FISHING FOR IVORY WORMS:

A REVIEW OF ETHNOGRAPHIC AND HISTORICALLY RECORDED *DENTALIUM* SOURCE LOCATIONS

by

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ABSTRACT

This study reviews and examines historic and ethnographic written documents that identify locations where *Dentalium* shells were procured by west coast Native North Americans. The occurrence of *Dentalium* shell in archaeological sites in western North America has been used by archaeologists to construct trade routes and to comment on contact between different prehistoric groups as well as discuss the development of complex stratified societies on the northwest coast. Source locations have usually been determined by reference to a limited number of historic and ethnographic documents.

The thesis begins by reviewing the biological information on scaphopod molluscs to determine the availability of species of this class on the west coast of North America. *Dentalium pretiosum* is one of several different species of marine scaphopod molluscs found along the coast of North America that would have been procurable by Native people. An examination of historic fur trade documents indicates that Euroamerican fur traders were using the shell as a trade good and were obtaining it at a diverse number of locations along the coast. Native geographical place name information, and ethnographic accounts of the procurement methods and technology also identify a number of different source locations for the shell. This review indicates that during the historic period *Dentalium* shell was procured at numerous locations along the west coast of North America with the highest number of source locations recorded on the west coast of Vancouver Island.

The results of this study have three implications for the interpretation of *Dentalium* shell from prehistoric archaeological sites. There were at least two species of scaphopod mollusc, and possibly more, in use during the prehistoric period. The volume of shell traded during the historic period may not be indicative of the trade that occurred prehistorically. Construction of exchange networks that identify the west coast of Vancouver Island as the main origin point of the shell may be inaccurate.

DEDICATION

For my parents, Patricia and Vern Barton.

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provided me with specimens of *Dentalium* shell Arnoud Stryd of Arcas Associates allowed me access to the *Dentalium* artefacts from the Tsawwassen Site and my visit to view the specimens was facilitated by Joanne Curtin, Geordie Howe, Karen Preckel and Mary Quirolo. Brian Hayden from the Department of Archaeology at Simon Fraser University kindly provided access to the *Dentalium* artefacts from the Keatley Creek Site. Marjorie Dunlop drafted the base map of Vancouver Island used in Figure 17, and John Breffitt made available the base map of the Queen Charlotte Islands used in Figure 25.

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My family has been quite supportive during my endeavors even though it seemed to take me forever to finish 'the book". My mates Colin Cook, Don Currie, Mark Filmer, Gary Keane, Mark Lash and Dan Uchacz were always there to provide an alternative perspective at our Monday night sessions. And finally, Jennifer Whiteside's care and support got me through the tricky bits at the end. It's never finished until it reaches the library stacks.

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CHAPTER ONE

INTRODUCTION

> *At this time of year [June] they used to go up to Copper River, then come back in August. They used to fish for ivory worms [dentalia] at Copper River [de Laguna 1972:349].*

This thesis will review and evaluate *Dentalium* source locations that are recorded in historic and ethnographic literature as an aid to the archaeologist interpreting *Dentalium* shell found in prehistoric archaeological sites. *Dentalium* shell is an item of material culture that has received a great deal of attention in archaeological contexts as it is; (1) relatively non-perishable, (2) occurs frequently in important ceremonial contexts (such as interments) and is construed to represent wealth and status (Burley 1981; Carlson and Hobler 1993; Coupland 1993; Hayden and Ryder 1991; Hayden and Spafford 1993; Wessen 1994), and (3) is an indicator of cultural contact and interaction, particularly when recovered from archaeological sites in non-maritime locations. During the historic period, and by inference, the prehistoric period, it is reputed to have been fished for exclusively by the Nuu-chah-nulth people on the west coast of Vancouver Island (Andrews 1989; Clark 1963; Drucker 1951; 1965). From these procurement sources on Vancouver Island, it was dispersed through native exchange networks across western North America (Clark 1963).

The subject of trade between cultural groups and the determination of exchange networks has long been of interest to archaeologists working on the northwest coast. The occurrence of *Dentalium* shell in archaeological sites in western North America, particularly in interior sites, has been used by archaeologists to construct trade routes and to comment on contact between different prehistoric groups (Erickson 1990). *Dentalium* shell recovered from the Crown Site in Saskatchewan in deposits dated to 4000 years BP

(Quigg 1986:87-89) illustrates the antiquity and the scope of the trade in this species of marine shellfish, and the quantity of *Dentalium* shell recovered from sites on the coast and interior plateau indicate that it was in fairly standard use by 2500 BP (Burley 1981; 1989; Arcas Consulting Archaeologists Limited 1991:161, 191; Erickson 1991).

When discussing the coastal locations for the origin of this shell, archaeologists have consulted ethnographic and historic records in order determine the answer to this question. Archaeologists frequently cite Drucker (1951) as the main reference on issues involving the source of the shell. As a result, archaeological interpretations tend to regard *Dentalium* as a single species of deep water dwelling mollusc distributed along the coast of North America, but only accessible along the west coast of Vancouver Island. This view is reinforced by ethnographers. A recent example can be taken from Moore's (1977:201) study of the Mowachaht, where he comments on the role trade played in Nuu-chah-nulth society and states that "for centuries dentalium shell radiated from central Nootkan territory along trade networks across native North America to the Atlantic drainage".

When discussing the occurrence of *Dentalium* in archaeological contexts archaeologists have, and continue, to draw selectively and uncritically from the ethnographic and historic literature to interpret the source of *Dentalium* shell along the west coast of North America. In Gary Wessen's recent summary of the invertebrate remains from the Ozette site in Washington State he discusses the *Dentalium* shell that was recovered from one of the buried structures on the site designated as House 1. Wessen (1994:353) identifies the shell as belonging to the species *Dentalium pretiosum*, and comments that the source of this shell was on the west coast of Vancouver Island.

However, ethnographic and historic literature suggests that there are other areas that could have potentially supplied *Dentalium* as a trade item. The biological literature also indicates that there are more that one species of this class of invertebrate animal found along the west coast of North America. The first step in attempting to reconstruct

an exchange networks involves isolating the source of the material being traded. Therefore, the intent of this thesis is to examine the source locations for *Dentalium* shell along the West coast of North America and to conduct this study in conjunction with a review of the species of shell that could have been exploited.

ETHNOGRAPHIC AND ARCHAEOLOGICAL OCCURRENCE

Ethnographic studies indicate that *Dentalium* shell was used extensively along the west coast of North America, and it was traded widely into the interior of the continent (Andrews 1989; Karklins 1992). *Dentalium* shell was widely used and circulated by coastal groups from the Hupa, Tolowa and Pomo in northern California (Kroeber 1925; Powers 1877) to the Aleut in Alaska (Dall 1870; Sauer 1802; Whymper 1868). It was in use by a number of western Athapaskan groups in the boreal forest area and use of the shell extended to groups along the Arctic coast among the MacKenzie Delta Inuit (Anonymous 1822; Richardson 1851; Stefansson 1914). On the Plains it has been recorded from a diverse group including the Blackfoot and Hidatsa (Denig 1930; Matthews 1877; Wood & Thiessen 1985) as far west as the Great Lakes area where it is reported in use by the Chippewa and Ojibwa (Karklins 1992). The shell was used as an item of personal adornment, as decorative elements on items of clothing or on utilitarian items and had uses in various ceremonial contexts (Andrews 1989; Karklins 1992).

The distribution of *Dentalium* shell during the prehistoric period is similar to that during the ethnographic period except that it has been found a little further south in sites in California and has not yet been recovered from sites in the far north. On the coast and in the interior plateau areas, *Dentalium* shell first occurs in sites in the period around 5000 to 6000 years BP while on the plains it appears a little later around 4000 years BP (Andrews 1989; Erickson 1990; Quigg1986). Intensive use of the shell starts around 2500 years BP on the coast and interior plateau and continues up to the historic period (Erickson 1990). The shell is found primarily in burial contexts but the occasional shell is recovered in non-

burial contexts. *Dentalium* with incised designs on the surface of the shell have been recovered along the west coast of North America from British Columbia to California as well as from sites on the interior plateau (Erickson 1990).

RESEARCH GOALS

In formulating a focus for the research in this thesis, a number of questions were developed which centered around four main areas of study. These questions served to inform and guide the research and are enumerated below.

1. **An examination of the *Dentalium* source locations recorded in historical and ethnographic literature**. Were the *Dentalium* fishing sites recorded by Drucker the only sources for the shell on the west coast of North America? Was the development of a procurement technology necessary to successfully exploit this resource?
2. **An examination of the biological information on the Class Scaphopoda, the class under which *Dentalium pretiosum* is classified**. How many species of Scaphopod molluscs are found along the west coast of North America? What are their geographical ranges and the depth that they are found within those ranges? Which of the species of scaphopod mollusc could have been potentially exploited by native people who inhabited the west coast of North America?
3. **The role of the fur trade**. Which Euroamerican traders are recorded as having used *Dentalium* shells as a trade item? How widespread was the trade in *Dentalium* shells? Is there any way of assessing the volume of trade in *Dentalium* shell in the historic period? Is the volume of *Dentalium* recorded during the historic period indicative of the traffic of this item prehistorically? If the demand by fur trade companies increased the volume of shells being harvested by the native groups, did this result in an increase in the number of procurement sites, or were the existing sites more heavily exploited? What was the impact on the native groups that were procuring the shells?

4. **Archaeological construction of prehistoric exchange networks along the west coast of North America that involve *Dentalium* shell**. Are currently constructed exchange networks based on ethnographic information valid in light of a more extensive examination of the historically recorded sources? Given the 6000 year use of the shell in western North America, is it also valid to extend the analogy back this far? Does the increase in the amount of shell around 2500 BP in the archaeological record correspond to the development of new procurement technology that allowed for greater exploitation of the shell, or was it related to an increase in the demand for the shell?

Needless to say, the following study does not fully explicate or address all these questions. They were, however the questions that framed the orientation of the research.

METHODOLOGY

The thesis draw together and summarize the information on *Dentalium* from two different sources: (1) the biological data available on scaphopod molluscs and (2) the ethnographic and historic period writing that refers to the procurement and trade of the shell. Research was conducted primarily by an extensive literature search that covered early fur trade journals, early historical accounts by the first colonists to the northwest coast, ethnographic studies and recent historical commentary on the fur trade during the late eighteenth and early nineteenth centuries. This literature search was supplemented by archival research that reviewed primarily ethnographic and historical materials. Museum collections were visited and artefacts that used *Dentalium* shell as decorative elements were examined. The *Dentalium* fishing spears in the collections of the Royal British Columbia Museums were also studied.

OUTLINE OF CHAPTERS

Having now provided a general outline of the research problem that this thesis will address and the research goals of the study. Chapter Two reviews and summarizes information about the biology and natural history of the Scaphopod molluscs that is relevant to the discussion of source locations. An understanding of some aspects of the natural history and basic biology of this class of molluscs is necessary as some archaeological and ethnographic discussion of its occurrence and distribution is based on inaccurate biological information. The taxonomy and classification of the scaphopod molluscs is discussed and the morphological criteria that have been used to identify these molluscs at the species level are outlined. The problems associated with the identification of archaeological specimens to the species level is examined in relation to the morphological features of the shell. All species found on the west coast of North America are outlined in relation to their location and habitat range and the species that were potentially available, historically and prehistorically, are listed and discussed.

Chapter Three reviews the use of *Dentalium* shell during the historic period and examines the changes that occurred in the use, distribution and exchange of *Dentalium* shell during the fur trade of the eighteenth and nineteenth centuries. Locations where *Dentalium* shell was procured during the fur trade are identified and discussed. The claims for importation of foreign species of scaphopod molluscs for trade with native groups in western North America are presented and evaluated.

Chapter Four reviews the procurement technology and methods including an evaluation on recent experimental work using reconstructed *Dentalium* fishing spears. Many of the historically recorded source locations are identified on the basis of the association with a particular method of shell procurement. The viability of the various reported procurement methods are also outlined and discussed.

Chapter Five outlines the ethnographic and historic recorded source locations and will be discussed in relation to the trade of the shell during the fur trade and the procurement technology discussed in Chapters Three and Four.

Finally, Chapter Six summarizes the information presented in earlier chapters and discusses the procurement sites as they relate to the interpretation of trade routes on the northwest coast and the applicability of using historic and ethnographic recorded *Dentalium* source locations to interpret the archaeological occurrence of the shell.

CHAPTER TWO

NATURAL HISTORY OF THE SCAPHOPODA

In order to assess and evaluate the historic and ethnographic information on the use of scaphopod mollusc shells, the locations where these shell were procured, and the methods that were employed to procure them, a basic understanding of the biology and taxonomy of this class of animals is required. In this chapter, I review the criteria used in classifying the species in Class Scaphopoda, discuss extent information on the basic biology and ecology of the class, and describe those species that occur off the west coast of North America. Information on the geographical range west coast species and the depth at which they are found within this range is presented relative to those species that would have been potentially available for exploitation by native people during the prehistoric and historic periods.

Dentalium pretiosum is the species of scaphopod mollusc that has been identified as providing the shell that was in use historically and prehistorically. The shell is usually referred to as *Dentalium* or dentalia in historic and ethnographic writing. As will be discussed in this chapter, this species has recently been reclassified under the genus *Antalis*. In this chapter, *Dentalium pretiosum* will be referred to as *Antalis pretiosum*, but in order to avoid confusion when dealing with the historic and ethnographic sources, the genus name, *Dentalium,* will be used in reference to the shell in all other chapters in this study.

TAXONOMY AND CLASSIFICATION

Phylum: Mollusca

Molluscs are a phyla of animal that have been grouped together not on the basis of exclusive characteristics but on the basis of a number of similar shared characteristics.

Therefore, there is no single key characteristic that separates mollusca from other phyla. They are recognized by a variety of general features or structures which Abbott (1974), Moore (1960), Trueman and Clarke (1988) and Yonge (1960) have outlined as including:

(1) a mantle (skin), which serves as a protective barrier by secreting the dorsal integumen (shell) and periostracum and functions in respiration, assimilation, locomotion and reproduction;

(2) a calcareous shell, used for the protection of the animal. The shell may be reduced or lost in some molluscan species;

(3) a respiratory mantle cavity;

(4) a gonopericardial complex and open circulatory system;

(5) a gut with radula and digestive glands. The radula is a specialized calcified structure used in the processing of food prior to digestion; and

(6) a ventral muscular foot which is used in locomotion, burrowing and in some species, for capturing food.

These structures are developed to different degrees in the various orders and families, and some traits, like the presence of a shell, may be vestigial or not developed at all.

Class Scaphopoda

Scaphopods are one of eight classes of molluscs classified under the phylum mollusca which includes bivalves [clams], gastropods [snails], chitons, cephphalopods [octopus, squid], and three lesser classes. The scaphopod molluscs are a class that contains approximately 350 identified species that have been divided into two orders and eight families (Boss 1982:1162). They are cosmopolitan in distribution, exclusively marine dwelling animals and are found sub-littorally to depths of over 6000 m (Boss 1982:1162). Scaphopod molluscs have been differentiated from the rest of the Mollusca (Abbott 1974; Ludbrook 1960; Purchon 1968) on the basis of the following features:

(1) a hollow, tubular shell which has a larger anterior orifice than posterior orifice-the shell may be smooth or exhibit surface sculpture;

(2) the development of a specialized structure called captacula which are a series of feeding tentacles found on the foot, making the foot a structure for both feeding as well as locomotion;

(3) a reduced circulatory system with the absence of a heart;

(4) the absence of eyes and gill structure-respiration occurs on the surface of the mantle aided by ciliary action on the floor of the mantle; and

(5) the mantle cavity is used exclusively for respiration and excretion.

Scaphopods are burrowing molluscs and are oriented in ocean substrates with the large end down into the sediments and the smaller end protruding just above the surface of the sediments (Figure 1). In this position, the concave side of the shell is oriented up and forms the dorsal face and the convex side of the shell is termed the ventral face. The large end of the shell is the anterior end and the opening is referred to as the oral aperture; the small end is the posterior or apical end and contains the anal aperture.

Taxonomic study has divided the Scaphopoda into two orders based on differences in the morphology of some of the soft tissue structures, radula morphology and on features of the gross morphology of the shell. One of the primary criteria for distinguishing between the orders in earlier taxonomic work on the Class Scaphopoda was based on the morphology of the foot. The shape of the foot, a soft tissue structure, was used on a gross taxonomic level to differentiate between the Order Dentaliida, which has a conical foot and the Order Gadilida, having a vermiform foot with a distal crenulated disk. Supplementary distinguishing characteristics between the orders are outlined in Purchon (1960) and in recent phylogenetic work by Steiner (1992b). The major morphological differences between the two orders is presented in Table 1.

TABLE 1: Comparison of morphological differences between the scaphopod Orders.

Order Dentaliida	Order Gadilida
Paired midgut gland.	Unpaired midgut gland.
Foot with a conical pedal tip; foot is protracted by a combination of hydraulic pressure and action of the pedal musculature.	Foot is a simple vermiform shape or expanded distally in a symmetrical disc with crenulated margins; foot is protracted solely by hydraulic pressure.
Radula: medial tooth is wider than it is high, lateral teeth have a narrow straight base, marginal teeth are not keeled.	Radula: medial tooth is higher than it is wide, lateral teeth exhibit a broader base, marginal teeth may be keeled .
Each captaculum has 10 longitudinal muscles.	Each captaculum has 5-7 longitudinal muscles.

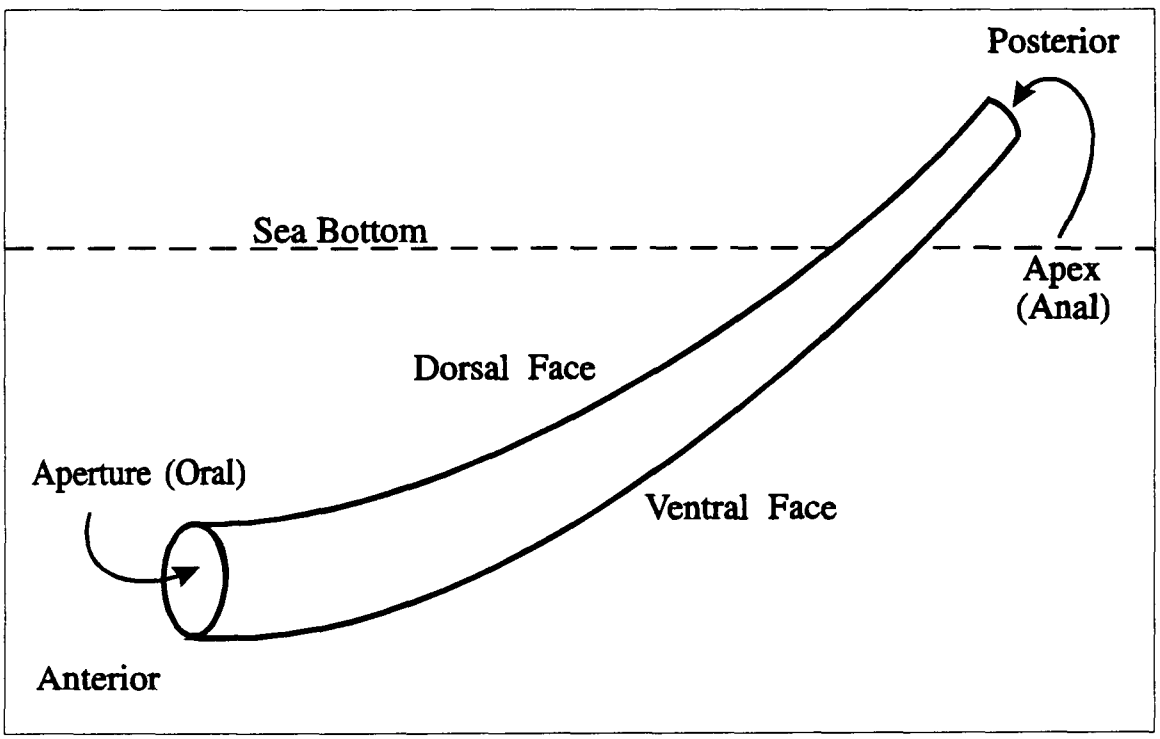

FIGURE 1: Illustration of a scaphopod mollusc shell showing the descriptive terms for the orientation of the shell.

TABLE 2: Identification criteria for species level classification of scaphopod molluscs.

External Shell Morphology		Internal Morphology	
Shell Shape:	-cross section -profile	Radula	-medial tooth -lateral teeth -marginal teeth
Dimensions:	-apertural width -apical width -maximum diameter -total length		
Surface Sculpture:	-groove -lattice -lira -ribs -riblet -striae -thread		
Apical Morphology:	-notch -pipe -plug -slit		

Species Classification and Identification Criteria

There are a number of morphological criteria on which scaphopod molluscs have been differentiated into separate species. They can be subsumed within two main criterion: external shell morphology and internal soft/hard tissue morphology (Table 2). The current taxonomic classification system for the Class Scaphopoda has been based largely, but not wholly, on the early taxonomic work which relied on external morphology as the criteria for determining separate species. Recent taxonomic work focuses more on internal morphological characteristics and has resulted in extensive revision of the earlier classification systems.

There are four basic types of external shell morphology which have served as criteria for classifying scaphopod molluscs: 1) shell shape; 2) shell dimensions and length; 3) shell surface sculpture; and 4) apical morphology (Figure 2). Usually these criteria have been employed together, as a single criterion is usually not sufficient to reliably identify any one species.

Shell shape is based on longitudinal or radial cross section of the shell as viewed in profile. This criteria has been employed as a general criteria to separate species on the family level as well as being applied at the generic level. The measurement of specific dimensions of the shell have been used as a method of separating species. Most common are length measurements taken along the long axis of the shell, and some species are distinguished on the basis of width measurements taken at specific locations along the length of the shell.

Surface sculpture refers to prominent features such as ridges, ribs, nodules, threads, beads, indented striae and concentric growth rings. Within species, however, these features may vary depending on the age of the specimen. In juvenile specimens surface sculpture may not be as prominently developed as in the adult. Adult specimens

also suffer erosion which in some species may significantly modify or alter the surface sculpture and the appearance of the shell.

Apical morphology refers to features found at the small end or the aperture of the shell. These features are classified as slits, notches, and pipes which are secondary extensions of the shell and concerned with water circulation in the mantle cavity of the shell. In Steiner's (1992b:395) recent cladistic work on the classification of Recent families within the Scaphopoda he discounts the utility of apical characteristics as he found that they were not sufficiently reliable.

An internal hard tissue structure called the radula has also served as a morphological identification feature (Figure 3). Radula are minute teeth located in the floor of the buccal cavity which are used to rasp or macerate the food taken in by the animal. Abbott (1974:10) has described the radula as "so very distinctive in the various families, genera and species that they have been used as a fairly reliable identification criterion".

