TWIST: not applicable GAUGE SIZES (WIDTHS) a. String: n= 2, -	 (n= 2, -)
	TOTAL: n=631

Figure 107. (continued)

Table 26

Occurrence of cordage classes and subclasses recorded from Northwest Coast wet sites[1]

Cordage classes and subclasses	Ozette Village	Hoko River	Musqueam Northeast	Biederbost	Axeti	Lachane	Conway	Fishtown	Wapato Creek	Little Qualicum River
(HO-C1)										
OC1a	+	+	+	+	+	+				
OC1b	+	+	+	+	+	+		+		+
OC1c	+			+			+			+
OC1d	+									+
(HO-C2)										
OC2a	+	+	+	+						+
OC2b	+	+	+	+	+	+			+	+
OC2c	+	+	+	+			+	+		
OC2d	+	+								+
(HO-C3)										
OC3a	+	+								
OC3b	+	+								
OC3c	+									
(HO-C4)										
OC4a	+		+							
OC4b	+	+	+	+						
OC4c	+		+	+						+
OC4d	+									
OC5a	+									
OC5b	+		+							
OC5c	+									
OC6a	+									
OC6b	+		+							
OC6c	+									
OC6d	+									
OC7a	+									
OC7b						+				
OC8b	+		+							
(HO-C5)										
OC9a	+	+	+		+	+				+
OC9b	+	+	+		+	+				+
OC9c		+			+					
OC9d					+					

Table 26 (continued)

Cordage classes and subclasses	Ozette Village	Hoko River	Musqueam Northeast	Biederbost	Axeti	Lachane	Conway	Fishtown	Wapato Creek	Little Qualicum River
(HO-C6)										
OC10a	+	+								
OC10b	+									
OC11a					+					
OC11b	+				+	+				
OC11c					+					
OC12a	+									
(HO-C7)										
OC13a	+	+			+					+
OC13b	+	+		+	+	+	+			+
OC13C	+	+			+		+			+
OC13d	+				+					
OC14a	+									
(HO-C8)										
OC15a	+	+								+
OC15b	+	+			+	+				+
OC15c	+	+								
OC15d	+									
OC16a	+									
OC16b	+				+					
OC16c	+									
OC16d	+									
OC17a	+									
OC18d	+									
OC19a	+									
(HO-C9)										
OC20a	+	+								
OC20b	+	+								
OC20c	+	+								
(HO-C10)										
OC21a	+	+						+		

Table 26 (continued)

Cordage classes and subclasses	Ozette Village	Hoko River	Musqueam Northeast	Biederbost	Axeti	Lachane	Conway	Fishtown	Wapato Creek	Little Qualicum River
(HO-C11)										
OC22a	+	+								
OC22b	+	+								
(HO-C12)										
OC23a		+								
OC23b	+									
OC24a	+									
OC24b	+									
(HO-C13)										
OC25a	+	+	+	+				+		+
OC25b	+	+					+	+		+
OC25c		+								
(HO-C14)										
OC26a	+	+			+					
OC26b	+				+					

[1]Actual frequency of collections: Ozette Village 1967; Hoko River 633; Musqueam Northeast 108; Biederbost 59; Axeti 671; Lachane 23; Conway 12; Fishtown 9; Wapato Creek 1; Little Qualicum River 47.
[2]Class designations after assignments of Ozette cordage ()C) classes (Croes 1979); Hoko cordage classes (HO-C) are given in parentheses.

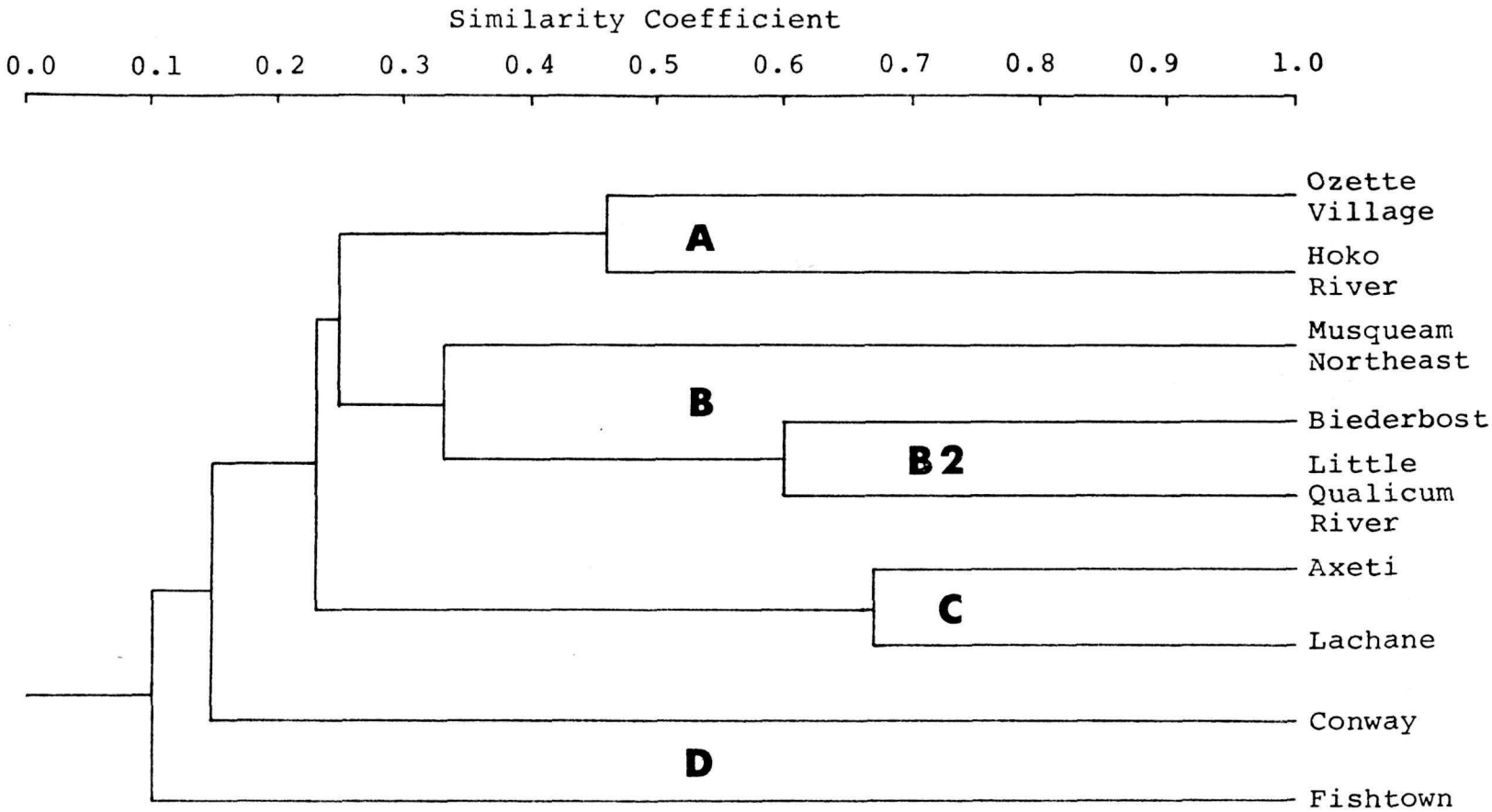


Fig.108. Dendrogram representing an average linkage cluster analysis of Northwest Coast wet site cordage classes on a matrix of Jaccard's coefficients. Degrees of similarity: 1 = complete similarity to 0 = no similarity.

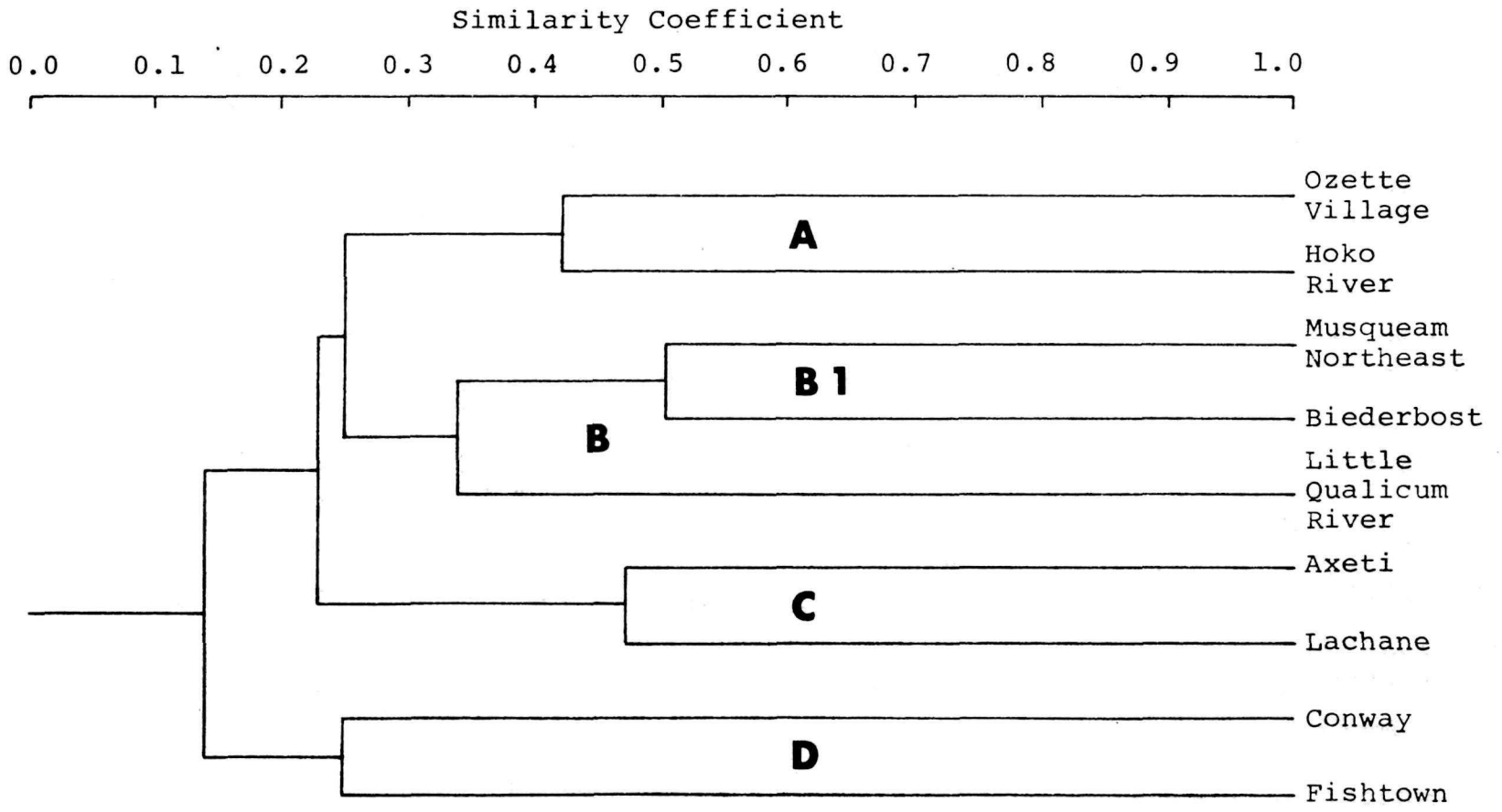


Fig.109 . Dendrogram representing an average linkage cluster analysis of Northwest Coast wet site cordage subclass (based on diameter gauge) on a matrix of Jaccard's coefficients. Degree of similarity: 1 = complete similarity to 0 = no similarity.

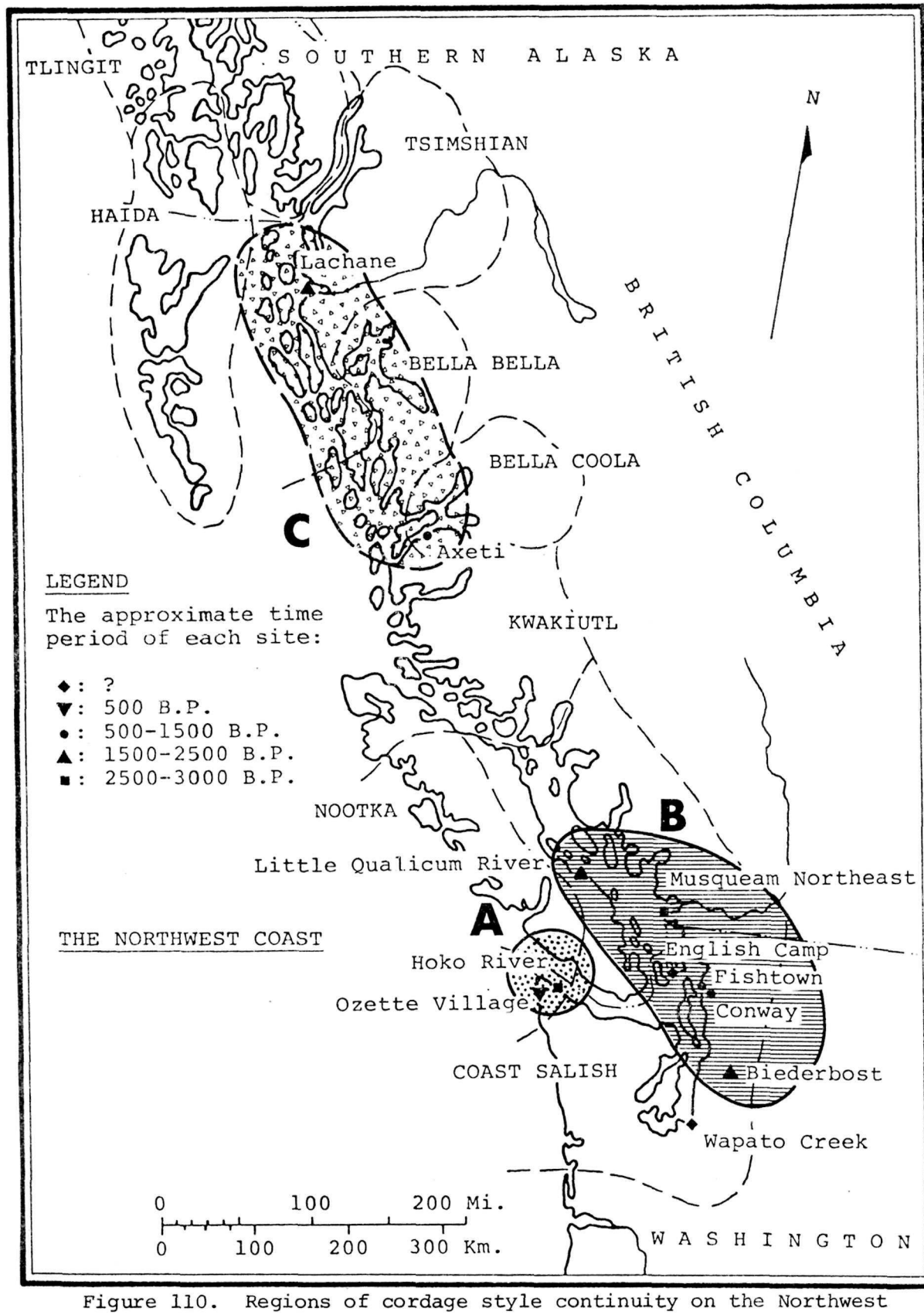


Figure 110. Regions of cordage style continuity on the Northwest Coast, based on average linkage cluster analysis. Reproduced from Croes 1979.

early Puget Sound/Gulf of Georgia sites of Biederbost, Musqueam Northeast, and Little Qualicum River), a regional continuity of cordage S/T classes and subclasses through time in these regions is suggested. Since these data are consistent with regional basketry style continuity between Hoko River and Ozette (Croes 1977; see also Basketry, above) as well as in other regions, the hypothesis of cultural continuity in these areas certainly is supported. It is becoming more apparent that the many style similarities between Hoko River and Ozette Village are not coincidental.

Knots and Functional Forms

Several knotting, hitching, and whipping techniques are recorded on cordage from Hoko River (Table 27). Especially common knots are overhand, square, and granny knots. Overhand knots probably were used for a variety of purposes, including use as stopper knots (Figure 111) and use as whips to keep the ends of cordage lines from unraveling. Square knots were used to tie the ends of fishline leaders and as net knots (discussed below). In nets this typically is the knot tied by hand, without a netting needle (Ashley 1944:64-65). Granny knots are common at Hoko, and they were used mostly to tie rootlet strings together. Clove hitches are common and are found attached to the knob end of composite and bentwood fishhooks (see Figures 58,59,63 and 64).

Forms of Hoko River cordage include lines, wedge collars, fishline leaders, nets, rigid lattice works, and cherry/spruce-root binding elements. Each form and its functional implications will be discussed separately below.

Independent lines are the most frequent examples (n=605; 96 percent) and typically occur as small broken pieces. The lines mainly are two-ply rootlet strings (HO-C9) that probably were once parts of fishline leaders, sewing elements in sewn tule mats (Figure 96), and/or twining elements in shredded cedar bark skirts (Figure 97). They are recorded in these three functional contexts at the site. Also found are cedar-bough withe lines (Figure 112), two- and three-strand cedar-bough or spruce-root cords and ropes (Figure 113), and multistrand cedar-bark lines (Figure 114).

The cordage wedge collars (n=8) typically are two- or three-strand twisted cedar-bough grommets that are recovered both independently and on the poll ends of wooden wedges (Figures 115, 124). These collars would have prevented the wedge end from splitting while it was pounded into a log in the process of removing boards. Multistrand collars on wedges are recorded at most Northwest Coast wet sites through time.

Table 27

Knotting, hitching, and whipping techniques recorded at the Hoko River site

Technique	Frequency
Knotting	
Overhand	51
Square	34
Granny	24
Running noose	4
Figure 8	2
Sheetbend	1
Total	116
Hitching	
Clove hitch	10
Cow hitch	1
Half hitch	1
Total	12
Whipping	
Overhand whip	19
Wrap whip	1
Total	20

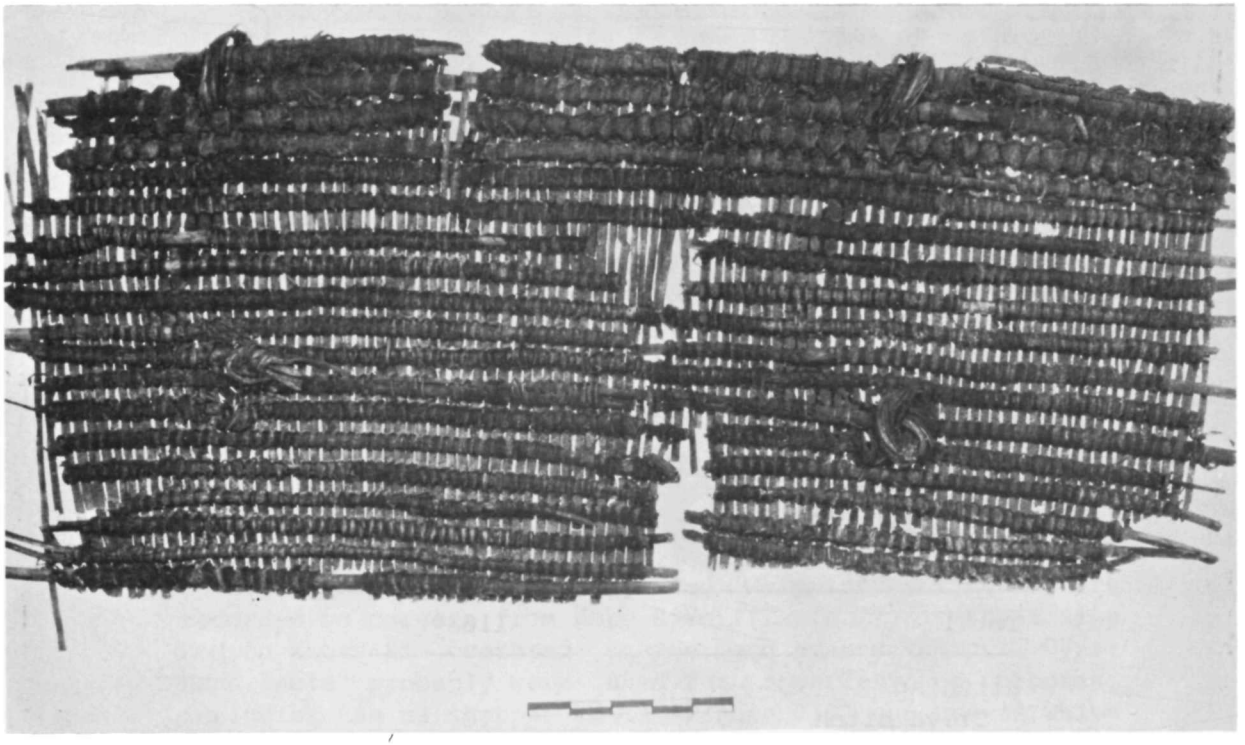


Figure 111. Inside surface of a burden basket, illustrating the use of overhand knots as stopper knots in initiating the cordage tumpline loops. (See also Figures 82, 86)

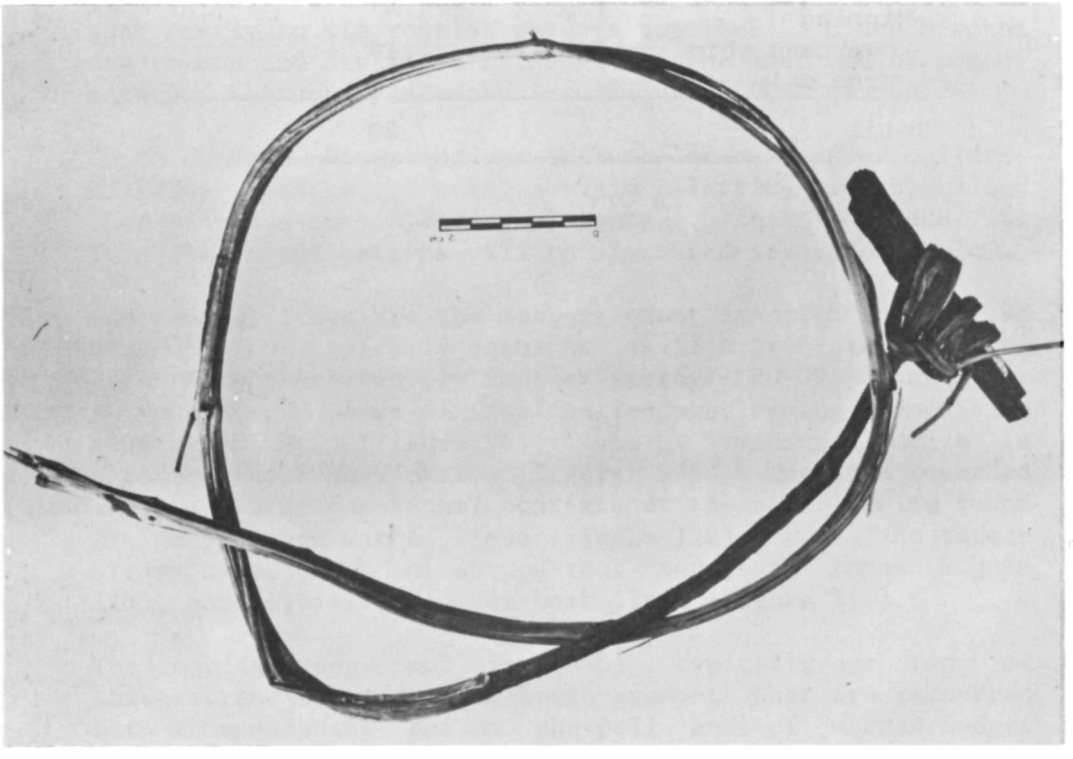


Figure 112. One strand, cedar-bough, twisted withe attached to a stake with a clove hitch.