Taxonomic work done on scaphopod molluscs during the early part of the twentieth century relied on extremely small sample populations to designate separate species, did not differentiate between juvenile and adult stages of development within species, and did not account for morphological variability within a species. Recent classifications of the Class Scaphopoda have been summarized by Emerson (1978) and cover the classifications that have been proposed by Emerson (1962), Palmer (1974a) and Starobogatov (1974). Scarabino (1979) re-examined the earlier work and presented a comprehensive classification scheme that forms the basis of the American Malacological Union's (Turgeon et. al. 1988) checklist of North American west coast Scaphopoda.

Discussion

An important issue that arises in discussing identification of scaphopod molluscs is the identification of archaeological specimens to the levels of genus and species.

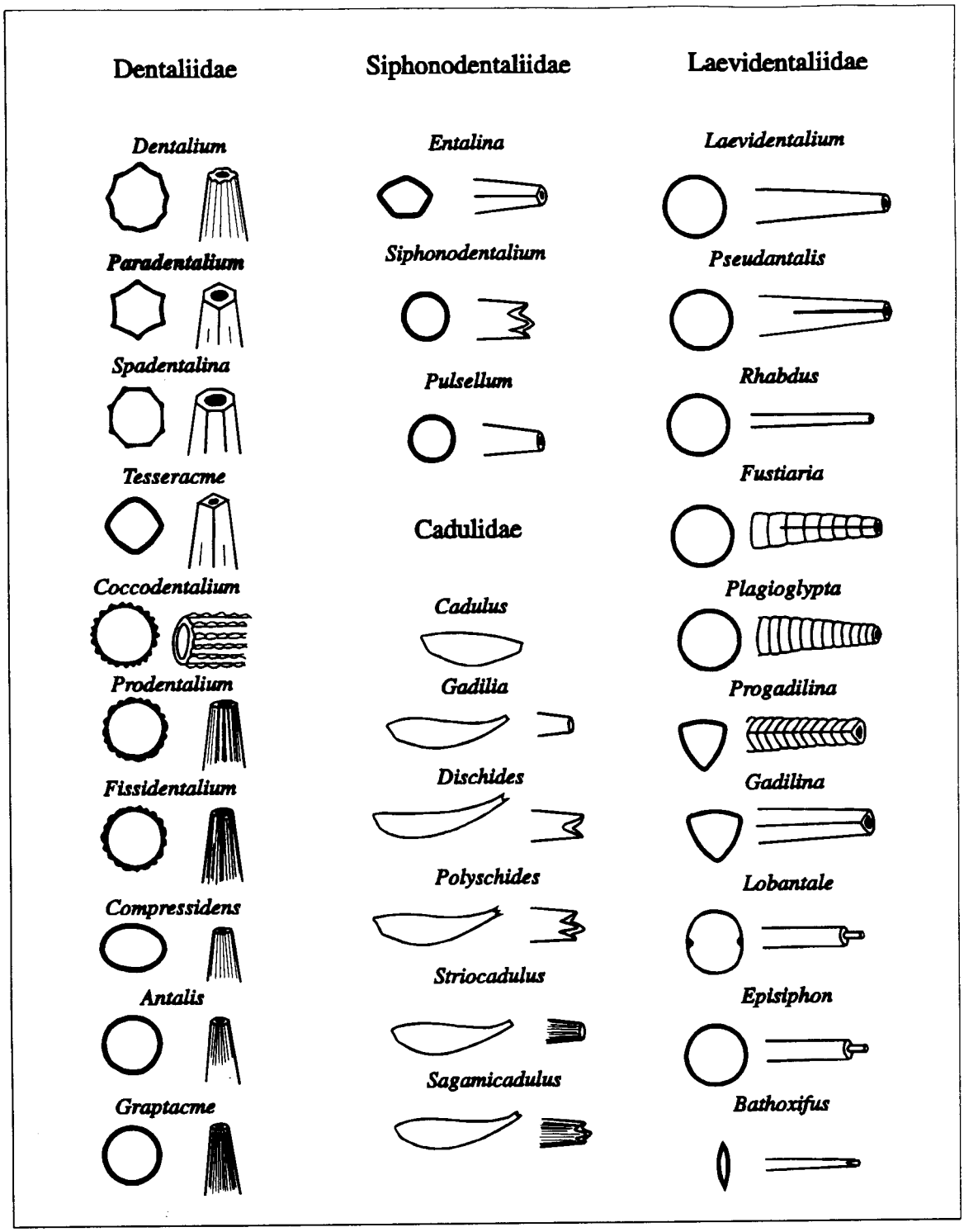

FIGURE 2: Apical morphology, shell cross-section and shell shape of scaphopod molluscs (based on Palmer 1974b).

Biological taxonomic systems use a suite of morphological characteristics to identify a specimen to species level that involve both characteristics of the shell and internal structures. A complete specimen, including soft tissue, is required in order for the identification criteria to be employed with any reliability. With archaeological specimens, this never the case.

Archaeological specimens lack the internal structures and the shell itself is usually modified in a number of ways. The ends of the shells are often broken or ground off, particularly the apical end. The surface of the shell may be incised with designs and the shell is often eroded by taphonomic process during burial. In both cases, surface sculpture is obscured or lost entirely. In many cases, the shell is recovered in a fragmentary condition. Obviously the internal soft/hard tissue morphological characteristics are of no utility to the identification of archaeological specimens. They do not preserve in archaeological context and the radula, while an excellent species indicator, is lost at the point of processing. Archaeological identification of specimens to genus or species levels must therefore be viewed with considerable suspicion.

WEST COAST NORTH AMERICAN SCAPHOPOD MOLLUSCS

There have been a number of scaphopod species lists for the west coast of North America that have been developed over the past 20 years (Abbott 1974, Bernard 1970, Marshall and Shimek 1987). In 1988 the American Malacological Union published a taxonomic species list for all molluscs in North America. The section on scaphopods was based on a classification scheme devised by Scarabino (1979). This is the classification scheme that is followed in this section. For the Class Scaphopod the list identifies 19 species found along the west coast of North America that are grouped under two orders, Dentaliida and Gadilida, and five families (Table 3, Figure 4). The Order Dentaliida contains the Families Dentaliidae and Laevidentaliidae and the Order Gadilida contains

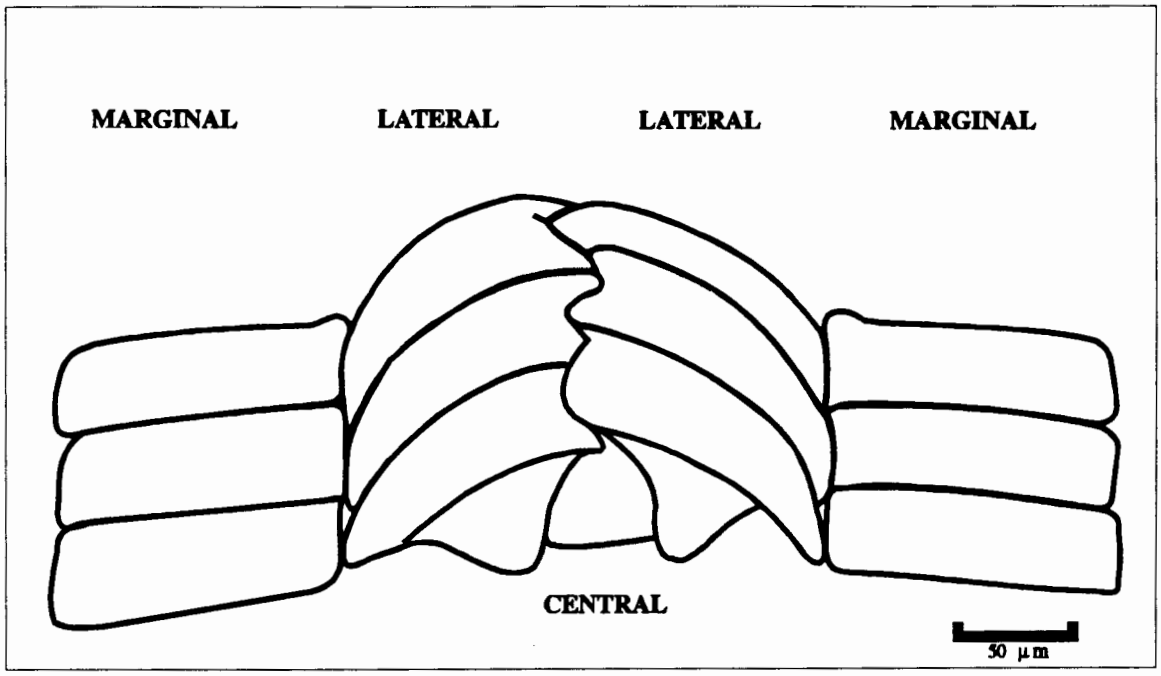

FIGURE 3: A view of the articulation of three of the tooth rows in the radula of *Pulsellum salishorum* showing the location of the central tooth and the overlapping, paired lateral and marginal teeth (based on the illustration in Marshall 1980:150).

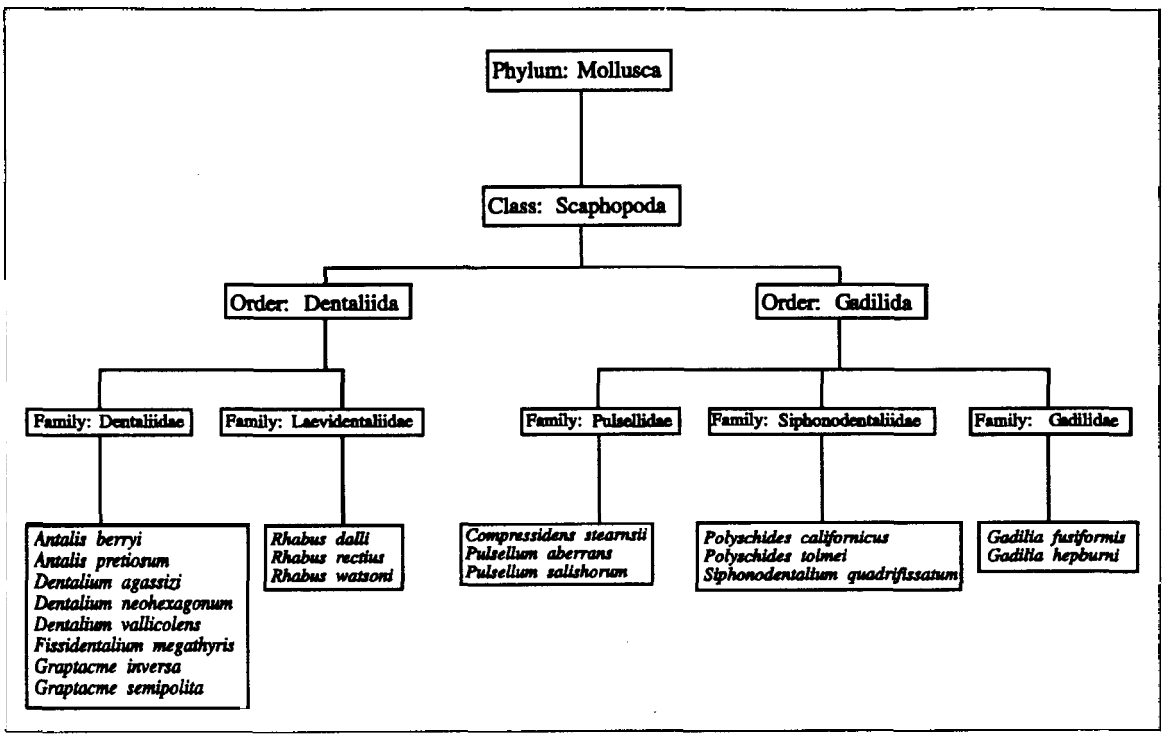

FIGURE 4: Classification scheme for the scaphopod molluscs found on the west coast of North America based on the American Malacological Union species list (Turgeon et. al. 1988).

Table 3: AMU species list of west coast North American scaphopod molluscs.

Class: **Scaphopoda** Bronn, 1862

Order: **Dentaliida** Da Costa, 1776

Genus and Species	Common Name	Synonym
Family: Dentaliidae Gray 1834		
Antalis berryi (A.G. Smith and Gordon 1948)	Berry Tuskshell	*Dentalium pretiosum berryi* A.G. Smith and Gordon 1948
Antalis pretiosum (Sowerby 1860)	Wampum Tuskshell	*Dentalium pretiosum* Sowerby 1860
Dentalium agassizii Pilsbry and Sharp 1897	Stained Tuskshell	
Dentalium neohexagonum Sharp and Pilsbry 1897	Hexagon Tuskshell	*Dentalium pseudohexagonum* Arnold 1903
Dentalium vallicolens Raymond 1904	Trench Tuskshell	
Fissidentalium megathyris (Dall 1890)	Costate Tuskshell	*Dentalium megathyris* Dall 1890
Graptacme inversa (Deshayes 1826)	Turned Tuskshell	*Dentalium inversum* Deshayes 1825
Graptacme semipolita (Broderip and Sowerby 1829)	Half-smooth Tuskshell	*Dentalium semipolitum* Broderip and Sowerby 1829; *Dentalium hannai* Baker 1925
Family: Rhabdidae Chistikov 1975		
Rhabdus dalli (Pilsbry and Sharp 1897)	Dall Tuskshell	*Dentalium dalli* Pilsbry and Sharp 1897
Rhabdus rectius (Carpenter 1865)	Straight Tuskshell	*Dentalium rectius* Carpenter 1864; *Dentalium watsoni* Pilsbry and Sharp 1897; *Dentalium dalli* Pilsbry and Sharp 1897
Rhabdus watsoni (Pilsbry and Sharp 1897)	Watson Tuskshell	

Order: **Gadilida** Starobogatov, 1974

Genus and Species	Common Name	Synonym
Family: Gadilidae Stoliczka, 1868		
Gadila fusiformis (Pilsbry and Sharp 1898)	Fusiform Toothshell	*Cadulus fusiformis* Pilsbry and Sharp 1898; *Cadulus hepburni* Dall 1897
Gadila hepburni (Dall 1897)	Hepburn Toothshell	*Cadulus hepburni* Dall 1897
Family: Pulsellidae Scarabino, 1982		
Compressidens stearnsii Pilsbry and Sharp 1897	Stearns Toothshell	*Cadulus stearnsii* Pilsbry and Sharp 1898; *Dentalium simplex* Pilsbry and Stearns 1897
Pulsellum aberrans (Whiteaves 1887)	Aberrant Toothshell	*Cadulus aberrans* Whiteaves 1887; *Cadulus hepburni* Dall 1897
Pulsellum salishorum E. Marshall 1980	Salish Toothshell	
Family: Siphonodentaliidae Simroth, 1894		
Polyschides californicus (Pilsbry and Sharp 1898)	California Toothshell	*Cadulus californicus* Pilsbry and Sharp 1898
Polyschides tolmiei (Dall 1897)	Tolmie Toothshell	*Cadulus tolmiei* Dall 1897; *Dentalium tolmiei* var. *newcombei* Pilsbry and Sharp 1898
Siphonodentalium quadrifissatum (Pilsbry and Sharp 1898)	Fourslit Toothshell	

three species Pulsellidae, Siphonodentaliidae and Gadilidae. Specific descriptions of each species are provided in Appendix I.

BIOLOGY, HABITAT AND ECOLOGY

There has been relatively little work done on the biology and ecology of the scaphopod molluscs that are found along the west coast of North America. Petersen (1972:5) has commented that "knowledge of the scaphopods of the new world [are] chiefly limited to comprehensive systematic accounts". Recently, there have been a few studies on specific species along the west coast but they are few in number and usually on a specific aspect of the biology. Information on the biology and ecology of scaphopod molluscs is by reference to studies conducted on non-North American species except in a few circumstances.

Feeding

Scaphopod molluscs have been characterized as detrital sediment feeders feeding on detritus, diatoms, algal cells and foraminifera. Feeding and the diet of scaphopod molluscs has been studied by Dinamani (1964b), Morton (1959) and Salvini-Plawen (1988, 1989). For species found along the west coast of North America, Poon (1987) has studied the feeding behavior in *Cadulus tolmiei* and Shimek (1988) has studied the morphology of the captacula in *Dentalium rectius, Cadulus aberrans* and *Pulsellum salishorum*.

Feeding in scaphopod molluscs is conducted by mucociliary emeshment of food particles by a specialized structure called the captacula and the food is processed in the gut of the animal by the radula, a specialized, interlocking tooth row (Figure 3), which is used to crush and grind the calcareous tests of the unicellular animals it feeds on. The captacula are extended into the sediments where they probe for food particles. When food particles are located the lobate end of the captacula directs the particle towards the oral

orifice of the shell, the particle is moved along the cilia on the captacula toward the buccal orifice. Little is known about digestion although Purchon (1968:207) has noted that it occurs extracellularly with the secretion of enzymes breaking down the food particles which are then absorbed.

The diet of *Cadulus tolmiei* recorded by Poon (1987:89-90) included foraminifera, nematodes, annelids and centric diatoms. Yonge (1937) has recorded them feeding on organic detritus, and Bilyard (1974:134) has identified ostracod and bivalve spat (free swimming larval stage molluscs) from stomach content analysis.

Locomotion

Scaphopods are mobile species with a lobate or disk shaped foot which is used for locomotion and for burrowing. The locomotion and burrowing behavior of scaphopod molluscs has been studied and described by a number of authors. Dinamani (1964a) has examined the burrowing behavior of *Dentalium entalis*. Trueman (1968) described the burrowing of *Dentalium inaequicostatum* while pedal musculature in the Class Scaphopoda has been studied and described by Steiner (1992a).

Based on the descriptions in these studies, locomotion and burrowing occur in the following manner. The foot of the animal is extended into the sediments and the hemocoel is filled with blood which causes the lateral lobes of the foot to expand and flare out. This anchors the foot in the sediments and when the pedal retractor muscle is retracted, the shell is pulled towards the foot and into the sediments. The animal comes to rest when the shell is in an oblique position and a small section of the tip of the shell is left above the surface (Gainey 1973).

There is some disagreement between authors on the exact orientation of the shell relative to the surface. Purchon (1968:486) states that the animal burrows three quarters into the sediment, Davis (1968:135) suggests that one half of the animal remains exposed while Shimek (1989:244) has observed that *Cadulus aberrans* was completely buried, and

that juveniles of the species burrowed even deeper that the adults, up to depths of 30 cm. As Shimek suggests, the reason that *Cadulus aberrans* burrows this deeply is to escape predation by ratfish.

Shell Structure

Relatively little work has been done on the shell structure and biomineralization of Scaphopod shells. The shell of scaphopod molluscs are composed of aragonite ($CaCO_3$) (Lowenstam and Weiner 1989:74). They are differentiated into three layers, similar to the structure of other molluscan shells. The shell has a thick middle layer with a cross-lamellar ultrastructure and a thin inner and outer layer which is composed of a homogeneous or finely prismatic structure. Beyond the basic mineral structure of the shell, Lowenstam and Weiner (1989:94) state that "almost nothing appears to be known about the shell formation process of Scaphopoda". Any comment on the mineralization processes in scaphopod molluscs therefore requires analogy with the more studied classes of Bivalvia and Gastropoda. In growth, the shell is laid down in annual rings at its oral end.

Bottom Sediments

Bottom sediments recorded for scaphopod molluscs range from mud through fine and coarse sand to gravel. Coarser bottom sediments are more likely to contain higher populations than habitats composed of mud or silt, and optimal bottom sediment for shallow water species would appear to be a sand and shell matrix. Petersen (1972:75) observed in his sediment analysis for *Dentalium texasianum*, an east coast North American species, that areas with "significant amounts of sand and shell material [were] more likely to have *Dentalium. texasianum* that those that do not". Petersen (1972:76) also noted that in a porous substrate, if the substrate contains a lot of clay particles these particles would "fill the interstices between sand particles and reduce water movement or

even the amount of water within the substrate", inhibiting the movement and feeding of the animal.

Symbiotic Species

There is one species of animal that exists in a limited symbiotic relationship with scaphopod molluscs that is of interest to this study. A species of hermit crab, *Orthopagurus minimus* (Holmes 1900) [Class: Crustacea, Order: Decapoda, Family: Paguridae] has developed a straight, tubular abdomen which adapted specifically for the hollow cylindrical shells of scaphopod molluscs. Hart (1982:116) has stated that this species of hermit crab "usually inhabit *Dentalium* shells" and described the ocean substrate on which they live as consisting of "broken shell and gravel". Hermit crabs are characterized as scavengers which feed on decayed animal material (Hart 1982:28). The geographical range of the species (Figure 5) extends from Tartar Strait, East Sakhalin in the northwest Pacific Ocean, south to San Diego, California, and is found in depths varying from 11 to 64 m (Hart 1982:116). This range corresponds to the northern range of *Antalis pretiosum* as well as a number of other scaphopods species along the west coast of North America (Figure 5).

Range, Depth, and Occurrence on the West Coast of North America

The data on recent range and depth distribution were compiled as a baseline against which prehistoric specimens can be evaluated. It is presumed the geographical range and depth of west coast scaphopod molluscs in prehistory were similar to the modern ranges.

Geographical Range

Information on the geographical ranges of the 19 scaphopod species found on the west coast of North America have been compiled from a number of sources (Abbott 1974; Austin 1985; Baxter 1983; Bernard 1967, 1970; Broderip and Sowerby 1829; Dall

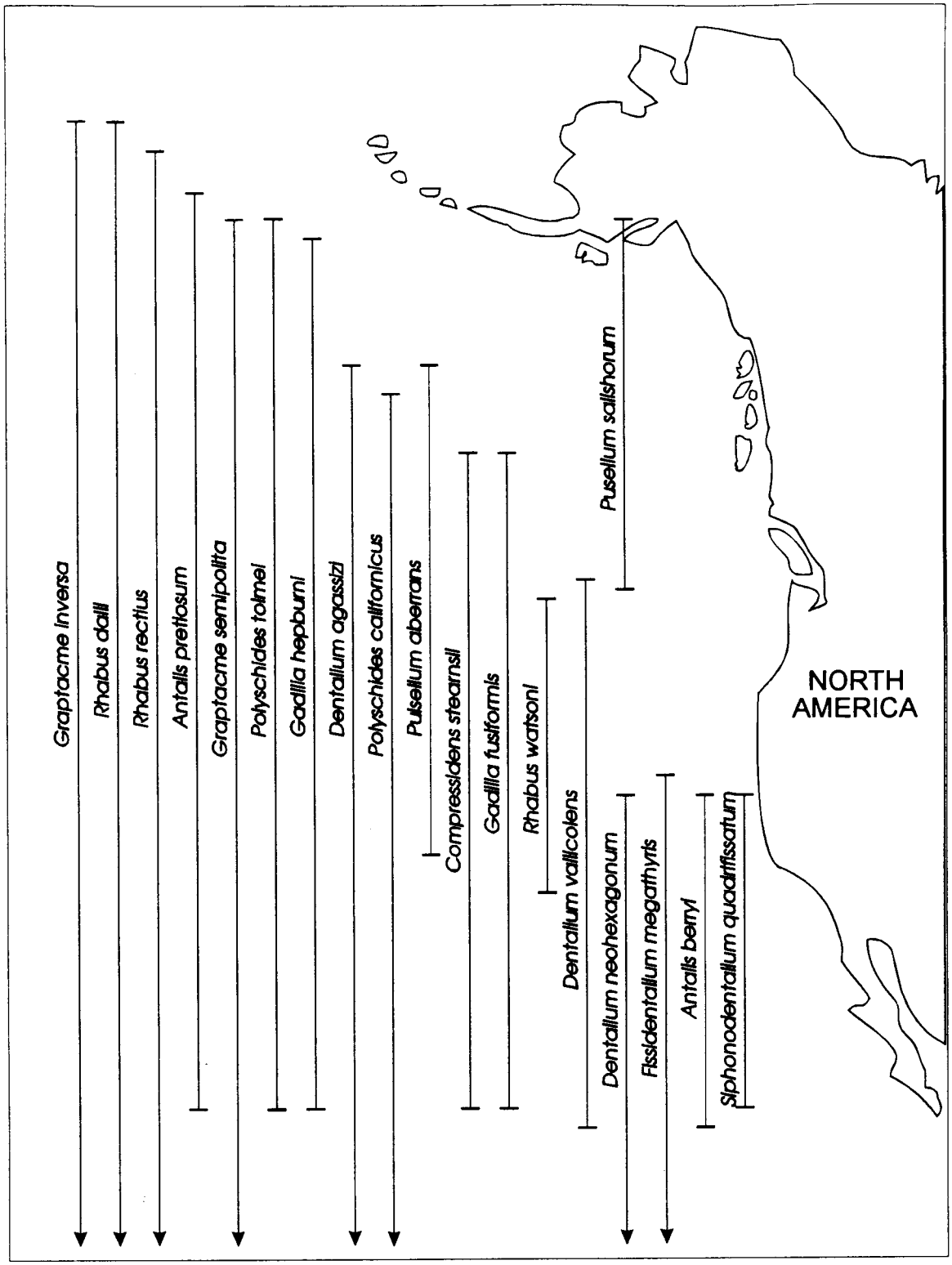

FIGURE 5: The geographical range of the 19 species of scaphopod molluscs found along the west coast of North America.

1890, 1897, 1921; Houston 1980; Johnson and Snook 1955; Keen 1958; La Rocque 1953; Marshall 1980; Marshall and Shimek 1987; Palmer 1958; Pilsbry and Sharp 1897-1898; Scott et.al. 1990; Whiteaves 1887) and are presented in Table 4. The distributional range of each species is plotted in Figure 5.

Six species, *Dentalium agassizii*, *Graptacme inversa*, *Graptacme semipolita*, *Polyschides californicus*, *Rhabdus dalli*, and *Rhabdus rectius* have extensive ranges that run from Alaska to South America. Three species, *Antalis pretiosum*, *Gadila hepburni* and *Polyschides tolmiei* have a distribution that runs from Alaska to Baja California. One species, *Pulsellum aberrans*, ranges from Alaska to California and another, *Pulsellum salishorum* has a restricted northern range running from Alaska to Puget Sound. Four species have a northern range that ends in British Columbia, with two of them, *Compressidens stearnsii* and *Gadila fusiformis* extending to Baja California and the other two, *Dentalium vallicolens* and *Rhabdus watsoni* ranging from the area around Puget sound to California. Four species have a northern range that extend into California. Two of theses species, *Dentalium neohexagonum* and *Fissidentalium megathyris* have ranges that extend to South America and two species, *Antalis berryi* and *Siphonodentalium quadrifissatum* have restricted ranges that run from California to Baja California.

Depth Range

Information on the depth ranges of the 19 scaphopod species found on the west coast of North America have been compiled from a number of sources (Abbott 1974; Austin 1985; Baxter 1983; Bernard 1967, 1970; Broderip and Sowerby 1829; Dall 1890, 1897, 1921; Houston 1980; Johnson and Snook 1955; Keen 1958; La Rocque 1953; Marshall 1980; Marshall and Shimek 1987; Palmer 1958; Pilsbry and Sharp 1897-1898; Scott et.al. 1990; Whiteaves 1887) and is presented in Table 5 and Figure 6.

Although characterized as a deep dwelling species, there are 12 species (*Antalis pretiosum, Dentalium neohexagonum, Dentalium vallicolens, Gadila fusiformis,*

TABLE 4: The geographical range for scaphopod molluscs found along the west coast of North America.

Genus and Species	Northern Range	Southern Range	Latitude
Antalis berryi	California, Monterey	Gulf of California	
Antalis pretiosum	Alaska, Forrester Island	Baja California	32-55 N
Dentalium agassizii	Southeastern Alaska	Panama	8-50 N
Dentalium neohexagonum	California, Monterey	Central America, Guacomayo	
Dentalium vallicolens	Washington, Straits of Juan de Fuca	Gulf of California	10-55 N
Fissidentalium megathyris	California	Chile	
Graptacme inversa	Alaska, Bering Sea	Equador	8-58 N
Graptacme semipolita	Alaska, Kenai Peninsula, Cook Inlet	Costa Rica	
Rhabdus dalli	Alaska, Bering Sea	Peru, Point Aguja	6-60 N
Rhabdus rectius	Alaska, Stephens Passage	Panama, Panama Bay	8-60 N
Rhabdus watsoni	Washington	California, San Diego	
Gadila fusiformis	British Columbia	Baja California	27-60 N
Gadila hepburni	Alaska, Prince William Sound	Baja California	37-61 N
Compressidens stearnsii	British Columbia	Baja California	30-54 N
Pulsellum aberrans	Southeastern Alaska	California, San Clemente Island	50-52 N
Pulsellum salishorum	Alaska, Cook Inlet	Washington, San Juan Islands	
Polyschides californicus	Alaska, Clarence Strait	Ecuador, Manta	1-56 N
Polyschides tolmiei	Alaska, Cook Inlet	Baja California	27-51 N
Siphonodentalium quadrifissatum	California, Monterey Bay	Baja California	

TABLE 5: The depth range for scaphopod molluscs found along the west coast of North America.

Genus and Species	Minimum Depth	Maximum Depth
Antalis berryi	37 m	298 m
Antalis pretiosum	2 m	146 m
Dentalium agassizii	322 m	2320 m
Dentalium neohexagonum	2 m	250 m
Dentalium vallicolens	5 m	485 m
Fissidentalium megathyris	1467 m	2080 m
Graptacme inversa	18 m	1463 m
Graptacme semipolita	1 m	64 m
Rhabdus dalli	9 m	1895 m
Rhabdus rectius	13 m	1799 m
Rhabdus watsoni		1437 m
Gadila fusiformis	1 m	365 m
Gadila hepburni	37 m	200 m
Compressidens sternsii	73 m	1437 m
Pulsellum aberrans	1 m	300 m
Pulsellum salishorum	3 m	426 m
Polyschides californicus	110 m	1503 m
Polyschides tolmiei	104 m	1000 m
Siphonodentalium quadrifissatum	4 m	365 m

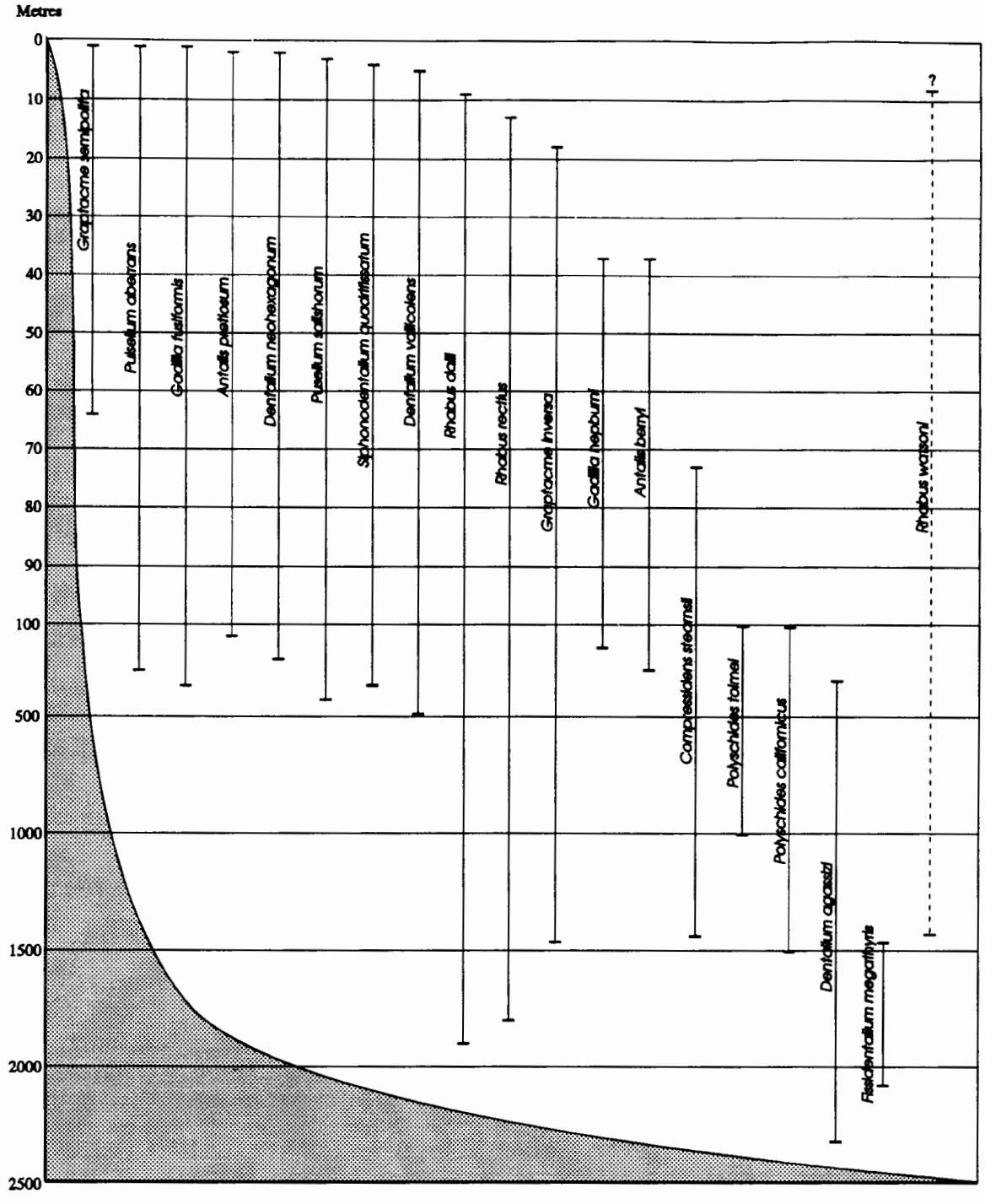

FIGURE 6: The minimum and maximum depth range of the 19 species of scaphopod molluscs found along the west coast of North America.

Graptacme inversa, Graptacme semipolita, Pulsellum aberrans, Pulsellum salishorum, Rhabdus watsoni, Siphonodentalium quadrifissatum, Rhabdus dalli, Rhabdus rectius) identified on the west coast of North America that can be found in water of less than 20 m in depth. Two other species (*Antalis berryi Gadila hepburni*) can be found in waters of less that 40 m in depth. The remaining five species (*Dentalium agassizii, Fissidentalium megathyris, Compressidens sternsii, Polyschides californicus, Polyschides tolmiei*) are deep water dwellers with minimum depths ranging from 70 to 1500 m.

Discussion

The information on geographical range and the depth within the range was examined to determine which species would have potentially been available for exploitation by prehistoric Native North Americans. Drucker (1950:273) has recorded that the fishing spear described to him could have reached shell bearing beds of up to 144 feet (44 m). Fourteen of the 19 species of scaphopod molluscs found along the coast had recorded minimum depths above 44 m within their geographical range.

As the scaphopod shells in use during the prehistoric and historic have been identified as either *Dentalium pretiosum* or *Dentalium neohexagonum*, shell length can be used to further eliminate species. The average length of *Antalis* (*Dentalium*) *pretiosum* ranges between length, 51-55 mm or approximately 2 inches (Abbott 1974:385) and *Dentalium neohexagonum* which is 25-35 mm or 1 inch (Abbott 1974:383). Nine species of scaphopod molluscs, all in the Order Dentaliida, fall within this size range (Table 6). The geographical range of these species are illustrated in Figure 7. These nine species are taken to represent the species that were potentially available for Native shell procurement.

TABLE 6: The shell length for shallow water scaphopod molluscs found along the west coast of North America.

Genus and Species	Maximum Shell Length (mm)
Antalis berryi	51-55
Antalis pretiosum	51-55
Dentalium neohexagonum	25-35
Dentalium vallicolens	51-64.5
Graptacme inversa	30
Graptacme semipolita	26-38
Rhabdus dalli	69
Rhabdus rectius	26-38
Rhabdus watsoni	38-55

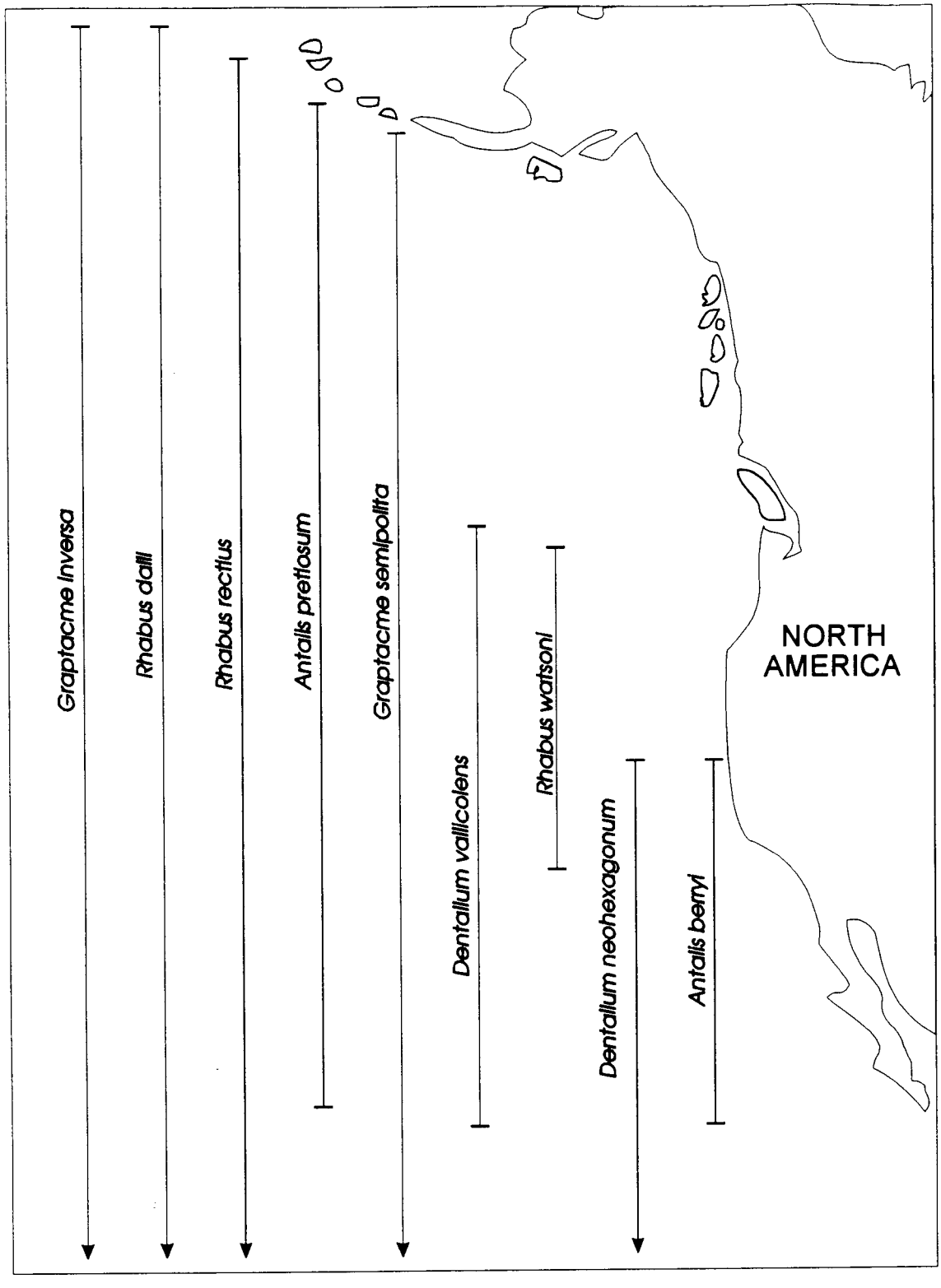

FIGURE 7: The geographical range of the 9 species of scaphopod molluscs that could have been potentially exploited by prehistoric native north Americans.

SUMMARY

The Class Scaphopoda to which the genus *Dentalium* belong are primarily a deep water molluscan species (up to 6000 m), but within their range they can be found intertidally as well as in shallower waters. Their occurrence at a particular depth is dependent on number of different ecological and environmental factors, including salinity, temperature, oxygen and sediment grades. They are cosmopolitan in distribution, being found worldwide, and number over 350 separate species. Recent taxonomic work on the North American scaphopod molluscs have identified nineteen species that occur off the west coast of the continent, each with a distinct and discrete range.

Examination of the geographical range and depth data for the species on the west coast of North America, in conjunction with information on shell size indicates that there are nine species that could have potentially been exploited by Native people during the prehistoric and historic periods.

The identification of archaeological specimens of the scaphopod molluscs by morphological characteristics is problematic. Taphonomic processes and modification to the shell remove many of the diagnostic morphological features that are used to identify the shells to the species level. As well, the internal structures that can be used in conjunction with the shell features are absent in archaeological specimens.

CHAPTER THREE

HISTORIC PERIOD *DENTALIUM* SHELL TRADE

> *It is important to remember as well that the culture change in this period was not solely an inexorable progression towards the wonders of European civilization, and that the fur trade era provides examples of how the fur trade served to embellish, rather than replace, some cultural forms [Coates 1979:71].*

This chapter will examine and discuss Euroamerican trade in *Dentalium* shell in western North America during the historic period. A number of authors have written overviews documenting the use of *Dentalium* shell as a trade item within the fur trade (Andrews 1989; Barton 1990; Galois and Mackie 1990a and 1990b; Gibson 1992) and a series of detailed articles have focused on the historic trade in *Dentalium* shell among the Kutchin in the interior of the Yukon and Alaska (Krech 1976; 1981; 1987). These reviews of the historical literature have revealed that by the late eighteenth and early nineteenth centuries, fur traders were actively participating in the exchange of *Dentalium* shell in western North America.

The use of shell as an item of barter was not unfamiliar to the traders that arrived on the northwest coast of North America at the end of the eighteenth century. Shell "money" had been employed in these types of exchanges long before the exploration of the north Pacific coast. Cowrie shell (*Cyprea monata*) served as a medium of exchange among central African groups, and Europeans involved in the slave trade during the seventeenth and eighteenth centuries imported them from the Maldive Islands in the Indian Ocean as well as from India and the east coast of Africa (Hogendorn and Johnson 1986). On the east coast of North America, the Dutch and British colonists were quick to recognize that manufactured shell beads, termed "wampum", served as a medium of exchange in this area (Beauchamp 1901; Bushnell 1906; Herman 1956; Slotkin and

Schmitt 1949; Weeden 1884). Wampum was manufactured in the form of disk shaped beads from the shells of the quahog, *Venus mercenatia* or as tubular beads that were formed from the inner columnella of univalves shells such as *Sycotypus canaliculatus* and *Fulgar carica* (Herman 1956:21). In response, Europeans began manufacturing the shell beads in factories (Weeden 1884) for trade with the native people along the east coast. In New England during the seventeenth century, wampum served as legal tender and as a circulating currency for both Natives and Europeans (Weeden 1884:6; Herman 1956).

Euroamerican use of *Dentalium* shell as a trade item on the northwest coast is examined over two time periods; the maritime fur trade of the late eighteenth century, and the fur trade of the first half of the nineteenth century. Locations and groups with whom the fur traders were trading the shell will be described as well as the native sources of supply (Table 7). Euroamerican entry into *Dentalium* trade will also be considered in relation to the impact on native use and distribution of the shell, the volume of shell in the exchange networks during the historic period and its effect on those groups that are reported as producers of the shell.

THE EARLY MARITIME FUR TRADE PERIOD

The maritime fur trade started after James Cook's third voyage to the Northwest Coast in 1778, and coincided with the publication of both official and unofficial accounts of the voyage in the first half of the 1780s (Gibson 1988:379). The published accounts of the voyage mentioned that while anchored at Nootka Sound in 1778, Cook's crew had traded scraps of iron for sea otter skins which were later sold in Canton for a substantial profit (Cook 1967:437). The English were the first to make use of the information in Cook's account in 1785 when Captain James Hanna outfitted a ship and set sail to the northwest coast to trade for furs. They were shortly joined by New England traders when Robert Gray arrived in 1788 and by the beginning of the nineteenth century American

TABLE 7: Date and location for the acquisition and trade of *Dentalium* shell by Euroamerican traders.

Date	Location Purchased	Location Traded To	Remarks	Source
1793-94	Clayoquot Sound	Columbia River Area	Josiah Roberts *Jefferson* purchases 160 fathoms of *Dentalium* shell for trade further south around Columbia River area	Magee n.d.
1801		Kaigani		Haskins as cited in Gibson 1992:242
1802		Northern Coast	traders barter 200 *Dentalium* shells for one fur	Gibson 1992:235
1806	Columbia Cove	Northern Coast	*Vancouver* purchases a great deal of *Dentalium* for sale among the northern Indians	Clinton as cited in Gibson 1992:241
1825 (spring)	Newhitty		*Convoy* purchases 5000 shells	McNeill as cited in Gibson 1992:248
1826, July 20		Snake River District	Peter Ogden trades *Dentalium* for beaver skins	Ogden 1961:166-167
1826, November 5		Oregon	Alexander McLeod to McLoughlin requesting *Dentalium* be sent to the Lower Umpquas, Oregon Territory	Ruby and Brown 1981:60
1826, November 15		Snake River District	Peter Ogden to McLoughlin requests *Dentalium* shell be sent to trade in the Snake River District	Ogden 1961:222-223
1828	Newhitty	Northern Coast	Lieutenant Simpson notes that *Dentalium* are regularly purchased from the Newhitty Indians and "were a good article of trade with the Northern Indians"	Simpson to McLoughlin 1828 as cited in Gibson 1992:249
1828, October 9	Fort Nisqually, Puget Sound		Tolmie purchases *Dentalium* off the Makah	Ruby and Brown 1981:64
1829, October 5			McLoughlin to Donald Mason at Fort Vancouver request to purchase *Dentalium* to the value of thirty blankets	McLoughlin 1948:59
1831, June 4			McLoughlin to Thomas Sinclair, Master of the *Cadboro* request to purchase 30-40 fathoms of *Dentalium*	McLoughlin 1948:198
1834, March 1-1835, January 20	Fort Nisqually, Puget Sound		HBC buys 170 fathoms of *Dentalium* over an 11 month period	Bagley as cited in Gibson 1992:250
1835		Bella Coola	Bella Coola purchase 12 feet of good/60 feet of poor dentalia for 1 beaver pelt	Gibson 1992:235
1835	North end of Vancouver Island		John Work, HBC, trades for a "a few dentalium" from a canoe that came along side	Work 1945:36
1837, September	Fort Nisqually, Puget Sound		Dr. William Tolmie purchases 280 fathoms of *Dentalium* in the month of September	Weld 1963:13-14

traders dominated the coastal fur trade (Gibson 1988:379-380).