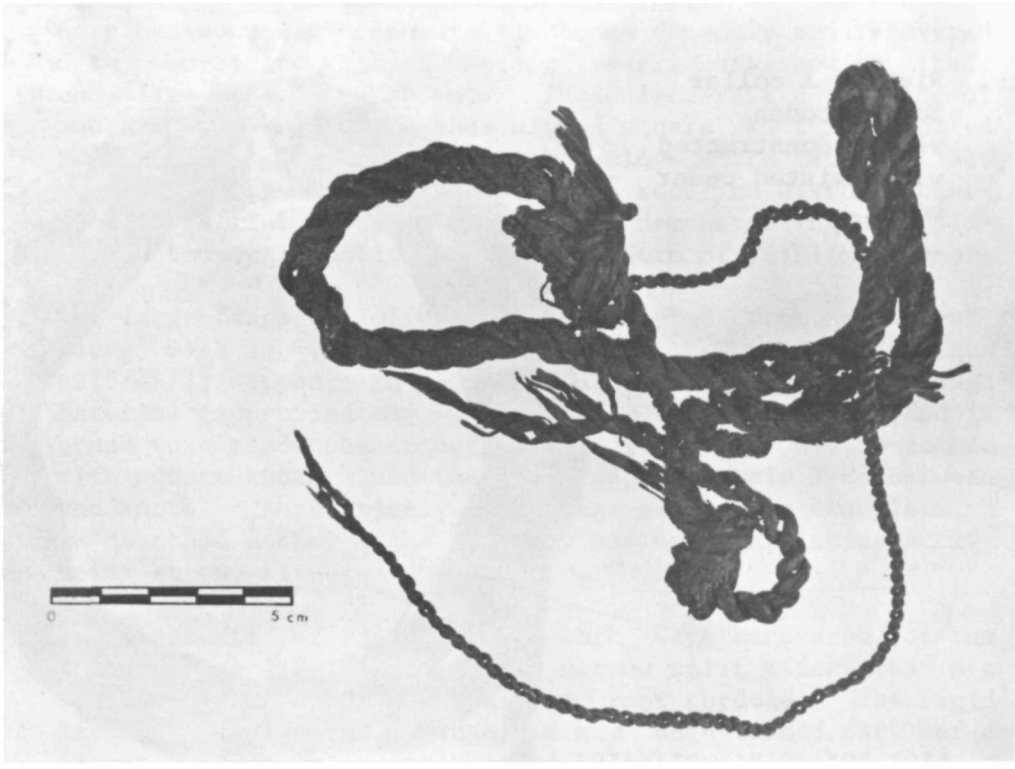


Figure 113. Two spruce root lines (a three-strand rope and a two-strand string) tied together with multiple knots.

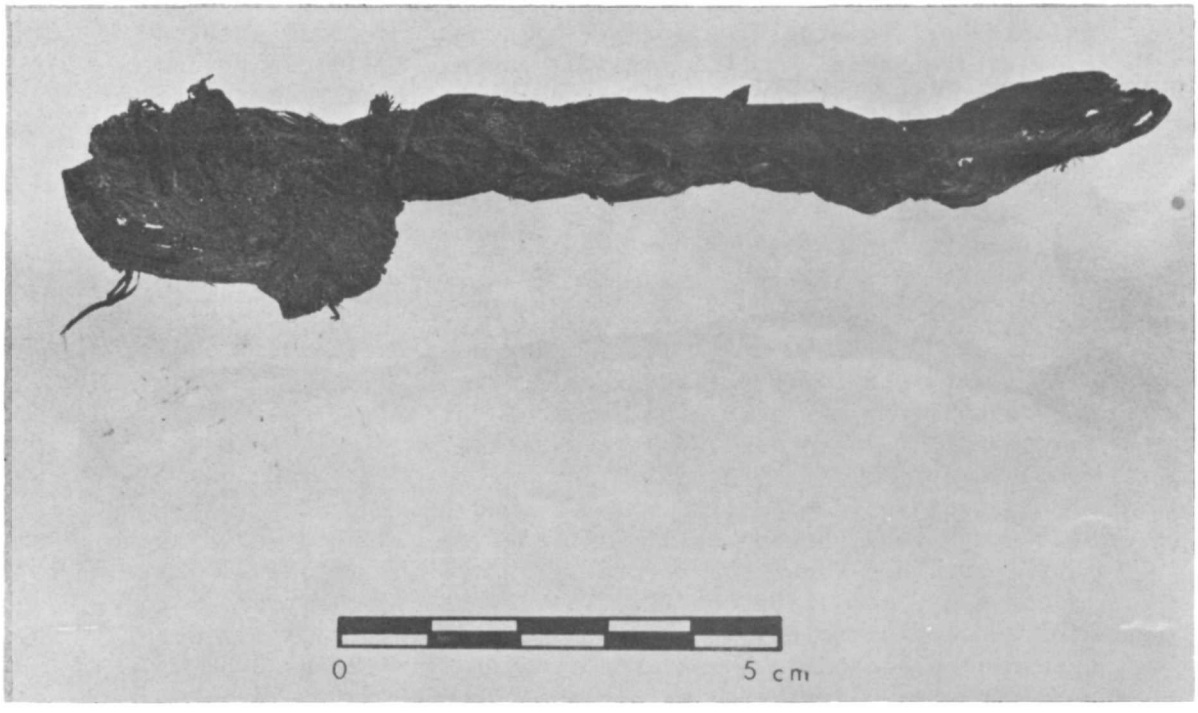


Figure 114. A three-strand cedar bark line with an overhand whip on its end.

Figure 115. Right. A collar for a wooden wedge, constructed with twisted cedar bough.

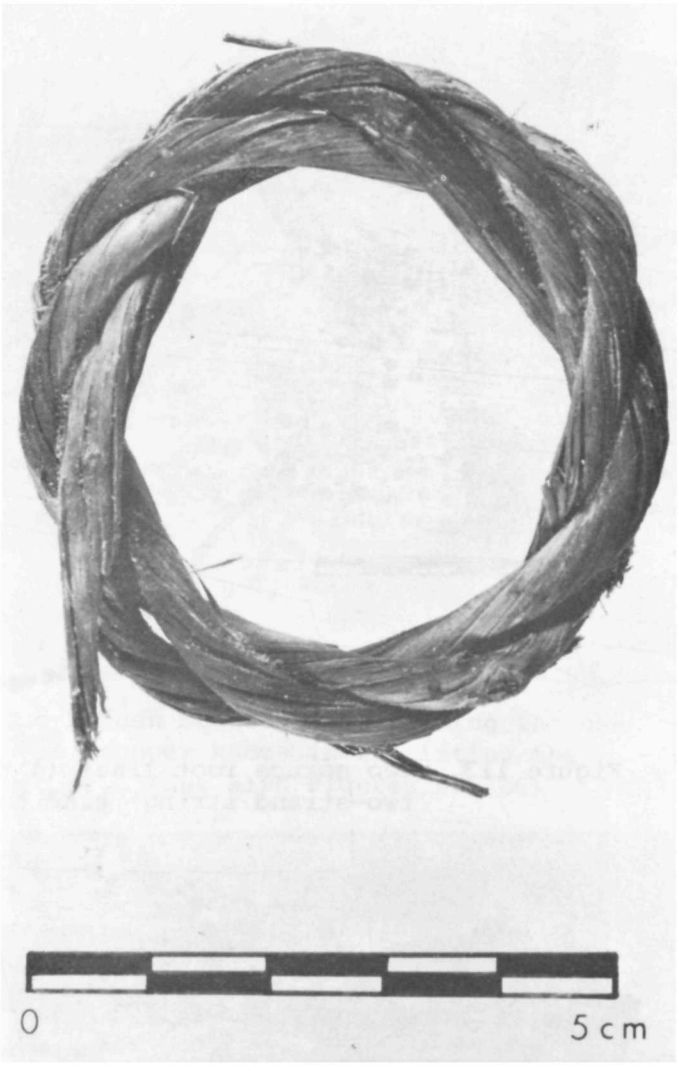
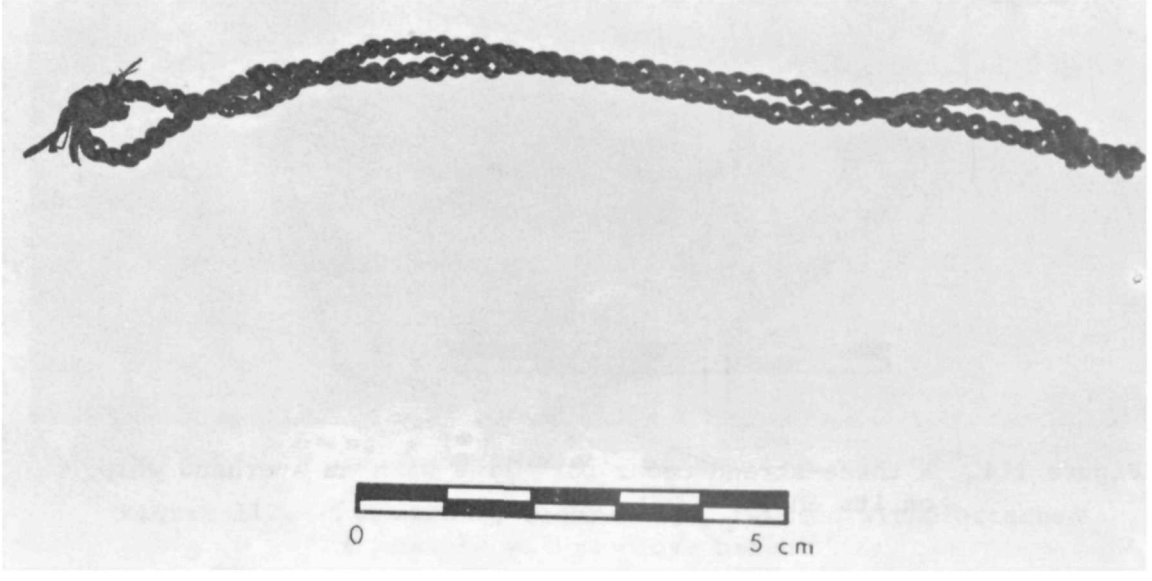


Figure 116. Below. Detached rootlet fishline leader with a square knot on its end.



Both bentwood and composite fishhooks commonly are recovered with two-strand rootlet string leaders attached to their ends (see Fishhooks, above). These leaders are composed of one string tied on the ends with a square knot and applied to the knob end of the hook with a clove hitch (Figure 116). The same form of fishline leader is seen on historic bentwood or halibut hooks in this area, demonstrating a considerable temporal continuity for this form of fishline leader.

One large fragment of a net was recovered from Hoko River, along with a very small fragment. The larger piece (215/AS/1) appears to be constructed of split spruce-bough material (approximately .4 to .5 cm wide strips) and is bound to a sandstone anchor (Figure 117). The net is formed with square knots, and there are approximately 5 cm between the knots. A relatively wide-gauge net, this example with an attached anchor stone probably was used in fishing activities at the site.

Two fragments of rigid lattice-work were recovered at the site (Figure 118). These are narrow split sticks that are open-twined together with twisted root cordage. The rigid lattice-work is small gauge and may have formed part of a dipnet or weir (also see Munsell 1976a:50, 1976b:102-103).

Narrow cut strips of cherry bark and split root are found as separate pieces at Hoko River and also as binding elements holding together composite fishhooks (Figure 64) and binding hafted microlith knives (Figure 127). These strips were prepared as binding elements, and probably they were used for several binding purposes.

Summary and Conclusions

Hoko River cordage is characterized by a wide variety of modes, classes (types), and functional forms. When these modes and stylistic/technological classes of cordage are compared with other Northwest Coast wet sites, it becomes clear that the Hoko site shares the greatest degree of similarity with cordage from Ozette Village. This corresponds with the basketry style similarities between these two sites (Croes 1977; see Basketry, above) and lends additional support to a hypothesis of cultural continuity in this south-central region of the Northwest Coast for approximately 2500 to 3000 years. The functional forms of Hoko River cordage associate with fishing activities (fishline leaders), mat forms (sewn tule mats), clothing (twined shredded cedar-bark skirts), woodworking practices (wooden wedge collars), procurement techniques (nets and open lattice-work), and manufacturing activities (cherry-bark/spruce-root binding ele-



Figure 117. Split twig net with attached sandstone anchor. Knots are square knots and the mesh measures approximately 5 cm between knots.

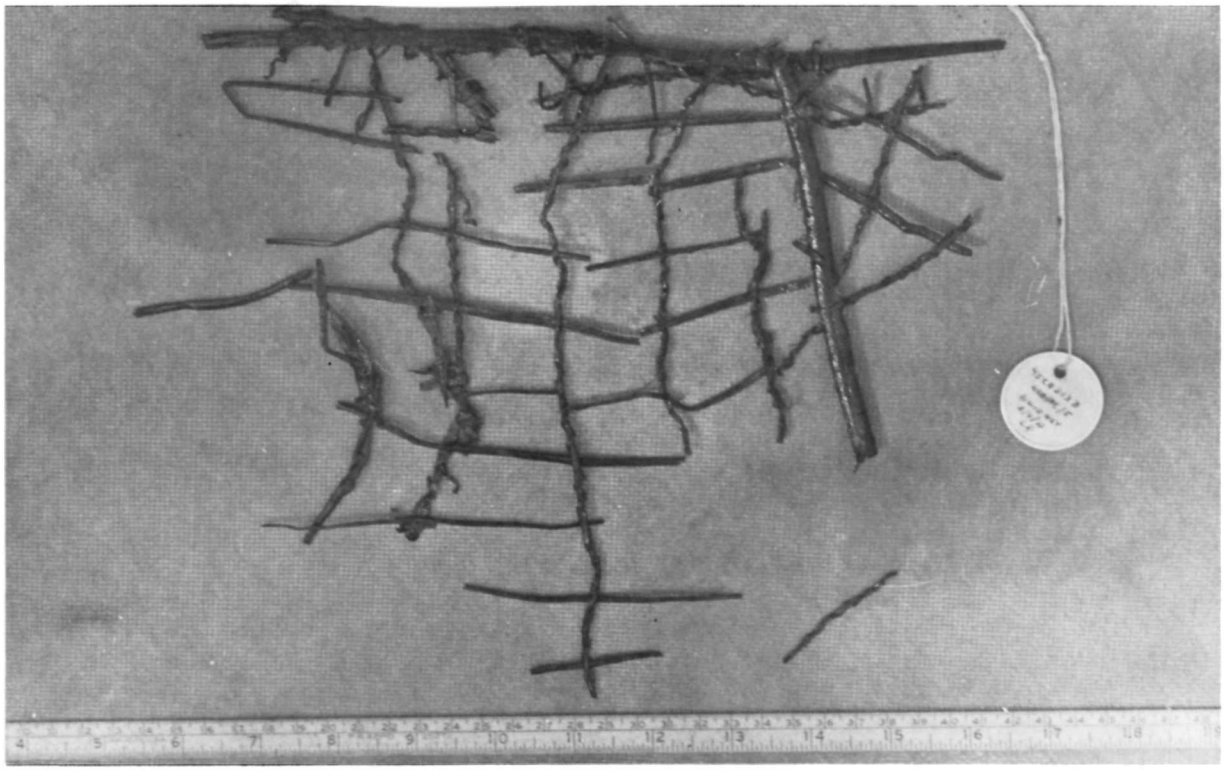


Figure 118. Rigid lattice-work made from split and twisted elements.

ments). Cordage from Hoko River has proved to be stylistically and technologically useful in comparative studies. It also reflects many of the activities participated in by the people who occupied this 2500-year-old fishing camp.

TENSILE STRENGTH OF REPLICATED HOKO RIVER CORDAGE

By Jennifer V. Jones-Brooks

Cordage fragments constitute a large percentage of the artifacts recovered from the Hoko River site during the summer of 1977 (n=625, 55 percent). Most of the cordage is composed of roots of conifers such as cedar or spruce and is two ply with a Z lay (as discussed above). The fragments range from 1 to 10 mm in diameter. Two apparent uses of the cordage were for fishhook leaders and in the construction of sewn mats and garments. Roughly 2500 years of water-logging have robbed the recovered cordage of its original strength and give purpose to this project which is to test the tensile strength of replicated cordage and to infer from the results additional information about the recovered cordage.

Replication of the Hoko River Cordage

Replication posed the first set of problems: gathering the materials, preparing them, and making them into cordage. I chose the western red cedar (Thuja plicata) for this experiment because this tree is available both near the Hoko River site and near Washington State University. The preliminary tests were done in the field and at the Neah Bay Lab in the summer of 1977. For these tests I used roots from a grove of western red cedar trees that were west of Neah Bay, Washington, approximately 20 miles from the Hoko site. Cedars on Moscow Mountain, some 18 miles east of Pullman, Washington, provided the roots for the main body of tests done in the fall of 1977.

The cordage materials gathered in Idaho can be compared with those from Hoko and Neah Bay because the structure of Thuja plicata roots does not vary much from tree to tree. The roots take in a certain set of nutrients, and there probably is no particular strengthening factor in the soil of one area as opposed to that of another.

When the roots were gathered, it was found that the best quality roots were in the small clearings between younger

trees, especially along nurse logs and sometimes at the base of the tree itself (see also Boas 1909). Small diameter roots were the most desirable for this project; they ran nearly parallel and fairly close to the suface. When the bark of these roots is scratched, a bright red color appears, identifying the root as cedar. Native peoples typically used digging sticks for locating and removing roots; although it could be considered a breech in the rules of replication, we used short handled, three-pronged garden claws.

The next step, preparation, is best done immediately after the roots are gathered. Several gathered roots were wasted when preparation was postponed. Preparation entails two phases: peeling the outer bark and twisting the roots into preliminary kinks. To peel the bark, the replicators gently heated the roots over the coals of a fire to make the sap run, placed the heated root into a prepared tong--a split stick approximately 1.5 m long and 3.5 cms in diameter---clamped the sides of the stick together with one hand, and pulled the root through the slot with the other. This process usually strips the root of its bark completely (see Boas 1909:377-378; 1913:313-318); if it fails to do so, one can employ teeth and fingernails successfully.

Kinking a root is the act of twisting it until it bends sharply back upon itself. The entire length of the root must be twisted in this manner. Kinking loosens the fibers of the root and allows it to be stored indefinately in a twisted condition; it is, however, a slow laborious process for the inexperienced worker. At this point another departure from the rules of exact replication was taken. A hand drill with a bit can accomplish the same amount of twisting faster and with less strain to the hand, and this tool was used to prepare experimental cordage.

The last step in replication was the manufacture of cordage similar to the Hoko River cordage. Analysis of the cordage provided the control for manufacture in terms of diameter and the number of twists per unit distance. Each diameter had a specific range of twists per 2 cm, and the replicated cordage followed these specifications (Table 28). To manufacture cordage, the dried kinked roots were soaked in fresh warm water for a few hours to make them pliable, then they were unwound just enough to remove the sharp bends while leaving the twist. One twisted root, folded in half, formed both plies of a finished cord. To twine the plies, the midpoint of the root was secured either under the worker's second toe or around a small nail protruding from a fixed board while the hands retwisted and plied the elements into cordage (see Boas 1909:381). When this is done properly, the cordage will not unravel. Knots in the roots cause problems in that they do not readily twist and either the root will

Table 28

Numbers of twists per length for various diameters of Hoko River cordage artifacts

Number of twists per 2 cm length	Cordage diameter (mm)	Percent of cordage of indicated diameter having given number of twists
8 - 9	1	100.0
5 - 7	2	63.4
4 - 6	3	66.2
4 - 6	4	74.0
2 - 5	5	73.8
2 - 4	6	75.0
2 - 5	7	74.5
2 - 3	>7	66.3

Table 29

Preliminary tests, replicated cordage tensile strength[1]

Root type	Cordage condition[2]	Cordage diameter (mm)	Wet/dry	Position of break	Pound test	Number of Plies broken[3]
Cedar	Fair	3	Wet	Pinchers	23.51	both
Cedar	Poor	2	Wet	1 cm from clamp	20.51	1
Cedar	Fair	5	Dry	Pinchers	52.01	both
Cedar	Fair	2	Dry	5 cm from pinchers	22.25	1

[1]More that one type of material was tested, but these results are not included in this report.
[2]Cordage condition is an indicator of quality: Good = no obvious flaws; Fair: 1 or 2 knots, brittleness, poor twining; Poor: an increase in the above flaws.
[3]All of the tests were done on 2-strand, Z-laid cordage.

break during preparation or the finished string will be flawed. These knots cause one ply to make more twists that the other, so that there is an uneven load distribution.

The time element involved in cordage replication is significant. I found that only about 50 cordage pieces could be prepared and made in a full day's time. Even taking my inexperience into account, this is still a considerable amount of time, and native cordage makers must have spent sizable periods of time making strings, given the numbers that are recovered at Hoko River.

Tensile Strength Tests

The preliminary tensile strength testing done during the summer of 1977 used simple test devices. The original idea was to secure one end of the replicated cord to a fixed object and the other end to an empty bucket. The plan was to pour known amounts of sand into the bucket until the cord broke. Technical difficulties such as the problem of manufacturing a cord of sufficient length to permit tying two knots, knot failure, and uncontrollable outside influences such as wind defeated this method before it was implemented.

Gerald Grosso, Neah Bay laboratory, designed and provided the first satisfactory testing device. This instrument incorporated a gauge which measured in pounds of pull the strength of the cordage and determined the breaking point (Table 29). Inherent problems with this machine were the fiber damage caused by pincher grips and a lack of information on the stretch of cordage during the test.

Gary Sheldon, Mechanical Engineering Department, Washington State University, allowed me to use an elaborate tensile strength testing machine (Figure 119). It usually tests material such as steel cables, but with the proper load cell it is sensitive enough to test small diameter replicated cordage. Two large clamps hold the ends of the cordage while the machine slowly pulls from both ends. A pen connected to the machine records the pounds test strength and the amount of stretch on a sheet of graph paper. The clamps were padded with strips of inner tube rubber in order to limit fiber damage.

There are four obvious tensile strength determinants: root (and therefore finished cordage) quality, wetness or dryness of the cords, diameter, and the number of plies tested simultaneously (Table 30). Figures 120-123 illustrate each of the above characteristics. When a cord was tested for one of the four factors, all of the others were comparable.