In the 1790s competition for furs along the northwest coast increased as more trading voyages were organized and this had two consequences for the fur traders. As more traders entered the maritime fur trade, the sea otter began to be extirpated in certain parts of its range which resulted in a decline in availability of furs. The second consequence, as demonstrated by Fisher (1992), is that after the initial astonishment of meeting European voyagers, coastal peoples began treating them as they would any other trading partners, bartering much harder for the otter skins that the traders desired. Trading voyages became longer in order to acquire a cargo of furs, often forcing ships to winter over on the coast and trade for two seasons.

Native people's preferences for trade goods also became more selective as the maritime fur trade progressed. When traders discovered that items of native manufacture from one area of the coast were in demand on other parts of the coast these items were quickly incorporated by Euroamerican traders into their ships inventory as Drucker (1951:31) has described. During the maritime trade American traders from the New England states were the first to use *Dentalium* shell as a trade commodity. Drucker (1951:31) noted that "dentalia from Nootka territory...[was] frequently carried aboard Boston vessels as trade goods". Wike (1951:21) also observed that by 1794 "the traders themselves were occasionally serving as middlemen for native goods".

The earliest documented example of the acquisition and use of *Dentalium* as part of a ship's trading cargo is reported in the log book of Bernard Magee, supercargo on the *Jefferson,* a Boston ship trading along the northwest coast between the years 1792 and 1794. Traders on the *Jefferson*, and a companion ship, the *Resolution*, were "buying dentalium from the Nootka to trade to the Haida, or to the Chinook from whom [they] would purchase elk hides for barter with the Haida" (Wike 1951:21). Magee's journal entry for February 2, 1774 discusses the acquisition of *Dentalium* shell from the groups in Clayoquot Sound where they were anchored at that time.

> We purchased from the different tribes of the sound about 160 fathoms of Hiqua [*Dentalium* shell] for sending in our little vessel [the *Resolution*] to the south coast gave at the rate of a short jacket for one fathom and a musket for six fathoms and for an iron sword 1 to 2 fathoms in like proportion of any other articles. But I am very doubtful of the balance of trade being much against us, however from the reports of Mr. Burling and Mr. Kendrick who has been on the south coast and supposed that Hiqua was in great demand with the natives, induced the Captain to purchase them at so high a rate which if it so proves will no doubt be very much in our favor as we purchased the Hiqua mostly with dead articles of trade [Magee n.d.].

Magee also recorded the protracted negotiations for the purchase of the *Resolution* by the Clayoquot Chief Wickaninish. He had offered 50 prime otter skins to the commander of the voyage, Captain Josiah Roberts, who agreed to the transaction pending one final trip to the Columbia River to trade for elk skins from the Chinook. The *Resolution* was dispatched April 3rd, 1794 to the Columbia River with 378 iron swords, fifty-two copper sheets, eleven trade muskets, seven pistols, eight copper-mounted cutlasses, and some 150 fathoms of *Dentalium* shell which had been purchased in Clayoquot Sound (Magee n.d.). The *Resolution* never returned and was presumed lost at sea or attacked by hostile inhabitants along the coast.

Ralph Haskins journal kept aboard the ship *Atahualpa* recorded two extended trading sessions between August 24 to September 22 and October to December 6, 1801 at the Kwakwaka'wakw village of xwadzaxsdi' located in Bull Harbour on Norman Island off the northern end of Vancouver Island. Haskins noted that among the items traded for from Chief Ya'qoLas and others at this village were "furs, Haiqua [*Dentalium* shell], elkskins, and provisions" (as cited in Galois 1994:301).

Gibbs recorded a native account of an early visit of New England fur traders to the Salish of western Washington State. Lakh-kanam, a member of the Clallam group on the Olympic Peninsula, and the narrator of the account, stated that:

> When he had grown up and got a wife, two more ships came. Several had touched at Cape Flattery before the first came to New Dungeness. They came ashore at once, and put up a tent, and many of the Klallam came to see her. The name of one Captains was Lelis and the other Paput. That of

> another still was Kelalimuk. They always wanted skins from the Indians. The Indians had no beaver, but elk, deer, and sea-otter. For a large sea-otter they gave twenty blankets. They also brought haikwa [*Dentalium* shell] for blankets, five fathoms for a blanket. These blankets were different from the first, being heavier [1877:239-240].

Gibbs (1877:239) noted that Lakh-kanam's "remembrance of prices is probably very much exaggerated by distance" but the narrative itself was "probably substantially accurate".

When Lewis and Clark (1959:187, 191) reached the Pacific in 1806 they were informed by the Chinook Indians that a trader named Swipton furnished them with wampum [*Dentalium* shell]. On their return journey, they procured *Dentalium* shell themselves, to use as barter for horses or canoes en route (Lewis and Clark 1959:229, 232, 385, 387).

Euroamerican use of *Dentalium* shell as a trade item during the maritime fur trade was an opportunistic use of the native trade goods. The traders during this period recognized that items of Native manufacture were desired in other regions along the coast and in order to increase their bargaining power, acquired the valued goods.

THE NINETEENTH CENTURY FUR TRADE PERIOD

The extirpation of the sea otter and the decline in the availability of sea otter pelts occurred in the period between 1810 to 1830. Fur trade companies turned to other types of furs that were available in the interior regions of western North American. Trade during this period was carried out primarily by fur traders operating out of established trade posts or forts, with developed provisioning routes and communications. The Hudson's Bay Company did maintain a small fleet of ships, but this was more for provisioning the various posts along the coast, rather than for sustained trade. At this time, the Hudson's Bay Company and the Russian-American Company began actively and systematically trading for *Dentalium* shell in order to meet the demand for this item in their inland operations.

Trade Areas

The Hudson's Bay Company was acquiring *Dentalium* shell from several locations along the north Pacific coast and then shipping it inland, primarily to the Yukon, Colville and Columbia Districts (Coates 1979:115; Goldman 1940:353; Mayne 1862:298; Murray 1910:71-72; Ogden 1961:167; Ross 1849:277; Ruby and Brown 1981:60; Teit 1930:113). The Russian-American Company was concerned mainly with supplying the shell to traders in the interior of Alaska and were acquiring the shell from the Tlingit, at Sitka, who in turn were procuring it from the Haida (Krause 1956:137; Whymper 1868:173,178; Wrangell 1980:32; Zagoskin 1967:332). The Russians also appear to have been purchasing the shell from the Hudson's Bay Company and possibly one of the American fur trade companies (Murray 1910:71-72). When competition for furs in the interior of Alaska intensified, the Hudson's Bay Company diverted its *Dentalium* shell to support its own operations in the Yukon District.

Plateau

On the southern Plateau in the Oregon area, Ray (1928:100) described the pre-contact Chinook as middlemen who controlled trade along the Columbia River. In noting that one of the trade items of great importance was *Dentalium* shell, he stated:

> The quantities of these shells imported by the Chinook must have been tremendous, for not only did they use a great quantity in the daily routine of trade, but they also furnished the bulk of the supply used in the southern Plateau and Western Oregon [Ray 1928:100].

As noted, the demand for this shell was duly noted by the early fur traders.

Peter Ogden, in a journal entry on July 20th, 1826, writes about a group engaged in *Dentalium* trade on the first forks on the Siuslaw River in Oregon in the Hudson's Bay Company's Columbia District. Ogden (1961:166) stated that "one of the Chiefs traded 11 Beaver and another individual four all for Jye quoise [*Dentalium*] this article seems to be the principle Commodity of Trade with these Indians". While at the same camp, on

Saturday July 22, Ogden (1961:167) noted that the "Chief that we got skins from the day before yesterday brought 18 Beavers and a sea Otter traded for a Calico Shirt a small tin dish the remainder paid for in Jye quoise". In correspondence to John McLoughlin on November 5th, 1826, discussing provisioning arrangements for operations on the Umpqua River in southern Oregon, Ogden wrote:

> In case of a long absence I have enclosed a statement of sundries both for trade as well as for the use of the party all our blankets and cloth is disposed off our Scalpers [scalp knives] are of such an inferior quality that the natives prefer knives of their own manufacture to those imported for trade Hy-a-quois [*Dentalium* shell] claim the preference above every other article I hope you have some to send us [1961:222-223].

On the original letter, John McLoughlin noted [the handwriting is attributed to him] that "Hy-a-quois is the name the natives on this coast give to the *Dentalium* of Naturalists and which is the Current Coin among them forty of these shells are strung on a thread and as many as are over the fathom -- so many large Beaver Skins is the value of the String" (Ogden 1961:222-223).

Alexander McLeod, who was also employed by the Hudson's Bay Company in the Lower Umpquas region in southern Oregon, sent correspondence to McLoughlin on November 5, 1828, ten days prior to Ogden's letter, also requesting that *Dentalium* shell be sent to him as they were "sought after by the natives in the area for ornamentation and as an exchange medium with other groups" (Ruby and Brown 1981:60). Alexander Ross and John Work described *Dentalium* shell as the standard for trade with the Interior Salish people in the Hudson's Bay Company's Colville District of the Oregon Territory during the 1820s to 1850s (Ross 1849:277; Work 1945).

On the northern Interior Plateau, James Teit observed that the Coeur d'Alene, an Interior Salish group, originally obtained *Dentalium* shell in trade from neighbouring groups but that:

> all these shells came originally from the tribes along the Columbia River near the Dalles, who procured them from other tribes living on the coast or

> to the south. In later days fur traders sold dentalia and other shells [Teit 1930:113].

The Alkatcho Carrier, on the Chilcotin Plateau in British Columbia experienced a similar expansion in trade "with the coming of the whites to the coast, and soon [their] fur pelts were exchanged for firearms, tobacco, manufactured clothing, utensils, dentalia and foodstuffs" (Goldman 1940:353). Mayne (1862:298) noted that *Dentalium* shells acquired from the Nuu-chah-nulth at Nootka Sound were being used by the Hudson's Bay Company for trade in the interior of British Columbia.

Plains

On the Plains, independent American fur traders were trading *Dentalium* shell to the Mandan and Hidatsa by the 1850s. Matthews (1877:28) stated that they had noted the "great value attached by the Northern Plains Indians to dentalia, [and] were importing the shells to Mandan and Hidatsa villages from the eastern states under the name of "Iroquois shells". The Hidatsa had a permanent village at Fort Berthold in the Dakota Territory between 1854 and 1862 and prior to that time it appeared that they once carried on a trade indirectly with the tribes of the Pacific coast for *Dentalium* shell (Maximillian 1843:258).

> As late as 1866, ten of these shells, of inferior size, costing the traders only a cent apiece, would buy a superior buffalo robe, and formerly only two or three of the same quality were paid for a robe. [Matthews 1877:320]

Traders, with whom Matthews conversed in the 1870s stated that they obtained their shells from eastern importers and did not know the source of the shell although they "supposed them to come from the Atlantic coast or the Great Lakes" (Matthews 1877:28). Griswold (1970:34) speculated that the shells in use by the eastern importers may have originally come from the northwest Pacific coast and were shipped to the Atlantic coast around Cape Horn.

Yukon and Alaskan Interior

In Alaska and the Yukon, several subarctic northern Athapaskan groups used *Dentalium* shell for ornamentation, including the Tahltan, Inland Tlingit, Tagish,

Tutchone, Ahtna, Tanaina, Tanana, Han and Kutchin (Crow and Obley 1981; de Laguna and McClellan 1981; McClellan 1981a, 1981b and 1981c; MacLachlan 1981; McKennan 1981; Slobodin 1981; Townsend 1981). McClellan (1975:505) noted that *Dentalium* shells among these groups had a "long tradition of indicating a person from a higher class or chief" and speculated that they were "probably introduced into the interior of Alaska by the Chilkat Tlingit".

During the fur trade, groups such as the Kutchin, Han and Tanana, were intent on obtaining glass beads and dentalia in exchange for their furs (Whymper 1868:177-178). These trade items were supplied by both the Hudson's Bay Company and the Russian American Trading Company (Whymper 1868:173,178).

The Russian-American Trading Company was engaged in trading *Dentalium* shell to the Athapaskan groups that lived in the interior of Alaska. On his exploratory trip up the Yukon river in 1843, Lieutenant Lavrenti Zagoskin (1967:162) carried a number of goods to trade, including 517 *Dentalium* shells. The Russians were also obtaining *Dentalium* from the Hudson's Bay Company in the Oregon territories as Ivan Petroff (1884) remarked in 1884 that "this shell did not exist in the Russian possessions but was imported from the British colonies north of the Columbia River". This import was later to haunt the Hudson's Bay Company as the Russians were in direct competition with them in the Yukon, where *Dentalium* shell was a much coveted trade item. Recognizing the situation one of the traders at Fort "Youcon" stated in 1851 that "we have not only been deprived of an essential article of trade for the posts west of the mountains, but have also been furnishing arms to our opponents" (Krech 1987:249).

In 1851 the Hudson's Bay Company trader Colin Campbell found that the Indians around Fort Selkirk "demanded dentalia from him for their furs" (McClellan 1950:182). Thomas Simpson (1843:190) who was stationed on the MacKenzie River in 1843 recorded that "several Loucheux brought in furs to trade, and were very anxious to obtain, in exchange, the shells called eyeaquaws [*Dentalium*], a sort of cowries, which in the

Columbia and New Caledonia [Districts] form the native currency". Alexander Murray, writing from Fort "Youcon" to Murdo McPherson at Fort Simpson in 1848 discussed the Russian trade with the Kutchin and neighboring groups. Murray noted that the most popular or sought after trade goods imported by the Russian traders included:

> the small shell [*Dentalium*], some of which you sent me from Fort Simpson, but I am not aware of their proper name. These are traded in this country 6 and 8 for a beaver or three martens, [and] a box of these shells here would be [worth] over *two thousand pounds* [Murray 1910:71-72].

In response to Murray's request, John McLoughlin, the officer in charge of the Columbia District, instructed Hudson's Bay Company employees to collect the shells whenever possible and forward them to Fort "Youcon" (Coates 1979:115).

An indication of the volume of trade in *Dentalium* at Fort "Youcon" can be gained from Hudson's Bay Company records. These report an 1853 shipment of ten thousand *Dentalium* sent to Fort 'Youcon' where they were traded at four shell per Made Beaver and later to the Yukon Flats Kutchin at ten dentalia per Made Beaver (Krech 1987:249-250). The demand was so great in 1855 that "an Indian will often trade 200 shells in preference to a gun" (Krech 1987:249-250). The traders at Fort "Youcon" continually experienced a shortage in the supply of *Dentalium* from Fort Vancouver during the mid-1850s, yet at the end of the decade the stated demand had risen to 14,000 per year (Krech 1987:249-250).

The reason for the Hudson's Bay Company's interest in acquiring the shell for this district can be found in a report made by James Anderson in 1858 for the Mackenzies River District (Krech 1976:221). In the report, Anderson discussed the profitability of certain trade items in this district commenting that:

> The gross profit potential was very high in the exchange of beads or dentalia for marten (the most important fur). For example, it has been estimated that the cost (manufacture cost or purchase cost) to the Company of five dentalia shell was 2 pence, of one pound of beads was 10 pence, and of one gun was 23 shillings...On the European market in the 1850s, marten were worth 12 time more to the Company than the cost of a gun (ca. 1000% gross profit), 62 times more than 5 dentalia shells (ca.

6000%) and 149 times the cost of 1 pound of beads (ca. 15,000%). (Anderson, 1858 Report as cited in Krech 1976:221)

Krech (1976:232) commented that the "accuracy and applicability of these estimates can be debated". Of the three items discussed by Anderson, *Dentalium* shell was the only trade item requiring only a purchase cost, rather than a manufacture cost, and it did not have to be shipped from great distance as it was available locally.

California

In California, *Dentalium* shell was traded with the northern groups not for furs, but for gold (Rogers 1908). Hewitt (1907:905) stated that "Powers, Stearns, Goddard, and others mention facts showing that shell money at an early time on the Pacific coast became a medium of exchange, not only among the Indians but also among the whites". Stearns (1889:318) also commented that when the Americans first arrived in California "an Indian would give from $40 to $50 in gold for a string of it; but now it is principally the old Indians who value it at all".

Beckham has noted that during the 1850s, George Gibbs was conducting a lucrative business exporting *Dentalium* shell he purchased from Native groups in the vicinity of Puget Sound. He packaged the shells and sent them to his partner, Duperu, at Humboldt Bay, California who traded them to local native groups for gold dust (Beckham 1970:157). Gibbs had purchased property at Steilacoom, about five miles inland from Puget Sound, and used this as a base to obtain *Dentalium* from the local peoples. Beckham (1970:106-107) noted that the trade conducted by Gibbs and Duperu "speeded up the transfer of the 'tooth shell' money, an event that often took months, if not years, of trading from tribe to tribe down the Pacific coast".

Fur Company Procurement Areas

The demand for *Dentalium* by Native peoples in the Hudson's Bay Company's interior districts and the requests from the traders in these districts for shipment of this commodity led the Company's Chief Factor, John McLoughlin to seek a sustained source

for the shell. John McLoughlin, Chief Factor of the Hudson's Bay Company's Columbia district on the Pacific coast from 1824 to 1845, was headquartered at Fort Vancouver on the Columbia River in the Oregon Territory. Several of his letters record transactions where Hudson's Bay Company employees are instructed to procure *Dentalium* shell on the coast for servicing trade in the interior and northern districts. The date and locations where the shell was being procured and the destination for the shell is outlined in Table 7.

Fort Rupert/North Vancouver Island

One of the most important source locations for Hudson's Bay Company *Dentalium* shell was the area around the north end of Vancouver Island in the vicinity of Fort Rupert. William Tolmie identified six Kwakwa̲ka̲'wakw villages here that fished for the shell. During the 1820s and 1830s there are a number of references to this area in relation to the acquisition of the shell.

John Work (1945:36), while trading with the Kwakwa̲ka̲'wakw at the north end of Vancouver Island in 1835, recorded in his journal that "a considerable number of the Indians came aboard and along side, but traded only 1 small Sea Otter, 2 Land otters, 13 Martens, 26 Minks, and a few Haiquas [*Dentalium*] and some fish". William McNeill (as cited in Galois 1994:303) records trading for *Dentalium* shell with the Newittee tribe from the Scott Islands at Shushartie Bay in 1825. Alexander Anderson (1868) noted that the east coast of Vancouver Island around Fort Rupert was where the shell was procured historically and Pickering (1841) observed that the Hudson's Bay Company at Fort Rupert purchased large numbers of the shells from the Koskeemo Indians which they then traded to California.

West Coast of Vancouver Island

Dentalium shell was offered for sale to George Simpson, Governor General of the Hudson's Bay Company, during his inspection tour of the Hudson's Bay Company's operations on the Pacific coast during the years 1841 to 1842. As he (1847:196) stated,

"After our friends had disposed of their furs, they brought into the market a large number of hiaquays [*Dentalium*]--white shells, found only on the west coast of Vancouver's Island". Mayne (1862:299) commented that the shell was obtained off Nootka Sound and that the Nootka "sell them to the Company at Fort Rupert and other coast posts".

Fort Nisqually/Puget Sound-Olympic Peninsula

Fort Nisqually, located in southern Puget Sound in what is now Washington State, is frequently cited in fur trade records as a location where *Dentalium* was purchased by the Hudson's Bay Company. The shell traded into this fort originated with the Makah and possibly from groups along the west coast of Vancouver Island. William Tolmie recorded in his journal that on October 9, 1828 thirty Makah visited the fort, and "To keep them at the post, [he] purchased from them not only some of their beaver, but also dentalia" (Ruby and Brown 1981:64). A second entry in Tolmie's journal for the month of September in 1837 records a list of goods purchased from the native people for that month which included 280 fathoms of *Dentalium* shell (Weld 1963:13-14).

Fort George/Fort Vancouver/Oregon Coast

Thomas Sinclair, Master of the Schooner *Cadboro*, was engaged by the Hudson's Bay Company to transport supplies from Fort Vancouver to Fort Langley on the Fraser River. McLoughlin's instructions to Sinclair, issued on June 4, 1831 requested that Sinclair do a little trading while traveling along the coast between the two forts. McLoughlin (1948:198) specifically stated that "If you can trade thirty or forty fathoms of shells, of six over the fathom, at a blanket a fathom, we would take them". On October 5, 1829 he (1948:59) wrote to Donald Manson at Fort George "If you buy for us [up to] the value of thirty blankets of Hiaquois [*Dentalium*] it would be desirable".

Oberg (1973:112), who conducted field work among the Tlingit between 1931 and 1933 at Kluckwan, Sitka and Wrangell, Alaska, notes that English and American traders

brought in *Dentalium* shells from the Columbia River region in vast quantities when it was discovered the "shell were used as money".

Queen Charlotte Islands-Sitka

The Queen Charlotte Islands have been identified as the source for some of the *Dentalium* shell being employed by the Russians in Alaska. Ferdinand Wrangell (1980:32) observed in 1839 that the *Dentalium* acquired by the Tlingit was "collected in the Queen Charlotte Islands". Lieutenant Lavrenti Zagoskin also identified the Queen Charlotte Island as the source for Tlingit *Dentalium* shell and noted that the Russians subsequently purchased them off the Tlingit at New Archangel in Alaska. Krause (1956:137) in discussing the Russian procurement of the shell identified Sitka, Alaska, as the location where the shell was purchased and noted than in Lutke's time the price for the shell was "thirty rubles for one hundred pieces".

IMPORTED *DENTALIUM* SHELL

The reference to the importance of imported shell of the species *Dentalium entalis* that appear late in the eighteenth century may be overstated. While imported shell from locations in Europe and the east coast are widely reported and speculated upon by later writers, the information supporting these claims is primarily anecdotal. Sources that record the use of replicated shell, while an interesting highlight, were minor and had little appreciable impact on shell exchange patterns or the use of the shell by Native people.