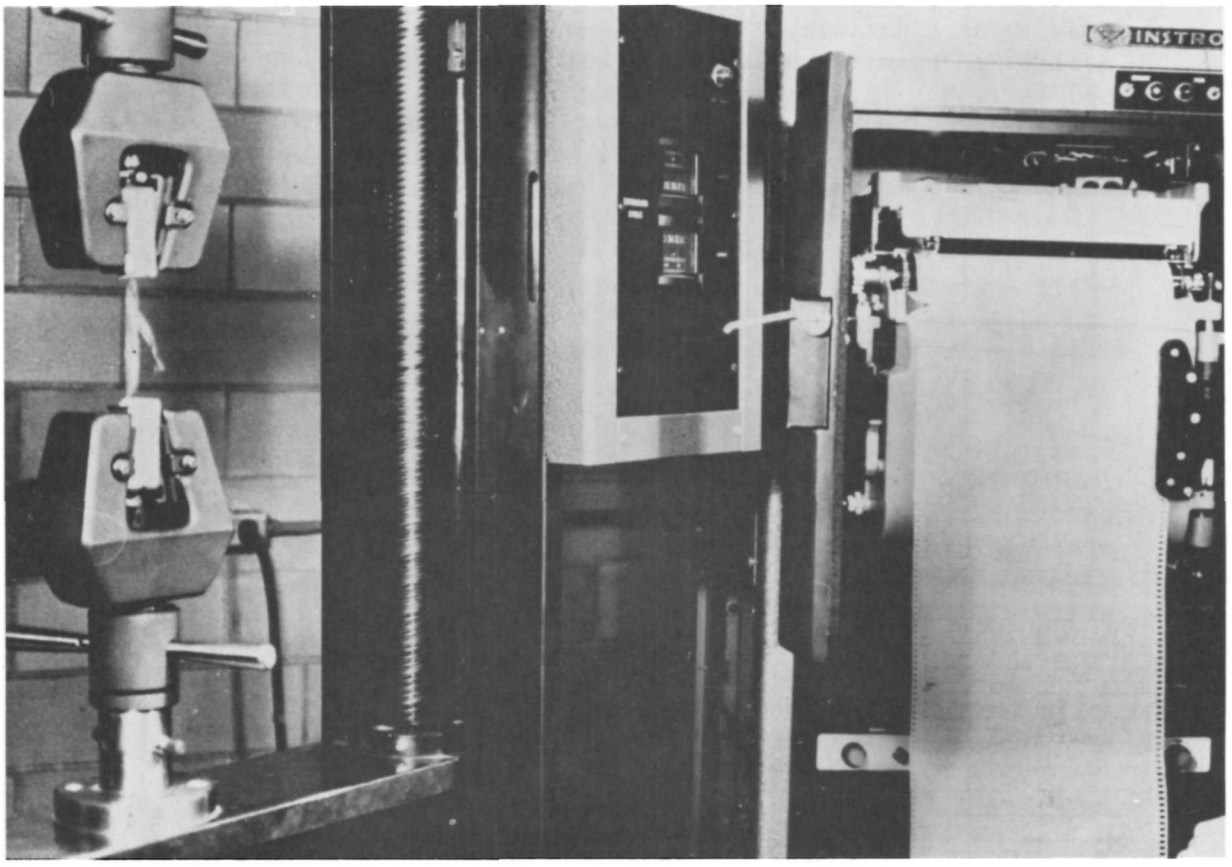


Figure 119. Tensile strength testing machine.

Table 30

Main tests, replicated cordage tensile strength[1]

Sample number	Diameter (mm)	Number twists per 2 cm	Cordage condition[2]	Number strands[3]	Wet/dry	Number plies broken	Pound test[4]
3a[5]	2.5	6	Good	Single	Dry	1	33.0
3b	2.1	6	Fair	Single	Dry	1	28.0
3c	2.5	5	Poor	Single	Dry	1	14.0
4a	3.0	5	Fair	Single	Wet	1	42.5
4b	3.3	5	Fair	Single	Dry	1	49.0
4c	3.5	4	Fair	Single	Wet	1	41.5
5	2.9	5	Fair	Single	Dry	1	37.5
6a	2.5	5	Fair	Single	Dry	1	39.25
6b	2.0	4	Good	Single	Dry	1	39.25
7a	3.2	4	Fair	Single	Wet	1	51.5
7b	3.2	4	Good	Single	Dry	1	57.0
8	2.3	5	Good	Double	Dry	1	70.0
9	2.5	6	Good	Single	Dry	2	37.0
10	2.0	6	Good	Double	Wet	1	31.0

[1]The main tests were done with a tensile strength machine in the Mechanical Engineering Department, Washington State University.
[2]Cordage condition: same as Table 29, note 2.
[3]Double means that two strands of two-ply cordage were tested simultaneously.
[4]The pound test was recorded when the first ply broke.
[5]Parts a, b, and c are from the same piece of cordage if their number is the same.

Figure 120 shows the cordage strength difference based on quality. Usually poorer quality cords are weaker. Knots in the root cause one ply to make more twists then the other, thus causing an uneven load distribution between the plies so that one ply breaks sooner than it should. Most of the cords tested snapped one ply at a time. Cords with broken plies are still somewhat viable; the peaks on the graph after the initial peak indicate the breaking of the other plies involved in the test.

Figure 121 compares wet cordage with dry. Dry cordage withstands a greater pound test than the wet; however, the wet stretches more. This stretching could allow for more play in the line and a greater apparent strength.

Figure 122 plots diameters. Greater diameters equal stronger cords for the most part. From the diameter information, some of the best inferences about the artifact cordage can be drawn. Artifact cordage diameters and number of plies are easily measured aspects; the other factors must be surmised. Average strength determined for each diameter of the replicated cords can be used with the measured diameter of artifact cord to set up ratios estimating the tensile strength of the artifacts. This type of estimation would be most accurate when data from a very large sample of each diameter, perhaps from 1 to 5 mm, have been collected and set into an easily readable chart. The type of experiment done in this project and the inferences derived from it can be extended to other forms of cordage such as braided cedar-bark lines.

Leaders are two lines of two-ply cordage held side by side. Figure 123 compares a wet double-line leader with a dry one; the dry leader proved to be much stronger, and the wet one stretched a great deal. The vast difference between these two leaders is hard to account for on the basis of wet/dry alone, yet all other aspects were very comparable. At this point it is not known if the results of this test are valid. The writer included them to show that leaders are considerably stronger than single strand lines. Replicated double strand fishline leaders can hold considerable weight, reflecting the size of fish that can be handled, and the strength would increase under water. Therefore a 100 pound fish could concievably be brought in with these leaders. More testing of leaders is needed.

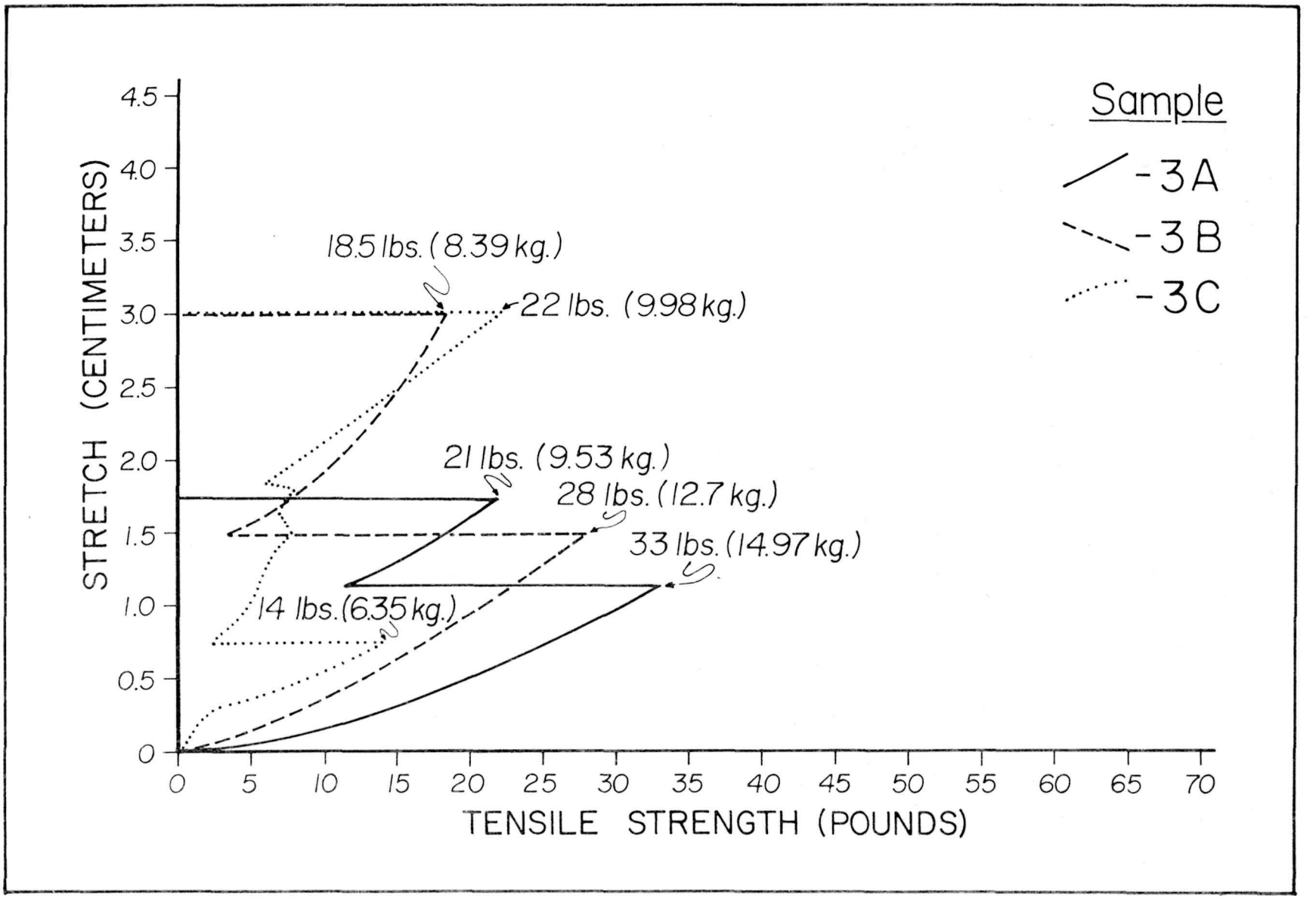


Figure 120. Test of cordage strength based on quality. Sample 3A is rated good; 3B is fair; 3C is poor. See Table 29 note 2 for definition of the quality characteristics.

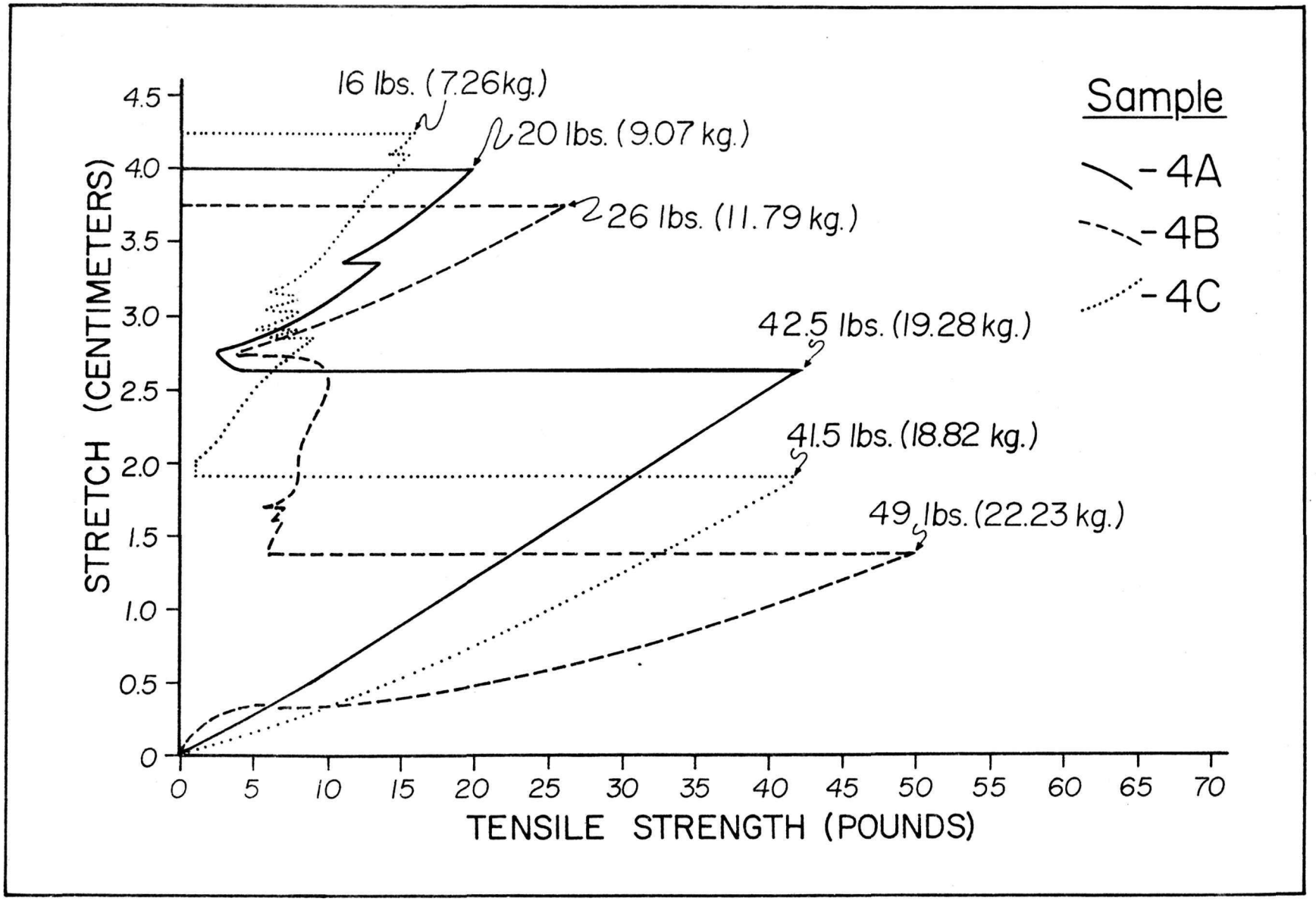


Figure 121. Test of cordage strength based on wetness vs. dryness. Samples 4A and 4C are wet; sample 4B is dry. See Table 30 for additional information.

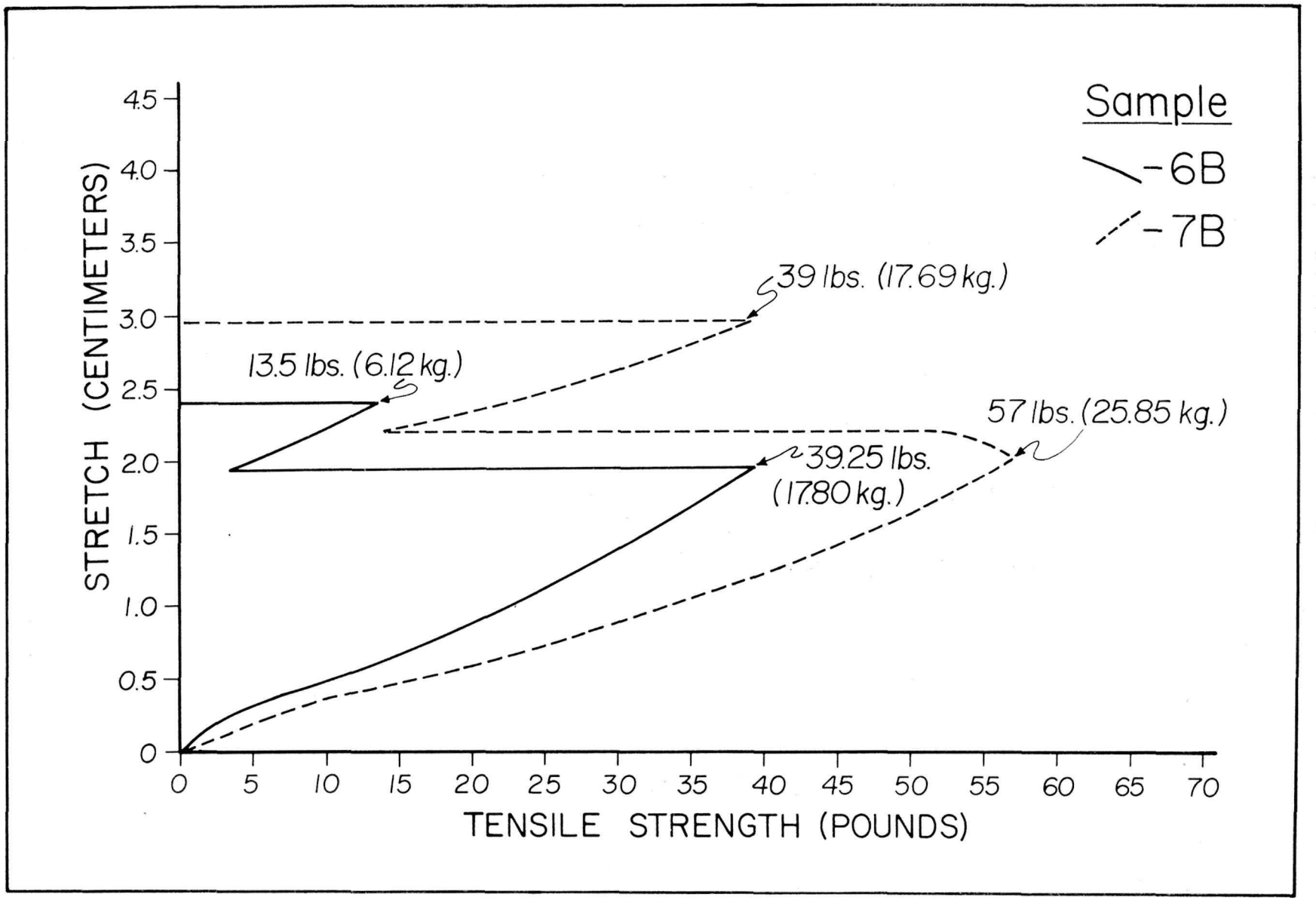


Figure 122. Test of cordage strength based on diameter size. Sample 6B diameter is 2.0 mm; sample 7B is 3.2 mm.

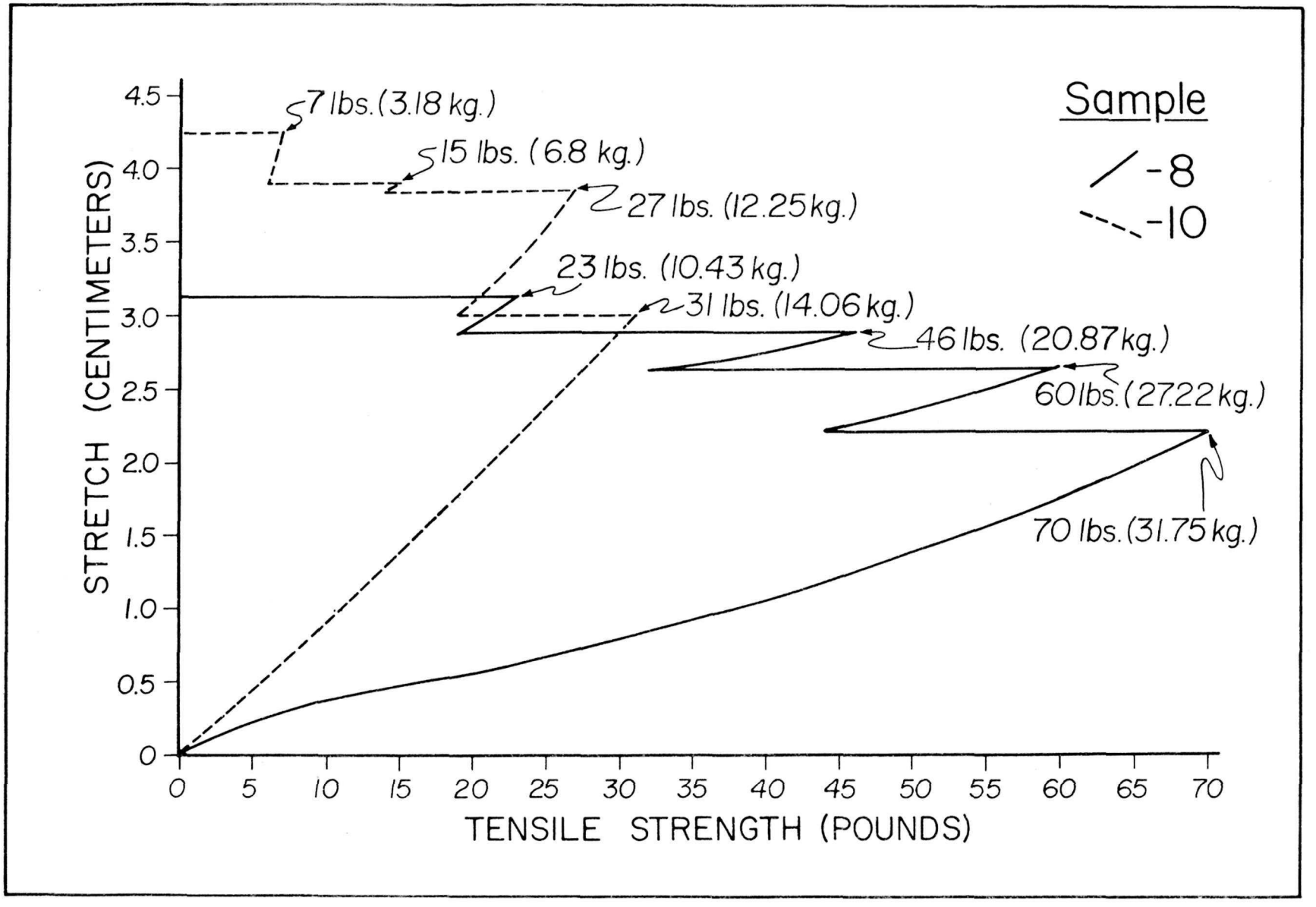


Figure 123. Test of strength of double-line fishline leader, wet vs. dry. Sample 8 is dry; sample 10 is wet.

Conclusions

The tensile strength experiment demonstates the relationship between diameters, root conditions, and dryness in tests of cordage strength. Through replication and testing, a ratio chart could eventually be prepared estimating the strength of all cordage found at Hoko River and elsewhere.

My first conclusion concerns the time element involved in a replicated cordage tensile strength experiment. I found that it was not possible for one person to gather and prepare enough roots for a small test group in one afternoon. The gathered roots must be stripped of their bark and kinked soon after removal from the ground, otherwise they become too stiff and brittle to make into cordage.

Though these experiments are very preliminary, it is obvious that they should be developed and expanded into tests of other forms of prehistoric cordage, i.e., cedar-bough harpoon lines, cedar-bark vs. cedar-bough and/or root cordage, kelp fishlines, cedar-bark braids, etc. These kinds of tests will increase our understanding of the functional capabilities of cordage used in several activities of prehistoric Northwest Coast peoples.

WOODEN WEDGES

By Dale R. Croes

The four wooden wedges recovered during the 1977 field season brought the total number of wedges recovered from the Hoko River site by collectors and excavations to 17. Two other items that are possibly wedges are also recorded. The recovered wedges are made of yew wood (see Microscopic identification of artifactual plant materials, above), are formed with a tapered point, and have cedar-bough withe collars (see Cordage, above) around their poll ends. That they have been heavily used is evidenced by their battered polls and some broken collars and broken tips (Figure 124).

Wooden wedges are a basic woodworking tool of historic Northwest Coast people, and their importance to woodworking is described by many authors. Historic houses, canoes, boxes, bed benches, and most tools and hunting/fishing equipment were made from wood, and wood splitting was a major technique for constructing many of these things, at least in the initial forming or shaping stages of manufacture. As Stewart emphasizes:

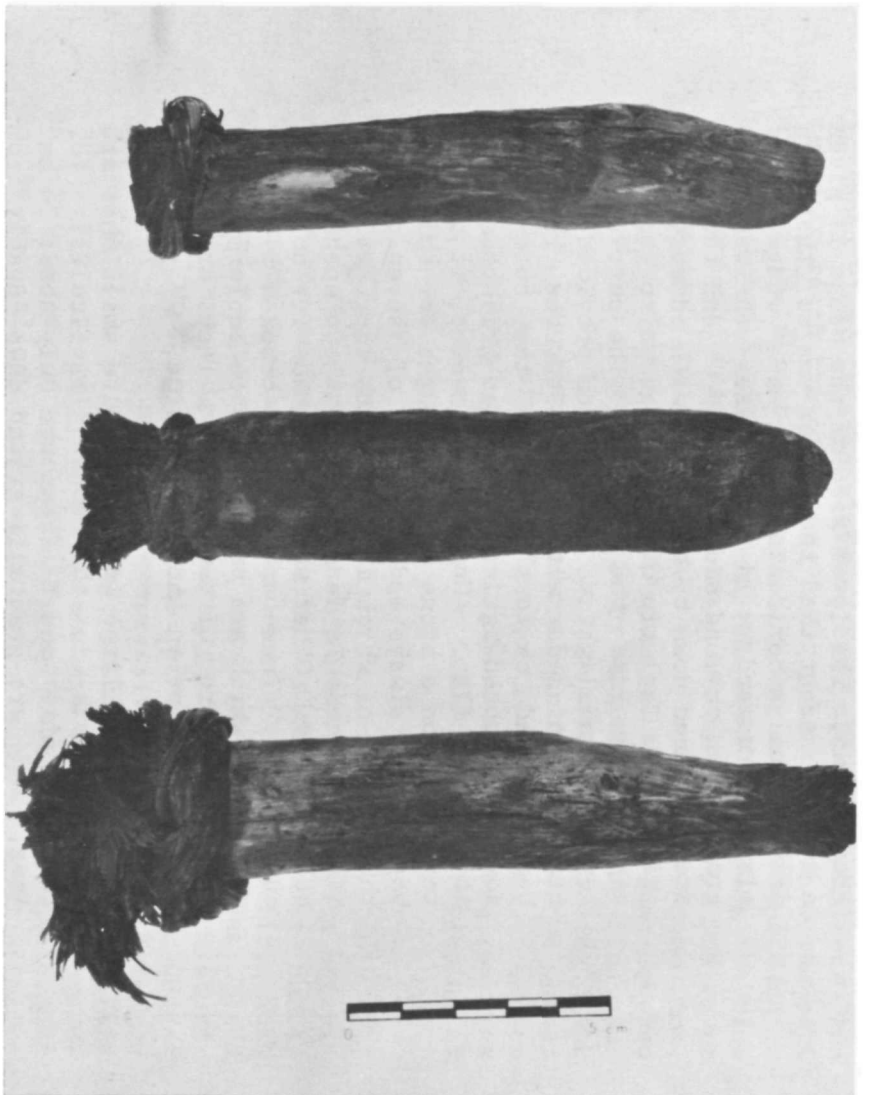




Figure 124. Examples of wooden wedges with cordage collars from Hoko River. Material is yew wood.

> One of the basic tools of the well developed wood-working industry of the Northwest Coast was the wedge. Together with the maul and the adze, this triad probably shaped the Indians' life style as much as the salmon run (1973:116).

Boas provides an excellent description of the Kwakiutl manufacture of wooden wedges. Since the form of the wooden wedge appears to be consistent along the entire Northwest Coast both through time (below) and across space, his description is quoted at length below:

> Wedges.--Wedges (LE'mg.ayu) are made of yew-wood. One man bends a small yew tree to the ground, and another one cuts it through at the bend with a gritstone which is kept wet. The tree generally snaps before it is cut half through. Then the branches are removed, and the tree is cut with gritstones into pieces of the desired length. The points of these pieces are next burned off to harden them, and are rubbed down with water on a large slab of sandstone. The burning of the wood prevents it from warping. When the point is ground down, the lower side of the wedge is given a steeper slant than the upper one so that when driven into a horizontal log, the wedge stands slanting upward. In other cases the wedge is ground down on one side only ... and the sides are flattened down by chopping with an adze or by grinding. The tip of the wedge also generally tapers down from the sides. The butt-end is tapered down slightly, and is then provided with a ring made of cedar-withes. After the ring has been fastened on to the wedge, the butt-end is sometimes rubbed against a wetted gritstone until it is quite flat. Generally, however, it is battered down on a stone slab. Wedges for splitting boards are always made in sets of seven pieces, the longest of which is four spans long, while the others decrease in length to about two spans and a half or less. Other wedges are made for hollowing out canoes. These are made of crooked pieces of yew-wood, which are bent so as to conform to the inner curvature of the canoe. They are ground down to a point on the concave side.
>
> Besides these large wedges, quite small ones are used for work in the house, particularly for splitting fire-wood. These are only about 20 cm. long, and are generally ground down evenly from both sides, the point of the wedge being rounded (Boas 1909:323).

The Hoko River wedges are yew wood, show signs of burning on their points (presumably for hardening), are adzed and ground into shape, and have cedar-withe collars. The most obvious difference between Hoko River wooden wedges and the Kwakiutl examples is the time of manufacture, approximately 2500 vs. 70 years ago. At Hoko River these wedges may also have been used to form planks for dwellings, bentwood boxes, and other items; to split out pieces of wood in making dugout canoes or large bowls; and/or to split firewood. Large quantities of split cedar and other wood detritus were recovered from the site, and much of this could be attributed to wood-wedge splitting activities.

Most wet sites on the Northwest Coast have examples of wooden wedges, and some have considerable numbers recorded (Table 31). The use of this specific wood-splitting tool prehistorically is recorded along the entire coast and for a considerable time depth. In a general perspective these data can be used to suggest the preparation of planks for dwellings and of dugout canoes as early as 3000 years ago on the coast. These two basic historic components of plank dwellings and dugout canoe transportation could have a long time depth on the Northwest Coast, though the forms they took may have varied considerably. Certainly 2500 years ago at Hoko River the population had efficient shelters and means to reach the offshore fishing banks. Since the site area and materials recovered are beginning to indicate a potential for a sizable population which was using the rich deep-sea fish resources as well as the estuary and river resources and remaining at the site location for some time, it is reasonable to suggest the use of sizable plank-covered dwellings and sizable "sea-worthy" dugout canoes. The numerous pieces of split cedar wood debitage, including plank fragments, suggest considerable manufacture at the site. Hopefully, as site excavation continues, parts of canoes will be recovered and, in the onbank areas, house features will be found, giving us a much better understanding of these cultural components.

When comparing wooden wedges from several sites (Table 31), it also is worth noting that different construction materials were emphasized at different sites. To the north, Lachane wedges mainly were constructed of western fir; Hoko River and Musqueam Northeast have yew wood wedges; and Ozette Village wedges are generally Sitka spruce. Historically yew wood is cited as the preferred wood for wedges because of its structural (compressive) strength (Friedman 1975a:115-121). Although the Lachane and Ozette Village wedges are most often made of western fir and Sitka spruce, in both cases the wood used to make the wedges exhibits a condition called compression or reaction wood (Inglis 1976:166; Friedman 1975a:121). This kind of wood typically is found on the underside of leaning coniferous trees, and

Table 31

Wooden wedges recorded from Northwest Coast wet sites

	Site	Approximate time period	Number of wooden wedges	Dominant material type	Reference
1.	Ozette Village (House I)	500 B.P.	over 550	Sitka spruce	Friedman (1975, 1976)
2.	Conway	500-1500 B.P.	none recorded		Munsell (1976b:106)
3.	Fishtown	500-1500 B.P.	5	?	Onat (1976:131)
4.	Little Qualicum River	500-1500 B.P.	present	?	Simonsen (1976:71)
5.	Axeti	500-1500 B.P.	21	?	Hobler (1970:91)
6.	Lachane	1500-2500 B.P.	75	Western fir	Inglis (1976:170)
7.	Biederbost	1500-2500 B.P.	present	?	Croes (1979)
8.	Hoko River	2500-3000 B.P.	17	Yew	Croes (1976b:213-214)
9.	Musqueam Northeast	2500-3000 B.P.	12	Yew	Friedman (1975b)

it is noted for its structural strength (Friedman 1975a:122). Even though they did not use yew as the main wedge material, the Lachane and Ozette wedge makers demonstrated a knowledge of wood properties by using the strongest portions of the western fir and Sitka spruce trees for this purpose.

The wedges recovered in 1977 from the Hoko River site (n=4) vary from 10.8 to 15.3 cm long. Their small size may reflect a continual resharpening of large wedges until they were totally reduced, worn out, and discarded. They have a round cross-section at the poll end that tapers to an ovoid cross-section toward the rounded bit. Three are bifacially and symmetrically beveled; the fourth is beveled on one side only. They are modified through adzing and abrasion at the bit and poll ends. The wedges were evidently thoroughly used and possibly discarded, since their bits are broken and their polls battered from use. All have single looped, two- to four-strand twisted cedar-bough collars protecting the poll ends. These four examples were found in widely separated stratigraphic units, from the deepest vegetal mat (AX) to much higher ones (AE, which is 19 units higher).

In conclusion, the formal characteristics of the yew wood wedges from Hoko River are very similar to those found through time and across space, both prehistorically and historically on the Northwest Coast. The thousands of pieces of split cedar and other wood debitage, the adze blades, and the wood wedges from Hoko River, as well as the continuity of wood wedges and adze blades through time prehistorically on the coast, provide the data for a general hypothesis that this tool may have been used to construct split cedar plank dwellings and dugout cedar canoes 2500+ years ago. Certainly wooden wedges are used for other tasks, but their presence at Hoko River and at other early sites tends to project these two major and basic cultural components back thousands of years. What is needed now is the recovery of house features and canoe pieces from the site, and evidence of both may be recovered through further excavation.

WOODCHIP DEBITAGE

By Margaret Paden

The occurrence of woodchips, an adze blade, and wood wedges at the Hoko River site is evidence of sophisticated prehistoric woodworking--a technology highly developed among historic Northwest Coast people (Drucker 1965:22). No other

woodworking implements have been recovered to date, but further excavation might be expected to produce hand hammers, stone mauls, beavertooth chisels, drills, horn and bone tools, and large knives. There is ethnographic evidence that clam or mussel shells also were used for woodworking (Drucker 1965:23), but the mussel shell fragments recovered from the Hoko site (see Analysis of mollusk remains, above) were too poorly preserved to permit any functional interpretation. It is possible that the hafted microliths found at Hoko may have been used for "whittling" fishhooks or small items, but experiments with replicated examples indicate that they work best on softer materials. It is likely that most of the more than 600 woodchips from Hoko were produced by adzes like the recovered greenstone example. The adze serves an aboriginal carpenter as both saw and plane, and the finished wooden artifacts from the site often exhibit adze scars.

Preliminary Procedures

The woodchips used in this study were collected in level-bags then processed by being washed, dipped in cytox, and allowed to dry. They were then counted, their attributes were recorded, and they were put into small envelopes, numbered, and eventually returned to their original level-bag. The attributes of the woodchips that were recorded include: length, width, thickness, weight, angle into chip, angle out of chip, shape (profile), feathering, surface texture, facets, striations, and miscellaneous characteristics (branch knots, burn marks, etc.). The data on woodchips then were translated into computer format and stored. Paul Gleeson, Ozette Village archaeological project, formulated the computer coding system for woodchips and assisted me throughout this research.

Attribute Analysis

Measurements

Length was calculated only on examples that were complete along this dimension. The number of woodchips that were not broken across the grain numbered 382 or 60.5 percent of the total. The mean length is 4.1 cm with a standard deviation of 2.6. The majority of the woodchips (n=293, 76.7 percent) are between 1.6 and 6.0 cm in length. Of the remaining woodchips, 24 (6.3 percent) are between 0.1 and 1.5 cm long, and 65 (17 percent) are between 6.1 and 28.2 cm in length

(Table 32). Some of the longer pieces may be the result of cedar wood having split when wood was being taken off with the grain. This strongly unimodal distribution of lengths indicates that a specific woodchip length was typically produced, possibly by the use of a "standard" tool.

The width of a woodchip was calculated only on examples that were not broken along this dimension (n=458, 72 percent). The mean width is 1.1 cm with a standard deviation of 0.5. The majority (n=415, 90.6 percent) are between 0.5 and 1.6 cm wide, (Table 33). Of the remaining chips, six (1.3 percent) are between 0.1 and 0.4 cm wide, and 37 (8.1 percent) are between 1.7 and 3.6 cm wide. A possible determinant of woodchip width is the relationship between the width of the woodworking utensil and the surface of the wood involved. For example, an adze can create a woodchip which is very narrow if the surface of the wood being worked is narrow or rounded; the chip will be very wide if the wood surface is wide and flat. At the same time, a microlith knife or beaver tooth will tend to make narrower woodchips on a larger surface than will a typical adze. It is quite possible that a mussel shell blade would create a relatively narrow woodchip whereas the Hoko green-stone adze blade would have created wider woodchips. More replication experiments should shed light on this problem. The strong unimodal distribution of woodchip widths would, again, seem to indicate the use of a single tool type or possibly the production of similar objects.

The thickness of a woodchip was calculated only on those examples that were not broken with or across the grain (n=316, 50 percent). The mean thickness was 0.192 cm, with a standard deviation of 0.1. The average is between 0.11 and 0.25 cm, with 195 (61.8 percent) of the total number of woodchips falling within this range (Table 34). One factor which may affect thickness is the workability of the wood itself. To take a large, thick, long woodchip from a piece of wood, especially a hardwood (i.e., alder or maple--both which were used) would require a great deal of strength. It probably is easier (on the workman and on the tool) to take off many thin chips than it is to take off larger and thicker ones. Also the sharpness of the blade might affect the thickness of the woodchip. Again, the strong unimodal distribution of thicknesses suggests the use of a single size of woodworking tool.

The weights of the woodchips were only taken from those that were unbroken (n=316, 50 percent). The mean weight is 0.19 grams with a standard deviation of 0.1. Most of the woodchips (n=147, 46.5 percent) fall into the smallest bracket, 0.01-0.08 g. The next group seems to be around 0.09-0.32 g (n=114, 36.1 percent; Table 35). The heaviest of the woodchips, between 0.33 and 6.22 g, number 55 (17.4 percent).

Table 32

Hoko River woodchips: length

Length (cm)	Number	Percentage
0.1 - 1.5	24	6.3
1.6 - 3.0	146	38.2
3.1 - 4.5	104	27.2
4.6 - 6.0	43	11.3
6.1 - 7.5	29	7.6
7.6 - 9.0	20	5.2
9.1 - 10.5	9	2.3
10.6 - 12.0	2	0.5
12.1 - 13.5	3	0.8
13.6 - 15.0	1	0.3
15.1 - 16.5		
16.6 - 18.0		
18.1 - 19.5		
19.6 - 21.0		
21.1 + (28.2)	1	0.3
Total	382	
Mean	4.1 cm	
Standard deviation	2.6 cm	

Table 33

Hoko River woodchips: width

Width (cm)	Number	Percentage
0.1 - 0.4	6	1.3
0.5 - 0.8	140	30.6
0.9 - 1.2	194	42.3
1.3 - 1.6	81	17.7
1.7 - 2.0	20	4.4
2.1 - 2.4	8	1.7
2.5 - 2.8	4	0.9
2.9 - 3.2	1	0.2
3.3 - 3.6	4	0.9
Total	458	
Mean	1.1 cm	
Standard deviation	0.5 cm	

Table 34

Hoko River woodchips: thickness

Thickness (cm)	Number	Percentage
0.02 - 0.05	7	2.2
0.06 - 0.10	44	13.9
0.11 - 0.15	83	26.3
0.16 - 0.20	70	22.2
0.21 - 0.25	42	13.3
0.36 - 0.30	39	12.3
0.31 - 0.35	9	2.9
0.36 - 0.40	6	1.9
0.41 - 0.45	7	2.2
0.46 - 0.50	2	0.6
0.51 - 0.55	2	0.6
0.56 - 0.60	4	1.3
0.61 - 0.65	1	0.3
Total	316	
Mean	0.192 cm	
Standard deviation	0.1 cm	

Table 35

Hoko River woodchips: weight

Weight (gm)	Number	Percentage
0.01 - 0.08	147	46.5
0.09 - 0.16	60	19.0
0.17 - 0.24	37	11.7
0.25 - 0.32	17	5.4
0.33 - 0.40	11	3.5
0.41 - 0.48	8	2.5
0.49 - 0.56	4	1.3
0.57 - 0.64	7	2.2
0.65 - 0.72	5	1.6
0.73 - 0.80	5	1.6
0.81 - 0.88	4	1.3
0.89 - 0.96	3	1.0
0.97 - 1.04	2	0.6
1.05 - 1.12		
1.13 - 1.20	1	0.3
1.71	1	0.3
2.10	1	0.3
2.74	1	0.3
2.76	1	0.3
6.22	1	0.3
Total	316	
Mean	0.19 gm	
Standard deviation	0.1 gm	

These include larger pieces of split cedar. The middle division may be the denser hardwoods (maple, alder, etc.). Ethnographically these hardwoods often were used for dishes, bowls, and other small designed objects. Canoes and house planks typically were made of cedar. Since cedar is less dense, it is from manufacture of these items that the abundant lighter debitage most likely originated. (Wood identification is in progress, see Microscopic identification of artifactual plant materials, above). Since wooden debitage from the manufacture of small items is, of course, much smaller than the debitage from larger items, and since so few woodchips from this site (n=6) weigh more than 1.05 g, it is suggested that most of the manufacturing activities at the Hoko River site involved small finished products.

Overall, the charts of woodchip length, width, thickness, and weight (Tables 32 to 35) show unimodal distributions with a consistant size of woodchip. They also indicate that typical woodchips are long enough and thick enough to have been made with an adze, and wide enough to have been made by a large (wide) tool bit. Therefore it would appear that a standard "adzelike" tool produced most of the Hoko River woodchips.

The angle "in" was measured on woodchips with the instroke angle preserved. This measurement indicates the angle at which the woodworking implement entered the wood. The mean angle-in is about 18, with a standard deviation range from 12.5 to 22.5 There are 391 (62 percent) woodchips in this range (Table 36). Type of wood may have something to do with the angle-in, although woodworkers generally are consistent in how they hold a tool and work wood. The angle of the blade itself may make a difference. A modern axe, which has a very thin blade, will probably produce a woodchip with a small angle-in while an adze, which is not as sharp and has a thicker blade, might produce a chip with a larger angle-in. More work in terms of replication and use has to be done before further conclusions can be reached.

The "out" angle was measured on woodchips that had this area preserved; 153 of them did not, possibly due to breakage. The mean angle is 15 with a standard deviation range from 7.5 to 22.5 (Table 37). The variation of the angle-out is greater than that of the angle-in. As suggested above, woodworkers are fairly consistent as to how they hold and use woodworking tools. The tool itself or the material worked may make the difference. Again, an axe-produced woodchip tends to have a smaller angle-out than does an adze-produced chip. As with other questions about woodworking, more testing needs to be done in this area, but it is possible to reach the general conclusion that the woodworkers at Hoko River were probably using dull, large-angled tools like the stone adze recovered.

Table 36

Hoko River woodchips: angle-in

Angle (degrees)	Number	Percentage
2.5	2	0.3
5.0	6	0.9
7.5	13	2.1
10.0	33	5.2
12.5	67	10.6
15.0	91	14.4
17.5	96	15.2
20.0	90	14.3
22.5	47	7.5
25.0	30	4.8
27.5	25	4.0
30.0	21	3.3
32.5	2	0.3
35.0	1	0.2
37.5	1	0.2
40.0	1	0.2
42.5	5	0.8
45.0	3	0.5
47.5	6	0.9
65.0	1	0.2
Total	541[1]	
Mean	18°	
Standard deviation	45°	

[1]The remaining woodchips (14.1%) had no angle-in.

Table 37

Hoko River woodchips: angle-out

Angle (degrees)	Number	Percentage
2.5	6	0.9
5.0	28	4.4
7.5	55	8.7
10.0	89	14.1
12.5	79	12.5
15.0	76	12.1
17.5	45	7.1
20.0	29	4.6
22.5	11	1.8
25.0	17	2.7
27.5	9	1.4
30.0	13	2.1
37.5	3	0.5
40.0	2	0.3
42.5	3	0.5
45.0	2	0.3
47.5	3	0.5
62.5	1	0.2
70.0	2	0.3
72.5	1	0.2
75.0	3	0.5
Total	477[1]	
Mean	15°	
Standard deviation	7.5°	

[1]The remaining 153 woodchips (24.3%) had no angle-out.

Feathering

The feathering on a chip may indicate whether or not the tool used was an adze or a smaller instrument such as a knife: 288 (91.9 percent) of the complete chips were feathered; 28 (8.9 percent) were not (Table 38). The abundance of feathering would seem to indicate that the woodworkers at Hoko were using a larger cutting implement such as an adze rather than a smaller tool such as a hafted microlith or a mussel shell.

Surface Texture

Surface texture of a woodchip may reflect the type of tool used to produce it. For example, the chips created by a sharp-edged metal tool will be smooth in texture, while the chips created by a stone adze will vary in texture according to the sharpness of the adze blade. The "graininess" of the wood may also make a difference--cedar shows its grain more than maple, for example. Working of softwoods may account for the 113 chips (35.8 percent) which are rough on both the top and the bottom surfaces, while working of hardwoods would be reflected in the 36 chips (11.4 percent) that are smooth on both surfaces. Most chips (n=159, 50.3 percent) are rough on the bottom side and smooth on the top (Table 39). Some of these may be chips removed by the first blows, or chips that were originally on the cortex of the piece of wood worked. A not very sharp tool such as an adze hitting the wood would account for the rough bottom. This suggests a considerable amount of surface smoothing of wooden pieces at Hoko. The remaining 8 chips (2.5 percent) are rough on the top and smooth on the bottom; this may be a result of depositional and postdepositional factors (e.g., trampling).