It has been reported in the historic literature that *Dentalium* shell was being exported to the west coast of North America from other locations; the east coast of North America and Europe being two of the cited examples (Table 8). Historical documents that report the importation of foreign species of scaphopod shells were written during the latter half of the nineteenth century and identify three locations that were the destinations for this imported shell: the Russian territory in Alaska (Stearns 1869:2-3), California during

TABLE 8: Historical documents that record the importation of *Dentalium* shell from areas other than the northwest coast of North America.

Date	Origin of Shell	Species Identified As	Imported to	Source
1869	Europe	*Dentalium entalis*	San Francisco, California; Alaska (Russian America)	Stearns 1869:2-3
1873	Europe	*Dentalium entalis*	San Francisco, California; Alaska (Russian America)	Stearns 1873a:116-117; 1873b:340-341
1877	East coast (North America)	*Dentalium*	Plains	Matthews 1877:28
1877	Europe	*Dentalium*	California	Yates 1877:30
1877	Europe	*Dentalium entalis*	Alaska (Russian America)	Stearns 1877:350
1883	imported by Europeans		west coast of North America	Holmes 1883:221
1908	East coast (North America)	*Dentalium*	California	Rogers 1908:301

the gold rush period (Rogers 1908:301; Yates 1877:30) and the Plains region during the early fur trade period (Matthews 1877:28). The imported shell is usually identified as *Dentalium entalis*, a species that is common to the Atlantic Ocean (Clark 1963). Koch (1977:47) has identified Mediterranean region and the South Pacific as sources for the shell traded on the on the Plains but cites an unpublished letter as the authority for this information.

Claims for the importation of foreign species of *Dentalium* to North America are found in a series of articles written between the years 1869 to 1889 by Robert Stearns. Stearns published a total of five articles on the subject of the use of shell for ornamentation and as a medium of exchange by the Native peoples of North America. He referred to the trade in *Dentalium* along the west coast of North America, noting that European traders were involved in the trade in this shell and that they were importing it from other sources to supply this trade. Stearns stated that:

> As to the specific names of the shells used above, and the localities from which they are obtained, it may be well to state that the "west coast of Vancouver Island" form is the *Dentalium indianorum* of Dr. P.P. Carpenter; but probably the greater part of the tusk-shells which are or have been in circulation, do not belong to the American species, but to the common European *Dentalium*, referred to by the gentleman, and which closely resembles the American. The foreign species has been extensively imported for the Indian trade, and we have noticed at different times large numbers of the imported shells displayed for sale in the fancy goods stores in San Francisco, together with beads and other Indian goods [1873:117].

In a following article, it is also stated that the Atlantic species *Dentalium entalis* was "abundantly obtained in Europe" and speculated that it was "highly probable that a great part of the Tusk-shells that have been in circulation of late years does no belong to the indigenous species" but were probably the imported Atlantic species that had been "worked off upon the Indians by the traders" (Stearns 1889:318).

The claim that the Russian-American Company was importing *Dentalium* directly from Europe to service the interior fur trade in Alaska can be traced to the articles written by Stearns. In 1869 Stearns wrote that after William Dall had returned from Alaska, Dall

had informed him that *Dentalium* shell was used by the Native peoples in this area and that "furs purchased of the Indians by the Fur companies, or their agents and traders, are still, at least in part paid for with these shells" (1869:2-3). Stearns then made his observation about the imported shells in shops in San Francisco. What Stearns did not state, however, was that Dall told him that *Dentalium* was imported from Europe by the Russian American Company. This interpretation has usually been made by subsequent authors (see Andrews 1989:151-159; Clark 1963:11; Einzig 1949:165).

Andrews (1989:158) further noted that it was "not possible to visually distinguish the two species of dentalium shells [*Dentalium pretiosum* and *Dentalium entalis*]" and also stated that it was "difficult to determine how extensive the importation of foreign shells was, and to what extent it effected Native American trade of the shell". Yet, she (1989:158-159) concluded by stating that she believed that most of the *Dentalium* traded on the Plains was imported from foreign sources. This is simply not supported by the data cited in her thesis, nor by historical documents.

REPLICATED *DENTALIUM* SHELL

There are a small number of references in the historic literature to traders replicating *Dentalium* shell in porcelain, or at least contemplating such an endeavor. George von Langsdorff, a German naval officer traveling on the northwest coast, on business for the Russian Government during the years between 1803 to 1807, observed that *Dentalium* shell was much prized by the Kaluschians [Tlingit] of Norfolk Sound, Alaska. He explained in his journal that:

> on account of the great price given for these shells, the American seamen got a quantity of them imitated in porcelain in England, which were so well executed both as to form, size, and polish, that they had a perfectly natural appearance: the Kaluschians, however, were not to be imposed upon; they detected the fraud, treated the pretended shells with the utmost contempt, and the speculation proved entirely abortive [1814:132-133].

The second recorded incidence of an attempt to use replicated shell occurred in 1852. George Gibbs, forwarding *Dentalium* shell from Puget Sound to his brother Frank, who had contacts with ceramics manufacturers in Shanghai, China, gave the instructions:

> I have thought that your Chinese could imitate it in porcelain with exactness, and if so, a very profitable operation could be made, not only by selling it to miners and traders here in Oregon, but in purchasing directly from Indians skins and [gold] dust [Beckham 1970:106-107].

He further noted in his letter that 5,000 fathoms of counterfeit "Indian money" would get him into business although it is not known whether he followed through on this endeavor (ibid.).

Andrews (1989:158-159) has characterized the American traders use of replicated *Dentalium* as reported by von Langsdorff as an "[attempt] to control the trade by introducing artificial shell". This is highly unlikely, as this reference dates to period during the maritime fur trade when ships trading along the coast were interested only in procuring the most furs in the least amount of time; long term strategies for controlling specific items of trade were not part of the fur trader's repertoire. Also, as Fisher (1977:71) has emphasized, Native trading partners were very astute traders who "not only paid great attention to the type of goods that they acquired, but they were also discriminating about the quality and trade articles were examined closely and carefully before bargains were struck". He illustrates this point by noting that "porcelain imitation of dentalia shells were treated with contempt" (ibid.) in reference to von Langsdorff's observations on replicated shells.

DECLINE OF THE *DENTALIUM* TRADE

The demand for *Dentalium* shell by fur trade companies declined toward the end of the nineteenth century. In the Peel River area in the Yukon, where a large quantity of the shell was sent by the Hudson's Bay Company, "the use of glass beads and dentalia declined rapidly in the last four decades of the nineteenth century and the use of dentalia

as a nasal septum ornament among the Kutchin began to diminish as early as 1850" (Krech 1987:267). Stearns (1889:318) noted a similar decline in the trading value of *Dentalium* shell among groups in northern California in 1880s. In a monograph on the marine mollusca of British Columbia published in 1893, Newcombe (1893:54) commented that the Hudson's Bay Company considered *Dentalium* shell "no longer of any value for trading with the Indians". Oberg (1973:112) noted in 1933 that after vast quantities of *Dentalium* were imported by English and American traders from the Columbia River area and California, it became so plentiful that it "lost its value completely among the Tlingit".

While the demand for *Dentalium* shell as a major item of trade declined at this time, the use of the shell did not disappear completely in some regions. Weld stated that *Dentalium* shell continued to be used on the Yakima reservation up to the 1960s.

> The shells continued to have a value as ornaments, however, and it is interesting to note that their value in money today is about the same as in 1854. They were being sold on the Yakima reservation in 1960 for $0.35 apiece, or 3 for $1.00, by a traveling trader in Indian goods. These shells were medium to small in size. Two years later, in 1962, this same dealer told me that he can no longer get this northern dentalia; instead he had a supply of shells similar in size and shape but with longitudinal sculpture, which he said came from California. These dentalia were stark white, lacking the rich ivory color and the gloss of the Nootka shells. The Indians were reluctant to buy it, wanting the "old kind". The dealer also had a few very large dentalia, about 5 inches long and 1/2 inch across at the large end, which he thought came from Japan. These also had longitudinal sculpture; they were ivory in color but not very glossy, and were looked upon by the Indians as a novelty but were not much liked [Weld 1963:16].

Similarly, Simeone and VanStone have commented on the Kutchin's continued use of Dentalium shell as a decorative element on clothing and other items of material culture. They have noted that:

> Today there are three types of dentalium used by native people: American, Japanese, and African. The American type was the original variety traded in the interior and comes from the west coast of North America. It is smooth and shiny in appearance, difficult to obtain, and consequently considered to be more valuable than the others. The most common are the Japanese varieties, ribbed and chalky in appearance; and because they are

> so easy to buy, much less prestigious. Much larger, but similar to the American, is the African variety; because of its size and relative abundance, it has an intermediate value [Simeone and VanStone 1986:17].

IMPACT OF THE FUR TRADE

One question that has arisen in conjunction with Euroamerican involvement in the *Dentalium* trade is how did this commercial activity during the fur trade affect existing Native American trade networks? A corollary question is did the historically documented trade increase the volume of shell being traded and, if so, what effect did this have on the source locations where this shell was procured?

To accurately gauge whether there was an increase in the volume of shell traded during the historic period requires a relatively accurate estimate of the amount of shell that was traded prehistorically. This evidence does not exist at the present time. Erickson (1992) has reviewed evidence for marine shell exchange on the Plateau over the last 6000 years, yet the only conclusion he could confidently state is that the trade had increased over this period.

It can be argued that little impact on the Native *Dentalium* exchange networks occurred during the maritime fur trade period in the late eighteenth century. There are a limited number of references that record Euroamerican procurement of the shell during this time, and most of the reported incidents appear opportunistic and intended to increase the trading potential of a single trading voyage. However, one of the early effects of the maritime fur trade was the local extirpation of sea otter populations along the northern Northwest Coast. With the passing of the sea otter trade in the first two decades of the nineteenth century, coastal Native groups suddenly found their access to European goods cut off or limited.

During this period, fur trade companies, particularly the Hudson's Bay Company and the Russian-American Company began systematically procuring the *Dentalium* shell from specific locations along the coast in order to supply it to a limited number of interior

locations. Based on some of the infrequent estimates of the number of shells traded into areas such as the Yukon District, this probably signaled an increase in the volume of shell in specific locations during the historic period. It is argued that some coastal groups such as the Nuu-chah-nulth may have resorted to the supplying fur trade companies with *Dentalium* shell to the in order to maintain their access to European trade goods. Mills has observed that:

> Though the significant change that took place in the interim between contact time and the recent period was the addition of trade goods of White manufacture, it is obvious that the Dentalium shell (*Dentalium pretiosum*) maintained its bargaining power, though certainly of lesser value in the declining years of the nineteenth century than it had been at contact [1955:76].

The Nuu-chah-nulth on Vancouver Island were one of the first participants in the maritime fur trade after Cook's published accounts of the voyage in 1778 identified the west coast of Vancouver Island, and Nootka Sound in particular, as the location of the sea otter pelts that brought such good return when traded in Canton. Marshall (1993) has suggested that the Mowachaht Chief Maquinna was in the process of drawing together a confederacy of the groups that live in the area of Nootka Sound during the latter part of the eighteenth century. Part of Maquinna's success in developing this confederacy was achieved through his relations with Euroamerican traders and access to European manufactured goods. The capture of the fur trade vessel, the *Boston* by the Mowachaht in 1802 coupled with the decline in the availability of the sea otter along the west coast of Vancouver Island limited the Nuu-chah-nulth's access to European trade good during the early nineteenth century. There was not, however, a corresponding decline in the desire for the acquisition for goods of European manufacture.

From the early maritime fur trade period the Nuu-chah-nulth were familiar with the European use of goods of Native manufacture or origin which the Euroamerican used for trade on other parts of the coast. They maintained active trade networks with groups

adjacent with them, particularly the Makah and the Kwakwaka'wakw and it was from these groups that the fur trade companies were now acquiring *Dentalium* shell. There is enough information from historic accounts to suggest Nuu-chah-nulth groups along the west coast of Vancouver Island may have been supplying, either directly or indirectly, some of the *Dentalium* shell that was appearing at these two fur trade posts.

The appearance of a *Dentalium* fishery in Nootka Sound during the first half of the nineteenth century may have resulted from this loss of access to European trade goods. John Jewitt, during the period of his captivity between 1802 and 1805, did not observe the Mowachaht fishing for *Dentalium* shell although he records numerous transactions involving the shell. By 1844, John Dunn records the groups in Nootka Sound fishing for *Dentalium* shell with bait. When Mayne (1862:) visits in the 1860s, he notes that the Nootka in Nootka Sound were fishing for the shell with a fishing implement, and selling the shell to the Hudson's Bay Company post at Fort Rupert.

The same situation may have held for the Haida in the Queen Charlotte Islands. After the decline of the sea otter in the Queen Charlotte Islands, fur traders abandoned the area to work further north among the Tlingit. It is at this time that the Queen Charlotte Islands become noted as a source for *Dentalium* shell. Shell from Queen Charlotte Islands is reported as being traded through the Tlingit to the Russians at Sitka, who were purchasing it to service their trading outposts in the interior of Alaska.

CHAPTER FOUR

PROCUREMENT METHODS AND TECHNOLOGY

This chapter will review and examine the ethnographic and historically recorded methods and techniques of procuring the shell. As well, the three existing examples of *Dentalium* fishing spears that are held in museum collections are described and recent experimental work using a replicated *Dentalium* fishing spear is examined. Previous reviews of the literature pertaining to procurement methods and *Dentalium* fishing implements have included Clark (1963), Weld (1963), Andrews (1989), and Barton (1992). *Dentalium* inhabit shallow to deep water so some method of procuring the shell from the deeper parts of its range was essential for its exploitation as an item of trade in both historic and prehistoric periods. A number of *Dentalium* procurement locations are identified by their association with particular implements used to procure the shell or by methods of procurement reported to have occurred at the site.

Ethnographic and historical sources describe three methods used by native people to procure *Dentalium* shell. The shells were either: 1) caught by using a fishing implement specially designed for the purpose; 2) fished for by using bait; or 3) collected off the beach. The methods employing bait or a fishing implement are in some respects, conjectural, as in all cases the ethnographers or historic period writers describing the implements and procurement methods did not actually observe *Dentalium* fishing taking place. Ethnographic research conducted in the twentieth century has relied on native informants who were not involved in the *Dentalium* fishery and may not have actually observed the operation taking place. Drucker (1951:112), who worked among the Nuu-chah-nulth between 1935 and 1936 noted that "the method of bring up shells is well known, even though none of my informants had ever actually seen it performed; it was abandoned before their time". Mills (1955:78) working in Nootka Sound two decades

later commented that none of the Mowachaht informants that he had worked with could describe the technique used for *Dentalium* fishing. Therefore, what was described in the historic and ethnographic literature may only approximate the actual methods and techniques and may not serve as a realistic account.

DENTALIUM FISHING SPEARS

The most widely reported method of procuring *Dentalium* shell involved the use of a specially designed fishing implement. A survey of the ethnographic and historical literature reveals numerous descriptions of the construction of these fishing implements and the method of their employment (Table 9).

Historic and Ethnographic Description of Fishing Spears

Historic and ethnographic descriptions of fishing spears indicates that, although the objectives of the implements were the same, the authors of these descriptions are describing two essentially related, but different implements. One is described as resembling a broom and the second as resembling a rake or comb. Both types of implements had a working end that contained rods, splints or teeth that the *Dentalium* shells would become wedged between, but the configuration of how the splints or teeth were attached to the implement and the type of handle differ. For the purposes of this analysis I have termed the first the *Broom Type* and the second, the *Board Type*.

There are a number of secondary accounts derived from, or based on earlier descriptions and these are noted as derivative descriptions in Table 9. In some cases, these later descriptions are inaccurate in describing the operation of the implement or in its construction or configuration. These are discussed separately at the end of each section.

TABLE 9: Summary of the collection date and the publication date for the descriptions of *Dentalium* fishing spears.

Method	Author	Date Collected	Date Published	Remarks
Broom	Newcombe ✓	1903	1909	
	Curtis	ca. 1910-1915	1915	
	Drucker ✓	1934-1935	1950 & 1951	
	Ellis and Swan ✓	ca. 1970-1980	1981	
	Ravenhill		1938	derived from Newcombe
	Coe		n.d.	derived directly from Underhill or vice versa
	Underhill		1944	
Board	Jewitt	1803-1805	1815	
	Tolmie	1835	1963	
	Kane	ca. 1846-1848	1859	
	Swan	ca. 1852-1857	1857	reported by Swan to be based on Jewitt it appears similar to Kane's
	Lord		1864 & 1866	possibly derivative
	Gibbs		1877	possibly derivative
	Ingersoll		1883	possibly derivative
	Hewitt		1907	derivative - Lord
	Rogers		1908	derivative - probably Lord

Broom Type

The broom type fishing spear has been recorded in detail by Curtis (1915:44-45), Drucker (1950:204, 273; 1951:112; 1965:152), Newcombe (1909:42; n.d.) and Ellis and Swan (1981:73) and there are a number of descriptions of the implement and its use that, most likely, are based on the descriptions provided by either Drucker, Curtis or Newcombe (Coe n.d.:26; Ravenhill 1938:36; Underhill 1944:163). A comparison of the descriptions of the construction of the spear and its components and materials are provided in Table 10.

The fishing implement or spear is described as a long pole, or a series of connected poles with a bundle of rods or splints bound to the end. Around the rods, a series of flat broad slats were arranged which contained the rods and allowed them to be compressed. The spear was weighted and in two of the descriptions there is a mechanism described for compressing the splints allowing the implement to entrap the shells. The spear is employed by lowering it to the sea bed, prodding it several times into the sediments that contain the *Dentalium* shells, and raising it and picking out the shells.

Drucker's description of the *Dentalium* spear and its use is usually the one quoted to illustrate the process. Drucker conducted his field work among the Nuu-chah-nulth during the years 1935 to 1936 and published his research in a monograph in 1951 that includes the information on *Dentalium* fishing and fishing locations. Drucker also included some information about *Dentalium* fishing in the University of California anthropological trait list series for the Northwest Coast (1950) and published a more popular account in the *Cultures of the North Pacific Coast* (1965). A reconstruction of the implement described by Drucker's informant is illustrated in Figure 8. In Drucker's account, the fishing implement is:

> a bunch of fine cedar splints was lashed to one end of a long fir pole in a round bundle flaring toward the unlashed end in a form resembling somewhat that of a home-made broom. The bundle was 8 or 9 inches across at the open end. The splints in the center were quite fine, those near

TABLE 10: Comparison of the descriptions of the construction, materials and configuration of the *Broom Type* fishing spear.

Component	Drucker[1]	Curtis[2]	Newcombe[3]	Ellis and Swan[4]
pole (handle)	-long -fir	-45' long, 3" diameter -yew	-long wooden handle	-Douglas fir or western red cedar -slit at one end
extension poles	-several 15' to 20' lengths (4 poles 36' lengths) -lashed to handle as implement is lowered	-absent	-several	-absent
rope	-absent	-absent	-long rope of twisted cedar bark -attached near sinkers	-line -attached to the top of the spear
splints	-cedar, fine to coarse -lashed in round flaring bundle -8" to 9" across at end	-piece of Spiraea (*Spiraea opulifolia*) 15" long and 2" thick -bent and split (500) stiff brush 6" diameter	-hardhack (*Shizonotus discolor*) or *Spiraea* -pointed strips -cylindrical brush-like arrangement	-yew -inserted in slits in handle and lashed in place
blades	-flat wide splints	-several, equal in length to brush -yew, 3 1/2" broad	-not noted	-not noted
lashing	-material not noted	-material not noted	-cedar bark	-split spruce root or cherry bark
weight	-2 stones, 10 lbs each -secured in withes and suspended from board	-2 oblong stones, 35-40 lbs each -secured on either side of pole above splints	-2 heavy stone sinkers -lashed to handle	-spear weighted
withes	-material not noted	-absent	-absent	-absent
compression board	-narrow board -hole in centre	-absent	-absent	-absent
compression withe	-absent	-cedar	-absent	-absent
cordage	-nettle fiber (lashing extension poles)	-not reported	-not reported	-not reported

[1] Summarized from Drucker (1950:204, 273; 1951:112).

[2] Summarized from Curtis (1915:44-45).

[3] Summarized from Newcombe (1909:42; n.d.).

[4] Summarized from Ellis Luke Swan (1981:73).

> the edge, coarser, and around the outside was a row of flat rather wide splints. A hole was cut in a narrow piece of board so it would slip over the end of the bundle where it was lashed to the pole, but would not slip off the flaring end of the "broom." Two stones of about the same size, weighing, informants estimated, about 10 pounds each, were lashed in withes and secured to the ends of the perforated board [1951:112].

When operating the spear, the *Dentalium* fisher used "enough additional poles in 15- to 20-foot lengths, to reach bottom at the grounds when joined end to end, and a quantity of good heavy cordage of nettle fiber" (Drucker 1951:112). Quatsino Sam, a Koskimo informant whom Drucker described as old (around 70 years) and who provided excellent information, told Drucker that the *Dentalium* beds were found at a depth of 24 fathoms (144 feet) and that they used four extension poles that measured six fathoms (36 feet) long. Drucker (1950:273), however, felt that this depth was over estimated.

With this implement, the *Dentalium* fisher paddled out to the fishing location and positioned the canoe over the *Dentalium* beds. There the broom end would be laid in the water:

> with the perforated board in place. The weight of the stones pulled the "broom" end down, and the fisherman lashed another of his poles to the upper end, continuing to join the poles til he could sound the bottom. For greatest efficiency of the rather clumsy implement, of course, the stone weights should have almost counterbalanced the effective buoyancy of the poles and board; it may be that the estimates of weights given are a little low. In any case, when he had enough poles lashed together, he jabbed downward sharply a few times, then pulled up the pole, letting the top lean over till the whole length was afloat in the water. One informant specified a line was made fast to the lower end, just above the bundle of splints, to pull it up by; this sounds like the most practical method. As the gear was raised the weights drew the perforated board down snug over the splints, compressing them slightly. If he had been lucky the fisherman found a dentalium shell or two pinched firmly between the splints (not, informants insisted, skewered on them); if not, there was nothing but mud and trash from the sea floor. Then he had to unlash his poles, paddle back to the place he had been sounding, for the water was too deep to anchor in, and rig his gear for another sounding [Drucker 1951:112].

Drucker (1951:112) commented that this appeared to be a "slow laborious task" and concluded by stating that "one hardly wonders that it has been a long time since anyone has gone to all that trouble".