Profile

The shape or long profile of each woodchip was described, although only whole examples (n=316) will be discussed here. The most frequent profile (Table 40) is feathered or cut at a sharp angle at one end and tapers to a gentle point at the other (n=264, 83.5 percent). This shape of woodchip could be achieved by adzing with the grain with a fair amount of force. The second most abundant profile (n=20, 6.3 percent) is straight with no sharp angles at either end. These may have been created by splitting wood with a small instrument such as a knife or stone wedge that leaves no feathering or sharp angles where the blade goes into the wood. This shape could also be obtained by splitting cedar lengthwise (e.g., to thin a cedar microlith handle). This can be done easily with a stone wedge. The third most common profile (n=13, 4.1 percent) describes those chips whose top surface is shorter than their bottom surface, that is, chips with a definite angle at both ends. It is suggested that a chip

Table 38

Hoko River woodchips: feathering

	Number	Percentage
Feathered	288	91.1
Not feathered	28	9.9
Total	316	

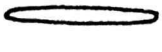
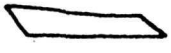
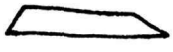
Table 39

Hoko River woodchips: surface texture

Surface	Number	Percentage
Both smooth	36	11.4
Rough bottom, smooth top	159	50.3
Rough top, smooth bottom	8	2.5
Both rough	113	35.8
Total	316	

Table 40

Hoko River woodchips: profile

	Profile	Number	Percentage
	Flat, rounded ends	20	6.3
	Long, flat trapezium	264	83.5
	Rhomboid	10	3.1
	Trapezoid	13	4.1
Irregular		3	1.0
Too feathered to define		3	1.0
Incomplete (broken)		3	1.0
Total		316	

with this appearance would be created if the woodworker reversed his angle or position in making the cut. The fourth most common category (n=10, 3.1 percent) includes those chips whose ends are parallel, forming a parallelogram. The back end of a chip of this shape would be formed as the woodworker was removing another chip. Subsequently he would hit the front of the parallelogram-shaped flake at a similar angle and with about the same force, thus removing the flake. Most of the chips with this profile were not feathered. In addition to these describable categories there were nine chips that were highly irregular.

Facets

Facets are the marks on a woodchip left from the removal of previous chips. Most of the complete woodchips have only one facet (n=164, 51.9 percent; Table 41); apparently these chips were the primary or first ones removed. The next category consists of chips with two facets (n=113, 35.8 percent). These generally are pointed at the top with a round or flat bottom and could be either the second chips taken off or those produced farther within a deeply carved wooden item. The next general group consists of chips with three and four facets (n=39, 12.3 percent). These were probably from the interior of the wood and may represent the later stages in the fabrication of a small item. Woodchips with several facets probably represent careful carving, while chips with one or two facets represent the beginning stages where the fabricator is trying to remove a great deal of bulk (wood) with the least amount of energy spent. More research in replication is needed before further conclusions can be reached in this area.

Miscellaneous Characteristics

Miscellaneous characteristics of woodchips include nicks, knots, burned areas, cortex, and split cedar (Table 42). Most of the woodchips (n=215, 68.1 percent) do not have any characteristics beyond those already described.

Nicks may be caused by a dull or uneven utensil; a stone adze, for example, cannot be worked into as consistently sharp an edge as metal. Seven (2.2 percent) of the chips show signs of nicks.

Generally, aboriginal people avoided knots in wood, and would go out of their way to select timber in the deep woods where the sun could not reach the lower areas of trees and create the branches which cause knots or irregularities (Boas 1909). Not only was such wood easier to work, but aesthetically unpleasing surface irregularities in objects such as wooden boxes were avoided. This could account for the fact that only seven (2.2 percent) of the recovered chips have knots.

Table 41

Hoko River woodchips: facets

Number of facets	Number	Percentage
1	164	51.9
2	113	35.8
3	33	10.4
4	6	1.9
Total	316	

Table 42

Hoko River woodchips: miscellaneous characteristics

Characteristic	Number	Percentage
Nicks	7	2.2
Knots	7	2.2
Burned	4	1.3
Cortex surface remaining	38	12.0
Split cedar	45	14.2
None of the above	215	68.1
Total	316	

Only four (1.3 percent) woodchips have burned areas. It is possible that these woodchips were used as kindling but did not totally burn.

Those woodchips with cortex on their surface (n=38, 12.0 percent) probably were the first chips to be removed from a piece of wood. Their presence in the site indicates that at least some of the preliminary removal of woodchips was being done at Hoko River rather than in the woods where the raw material was acquired. According to one ethnographic source (Underhill 1945) the woodworker did a lot of his primary trimming of wood at the spot where the tree or limb was cut. This would save having to bring the entire piece back to the village.

The last category consists of cut or split cedar pieces (n=45, 14.2 percent) which are not true woodchips; they would be the result of "peeling" rather than "chipping" apart the cedar. Even though this category is called "split cedar," it is possible that some examples may be other softwoods rather than cedar, but they are all clearly grained woods that are easy to "peel" with the grain.

Distribution

The map of overall horizontal distribution of woodchips by square (Figure 125) exhibits concentrations in area B-east, closer to the identified prehistoric shore. It is interesting to note that this area also contains the lithic workshop. However, the horizontal distribution of woodchips appears to be more random than that of the basketry waste materials and aboreal cones discussed above.

Distribution by levels varies considerably (Table 43). The level with the most woodchips (n=180) is level AX, which is the main lithic workshop level. This probably corresponds with the evidence of heavy site-use at this level and also with proximity to the onshore bank. Woodworking must have been an important activity along with the production of microlith tools. Possibly this concentration of chips reflects in part the production of split cedar handles for microlith tools. There is a concentration of woodchips centered around levels AE, AF, AG, and AH (n=101). These levels are consecutive and are practically the only levels that have consistant concentrations of woodchips. At these levels a few wood wedges and quite a bit of basketry material were found. The next level with concentrations of woodchips is level AN (n=40). The level with the largest concentration of chips in area B-west is level J (n=44). The last remaining concentration of chips worth noting is in area C

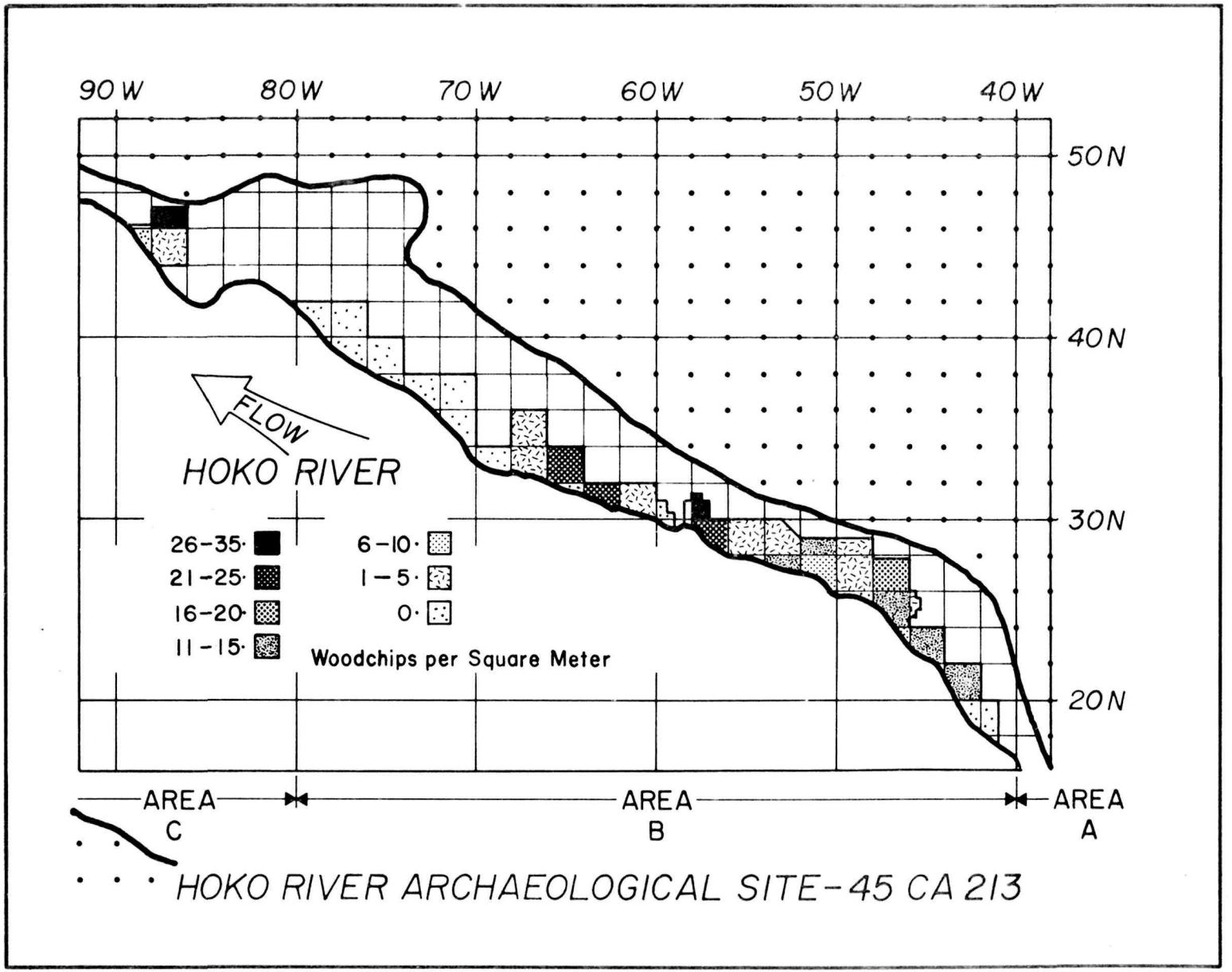


Figure 125. Frequency distribution of woodchips from the Hoko River site.

Table 43

Hoko River woodchips: distribution by level

Level	Number	Percentage
Area B, east		
AE	30	4.8
AF	37	5.9
AG	11	1.7
AH	23	3.6
AI	3	0.5
AJ	6	1.0
AK	3	0.5
AL	6	1.0
AM	1	0.2
AN	40	6.4
AP	5	0.8
AQ	6	1.0
AR	1	0.2
AS	1	0.2
AX	180	28.6
AY	33	5.2
AYB	1	0.2
SG	15	2.4
Subtotal	402	63.8
Area B, west		
J	44	7.0
JJ	10	1.6
JK	8	1.3
JL	11	1.8
KJ	29	4.6
KK	2	0.3
KL	3	0.5
A (square 567 only)	4	0.6
H	4	0.6
I	37	5.9
Subtotal	152	24.2
Area C		
C	54	8.6
CE	14	2.2
CF	8	1.2
Subtotal	76	12.0
Total	630	

(n=76). These levels encompass only two squares with three consecutive levels (squares 173 and 174 with levels C, CE, and CF).

Several factors may influence woodchip distribution, including:

1. The locations of original shore;

2. The amount of woodworking being done at a given location during the different periods of deposition;

3. The number of woodchips that would water-log and settle in a given area versus the number that would float away;

4. The "floatability" or size of the original woodchips, since smaller ones would probably water-log and sink faster;

5. The type of woodworking that was being done--a canoe would produce many woodchips while boards, weirs, fishhooks, etc., would produce few.

More consideration and testing of these factors is needed.

Conclusions

This brief examination of woodchips from Hoko River results in a number of hypotheses, many of which deserve further testing, especially with replication techniques. These hypotheses include:

1. Woodworking with adzelike tools was common at the Hoko River site at least 2500 years B.P. (One greenstone adze blade has been recovered from the site.)

2. Length, width, and thickness measurements of Hoko River woodchips all have a steep unimodal distribution, indicating production of a standard size of woodchip; this suggests use of a standard tool.

3. The width measurements and the angle-in and angle-out suggest that an adzelike tool was being used.

4. Surface textures suggest that many of the chips were taken from on or near the original wood surface, perhaps reflecting the shaping and smoothing of wooden objects.

5. The shape of the chips indicates that most chips were removed with considerable force and from the surface rather than from deep within the wood.

6. Most chips have single facets, which suggests that they were primary or first chips removed.

7. Many of the above characteristics suggest considerable shaping and smoothing of wooden objects. Possibly poles (e.g., for shelters or fish weirs) or split cedar boards (fragments of which are common at the site) were being smoothed and/or finished.

8. Horizontal and vertical distribution of woodchips (as compared with the distribution of basketry waste materials) suggests that woodworking activities probably varied in intensity through time and/or across space in the site vicinity.

These preliminary observations reveal some of the value of wet-site woodchip debitage analysis. Certainly the Hoko River materials demonstrate that there was a developed woodworking technology at the site approximately 2500 years ago, and they strongly suggest that it employed adzes. Several different wooden items could have been in production at the site, as the artifacts recovered (and those predicted, e.g., dugout canoes) indicate. Much more research in replication and some comparison of woodchips from Ozette Village (generally produced with metal-bladed tools) and Hoko River (produced with stone blades) would be important future studies. Comparison of woodchips with those from from several other wet sites also would be of value. In summary, the Hoko River carved wooden artifacts, woodworking tools, and woodchips demonstrate an early development of much of the woodworking technology observed at later times on the historic Northwest Coast.

SYSTEMS ANALYSIS OF THE LITHIC ARTIFACTS

By J. Jeffrey Flenniken

Introduction

The lithic artifacts recovered from the Hoko River site have provided a unique opportunity for lithic analysis. This site not only includes a lithic workshop area where stone tools were manufactured (Figure 126) but also has produced six stone tools hafted in wooden handles (Figure 127). Therefore, the Hoko River site has produced at least one entire system of stone tool technology, a unique case for any site but especially important for the Northwest Coast because hafted stone tools have not been recovered from any other prehistoric site in this region.

I have labeled the analysis currently being conducted on the lithic artifacts from Hoko River Replicative Systems Analysis (RSA). Rather than defining this type of analysis as a whole, I will discuss each term separately. Replicative or replication, as an archaeological term, has been used rather loosely. Replication, in the strictest sense, is the reproduction of stone tools, using the aboriginal tools as controls, by aboriginal stoneworking fabricators, employing the same raw materials, and following the same, not similar, reduction techniques. Therefore, the end products as well as the debitage, manufacturing stages, and rejuvenated tools are the same in reference to percentages, morphologies, and technologies. A system is the entire life of a stone tool from its inception to its deposition in archaeological context. In other words, a system involves the selection of raw materials, heat treatment, reduction of lithic materials into preconceived tools, hafting of the stone tools, and functions of tools--every aspect of a stone tool while it is in systemic contex or until it is rejected or abandoned. Analysis refers to compiling all of the previously described data in a coherent manner into a written report.

By employing RSA, I can demonstrate, not prove, actual processes that occurred, in this case, some 2500 years ago. With such data as a foundation, past stoneworking systems can be reconstructed on the basis of tested empirical evidence rather than on conjecture as has so often been the case in Northwest Coast artifact analyses.

This preliminary report will deal with the analysis currently being conducted on the lithic artifacts from the Hoko River site. At this time, the analysis is not complete, and therefore some of the details will not be discussed here.



Figure 126. Stratigraphic view of the lithic workshop area, Hoko River site.

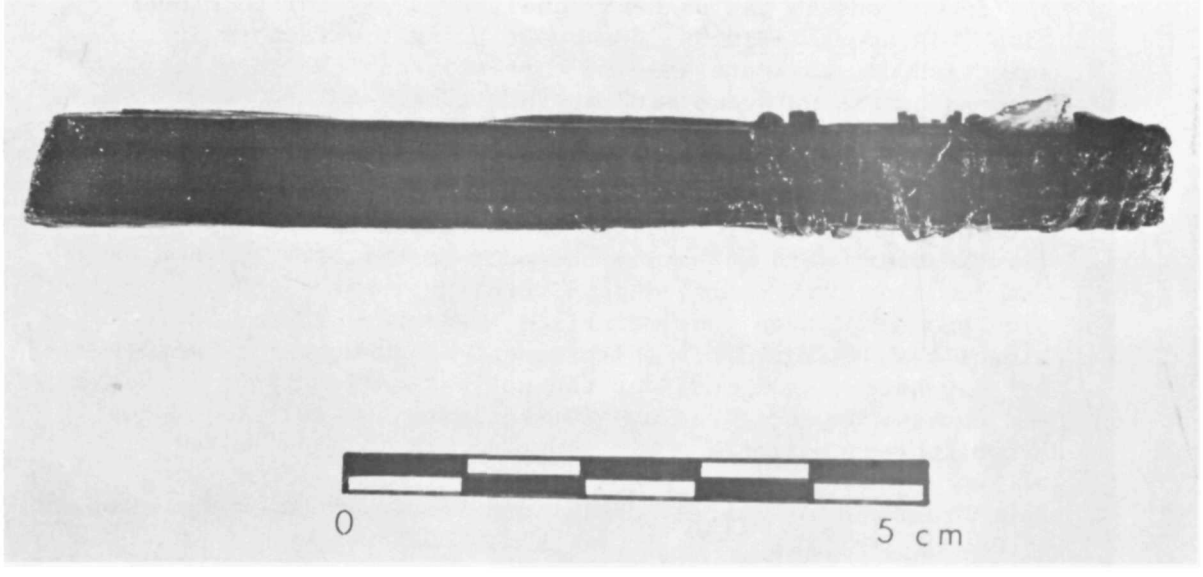


Figure 127. Example of the aboriginal microlith tools from Hoko River.

Technological Systems of Quartz Artifacts

Selection of Raw Material

The raw material selected for microlith manufacture, both aboriginally and experimentally, was vein quartz cobbles and pebbles. It is suspected that the origin of this material is Vancouver Island, British Columbia, and that it was transported across the Strait of Juan de Fuca by glaciers, but this has not been verified. Another speculation is that the quartz material has its origin in the Olympic Mountains, and that it was carried to its collection location by the Hoko River. In any case, the quartz cobbles and pebbles are presently found in abundance on the spit and beach at the mouth of the Hoko River, approximately 400 m from the site (Figure 128). This material is thought to be the same material employed 2500 years ago for the manufacture of microliths.

The quartz material ranges in size from large pebbles to small cobbles, in sphericity from subrounded to discoidal, and optically from transparent to translucent. Each cobble and pebble has an incipient cone cortex which indicates it has traveled a considerable distance from its primary context (Figure 129).

Flintknapping characteristics of flakeability range from poor to high quality, depending upon each objective piece's homogeneity and amount of checks or number of internal inclusions. Transparent material without checks and internal inclusions is the highest quality for microlith production. A heuristic model for quantifying the factors in the selection of raw material is currently in the formulation process but is not completed at this time.

Judging from the aboriginal quartz artifacts from the site, all grades of material were collected. Poorer material may have been collected for any of three reasons: 1) unskilled flintknappers were selecting the poor material; 2) due to the low time and energy expenditure involved in the reduction process, even poor materials were reduced for "a few" microliths; and/or 3) at any given time, good quality material may have been absent at the collection location. Time and energy expenditures are currently being calculated for microlith production.

Heat Treatment of Quartz Cobbles and Pebbles

Prior to the actual reduction of the quartz cobbles and pebbles, heat treatment may have been employed to improve the flakeability of this raw material (Mandeville and Flenniken 1974:146-148; Flenniken and Garrison 1975:125-131). Heat treatment analysis will be conducted by thermally pretreat-



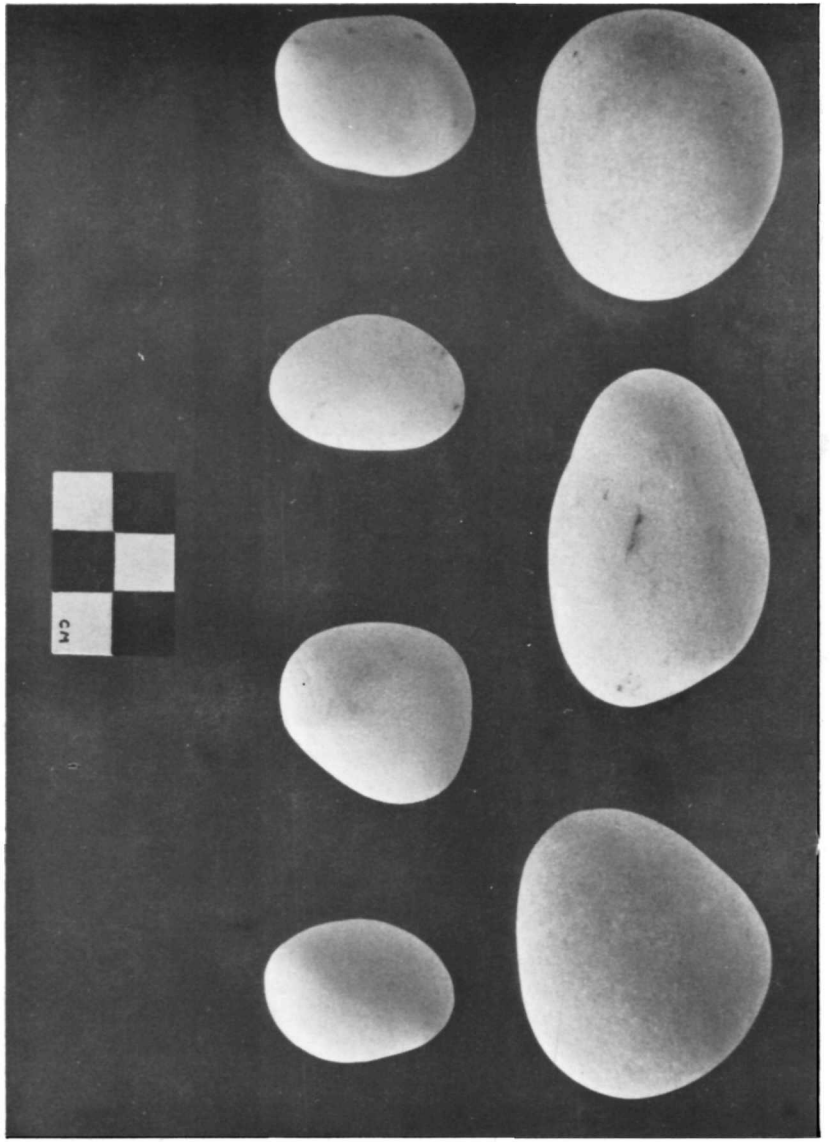


Figure 128. Spit beach at the mouth of the Hoko River where the quartz material for microlith manufacture is presently found.

Figure 129. Quartz cobbles and pebbles used for microlith manufacture.

ing a quartz sample collected from the mouth of the Hoko River in a furnace so that temperature and time can be controlled. Once the experimental heat treatment is completed, this sample will be compared with aboriginal samples suspected to have been heat treated by means of x-ray defraction. The results of the x-ray defraction analysis will demonstrate, in percentage of molecular water loss, whether or not heat treatment was used at the Hoko River site. This segment of analysis is in progress at this time.