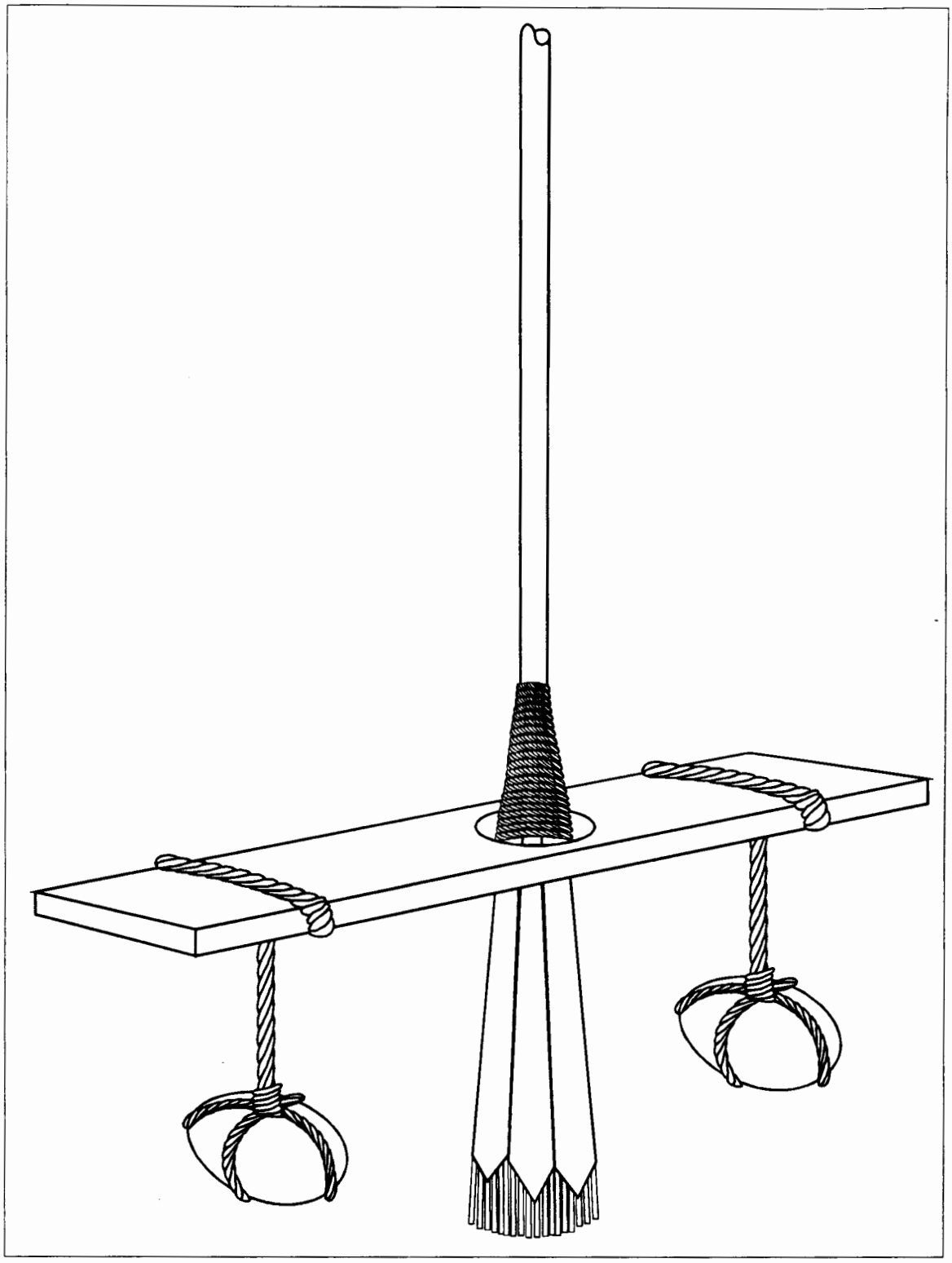

FIGURE 8: Illustration of a *Dentalium* spear based on the description by Drucker (1951).

Curtis collected a description of the fishing spear and its method of operation from the Kwakwaka'wakw living in Winter Harbour, Quatsino Sound in the early part of the twentieth century. He described the construction of the spear as a:

> three-inch yew pole about forty-five feet long was first secured. A sound piece of spirea (*S. opulifolia*) fifteen inches long and two inches thick was then, by bending, split into a great many thin, resilient splinters, about five hundred in number, so that when finished it resembled a great stiff brush six inches in diameter. Next were prepared several thin yew blades, equal in length to the spirea splints and three and a half inches broad, and with the corners of the lower end cut off so that it terminated in a fairly acute joint. The splints were now fastened securely about one end of the pole, the yew blades were bound by the upper ends about the bundle of splints, so as to form a continuous shield of a single thickness, and near the pointed lower ends a cedar withe encircled the bundle with sufficient tightness to hold the blades and splints firmly together. Two oblong stones, each weighting thirty-five to forty pounds, were secured on the shoulder, or upper end, of the bundle of splints, on opposite sides of the pole [1915:44-45].

A reconstruction of the spear as it might have appeared is illustrated in Figure 9.

Curtis further described the operation of the spear, although he is error about the bottom substrate that the animal inhabits. If the shells were found on a rock substratum, as he described, it is unlikely that the spear would have operated in the way he suggests.

> When this mechanism was put into the water, the stones just counterbalanced the buoyancy of the wood, and the pole stood upright with the bundle of splints resting not too heavily on the bottom. The fisherman, alone in his small canoe, seized the pole by the tip, to strike the bottom without too great a force. The shells, fastened to the rocks by the base and with the pointed end upward, were forced among the splints, and when the pole was lifted again they were torn from the rocks. At the next plunge of the mechanism, more shells were forced in, and those of the first catch were pushed up further. Thus it went until the resilient splints, held together by the yew blades, were distended at the bottom to a diameter of eighteen inches. The cedar-withe binding gradually slipped upward as the splints were distended. When the "feel" of the plunger indicated that the splints were filled, the pole was hauled up and the lower end was rolled into the canoe [Curtis 1915:45].

Curtis' description is similar to Drucker's but differs from it in two aspects. Drucker describes a weighted board that compresses the broom end of the spear after the shells have been trapped between the bristles. In Curtis' description, the opposite occurs; the bristles are compressed at the beginning of the operation and open up as the shells, bottom sediments and detritus are packed into the end of the brush, forcing up the

compression withe. Second, Drucker describes an implement for fishing at great depths using additional extension poles; Curtis implies that the shells were being procured in less than 45 feet of water.

Newcombe collected the first of two *Dentalium* spears at Kyuquot for the Royal British Columbia Museum in 1903 (R.B.C.M. specimen # 2231) (Figure 12). The Public Archives of British Columbia hold the Newcombe family papers and these contain two separate entries relating to the collection of this specimen. The first is Newcombe's field collection notes that include a description of the construction of the spear and its use. Newcombe recorded that:

> the brush part is made of *Spiraea* and is lashed to a long wooden handle by cedar bark, which also attaches two heavy stone sinkers, and a long rope made of twisted cedar bark. Used in deep water for spearing white tubular shells of the *Dentalium*, on sandy bottoms; after using for some time the spear is hauled up by the rope [Newcombe n.d.].

The second entry in the Newcombe papers is entitled "Story of HaiXwa" in which he recorded locations where the shell was procured as well as the Kyuquot names for the parts of the spear (Table 11, Figure 12).

Newcombe was commissioned to arrange and catalogue the ethnological specimens in the British Columbia Provincial Museum (Cole 1985:229) and as part of this project, he wrote a guidebook to the collections that included a description of the spear collected in 1903 (Newcombe 1909:42). It noteworthy that Newcombe deviated from his original field notes in describing the spear. In the published description he records the material of the brush as hardhack (*Shizonotus discolor*) and indicates that additional extension poles were attached to the handle to extend its reach.

Newcombe's description of the operation of the implement (entrapping the shells between the bristles of the spear) and the habitat of *Dentalium* (found in sandy sediments) is quite accurate. This is in contrast to some of the earlier descriptions, particularly Lord's

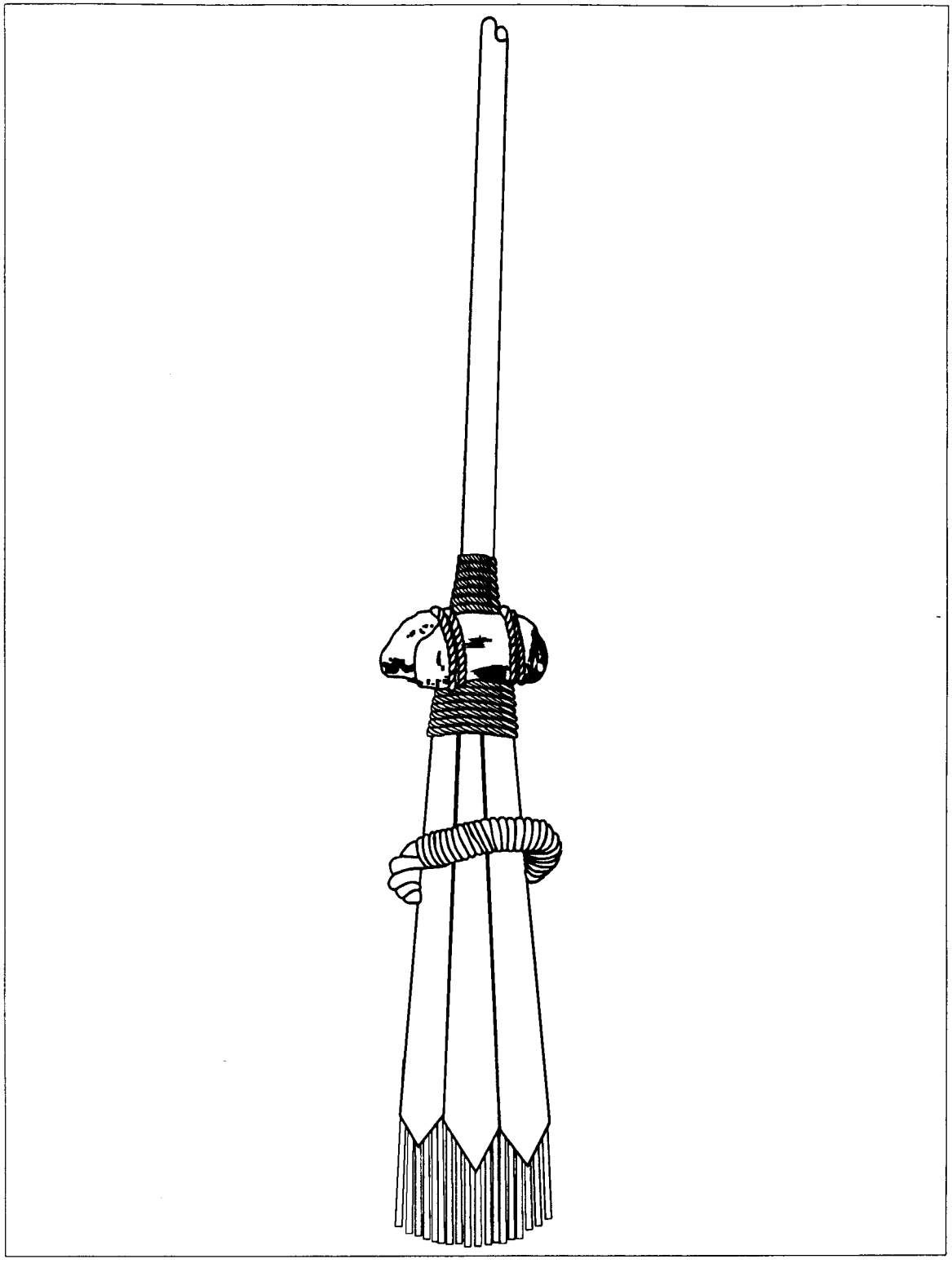

FIGURE 9: Illustration of a *Dentalium* spear based on the description by Curtis (1915).

TABLE 11: Kyuquot (Nuu-chah-nulth) names for parts of the *Dentalium* fishing spear. Recorded in Newcombe's (n.d.) field notes and collected with the *Dentalium* fishing spear now in the collection of the Royal British Columbia Museum (R.B.C.M. catalogue # 2231).

Component	Kyuquot Term
Entire Spear	shukyek
Handle Only	sibada
Lower End	shukyek
Wood of the Brush (*Spiraea*)	tciitiyek
Flat plaited cord of 3 strands	tsi isuq
2 stone sinkers	titi zitim
long throwing rope	teibat!o

(1866) which contains a number of errors regarding the biology of *Dentalium* and the operation of the fishing spear.

In a monograph on the subsistence resources of the Manhousat people of Clayoquot Sound, Ellis and Swan provide a description of a *Dentalium* spear that was collected in the 1970s. They note that the implement is called a *shaxyak*, which is very similar to the name recorded by Newcombe among the Kyuquot. It is described as a weight spear that was used in deep water at low tide. The handle was constructed of:

> Western Red Cedar or Douglas Fir, and slit at one end. Thin pieces of yew were inserted in the slits and lashed in place with split spruce root or cherry bark. A line was attached to the top of the weighted spear and it was sunk below the surface of the water and repeatedly jabbed into the ocean bottom. Dentalium shells were caught between the points at the end of the spear and were removed when the spear was brought to the surface [Ellis and Swan 1981:73].

This description is similar to one provided by Jewitt (1815), particularly as it would appear by the description that the spear is operated by jigging the implement up and down by means of the rope rather that operating it directly by means of the handle.

Underhill (1944:163) and Coe (n.d.:26) both published a description of *Dentalium* fishing although on reading them it is apparent that Coe copied his verbatim from Underhill (without crediting his source). The spear is described as having a "wooden handle ten or more feet long, with a number of slender wooden slats attached at its bottom, like a broom. When not in use, the slats were kept close together by a ring of cedar bark rope" (Underhill 1944:163). Underhill goes on to describe the operation, noting that as the spear is lowered into the water:

> the pressure of the water forced the ring up off the slats. They separated and could then be pressed down over the shell bed, catching any shells which were in their way and pulling them loose. The broom was then drawn up and the pressure of the water as it rose forced the ring down, holding the slats together [1944:163].

The operation of the compression withe seems unlikely and, as this description was probably abstracted from one of the earlier published accounts, probably misinterpreted.

Board Type

The second type of *Dentalium* fishing implement, sometimes described as resembling a rake or a comb, consisted of a board or plank between 12 and 15 inches square into which a series of closely spaced bone or wooden pegs or spikes were driven. In some descriptions (Gibbs 1877; Hewitt 1907; Ingersoll 1883; Kane 1925; Lord 1886; Swan 1857) a long pole was attached to the upper side of the board and the implement was operated by tamping the end with the wooden pegs into ocean sediments that contained *Dentalium* shell. In one account (Jewitt 1815) the implement is described with a short pole on the upper end to which a rope or lanyard was attached, and in another account (Tolmie 1963) the rope is attached directly to the board. Stone weights were lashed to the base of the pole or to the top of the board and the implement was lowered to the ocean floor where it was raised and let drop several times similar to handline fishing. In both cases, the operation of the implement would result in the *Dentalium* shells being wedged between the wooden spikes so they could be hauled up and retrieved.

There are a number of descriptions of this form of fishing implement and they have been summarized for comparison in Table 12. There do not appear to be any examples of this type of spear in existence in museum collections, although it is possible specimens do exist but are not recognized as *Dentalium* fishing implements.

Jewitt's description of this type of fishing implement and its method of use, collected sometime between 1803 and 1805 while he was captive at Yuquot in Nootka Sound, is the earliest recorded description of an implement designed for procuring *Dentalium* shell.

> To one end of a pole is fastened a piece of a plank in which a considerable number of pine pegs are inserted made sharp at the ends; above the plank in order to sink it, a stone or some weight is tied, and the other end of the

> pole suspended to a long rope; this is let down perpendicularly by the *Ife-waw* [*Dentalium*] fishers in those places where that substance is found which are usually from fifty to sixty fathoms deep; on finding the bottom, they raise the pole up a few feet and let it fall, this they repeat a number of times as if sounding, when they draw it up and take off the *Ife-waw* [*Dentalium*] which is found adhering to the points. This method of procuring it is very laborious and fatiguing, especially as they seldom take more than two or three of these shells at a time, and frequently none [Jewitt 1815:75-76].

Jewitt notes that he did not actually witness this operation and errs in his statement that the shells were caught on the points rather than trapped between them. A reconstruction of the implement described by Jewitt is illustrated in Figure 10.

William Tolmie, Chief Factor with the Hudson's Bay Company, recorded a *Dentalium* fishing implement in conjunction with his census of native villages located along the central British Columbia coast. As noted in Chapter 3, fur trade employees were actively seeking sources for obtaining *Dentalium* shell which were in great demand at the interior and northern fur trade posts. Tolmie's census, written in his journal on December 23, 1835 identified six villages located on the northern end of Vancouver Island who's inhabitants were actively fishing for *Dentalium* shell. Tolmie provided the following account of the implement used in fishing them:

> a flat piece of wood having its inferior surface stuck full of slender wooden pins & properly fitted with sinkers and a line is let down to the Hayaqua bed and gently moved up and down as in handline fishing until it is supposed that a sufficient number of the shells are fixed between the pins--the board is then pulled up--the paya picked out [1963:317-318].

This description is intriguing as it differs from that of Jewitt's in one major respect. Tolmie does not mention an attached handle on the implement, implying that the rope is attached directly to the board containing the pegs (Figure 11). Tolmie also correctly notes that the shells are trapped between the pins rather than impaled on them as described by Jewitt.

Artist Paul Kane, who traveled through western North America between 1846 and 1848 recorded a similar implement and technique for the Makah located at Cape Flattery

TABLE 12: Comparison of the descriptions of the construction, materials, configuration and operation of the *Board Type* fishing spear.

Component	Jewitt[1]	Tolmie[2]	Kane[3]	Swan[4]	Lord[5]	Gibbs[6]	Hewitt[7]	Ingersoll[8]
pole (handle)	pole	absent	long pole	long pole	long pole, fir or pine	long pole	suitable pole	long pole
rope	long rope attached to end of pole	attached line	absent	absent	absent	absent	absent	absent
board	plank	flat piece of wood	flat board 15" square	piece of wood a foot square (wooden block)	strip of wood placed transversely	piece of wood	strip of wood secured transversely across pole	board at the end of pole
pegs/teeth	-considerable number pine pegs sharpened at one end	inferior surface stuck full of slender wooden pins	number of bone pieces	filled full of little pegs - sharpened to a fine point	driven full of bone teeth spaced very wide apart	filled with spikes or teeth	studded with bone or wooden teeth	spiked
weight	stone or weight tied to top of plank	fitted with sinkers	absent	absent	absent	absent	absent	absent
operation of implement	raised up then allowed to fall a number of times	moved gently up and down like handline fishing	pressed down on sea bed	thrust down into the water	stabbed into sand	pole let down	carefully prodded the bottom of the water	prodding the sea bottom
	shells adhering to points	shells fixed between pins	shells stuck on pieces	points enter shells	shells impaled on teeth	shells fixed between teeth	shells impaled on teeth	shells caught on points

[1] Summarized from Jewitt (1815:75-76).

[2] Summarized from Tolmie (1963:317-318).

[3] Summarized from Kane (1925:165).

[4] Summarized from Swan (1857:159).

[5] Summarized from Gibbs (1877:213).

[6] Summarized from Lord (1866:25-26).

[7] Summarized from Hewitt (1907:908-909).

[8] Summarized from Ingersoll (1883:476).

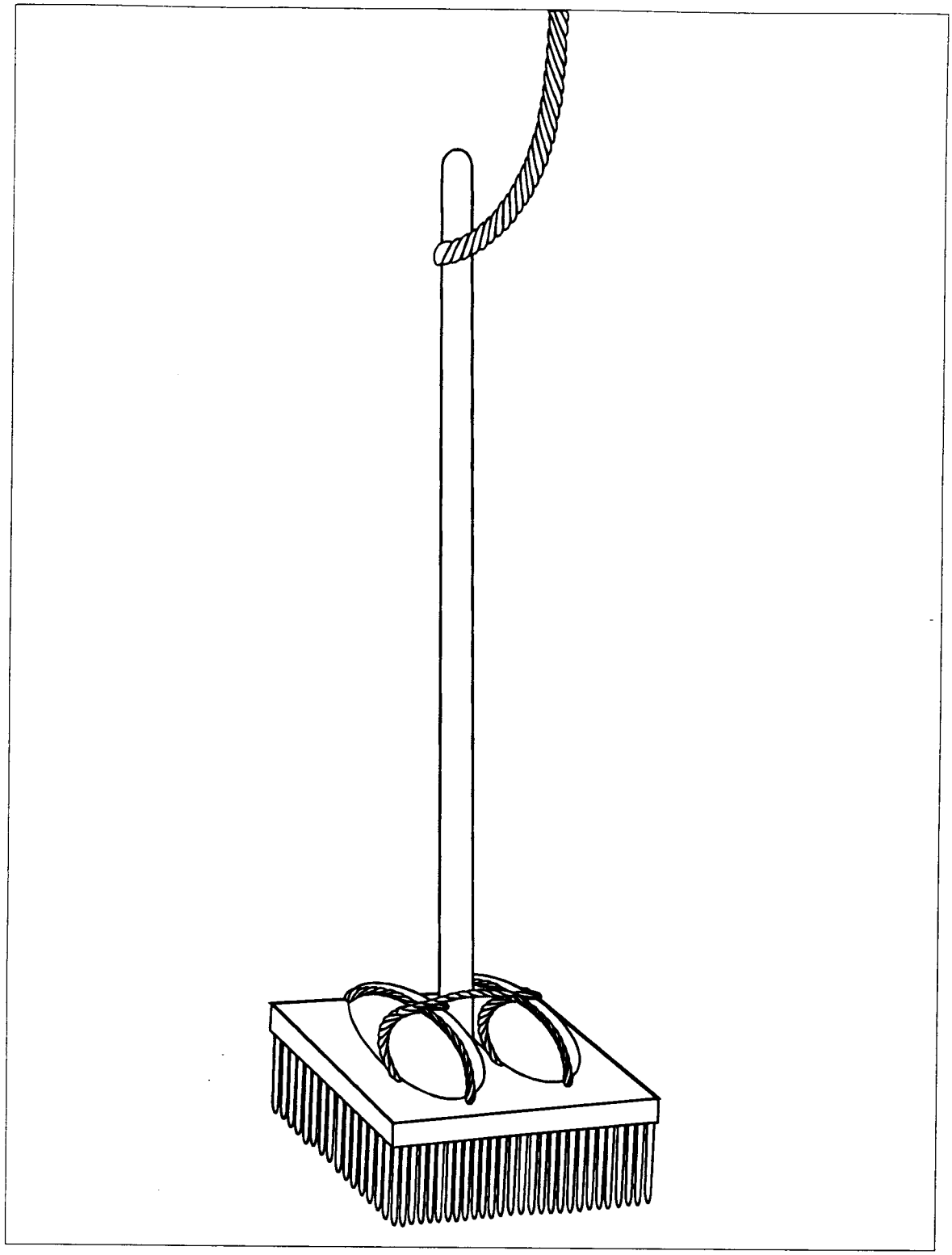

FIGURE 10: Illustration of a *Dentalium* spear based on the description by Jewitt (1815).

on the Olympic Peninsula in Washington State. Noting that the shells were obtained at a considerable depth on the sea bottom, Kane described the fishing implement as:

> a long pole stuck in a flat board about fifteen inches square. From this board a number of bone pieces project, which, when pressed down, enter the hollow ends of the shells, which seem to be attached to the bottom by their small ends. The shells stick on the pieces, and are thus brought to the surface [1925:126].

Swan, writing on *Dentalium* shell procurement in 1857 described a method that he attributes to Jewitt. Swan states that a

> piece of wood a foot square is filled full of little pegs, which are sharpened to a fine point. This block is fastened to a long pole, and thrust down into the water till it reaches the shell-fish, and the sharp points enter the hollow shells, breaking them from their hold on the bottom, and bringing them to the surface [1857:159].

This differs considerably from the description of Jewitt's as Swan's version has a pole with no rope, the implement is not weighted, and it is operated by thrusting the pole down over the shell bed rather than lowering the implement down by rope. Swan's description is probably influenced more by Kane's description, originally published in 1859, rather than being based on Jewitt's 1815 account.

John Lord, a British naturalist who traveled throughout British Columbia and Vancouver Island during the early 1860s, collected information on the biology and habitat of scaphopod molluscs as well as information on Native *Dentalium* procurement methods. Lord published a paper with William Baird in 1864 on the biology and use of the shells by west coast natives and later published an extended version on the natural history of Scaphopod molluscs and native fishing techniques in a two volume monograph on the natural history of Vancouver Island and British Columbia.

Lord provided the following description of the *Dentalium* fishing spear and it method of employment. The spear was described as possessing a long handle or shaft which was made "of light deal [fir or pine], to the end of which is fastened a strip of wood placed transversely, but driven full of teeth made of bone, resembling exactly a long comb

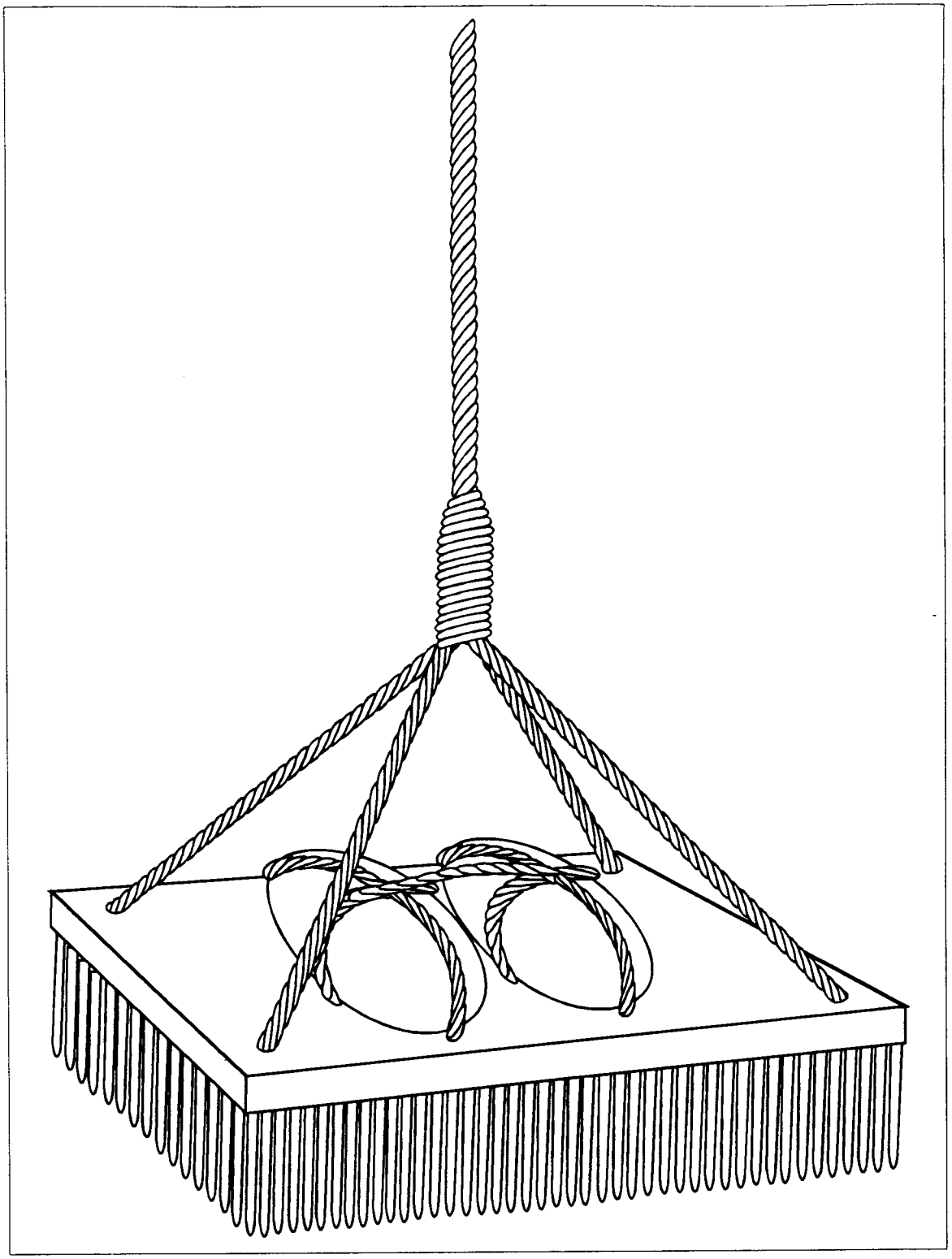

FIGURE 11: Illustration of the *Dentalium* fishing device based on the description by Tolmie (1963).

with the teeth very wide apart" (Lord 1864:137). Lord (1864:137) stated that the *Dentalium* fisher would stab "this comb-like affair into the sand at the bottom of the water, and after giving two or three stabs draws it up to look at it; if he has been successful, perhaps four or five dentalia have been impaled on the teeth of the spear".

Lord's natural history contains numerous errors regarding the biology and habitat of *Dentalium*. Lord (1866:18) believed that the animal was carnivorous, noting that they "continually devour small bivalves, foraminifera, or any small marine zoophyte". To feed in this manner, Lord (1866:18) stated that the " habit of the animal is to burrow in the sand, the small end of the shell being invariably downwards...the large end of the shell placed close to the surface, allows the animal free scope to seize upon any unsuspicious wanderer that prowls near it". This is the opposite to the way the shell is oriented in the bottom sediments. Based on an erroneous conception of the orientation of the animal Lord described a fishing implement that impaled the large end of the shell. Lord's description received rather wide distribution and a number of descriptions of the implement and its operation written after Lord's, incorporate these errors.

Gibbs (1877:213) noted that "dentalium, was procured on the northern coast by letting down long poles, to which was attached a piece of wood filled with spikes, or teeth, between which the shells became fixed". Northern coast, in this instance, probably refers to the west coast of Vancouver Island as Gibbs was writing a description of the Native tribes inhabiting western Washington and Oregon states for the U.S. Department of the Interior. Gibbs was compiling the information from sources as well as direct observation and the description of the *Dentalium* fishing implement may have been taken from one of the earlier sources that would have been available to him. Ingersoll (1883:476) noted that *Dentalium* shells were "gathered off the shores of Vancouver's and Queen Charlotte's Islands by prodding into the sea-bottom a long pole with a spiked board at the end, upon the points of which the slender shells were caught". Hewitt in the

Handbook of American Indians North of Mexico, provided the following description of the implement and its operation.

> To the end of a suitable pole a strip of wood was secured, being placed transversely to the line of the pole, and first studded with bone or wooden teeth. From the bow of a canoe or boat, propelled usually by a woman, the tusk-shell fisher stood and carefully prodded the sands at the bottom of the water a number of times with his comb-like instrument, and then drew it up to see whether any of the shells had become impaled on the teeth of the instrument. Sometimes four or five of the shells were brought up, and sometimes none at all. This was a practical method of obtaining these shells, as they are not found between tide marks [1907:908-909].

Both descriptions appear to be based on Lord's 1866 description and were not collected independently.

Two other descriptions contain elements that are based on an erroneous reading of the earlier accounts. Rogers (1908:300) description states that "the Indians use to collect these shells by combing the sandy bottom with a long fine-toothed rake". Safer and Gill also published an account of the operation that stated that the:

> Nootka were the only fisherman to collect live Dentalia, which burrow into the mud at twenty-to-thirty-foot depths. They devised complicated dredges for retrieving Dentalia, but even so were lucky to bring up three or four at a time [1982:53].

Neither description is substantiated by earlier accounts.

Existing Specimens of Fishing Spears

Three *Dentalium* fishing spears are found in museum collections; two in the Royal British Columbia Museum in Victoria, British Columbia were collected by Charles Newcombe in the early part of the twentieth century and the third is in the collection of the Thomas Burke Memorial Washington State Museum at the University of Washington in Seattle and was donated to the museum by Frederick Landsberg. All three are of the type described as broom fishing spears.

Royal British Columbia Museum #2231

The first of the two Royal British Columbia Museum specimens was collected in 1903 at Kyuquot, on the west coast of Vancouver Island (Newcombe n.d.). Newcombe was, at this time, engaged on commission by a number of museums to collect native artefacts from the northwest coast for their collections (Cole 1985). Newcombe, who up until this time, had been collecting exclusively among the Haida and Kwakwaka'wakw, made his first major collecting trip to the west coast of Vancouver Island in October and November, 1903 (Cole 1985:198) and it was probably during this trip that he purchased this *Dentalium* fishing spear. There appears to be some confusion about the collection date of this specimen as Clark (1963:15) has stated that it was collected in 1911 and Andrews (1989:97) uses this date as well, quoting from Clark's article. Clark (1963:15) was also unaware of Newcombe's description of the fishing technique published in 1909, as he states that "this is probably the type of apparatus used in the manner described by Jewitt (1896)".

The specimen consists of a bundle of yellow cedar rods which are enclosed by six guard slats (Figure 12). These are attached to the handle of the spear with cedar bark cordage along with two weight stones (10 lbs total weight) and a lanyard. The tapering handle of the spear appears to be made of oak, although Clark has identified it as ash, and the entire spear measures 1.73 m in length.

This specimen does not appear to have ever been used for fishing as the wood appears freshly carved and there is no patina as would be acquired with use. It has been suggested that this specimen was a non-functional model (Inglis 1990:per.comm.). This is borne out in Newcombe's field notebook where, in reference to his notes on *Dentalium* fishing he comments that the "weights about four times size in model" (Newcombe, n.d.). The specimen may have even been commissioned from a Nuu-chah-nulth carver, in the absence of an actual fishing implement.

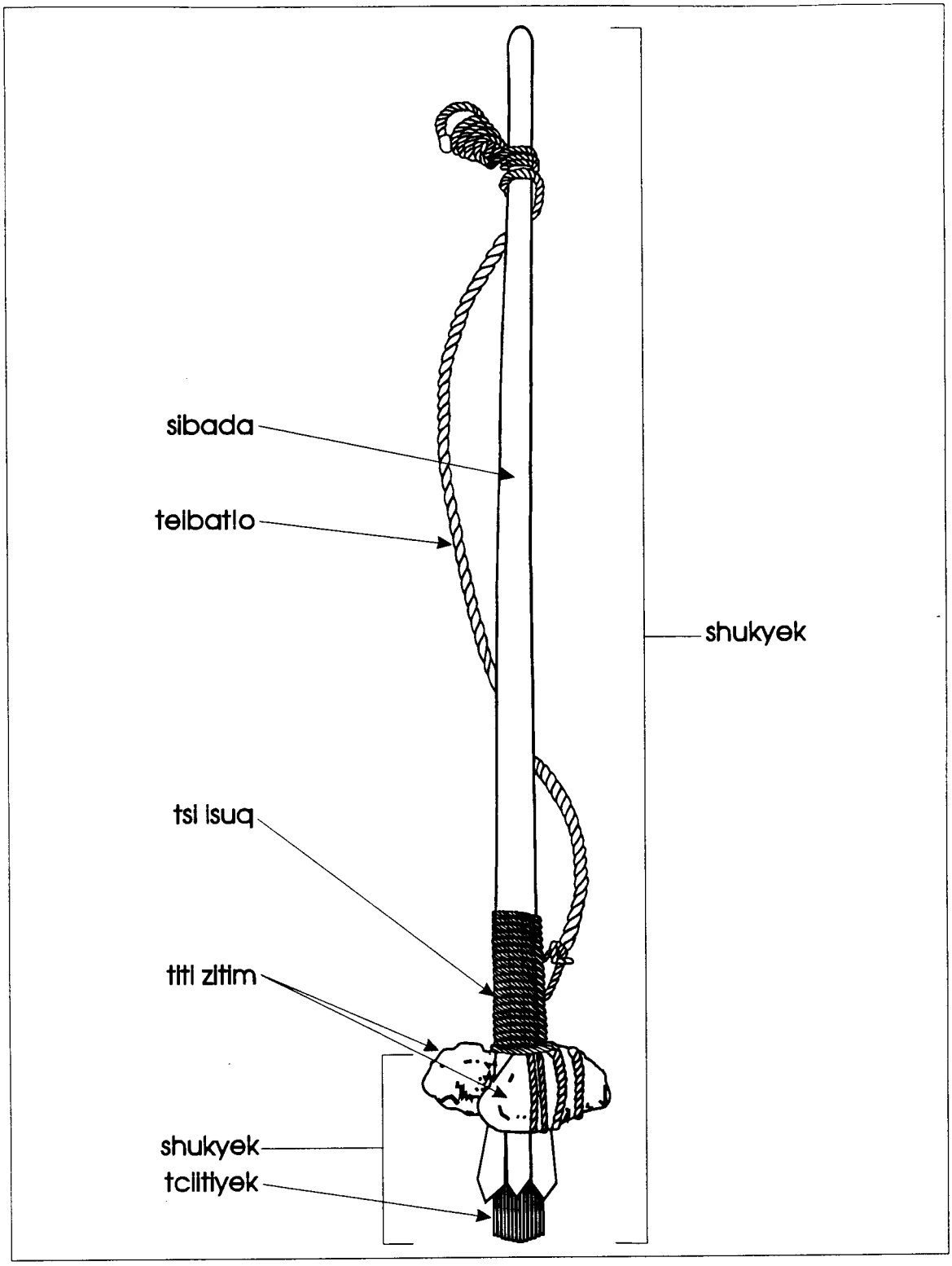

FIGURE 12: R.B.C.M. # 2231. Collected at Kyuquot by Newcombe in 1903.

Royal British Columbia Museum #2232

The second spear in the Royal British Columbia Museum was collected by Newcombe at Nootka [presumably Nootka Sound] in 1914. The spear's working end is composed of 60 to 80 cedar rods with 4 cedar compression or guard slats that are bound to a cedar shaft with cedar bark cordage (Figure 13). There is a thick woven cedar bark withe that fits over the rods and guard slats and can slide almost to the end of them. The overall length of the spear is 1.82 m, although the end of the shaft is cut off square and beveled, and judging by the difference in the patina on the shaft, may have been much longer at one time.

Clark (1963:16) speculated at some length on how the compression withe functioned on this spear. He (1962:16) notes that the catalogue entry at the museum indicated that "the rope grommet slipped down over the prongs as the spear was withdrawn after striking the bottom, so compressing the prongs" but he considered that unlikely. Duff (cited in Clark 1963:16) suggested that the cedar compression withe (or grommet) "was used to keep the prongs compressed when the spear was not in use, to prevent them splaying and so becoming useless for catching *Dentalium*". Clark (1963:16) also suggested that the "grommet could be adjusted to give the required compression on the prongs during use" although he considers it less likely. I would suggest that the compression withe functioned in the way stated by Curtis for the fishing implement described as in use in Winter Harbour at Quatsino Sound.

One noteworthy feature of this specimen is the guard pieces which are considerably longer than the rods. It is possible that in use, the guard slats could have prevented the rods of the spear from penetrating the bottom sediments and entrapping the shells.

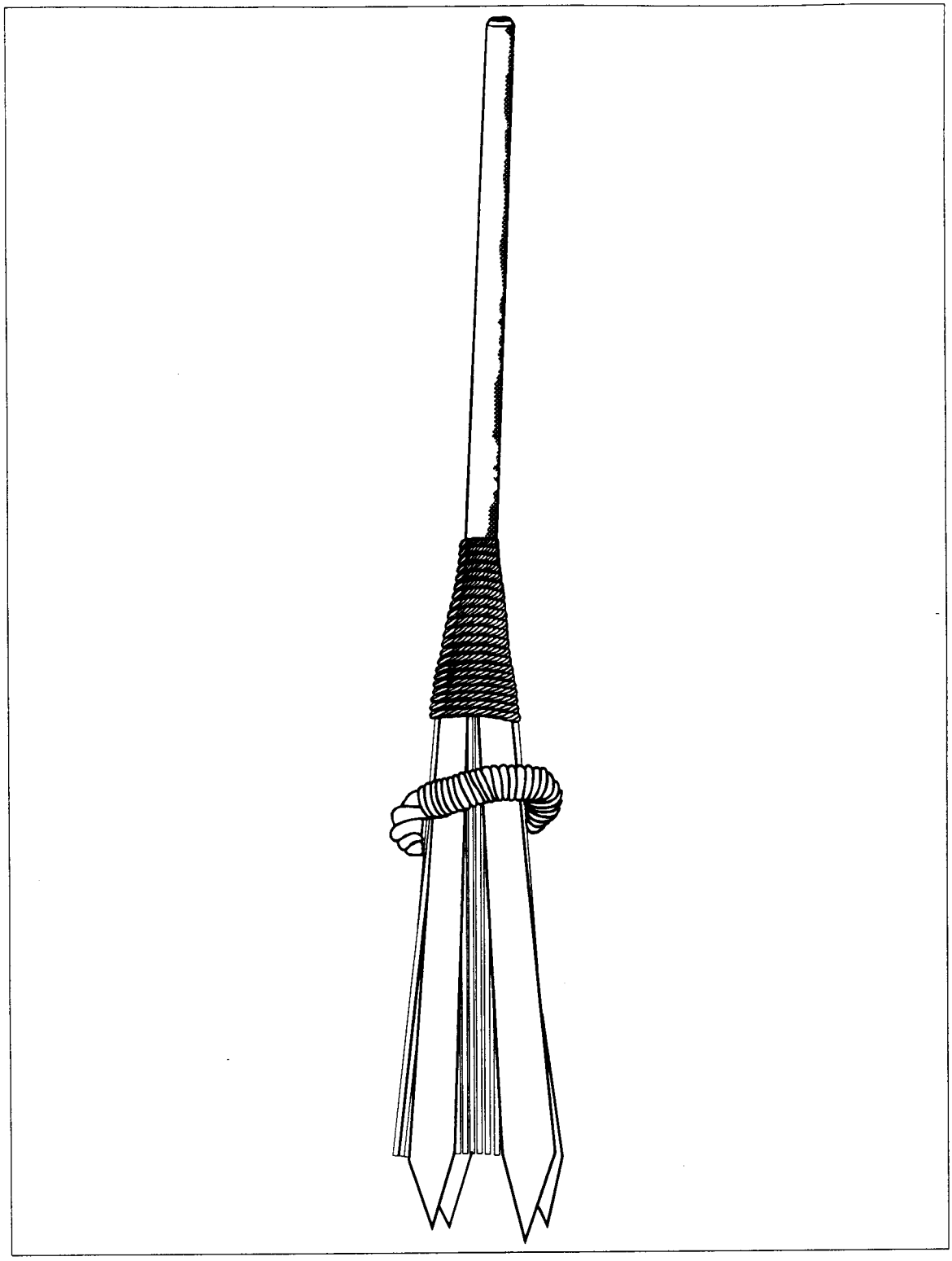

FIGURE 13: R.B.C.M. # 2232. Collected in the vicinity of Nootka Sound by Newcombe in 1914.

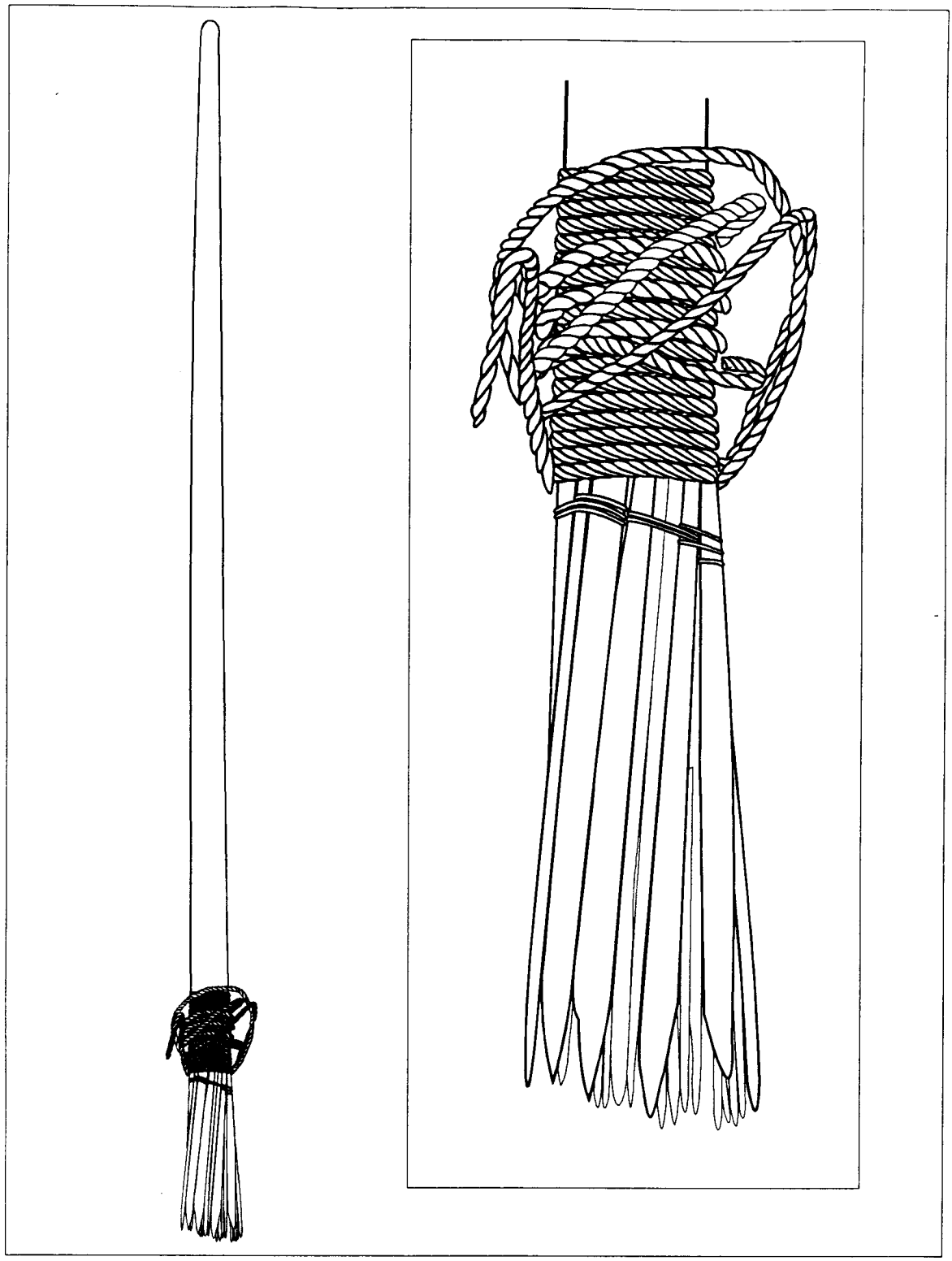

FIGURE 14: Burke Museum # 6931. Collected in Nootka Sound by Landsberg.