Reduction of Quartz Cobbles and Pebbles

I have labeled the reduction technology employed at the Hoko River site the Systematic Bipolar Microlith Technology (SBMT). This name was selected because the reduction technology is bipolar (Crabtree 1972:42), but rather than merely placing a cobble on an anvil and striking the cobble with a percussor then retrieving the usable remains, this technology involves systematic reduction of the lithic material. Employing the aboriginal artifacts as controls, SBMT was replicated in the following manner.

First, the selected quartz cobble was placed on a sandstone anvil (Figure 130) and split by percussion, using a hammerstone. Any given pebble or cobble will split into two, three, or four "pie-shaped" pieces; occasionally the entire quartz pebble or cobble will shatter, if it is struck too hard or it contains weaknesses in terms of checks or inclusions. Second, each "pie-shaped" piece was used as a core for the detachment of microliths (Figure 131). A core was placed on the anvil and held there by the index finger and thumb of the left hand. Then each core was struck with the hammerstone, using the top margin at the apex of the cortex and the fracture face as the platform. This action produced small slivers or microliths of quartz as well as any number of pieces of shatter. Each blow did not, however, produce a microlith. Often, nonfunctional microliths were removed inadvertently due to miscalculation or purposely in order to shape the core (Figure 132). In many instances, repeated blows were needed to fracture the core to produce a microlith. Finally, functional microliths were selected from the debitage to be hafted in wooden handles. The use of an anvil had two functions: (1) to support the core, which is small and difficult to hold free-hand, and (2) to produce microliths that are flat in half-section as opposed to curved, thus making hafting an easier task.

Time and energy expenditures, number of functional microliths, and number of exhausted cores are being calculated for each cobble and pebble reduced. These factors will provide data to calculate the man-hours of labor and possibly the number of knappers involved with microlith production.

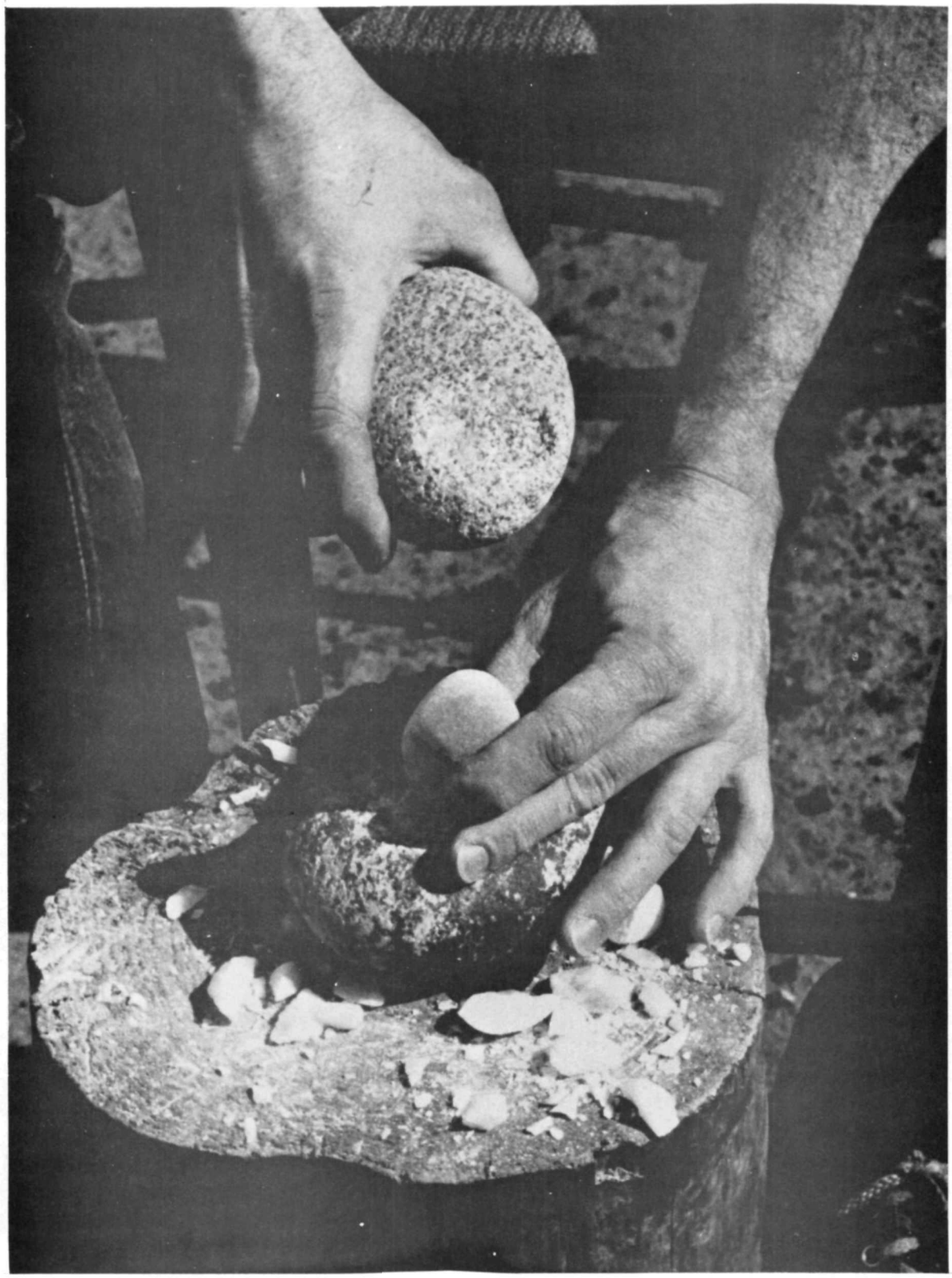


Figure 130. Placement of core for the experimental manufacture of microliths. Note use of anvil.

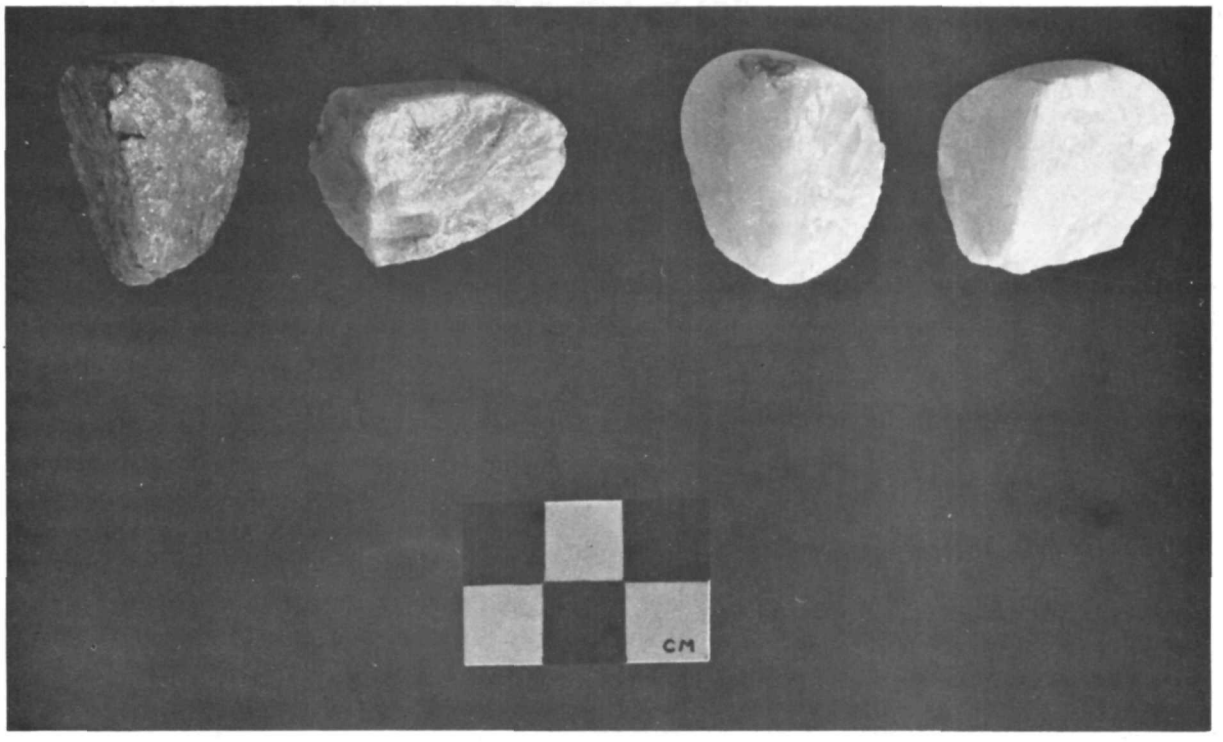


Figure 131. Pie-shaped potential cores for manufacture of quartz microliths. Cores on left are aboriginal; cores on right are experimental.

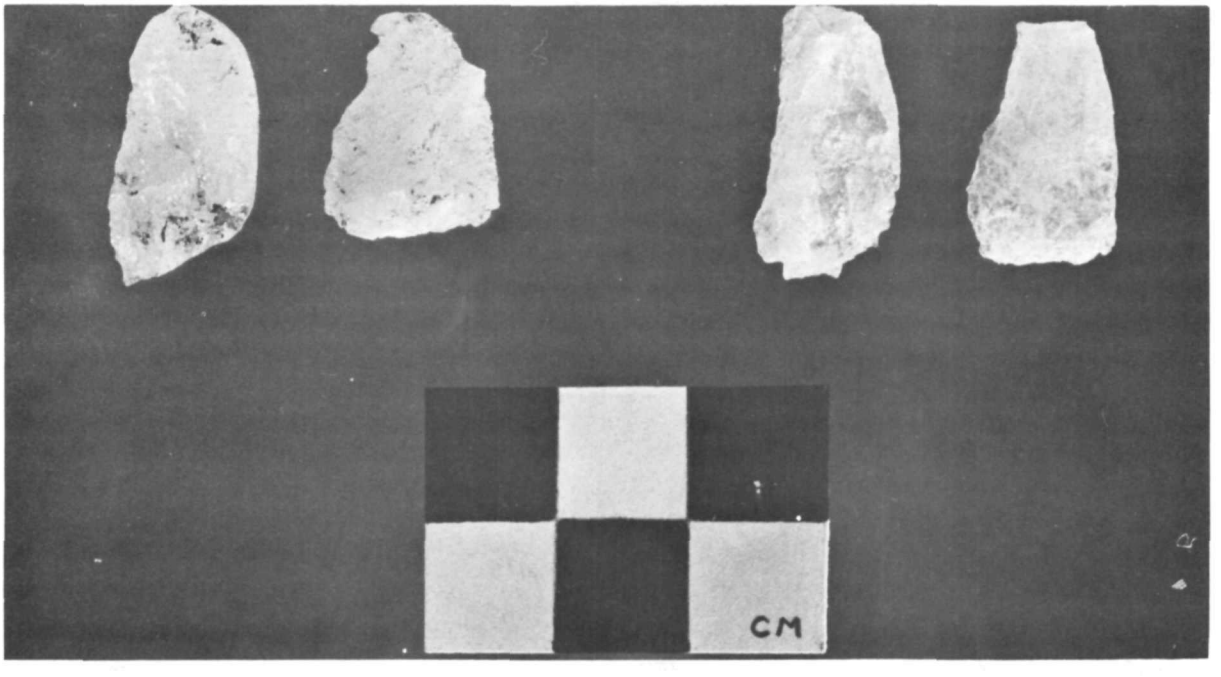


Figure 132. Nonfunctional microliths produced as a result of core preparation. Microliths on left are aboriginal; microliths on right are experimental.

A definition of the Hoko River functional microliths is in order. Microliths have been defined within the realm of lithic technology by numerous authors. For example, Crabtree (1972:78) defines microliths as: "very small geometric-form tools commonly used in composite tools. Formed from prismatic blades, using the sharp unmodified lateral edges as the cutting edge." Bordaz (1958:93) says, "microliths were manufactured from very small blade nuclei sometimes no more than an inch high and were worked with a punch and hammer, or perhaps rather by pressure."

Both of the above definitions, and most other definitions of microliths, are related to Mesolithic tools of the Old World that were produced from prismatic blades. My definition of microlith is based in the semantic meaning of the term--small stone. The Hoko River microliths are not true blades, microblades, or prismatic blades: a blade is a specialized flake twice as long as it is wide, with scars on the dorsal surface running parallel to the longitudinal axis. These tools are small specialized flakes that are quite short (average of six is 11.25 mm long) and have at least one margin, not necessarily a lateral margin, that is sharp (Figure 133). Functional attributes do not include only length and sharpness; width and thickness were important for hafting. Average width of the six hafted microliths is 6.87 mm, and thickness average is 1.82 mm. Wide and/or thick microliths were rejected because hafting would be a problem; these microliths would have been loose in the handle.

Of the six hafted microliths recovered at Hoko River, five are vein quartz and one is green chert. The reduction technology employed to manufacture the green chert microlith is not known because neither debitage nor exhausted cores of the green chert have been recovered in either excavation or bulk samples. The actual number of quartz artifacts recovered from the Hoko River site has not been totaled at this time, but it will exceed 1000.

It should also be noted that bulk samples were collected during excavation. A bulk sample consisted of a 25 cm wide by 25 cm long by natural stratum deep section of each excavation unit within the lithic workshop area. Bulk samples included all objects and all sediments. Each bulk sample was placed in a plastic bag, labeled, and transported back to the Lithic Laboratory at Washington State University where it was water screened through a 1 mm mesh screen (Figure 134). Therefore, the "representative" lithic sample from the Hoko River site includes not only the obvious artifacts recovered during excavation but also a sample of debitage greater than 1 mm in diameter.

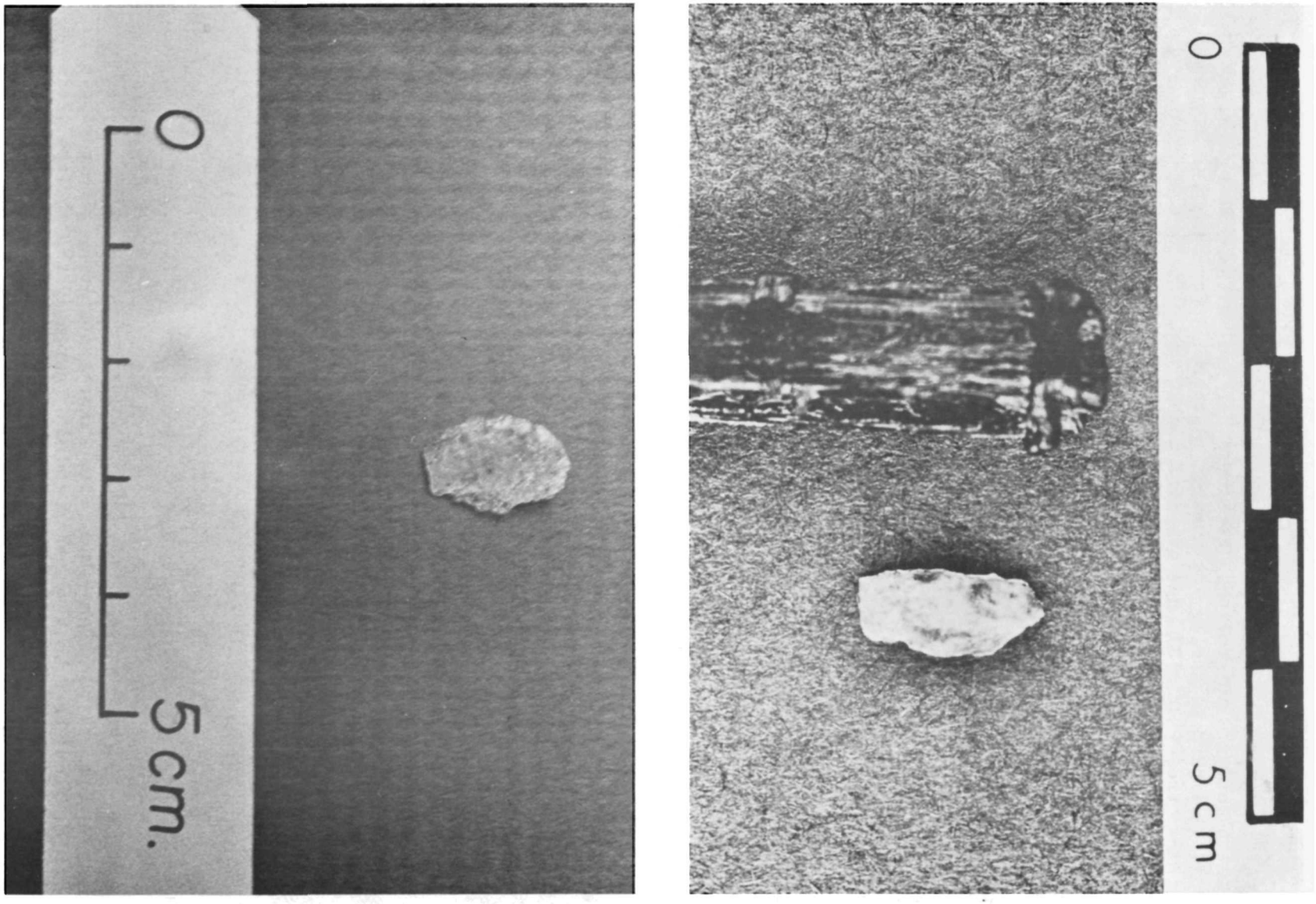


Figure 133. Microliths. A (left), aboriginal microlith from one of the hafted tools and B (right), experimental microliths.



Figure 134. Bulk sample from the lithic workshop area.

Labeling of actual technological debitage categories has not been completed, but interesting observations have been made during the early stages of analysis. For example, the discussions concerning pieces esquillee that occur in the literature do not agree with the results of this replication analysis. The details of this disagreement will be reported at a later date.

Hafting of Quartz Microliths

Once the functional microliths were selected for hafting, appropriate handles were made. Aboriginally, microlith handles consisted of two pieces of split western red cedar lashed together, with the microlith placed between them. For the replication, the cedar (Thuja plicata) was first selected for handle material and split into long, narrow, thin strips by using a basalt flake as a hand wedge (Figure 135). Second, these long strips of cedar were broken into pairs; the aboriginal examples averaged 98.70 mm long (average of five, one handle was broken), 8.60 mm wide (average of six), and 3.78 mm thick (average of six). Third, after the paired handles were made, a microlith was placed between the cedar splints at one end and the cedar was lashed together securely with vegetal material; the aboriginal examples were lashed with cedar bark (one example) and split root strips (five examples). After this stage was completed, the tool was ready for use (Figure 127). Time and energy expenditures can be calculated for the hafting process as well as for other steps in replication.

Functions of Hafted Microliths

Use-wear analysis of lithic tools is, at best, a difficult operation, particularly on quartz artifacts. The edge damage sustained by the aboriginal hafted microliths is in the form of polish, not flake removal. Therefore, these tools were most likely employed to cut a soft medium. Defining a soft medium is likewise a difficult task. Judging from the other artifact categories from the site, it is expected that these microlith tools were employed to process fish--flatfish and salmon. With this hypothesis in mind, 24 replications of the microlith tools were made, following the process described above (Figure 136). Eight of these tools were used to cut and fillet dog or chum salmon (Oncorhynchus keta), and they functioned extremely well for that task (Figure 137). The remaining 16 replicated tools will be employed on other types of fish as they become seasonally available, so at this time, the use-wear analysis is not completed.

It should be noted that the fish butchering process was conducted at Neah Bay, Washington, with the aid of several Makah Indians who were skilled at preparing salmon for smok-

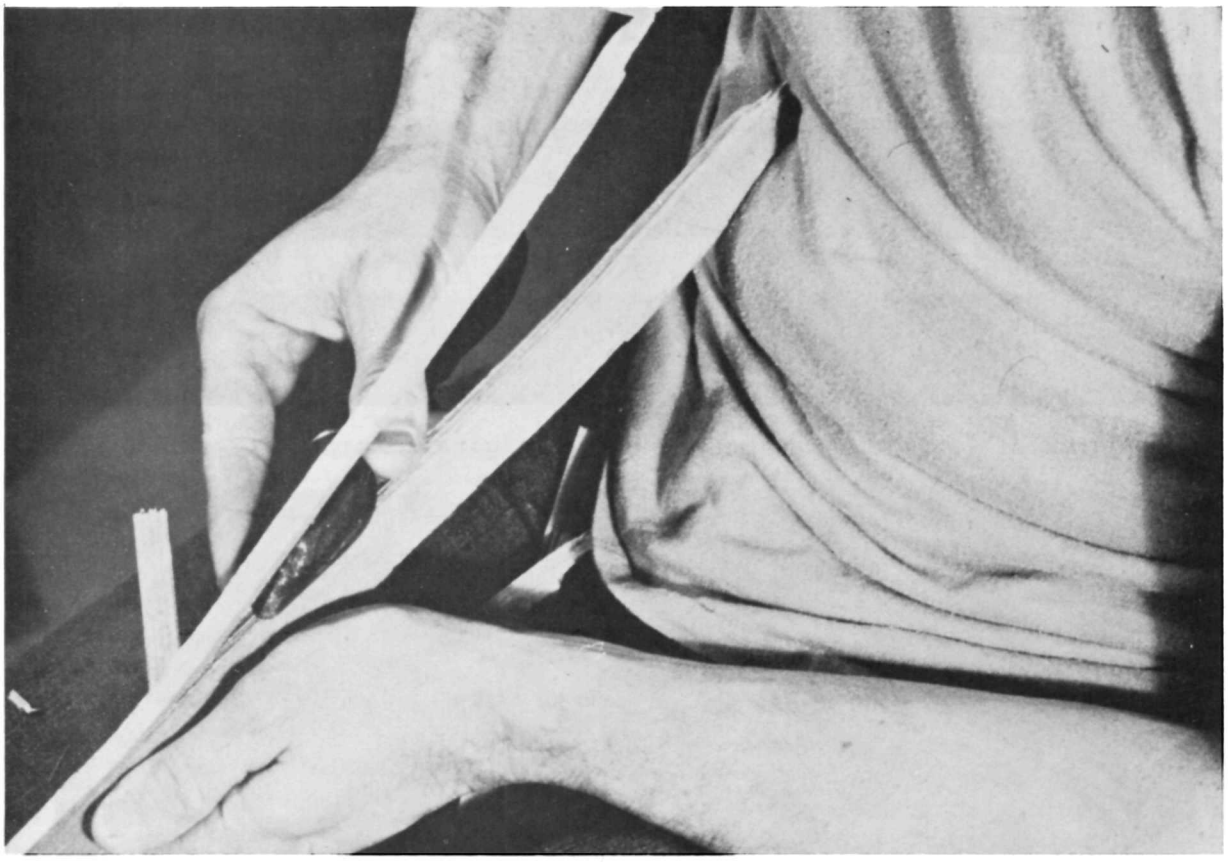


Figure 135. Splitting cedar for microlith tool handles with a basalt hand wedge.



Figure 136. Replications of the aboriginal microlith tools.

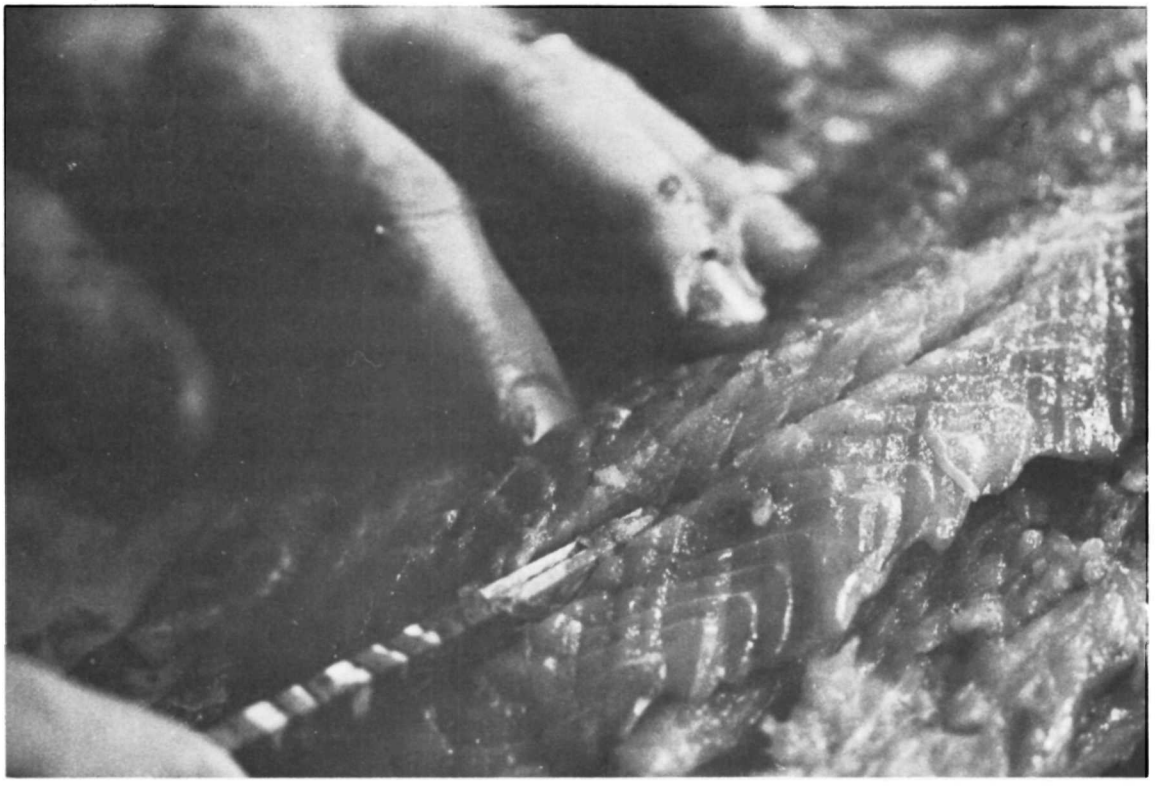


Figure 137. Filleting salmon with replicated microlith tools.

ing in the traditional manner. Therefore, these replicated microlith tools were employed by skilled people in what is potentially an aboriginal manner of fish processing.

Nonquartz Artifacts

The nonquartz lithic artifacts from Hoko River number less than 50 and obviously are not as well represented as the quartz artifacts. There are, at present, five techno-functional categories of nonquartz artifacts from the site. Experimental replication of these categories is, at present, incomplete. Therefore, only a brief description of each category will be presented in this preliminary report.

Basalt Cores and Flakes

Small discoidal basalt cobbles were reduced by a bipolar technique in order to produce a flat primary decortication flake (Figure 138). The basalt cores and flakes may represent a technological system for the manufacture of hand wedges, perhaps wedges to be used in splitting cedar for microlith handles. In terms of numbers of artifacts, however, this system is not well represented at the site.

Hammerstones

Six hammerstones with an average weight of 626.24 g were recovered from the site. These tools exhibit localized pocking and are very similar in weight, shape, and material to the experimental hammerstone used for microlith production (Figure 139).

Abraders

Two categories of abraders were found at Hoko River--flat-surfaced sandstone abraders and sandstone saws (Figure 140). These abraders exhibit striations on their working surfaces or edges and were most likely used for wood reduction in the production of wooden artifacts.

Adzes

One nephrite adze was found on the surface of the site. This adze appears to have been employed as a wedge, given the nature of the edge damage on the bit and the alteration, due to percussion, of the distal end (Figure 141).

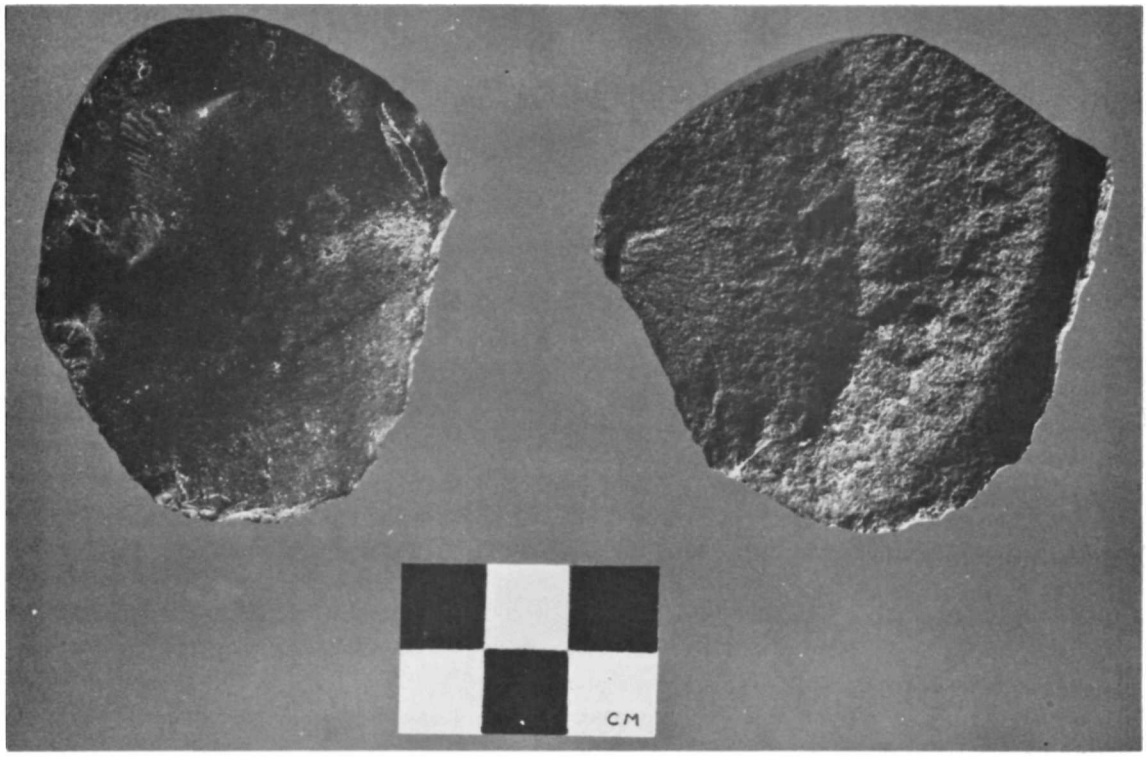


Figure 138. Basalt hand wedges. A (left), potential aboriginal hand wedge and B (right), experimental had wedge.

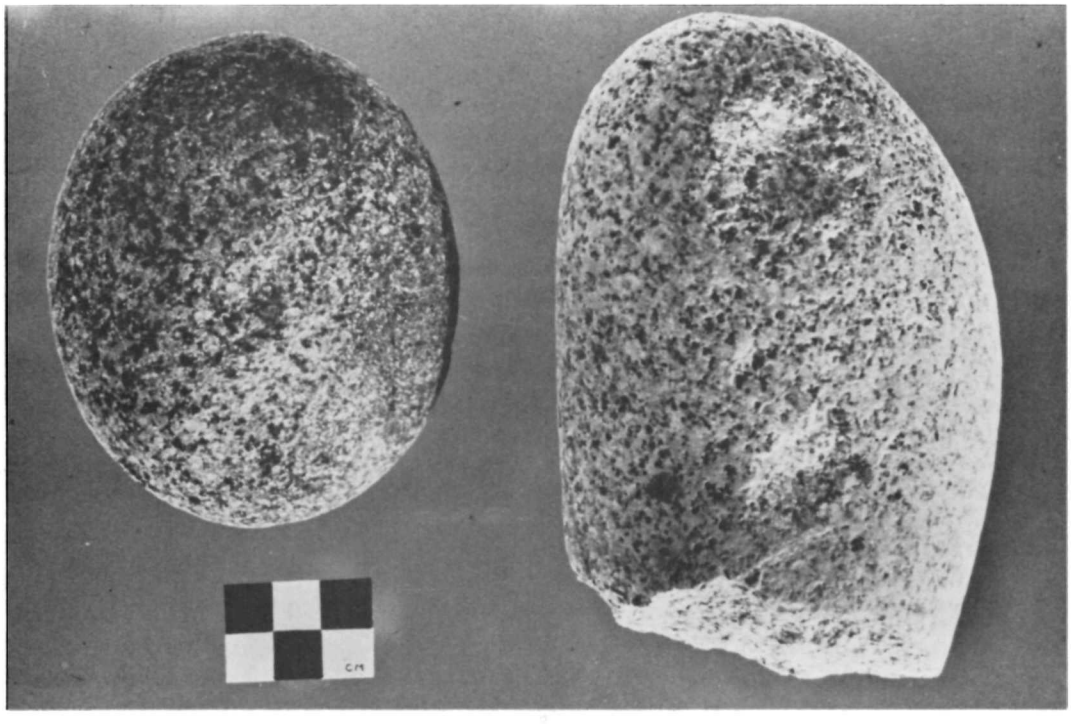


Figure 139. Hammerstoens. A (left) aboriginal hammerstones and B (right), experimental hammerstones.

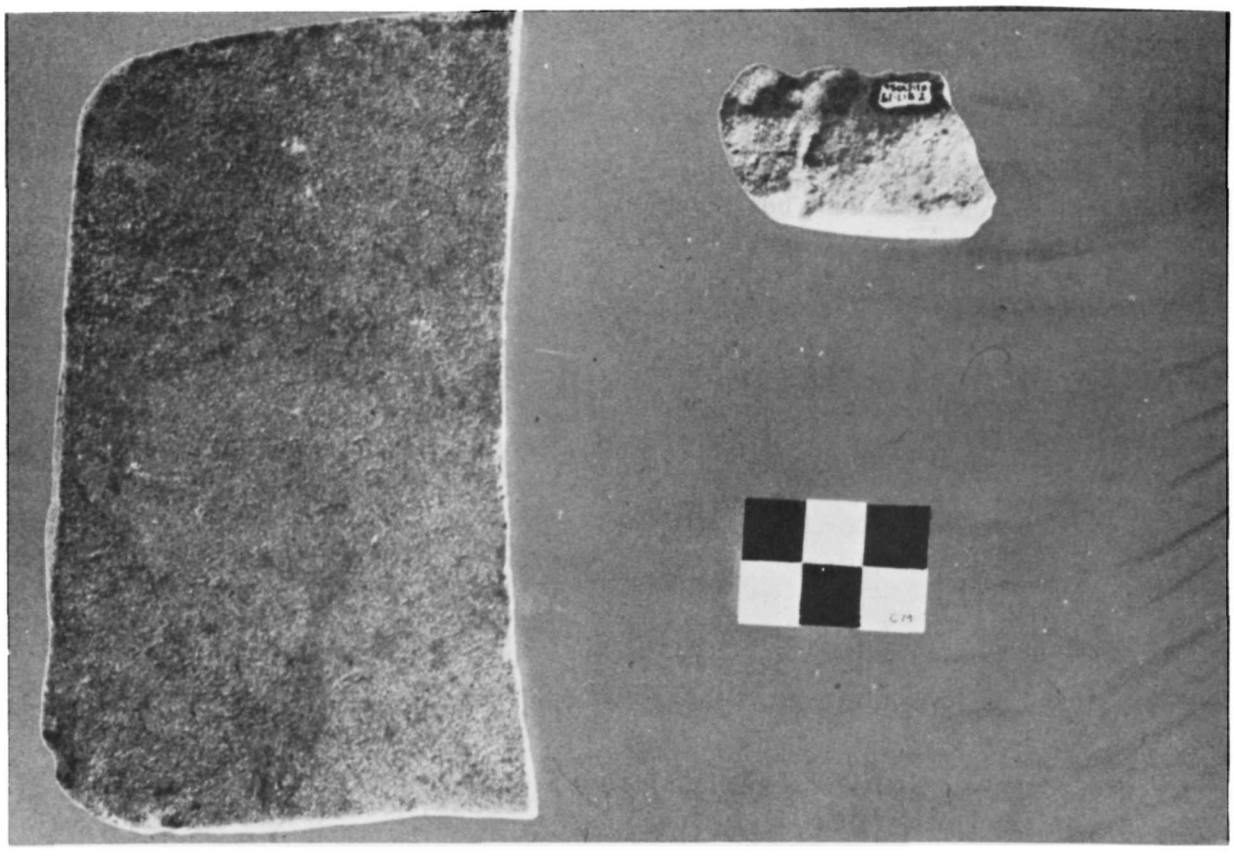


Figure 140. Abraders from the Hoko River site. A, flat surface sandstone abrader and B, sandstone saw.



Figure 141. Nephrite adze/wedge recovered from the surface of the Hoko River site.

The function of this category of artifact will be difficult to demonstrate. These artifacts, averaging 95 g in weight, are nothing more than cobbles with vegetal materials (probably split root strips) bound around their midsections (Figure 142).

Discussion

The purpose of this preliminary report is not to review the literature or to form conclusions concerning the lithic artifacts from the Hoko River site, but rather to acquaint the reader with the technologies and lithic artifact categories from the site. At this time I can speak with certainty only of the method of production of microliths and the hafting process of the microlith tools. Replicative Systems Analysis is time consuming, involving numerous personnel outside of the Lithics Laboratory; the final analyses are in progress, and the results will be available in the near future.

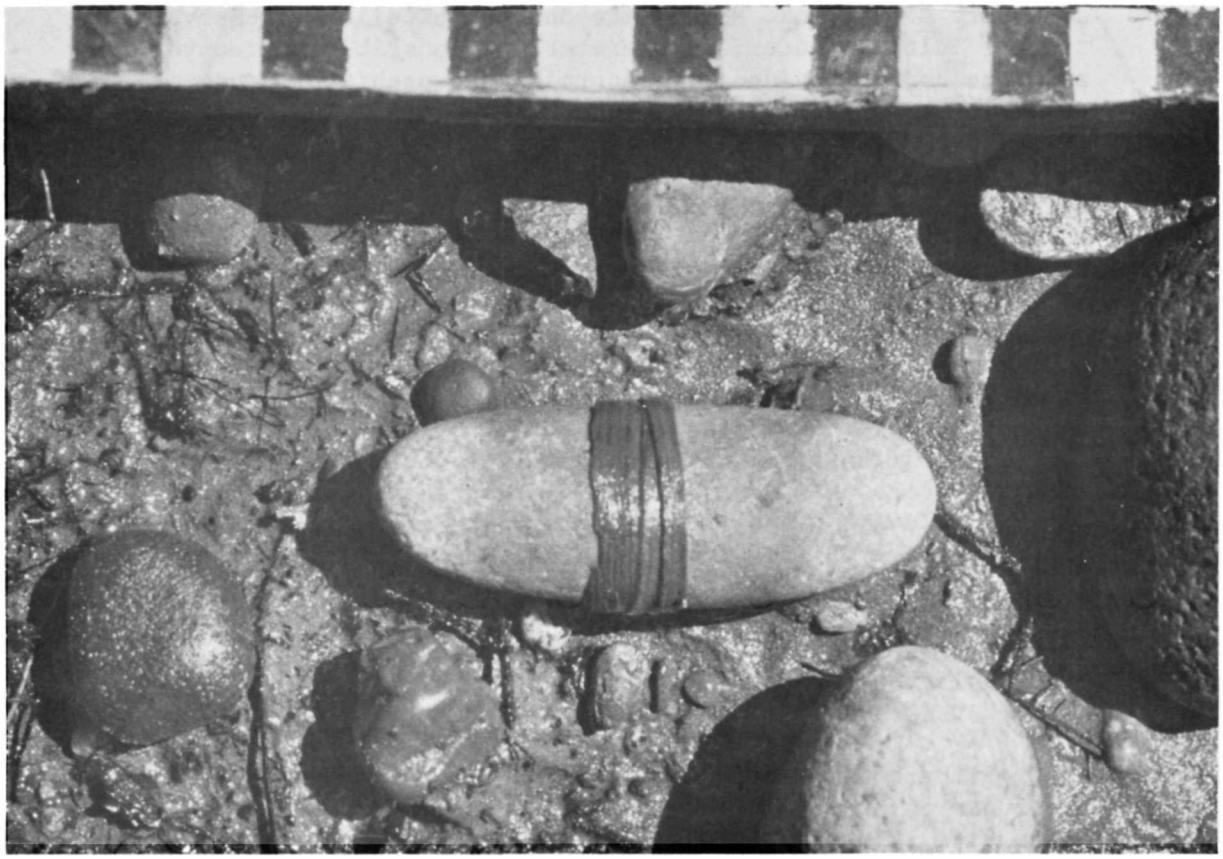


Figure 142. Net weight from the Hoko River site.

CHAPTER V SUMMARY AND CONCLUSIONS

Our knowledge of the ethnographically known subsistence technologies of this area of the Northwest Coast would enable us to predict that the Hoko River mouth would historically have been an important fishing camp location. The discovery of the Hoko River site and the excellent preservation of cultural materials there made it possible to recover a unique body of evidence concerning the prehistoric use of the river mouth by the native Americans in this region.

Environmental research concerning the Hoko River locality suggests that the overall environment has remained relatively stable over the past 3000 years. The stratigraphic deposition at the site indicates that the prehistoric Hoko settlement was along a river bar similar to those found at the mouth of the river today. The site and general area appear to have been tectonically uplifted approximately 2 m, exposing the previously inundated waterlogged deposits of this site. The Hoko River spit, formed by the easterly moving ocean currents and the discharge of the river along the bedrock outcrop of Kydaka Point, has probably been in much the same location and position through most of this time period. The prehistoric macrofloral and microfloral remains indicate that the immediate floral environment has remained similar through time. Faunal remains also reflect consistency of resources. The environment overall, excluding the local uplift, appears to have remained relatively unchanged through this time period.

The radiocarbon dates reveal that the occupation of the Hoko River bar campsite extended from approximately 2000 to 3000 years B.P., mostly at the midpoint of that time range or 2500 years B.P. As the river moved in new directions after approximately 2000 years B.P., the inhabitants probably remained in the area, but set up camp in other locations more convenient to the new courses of the river.

Several dimensions of cultural research and problem-orientation are being approached as part of the Hoko River project. In exploring how the early occupants interacted with their overall environment, the following major topics are considered: the food and material procurement techniques, and especially fishing and sea-mammal hunting technologies; the methods of transporation; the food-processing procedures; the woodworking technologies; and the dwellings (Figure 143). When considering how the inhabitants interacted

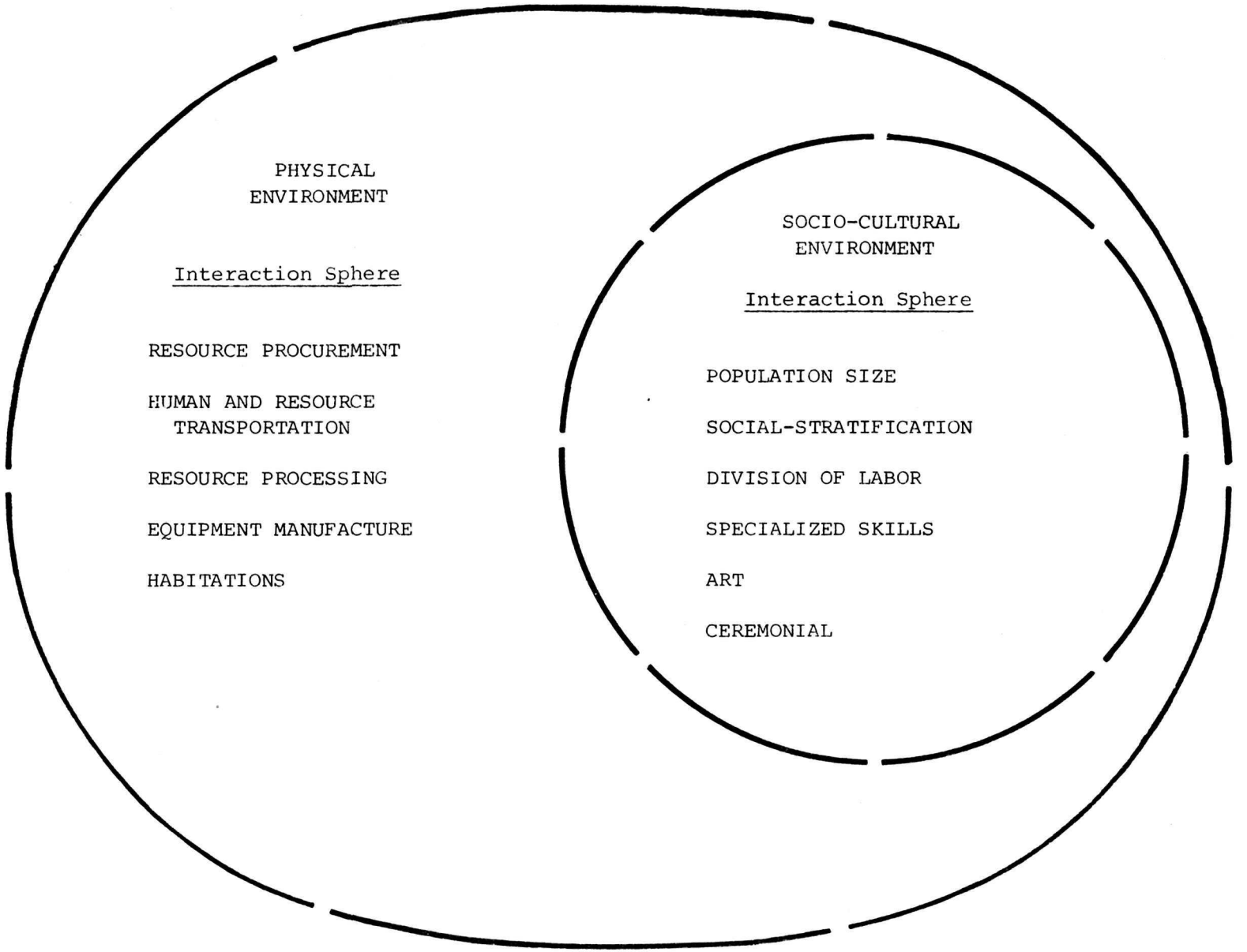


Figure 143. Topics of consideration when discussing interactions between the prehistoric Hoko River inhabitants and their (1) physical environment and (2) socio-cultural environment.

within their socio-cultural environment the following topics are discussed: the population size and potential social stratification; the possible division of labor and specialized skills; and the art and potential ceremonial life. Each of these topical categories is discussed separately below.

In approaching the question of cultural identity, the distinct cultural styles occurring at Hoko River are being studied and compared with those at other sites, leading to hypotheses of cultural relationships through time. This process has begun in this volume, and it has been possible to suggest the degrees of relationship existing between this site and others along the Northwest Coast.

Finally, the problem of when and how the location was used is being considered through interpretation of seasonal scheduling and site-use. Some tentative suggestions have been made as to the season of occupation at the Hoko River site and the site's part in the seasonal round of its aboriginal occupants.

Although much work remains to be done in several areas of research, the initial excavations have resulted in the following conclusions and suggestions.

INTERACTION WITH THE PHYSICAL ENVIRONMENT

Resource Procurement Techniques

Fishing was a major activity at the Hoko River camp; The preserved and abundant fishing equipment and fish faunal remains reflect this activity. Hook-and-line deep-sea fishing was well developed, with at least three different forms of hooks used: bentwoods, three-piece composites, and two-piece composites. Ground fish (and in particular halibut, petrale sole, Pacific cod, and various rockfish) were commonly caught. Fishing on the banks off the Hoko mouth, probably as deep as 40 fathoms, was accomplished with the use of kelp lines(?), anchors, and baited hooks. Fisheries data from the turn of the century reveals that the average daily catch of Makah fishermen using hooks-and-lines from a halibut canoe was about 40 fish, having an average weight of 30 pounds, though many of the fish were much heavier (Wilcox 1895:289). As early as 2500 years ago hook-and-line deep-sea fishing by Hoko residents probably was pursued with comparable equipment, skills, and success. This type of fishing certainly played an important role in the subsistence activities in the region for at least that time period.

The river itself undoubtedly was a major fishery for occupants of the site. When the three locally available species of salmon aggregated in their runs up the Hoko, they were apparently caught in a number of ways. Fresh salmon could have been speared using harpoon points such as the laterally barbed wooden projectile points recovered. Since most of these have notches for line attachment, and since none were found securely attached to a shaft, they probably were detachable harpoon points. Salmon may also have been netted at the river mouth. The recovered net with attached anchor stone could have been used as a gill net. This highly visible, thin-split spruce twig net would have worked best when the waters were muddy, as they commonly are in the fall during higher river discharges.

Fish-weir stakes have not been found, but lattice-works were recovered. Weirs themselves probably would have been constructed well upriver, above the area of tidal fluctuations. Not only would traps be easier to construct there, but the salmon would be leaner and better for drying as they moved farther upriver. The ethnographic pattern may provide a good prehistoric model in this case; the village/camp was at the river mouth, but the salmon traps were well upriver, and the fish were brought back to the village from the traps for processing.

Sea mammals were hunted from the site; remains of harbor seal, porpoise, dolphin, fur seal, and even gray whale have been recovered. The laterally barbed wooden projectile points may have been harpoons used to hunt sea mammals. Their size would make them very light-weight for whale-hunting equipment; the whale remains recovered may be the result of salvaging beached whales.

Waterfowl remains are common at Hoko River. The birds possibly were taken with the barbed wooden points, but no evidence of atlatl or appropriate spears has been identified.

Fishing for deep-sea fish with hook-and-line appears to have been the major activity at the Hoko River site 2500 years ago. Salmon fishing during the river runs using techniques of spearing, netting, and trapping probably was also common. Second in importance would have been waterfowl hunting. Sea-mammal hunting with harpoons appears to have been of only supplementary importance.

Watercraft Transportation

Although we have no direct evidence of their existence, watercraft must have been an integral part of Hoko River transportation; the deep-sea fishing activities alone would have required them. The characteristics of the prehistoric watercraft remain unknown. Historically coastal groups used

highly efficient dugout cedar canoes. Examples of these over 30 feet long have been recorded, and they were used several miles out at sea for fishing and sea-mammal hunting activities. Besides subsistence uses, the canoes were an equally important vehicle for human mobility/transportation. Long distances could be covered in a single day, and large loads of food or nonfood resources could be transported.

At the Hoko River site it is highly likely that cedar dugout canoes were the principle form of watercraft. The indirect evidence from the site includes: (1) the kind of woodworking tools recovered, (2) the abundant debris from wood splitting and adzing, and (3) the broken pieces of cedar boards that have been carved, not split, against the wood grain. The Hoko inhabitants used adzes with nephrite blades and wooden wedges for splitting wood; these are two of the basic tools used ethnographically to create dugout canoes. Cedar wood in the form of raw material, woodchips, and split pieces is abundant at the site, and this is the wood most often chosen for canoes because of its superior qualities for carving and its strength and resistence to decay. The broken pieces of cedar "boards" carved against the wood grain demonstrate that the Hoko people were carving cedar. Some of these fragments may very well be pieces from canoes. Therefore, it is highly probable that cedar dugout canoes were the vehicles used for water transportation and fishing 2500 years B.P. at Hoko. Hopefully, as excavations continue, actual canoes or identifiable pieces will be encountered, demonstrating something about the sizes, styles, and steps of manufacture for these watercraft.

Food-Processing Procedures

Only a limited amount of data is available on techniques of food processing, and most of this relates to fish processing. The caught fish would first have been transported to the camp by canoe, then carried to and from the processing area in pack baskets (an assumption based on the high relative frequency of burden basket fragments recovered at this location). The fish were most likely cleaned (dressed) on the beach, probably with hafted microliths as a primary tool. Experiments demonstrate the usefulness of these tools for cutting fish, and they were produced in large numbers at the site. Vein quartz lithic debitage and thin, split cedar-stick debitage are very abundant in the deposit, reflecting the numbers of microliths and handles that were being produced and used. This corresponds to the large numbers of fish that must have been processed at this location through the fishing season. After being cleaned, the fish would have been prepared for either consumption or preservation. The apparent and significant amount of fishing taking place off the site and the developed procuring and processing equipment indicate that the Hoko River people were capa-

ble of taking, and probably were taking, a surplus of fish which could have been preserved and stored for winter or slack season use. Prime candidates for preservation would be the spring-summer halibut and the fall chum/dog salmon. Historically, both of these fish were dried and stored for winter-use. One important physical characteristic of the location is its beach exposure direction (westerly); this would have been ideal for afternoon sun exposure, and therefore for sun drying of halibut and other fish. Of course until actual hearths and/or rows of postmolds indicative of smoking/drying racks are found, it is difficult to demonstrate large-scale preserving of foodstuffs. Also, fish butchering techniques must be examined in more detail as a larger sample of fish and other food remains are recovered.

Woodworking Technology

Woodworking techniques were well developed at the site. As mentioned in the discussion of potential dugout canoe transportation, the woodworking equipment from the site includes nephrite adze bits and wood-splitting wedges. The thousands of woodchips and split-wood debitage from the site reflect the amount of woodworking taking place. The Hoko inhabitants undoubtedly possessed most of the basic woodworking tools and skills that are seen in much later periods of Northwest Coast prehistory and history. This woodworking technology is an important element contributing to the overall composition of the Northwest Coast life-style as seen along the entire coast at contact.

Complete Hoko adzes with handles have not been recovered. Therefore it is not known whether the nephrite blade was hafted in an elbow, straight, "D" adze, or other form of handle. The potential certainly remains for finding handles or even complete hafted adzes at the site in future excavation.

The woodchip analysis suggests that a standard woodworking tool was used at the site; the chips are very consistant as to width, length, and thickness. Also a considerable amount of adze work was taking place, especially surface smoothing of wooden objects (as indicated by cortex woodchips). Possibly planks or poles were being finished for dwellings, fish weirs, and/or drying racks.

Split-wood technology was a basic woodworking practice. Thousands of pieces of split-wood debitage, mostly cedar, were recovered and kept for analysis. Since the split-wood studies are only now being initiated, specific results are not available. However, the debitage includes a large amount of small, stick-sized pieces, possibly microlith handle debitage, as well as some larger, board-sized pieces.

Artifacts resulting from woodworking using wood splitting techniques include split-cedar handles for hafted microliths, "line floats," and "hand reels." Blanks split from limbs for the initial forming of fishhooks and laterally barbed projectile points occur as well.

The planks and plank fragments recovered were undoubtedly formed using wooden wedges. The initial splitting of large logs into planks and workable pieces would have been best accomplished with wedges. Planks could have been used for a number of purposes, but the most obvious would be to cover dwellings and to construct benches, shelves, and bentwood boxes. Suprisingly, no fragments from bentwood boxes have been identified; the wood from damaged examples may have been reused to form the smaller split-wood artifacts described above, leaving little evidence of the original use.

In conclusion, adzing and split-wood techniques were very common at Hoko River, and both of these were basic to all later Northwest Coast woodworking technologies.

Dwellings

Though actual house features have not been found at the site, some suggestions can be made as to the possible composition of the Hoko dwellings. Split-cedar planking is a likely material to have been used (at least in part) in constructing dwellings, since wooden wedges and fragments of actual split-cedar boards are recovered from the site. Historically, this was a major wall and roof cover material, which was applied with overlapping boards to keep houses dry in rainy weather. Certainly some form of plank dwellings can be proposed for the Hoko camp, though their exact composition can not be determined until house features are discovered.

Another possible suggestion for dwelling composition at Hoko River involves the use of sewn "tule" mats to cover house frames. Fragments of sewn mats are found at the site, and historically, tule mats were used to cover temporary shelters at camps. However, sewn "tule" mats may have several other uses as well, including as mattresses, clothing, and covers for beached dugout canoes.

Even if no houses are preserved, if house features can be found in the associated dry portion of the site, much more can be determined about the composition of the structures. If the outlines are discernible, for example, then a square/rectangular outline may indicate plank dwellings and a rounded or oval one would suggest mat-covered dwellings.

INTERACTION WITHIN THE SOCIO-CULTURAL ENVIRONMENT

Population Size and Potential Social Stratification

At Hoko River only limited data have been recovered to reflect population sizes. No human remains have been found, and dwelling sizes and numbers are not known. The only data reflecting potential population sizes are site dimensions, number of artifacts, volume of food remains, and ecological potential of the region. The site appears, from coring, to be extensive, although original size cannot be determined due to the unknown amount of site erosion. The remaining site area, though representing numerous overlying occupations, has been determined to be at least 150 m by 60 m or 9000 sq m in area. Smaller areas than this were probably used at any one time, but the general dimensions are impressive and may reflect a sizable group using the location 2500 years B.P.

The artifacts demonstrate a sophisticated level of food procurement, especially the fishing equipment. The gear, including deep-sea fishing gear, nets, weir fragments, and spears, provides evidence that the inhabitants were able to gain access to fish with a variety of techniques and in several aquatic habitats. Food remains indicate that the early fishermen-hunters-gathers were able to obtain a wide range of different fishes, birds, sea mammals, land mammals, and plant food resources. The ecological potential of the site area is considerable, and the Hoko residents evidently were gaining some access to resources in each habitat zone. A sizable population can be suggested if we take into account the variables of available resources, developed technologies, and site size. Probably a population numbering into the hundreds for the region would be suggested at this time.

A major feature affecting population size would have been the seasonality of the food resources. This limiting factor could be partially overcome with food processing and preservation/storage technologies, and though this is not directly demonstrable, the Hoko River people do appear to have been familiar not only with procuring but with processing and probably preserving for slack-season-use considerable quantities of food. The abundance of and evidence for active manufacture of hafted microlith knives may reflect processing and possible storing of large quantities of food, especially fish. It seems probable that fish were smoke and/or sun dried for less abundant seasons. Potentially, large hearth areas for drying foods will be uncovered in coming seasons, illustrating further the food-processing abilities of the prehistoric peoples at the site.

Social stratification is difficult to demonstrate at Hoko River. Hats are the only evidence and must be interpreted

by ethnographic analogy. Knob-top and bound-top hat styles have been recovered from the site. This may mean that the wearers of these hats had different social statuses, since historically hat styles and shapes were associated with distinct social rankings. Possibly some form of this association between hats and statuses was in operation at the site. Hat styles will have to be carefully observed as more examples are recovered.

Division of Labor and Specialized Skills

Direct evidence for a division of labor between sexes and/or age groups is not available, but such a division can be suggested from ethnographic analogy. In a fishing community, especially when fish are only seasonally available in abundance, a division of labor between the sexes can be predicted, with males as procurers and females as processors, though neither role is exclusive.

If a large quantity of fish were being taken--such as for storage--then men would most likely be catching the fish by hook-and-line deep-sea fishing, spearing, river netting, and/or river weirs, and women would be involved in processing the large quantity of freshly caught fish. To help support a division of labor, it would be useful to demonstrate that the occupants of Hoko were processing (drying) a surplus of fish for later use. If extensive fire hearth areas are discovered in future excavations, they would provide evidence suggesting a need for organized labor forces and a division of labor.

Evidence for specialists at the site is not readily apparent. Most items made at Hoko would not necessarily require specialized skills, and most persons could be taught to produce the basketry, cordage, lithics, and worked wood at the site. Some division between the sexes could have existed, with such tasks as fishing and woodworking being done by males while other tasks such as food processing and basket-making were done by females, a pattern seen historically.

Art and Ceremonial Life

Although wet sites in general have great potential for increasing our understanding of the development of classic Northwest Coast art, representational art is rare at Hoko River. A few zoomorphic wood carvings are recorded, especially on laterally barbed projectile points and on one object of unknown use (possibly a fish lure device). Eyes are typically diamond-shaped and mouths end in cheek marks. Gill-like cresents are sometimes placed behind the eyes (Croes 1976b:229).

Art in the form of geometric patterning is somewhat more common. It is found on barbed points and particularly in basketry, where a dark/light contrast of material creates geometric designs.

The scarcity of art at the site can be partially explained because of the activities taking place there. As a procurement (fishing) station, most of the artifacts would be associated with direct procurement activities. Even the representational art that does occur is on barbed points and the possible fish lures. If the "winter" village settlement occupied by the Hoko people were located, more artwork would be predicted. The potential for more art in woodcarvings exists at Hoko, but its abundance would not be expected to be high.

There is no direct evidence for ceremonial life, and this again may reflect site-use, that is, fishing station vs. a winter village. Socialization, including ceremonialism, was particularly important at historic winter village gatherings and not as significant at fishing stations.

CULTURAL STYLE COMPARISONS

In order to approach the question of cultural affinities at Hoko River, style comparisons were made between materials from this site and those from all other Northwest Coast wet sites. This limiting of comparison to wet sites is necessary since non-wet sites do not contain many comparable materials. Certain items appeared to have widespread distribution through time and across space. These include wooden wedges, nephrite adze blades, burden baskets, basketry hats, fishhooks, laterally barbed projectile points, cordage, and nets. At more refined levels of comparison, the styles and technologies of certain items, in particular basketry and cordage, can be used to demonstrate separate regional patterns through time. In tests of similarity of basketry modes and types and two levels of cordage types, Hoko River consistantly associated with the spatially nearby site of Ozette Village. Basketry and cordage from other sites cluster in two separate regionally defined areas--Puget Sound/Gulf of Georgia and the northern coast. These data provide a basis for proposing cultural style continuity through time in three separate regions and lead to the hypothesis that the Hoko River occupants were culturally interrelated with the later groups in this south-central coastal region of the Northwest Coast. Since basketry is especially sensitive stylistically, it is hypothesized that the interrelationships of basketry modes and types through time in the south-central coast are the result of techniques

and styles being passed on from generation to generation by peoples who have remained in this general region for at least 2500 years. The cordage style continuity is less sensitive because of the less complex nature of the artifact; it does, however, certainly compliment the hypothesis of regional cultural continuity based on basketry.

An additional mode of continuity is suggested by the fishing techniques common to Hoko River, Ozette Village, and historic Makah/Nootkans. Hook-and-line deep-sea fishing with an emphasis on halibut appears to have been a dominant pattern in this region through time. These emphases on halibut fishing, even over salmon fishing (Swan 1869:19,24), and on taking salmon by hook-and-line trolling are distinct to this region. Ethnographically, in other areas of the Northwest Coast nets and weirs were the major equipment used in fishing, and hook-and-line was only secondarily used. Other Northwest Coast wet sites do not reflect quite the emphasis on hook-and-line deep-sea fishing seen at Hoko River. The 3000 B.P. Musqueam Northeast materials, for example (Croes 1975; Borden 1976), indicate a major emphasis on net fishing, and historically netting was a major technique in that Puget Sound/Gulf of Georgia region. Trends in subsistence techniques and orientation, then, seem to have considerable continuity in the Hoko region and potentially in others as well.

In summary, using the available data from prehistoric sites in several areas of the Northwest Coast, it is hypothesized that Hoko River artifact styles and types and procurement techniques are most similar to later examples in the immediate region, supporting a hypothesis of in situ cultural-continuity for 2500+ years.

SITE-USE AND SCHEDULING

The exact season (or seasons) of use of the Hoko River site is being deciphered using several different approaches. If we use the ethnographic pattern of a seasonal round as a model, the Hoko River site would have been used most heavily as a spring/summer deep-sea fishing station and a fall river-salmon fishing station. Winter use would have been minimal, and occupants would have congregated elsewhere for the winter village.

The fish remains at the site are mainly groundfish which are caught in the neritic habitat zone. Since these fish, and especially the halibut, are most available on the banks in spring/summer, this period can be considered a time of site

occupation. The fishhook types, being deep-sea fishing varieties, support this interpretation. Although the salmon being taken could be caught in the strait by trolling during most seasons, they were probably also netted, speared, and trapped in the river itself. The best runs are in fall, and this was probably also a period of major activity at the site. Bird remains, at least those that are seasonal, tentatively suggest a spring and/or fall occupation, possibly extending through winter. The sample size, however, is very limited. Ethnographically the Makah took shellfish in the summer (Singh 1956:113), and the recovered mussel periostracum remains may reflect a summer usage, though mussels can be harvested at any time.

From the above discussion it would appear most probable that the Hoko River site was actively occupied in spring/summer/fall. In the winter, when resources were not readily available for two to three months, the Hoko River inhabitants may have remained at this location, though it is not the most sheltered location in the area, or they may have moved to another spot, possibly to congregate with related groups in a winter village. At this winter location, the predicted dried and stored resources could have been consumed, traded, and/or redistributed. Possible winter locations that would afford more protection from westerly winds and storms include Neah Bay, Bullman Beach, and Sekiu.

SUMMARY AND CONCLUSIONS

The people who occupied the Hoko River site 2500 years B.P. had most of the basic components seen at contact among Northwest Coast cultures. They were well acquainted with the fishing technologies, and especially deep-sea hook-and-line techniques, so well developed by later groups of this south-central region. They apparently posessed watercraft, undoubtedly including sea-going dugout canoes. And even though dwellings have not been located, the abundance of wooden wedges and split cedar-wood suggests dwellings composed, at least in part, of planks. Populations may have been sizable, possibly approaching hundreds for the region. Their clothing was similar in manufacture to later periods, with shredded cedar-bark skirts and conical knob-top and bound-top rainhats. Division of labor along sex and age lines probably occurred, with males procuring fish and females and young people processing fish and gathering shellfish, berries, and other resources. Art in woodworking is not common, but the Hoko River camp was probably not a major village where more art objects would be expected. Rather, it was more likely a specialized site for procuring

fish and other resources, as it remains even into the present.

The question of the cultural relationships between the Hoko River people and occupants of other Northwest Coast wet sites has been approached using tests of cultural style similarities. Available data suggest cultural/stylistic continuity between Hoko River, the temporally later Ozette Village, and the contact Makah/Nootka. From another perspective, the emphasis on hook-and-line halibut fishing at Hoko River also is shared by later groups of this south-central west coast region. These data support a hypothesis of cultural interrelationship and continuity from the time period of Hoko River through the historic period of this region.

Prehistoric Hoko River inhabitants probably moved to the site in the spring and fished in the strait and hunted sea mammals through spring and into the summer. The people also probably busied themselves at this season and into the summer with gathering and processing sprouts, berries, and shellfish. This campsite was undoubtedly occupied into the fall for the major salmon runs. The site appears to have been used spring and fall, possibly in summer, and it is suggested that winters would have been spent elsewhere; just where is not clear, but possibilities are to be explored through future survey work.

Hoko River site research illustrates some of the overall potential and values of Northwest Coast wet site research. A much clearer and more comprehensive view of a 2500 years B.P. west coast fishing village is provided by the well-preserved materials from this site. This kind of site provides an especially valuable key to our understanding as to how people of this region and time period interacted with their physical environment and within their socio-cultural world. Anticipated future fieldwork will build on this baseline study, providing data for a more complete interpretation and reconstruction of the physical and cultural world inhabited by the people who camped at the mouth of the Hoko River 2500 years ago. This study also provides an important data base for understanding one aspect of the overall cultural evolution on the Northwest Coast of North America.

FUTURE PLANS

Though a sizable sample of perishable materials was recovered from along the water-logged exposed river terrace, large portions of the site still await future excavation. Since numerous well-separated vegetal mat deposits occur in

this river bar development, a comparison of artifacts between layers through time would permit a study of style changes in basketry, cordage, lithics, woodworking, fishing, and other technologies through the period of occupation. However, larger samples of artifacts will be needed for reliable between-layers interpretations.

Core testing behind the river exposure indicates the possible existence of campsite areas. A test excavation is planned in this section of the site to locate possible activity areas such as drying rack/hearth areas, lithic workshops, and dwellings.

Ethnohistory has opened new avenues for understanding the historic use of the Hoko River vicinity and how this use may reflect prehistoric uses as well. Therefore, a more extensive ethnohistoric field survey is planned in the future.

To develop more of a regional perspective on the prehistoric use of the Hoko River vicinity, a survey is planned to record the location of both natural resources and other archaeological sites in the region. Maps will be compiled to indicate where fishing banks are located, where shellfish and other intertidal resources are, and where plant food and nonfood resources would be found. This will provide important data for constructing a predictive model for overall use of the region by the Hoko River inhabitants. In following years this model can be further tested by examining other archaeoloical sites in the vicinity to see if they comply with the model's predictions.

With the exposure of the actual campsite area behind the bank and the recovery of an increased quantity of perishable materials from offshore, we should be able to develop a much more complete interpretation of the 2500 years B.P. fishing camp. From this baseline study and from developing regional research, an overall reconstruction of the world of these early people will be generated that could not be obtained without these well-preserved cultural resources. Other special studies will expand and continue the artifact analysis, faunal/floral resource analysis, geomorphological studies, cultural style comparisons, and ethnohistoric research and will initiate dendrochronological research, coprolite analysis, computer modeling of regional site-use patterns, and site survey and testing. This continuing research will be synthesized into a following volume.

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