Thomas Burke Memorial Washington State Museum # 6931

The Burke Museum specimen was collected from the Nuu-chah-nulth in Nootka Sound, on Vancouver Island and was donated to the Museum in January, 1920 by Landsberg (Andrews 1989:1-2, 97). Andrews notes that there is no collection date or any other information regarding the collection of this piece. The spear is described as:

> 51 cm long, consisting of a wooden shaft and a bundle of wooden slats. The slats are held in place by means of a braided cedar bark rope which is wound around the end of the shaft [Andrews 1989:97].

This specimen is illustrated in Figure 14.

Frederick Landsberg was a curio dealer who operated a shop on Johnston Street in Victoria, British Columbia from the late 1890s up until 1911 when he sold the business and became a real estate agent (Cole 1985; Hawker 1989). Landsberg conducted a brisk business purchasing native artefacts from both natives and other collectors and selling them to private collectors and collectors acting on behalf of museums. The collection date for this *Dentalium* fishing spear can probably be traced to this period (circa 1900 to 1911) and it may have been purchased from one of the commissioned agents acting on behalf of the museums.

Recent Experimental Work

In the summer of 1991 a replica of a *Dentalium* fishing spear was constructed and tested on the west coast of Vancouver Island at Kyuquot Sound. Phil Nuytten of Can-Dive Marine Services Limited, a North Vancouver company that designs and manufactures high tech diving gear and marine submersibles, conducted this project over a two week period (Nuytten 1991). The fishing spear was built by John Livingston, a white carver adopted by the Hunt family of Fort Rupert.

The spear was similar in construction to that described by Drucker with the exception that the weight stones instead of being suspended by withes, were attached to

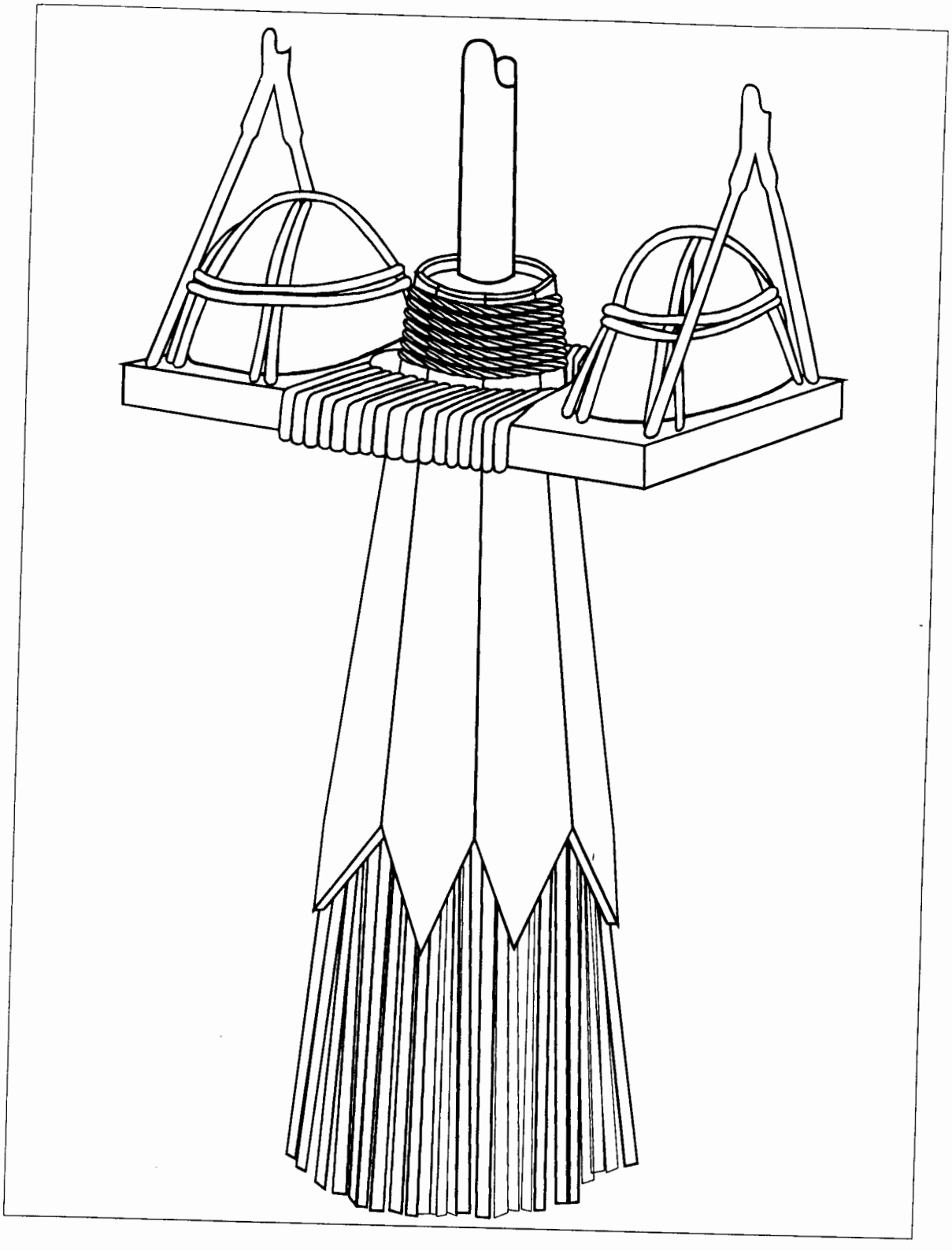

FIGURE 15: Illustration of the *Dentalium* fishing spear built and tested by Nuytten (1993).

the top of the compression board. The compression board was raised and lowered by lines attached to either side of the board that were controlled by the operator (Figure 15). The working end of the spear was constructed with over a hundred hardened yew splints, scorched to increase their hardness, and contained within a sheath of yellow cedar slats. The handle was 21 m (70 feet) long and was constructed in several sections (Nuytten 1991:114).

Nuytten conducted his test of the spear over *Dentalium* beds located at a depth of 50 to 60 feet. In the initial stages of the testing divers monitored the spears effectiveness and efficiency and assisted in its operation. The spear was initially tested on *Dentalium* shell that was planted in the ocean substrate. Once the operators became proficient in its use, the test was extended to the *Dentalium* bed. Nuytten noted that there was a great deal of skill required for the operation of the implement but was satisfied that it and the method of fishing would have actually worked.

Development of the Fishing Spear

Drucker has speculated on how the method and apparatus for fishing for *Dentalium* developed.

> The fact that the apparatus is an invention of no mean order is worth stressing. The part that made the gear function--the weighted perforated board that made the splints grip any small object inserted between them--is mechanically quite neat. One is impressed by the abstract reasoning involved. A primitive inventor conceivably could work out a new device for, let us say, hurling a spear, in great part by trial and error, for he could actually see what his experimental model was doing. Whoever invented the dentalia gear had to be able to visualize what his equipment was doing out of sight in deep water. He had to be sure enough of it to know that when it brought up no shells on several tries the reason was no shells grew where he made the soundings, until he eventually found the beds (unless he was such a fortunate individual that he achieved success on the first few tries) [1951:113].

Drucker assumed that the *Dentalium* beds were only found at great depths and therefore were not visible to the Native inventor.

As outlined in Chapter 2, *Dentalium pretiosum* and other Scaphopod molluscs vary in the depth they are found at within the geographical range in which they are located. This depth is dictated by a number of ecological parameters and scaphopod molluscs can occur on a gradient ranging from the intertidal zone to progressively greater depths. In Table 18 in Chapter 5, the depth ranges at identified *Dentalium* fishing locations are listed. The minimum water depth at five of the locations ranges from .9 m to 4 m.

It should also be noted that implements and techniques for procuring other species of marine animal are analogous to those employed in *Dentalium* fishing. The Nuu-chah-nulth developed two and three pronged leister spears for taking sea urchins in waters up to ten feet in depth (Drucker 1951:35), a procurement technique that is in some ways similar to that devised for *Dentalium* shell.

It is likely that the *Dentalium* fishing technique was originally developed in shallow waters where the shells were visible in the bottom sediments. After the implement was developed and its method of use established, it could have then been applied to beds in progressively deeper waters.

Preparation of the Speared Shells

Once the shells were obtained, they required preparation as live *Dentalium* have a periostracum and are usually encrusted with other marine organisms and growths. Drucker's (1950:204) Koskimo informant, Quatsino Sam, and Tseshaht informant, Jackson Dan, both stated that the dentalia were boiled to remove the flesh and in the case of the Nuu-chah-nulth they were "boiled in a small cooking box" (Drucker 1951:113). After the shells were boiled they were then put into a box of fine sand to polish them up a bit. Drucker (1951:113) noted that the shells were "stirred around" in the sand and possibly "shaken gently back and forth to remove mosslike marine growth that the boiling

had not detached". Drucker concluded that a great deal of such polishing was probably not necessary after the boiling of the shells.

Curtis (1915) also recorded the method used to clean the shells by the Kwakwaka'wakw *Dentalium* fishers in Quatsino Sound. After the fishing spear was brought to the surface the shells were combed out of the brush of the spear with a stick then stirred around in the water in the bottom of the canoe with the feet to remove the mud and other detritus. The animal in the shell was removed by placing a "row between the first and second finger of the left hand with the points upward, and then pushed a wooden needle into the small ends with a slight twist, when the contents were expelled" (Curtis 1915:45). This method of detaching the live animal from the shell with a wooden needle would have been quite effective as the animal is only attached to the shell at the apical end.

BAIT FISHING

The second method of acquiring *Dentalium* shell involved the use of bait. This has been recorded for a number of groups along the Northwest Coast with a number of different types of bait reported (Table 13). The bait in these descriptions was employed in the following way. First the bait was attached to a rope and lowered to the ocean floor. The bait would attract the *Dentalium* which would cling to it and, thus be drawn up and collected. In one description, the bait, specifically whale meat or blubber, was described as being attached to a long pole lowered to the ocean floor and pressed over the *Dentalium* bed. This supposedly resulted in the shells becoming imbedded in the bait.

On first examination, the use of bait would seem an improbable method of procuring *Dentalium*. As discussed in Chapter 2, scaphopod molluscs while being carnivorous animals, only feed on foraminifera or organic detritus and would be unable to feed on the bait described in historic accounts. However, as also discussed, the hermit crab *Orthopagurus minimus* lives in the discarded shells of Scaphopod molluscs, and

TABLE 13: Reported bait types used to fish for *Dentalium*, the location where it was used and the group that used the method.

Type of Bait	Location Where Used	Group	Source
deer flesh	Nootka Sound and along Vancouver Island	Nuu-chah-nulth	Dunn 1844:134
dog	not specified		Litke 1835
fish	Nootka Sound and along Vancouver Island	Nuu-chah-nulth	Dunn 1844:134
meat	Hydaberg, Alaska	Tlingit	de Laguna 1972:445
seal meat	not specified	Makah?	Swan 1857:159
slave	not specified	Tlingit	Davidof 1818
slave	not specified	people living south of the Tlingit	Drucker 1950:273
whale blubber	not specified	Makah?	Swan 1857:159

specifically the shells of *Dentalium pretiosum*. They are carnivorous scavengers that would be attracted to the type of bait that is mentioned in the historical accounts. The connection between hermit crab occupied *Dentalium* shells and the historic accounts of bait fishing methods was first noted by Andrews (1989:108-109) based on the observations of a molluscan biologist, Ronald Shimek.

The capture of *Dentalium* shells by fishing with bait was first described in 1818 by the Russian, Davydov, for the Tlingit. He was informed that the body of a slave was specially killed for the purpose was used as a bait to attract the *Dentalium* (as cited in Krause 1956:277). Litke, in 1835 reported that the Tlingit used a:

> dog's body weighted with stones is let down to the bottom of the sea on a long line. When it is raised again several days later, it is supposed to be covered with these animals [as cited in Krause 1956:277].

de Laguna also cites an example of bait fishing that was related to told to her by a Yakutat Tlingit informant. Fishing for the shell was reported to occur in the waters around the town of Hydaberg, Alaska.

> They get them from the bottom of the water, by sinking a piece of meat for bait. The taxxe are supposed to be alive, so they "clean out the live things inside" [de Laguna 1972:445].

George Kyan (Kaiän), a southern Tlingit of the Sanya group from the village of qac near Cape Fox, and one of Drucker's (1950:161) informants, related a story about bait fishing that was attributed to people that lived to the south of the Tlingit.

> Dentalia came from far to the south. The southern people used to tell a yarn to the effect that the fishing was done by killing a slave and sinking him in deep water. The dentalia assembled to eat the body, and were collected when the body was hauled up [Drucker 1950:273].

Dunn reported that the Nuu-chah-nulth of the west coast of Vancouver Island and specifically those that lived in Nootka Sound, fished using bait. The bait, described as "a piece of deer flesh, or of fish, is dropped from a line to the bottom: this they cling to; and they are then drawn up, and carefully gutted and preserved" (Dunn 1844:134). Swan

(1857:159) related a method that was described to him in Washington which involved tying "a large piece of seal or whale meat to a pole and press that down firmly on the shells, which, becoming imbedded in the meat, are easily broken off, and thus secured". Swan noted that he had not witnessed the operation and could not speak positively on the subject. Although Swan does not identify the group to which his informant belonged, it is likely Makah or possibly Nuu-chah-nulth. It is also probable that Swan misinterpreted this information as the operation, as described, would not seem to be possible.

A number of different groups along the west coast of North America have origin myths for *Dentalium* shell that associate the capture of the shells with the use of bait. These myths commonly locate the source of *Dentalium* shell in a country or region inhabited by supernatural beings who fish for *Dentalium* by using human bodies or human flesh as bait.

The Twana, a Salish group living in Puget Sound while identifying the west coast of Vancouver Island as the source of *Dentalium* shell also had an origin myth that had the shells coming from a "land far to the north and west where a pygmy people with protrusive, sucking mouths, the qwcxqwcxsta'ybixw obtained them by diving" (Elmendorf 1960:212-218). The Yurok, a northern California group describe a:

> *Dentalium* home, Tsi'ktsiko'l, [that] was far downstream (north along the coast), but could also be reached by going north inland from the Klamath until an ocean was reached. The people there killed human beings in order to feed their flesh to the dentalia, or used it as bait for them [Elmendorf 1960:216].

BEACH COLLECTION

The simplest method for obtaining shells was to collect them off beaches that fronted onto areas where *Dentalium* beds occurred off shore. Where *Dentalium* beds occurred close to shore, turbulence and wave activity during storms would scour the ocean floor, uprooting the shells and depositing them on the beach. After a period of

TABLE 14: Locations where *Dentalium* shell was collected off the beach.

Location	Specific	Group		Source
California	Enderts Beach	Yurok		Kroeber and Barrett 1960:112
Oregon	not specified	"Oregon Indians"		Drucker 1951:112
Vancouver Island	Long Beach	Nuu-chah-nulth	Ucluelet	Drucker, 1951:112
	Hesquiat Harbour, mu7is	Nuu-chah-nulth	Hesquiaht	Bouchard and Kennedy, 1990: 64
	Actis Island	Nuu-chah-nulth	Kyuquot	Kenyon, 1980:83
	Cape Scott	Kwakwaka'wakw	Koskimo	Drucker 1950:273
Central Coast	not specified	Kwakwaka'wakw	Bella Bella	Drucker 1950:273
Queen Charlotte Islands	not specified	Haida		Lord 1866:20
	not specified	Haida		Jenson and Sargent 1986:56
	not specified	Haida		Ingersoll 1883:476
	west coast	Haida		Drucker 1950:273
	tastlanas ("sand village")	Haida		Drucker 1950:273
North Coast	not specified	Tsimshian		Drucker 1950:273

rough weather, people would search the beach and collect whatever shells had washed ashore. Beach collection has been recorded for a number of different areas along the west coast of North America and among different cultural groups (Table 14).

In California, Kroeber and Barrett (1960) have recorded a location in Tolowa territory where *Dentalium* shell could be found on the beach, and in one instance that they were aware of, was collected from the beach. While noting that the *Dentalium* shells that were used for money among this particular group came from the far north, they state that:

> Occasionally pieces of *Dentalium* would be found on the beach and were called a-srärul. They consisted only of upper or open ends. The diameter was that of a large shell, but they were mere fragments, an inch or less long [and therefore useless as money; and they were too few to amount to anything as necklace beads] [1960:112].

The shells could be found at a location known as "Smetskéu weroi, the creek at the north end of Enderts Beach, 3/4 mile south of Nek'el, Nickel or Cushion Creek" (Kroeber and Barrett 1960:112). Kroeber and Barrett's (1960:112) informant stated that the shell recovered from the beach "brought him good luck for gambling, but not for more wealth or money". Drucker (1951:112) states that the Native people living along the Oregon coast "claim to have found dentalia occasionally washed up on the beaches" but does not indicate any specific locations where this occurred.

Several areas along the west coast of Vancouver Island have been identified as locations where *Dentalium* shell was beach collected. At Long Beach located just north of Ucluelet, Drucker (1951:112) reported that *Dentalium* shells were washed ashore on the beach where they were presumably collected by hand. Quatsino Sam, Drucker's (1950:273) Koskimo Kwakwaka'wakw informant claimed that "dentalia washed ashore and were picked up in the old tribal home of the Koskimo on Cape Scott". Tolmie (1963:318) made the observation that the finest shells "washed up on shore by the sea" along the northwest side of Vancouver Island which would indicate that the shells were collected off the beach in this area.

For the area running along the central British Columbia coast, William Dixon, a Bella Bella of the oyalitH tribe told Drucker that he was familiar with *Dentalium* collection from beaches (1950:159). He did not specify a location but the oyalitH tribe's traditional village site was located on the southern end of Hunter's Island during the early historic period. Further north, Peter Bates, a Tsimshian from Hartley Bay also told Drucker that *Dentalium* shell was collected on the beach, presumably in this case by the Tsimshian. Drucker (1950:273), however noted that the "both informants thought that dentalia were a variety of toredo [marine wood-boring worm], which washed ashore stuck in rocks and water-soaked logs". Drucker commented the information was probably in error but did not specify if he thought the information about the location was incorrect or if their identification of *Dentalium* shell was at issue.

On the Queen Charlotte Islands, two of Drucker's Haida informants, Andrew Brown of Massett on Graham Island and Henry Moody from the village of Skedans on Louise Island both stated that *Dentalium* shell was collected from the beaches. They went on to comment that the:

> Queen Charlotte Islands were an important center of distribution for dentalia, which washed up on certain beaches, especially on the west coast. In addition, the tastlanas ("sand village") chief is supposed to have owned a sand bank (up above tideline) in which the shells were quite plentiful, and he "mined" them there [Drucker 1950:273].

It was Drucker's (1965:151) opinion that beach collected shells did not play a major role in the Native trade in *Dentalium* as "the dull-surfaced drift shells" would have lacked the "luster of those taken alive" and therefore would have been less desirable as a trade item. It is interesting to note that Tolmie (1963:318) came to the opposite conclusion stating that the along the northwest Vancouver Island "the finest [shells] are washed up on shore by the sea".

SUMMARY

The historic and ethnographic literature contains numerous accounts of *Dentalium* procurement techniques. These can be classified into three categories: fishing with the use of some form of fishing implement, fishing using bait, and collection off the beach. Analysis of the literature pertaining to fishing implements indicates there were two related forms of the fishing spear; a board type of spear, originally described by Jewitt, and a broom type, described by Drucker and Curtis. A number of descriptions of the implement and the procurement methods would appear to be derived from earlier sources. Only the broom type of spear is represented in museum collections although the other type may exist unrecognized.

A replica of a fishing spear has been constructed and successfully tested. Based on Drucker's described method, the replica spear was modified to make it work more efficiently which indicates that the implement that Drucker described may not have worked, or worked very well. The replicated example did prove, however, to be effective.

A method of fishing for the shell with bait is widely reported along the northwest coast. The association of a hermit crab, *Orthopagurus minimus,* that inhabits discarded *Dentalium* shells lends credibility to the bait method being considered as a procurement technique.

Finally, beach collection of *Dentalium* seems to have been wide spread along the coast although opinion differs as to how much these sources actually contributed to the volume of shell in trade.

CHAPTER FIVE

DENTALIUM SOURCE LOCATIONS

Source locations for *Dentalium* shell have been recorded in numerous ethnographic and historic period documents and this chapter will review and discuss the literature that refer to these locations. The source locations will be discussed with reference to the Euroamerican involvement in *Dentalium* shell exchange during the late eighteenth and early nineteenth centuries, and in relation to information on Native American *Dentalium* procurement methods and technology. Source locations for the west coast of North America are outlined in Table 15 and are illustrated in Figure 16. Information on *Dentalium* source locations are found in three different types of documentary sources: (1) historical documents related to the fur trade, (2) historical documents associated with the European colonization of North America in the mid to late nineteenth century, and (3) ethnographic studies of indigenous peoples.

There are a number of references to areas where the *Dentalium* shell was procured in documents related to the fur trade on the west coast of North America. The acquisition of *Dentalium* shell by Euroamerican traders during the early to mid-nineteenth century was of commercial importance to the fur trade companies. The Hudson's Bay Company and the Russian-American Company were engaged in stiff competitive for furs in the interior of the Yukon and Alaska during the mid-nineteenth century and the native entrepreneurs they were dealing with were adamant in their desire to trade for *Dentalium* shells. Fur trade company employees stationed at the coastal forts were instructed to keep a look out for the shell and to purchase it when available In most cases, locations referred to in the fur trade journals contain references to villages or areas where the shell was acquired by employees of the fur trade companies, not the actual procurement location.

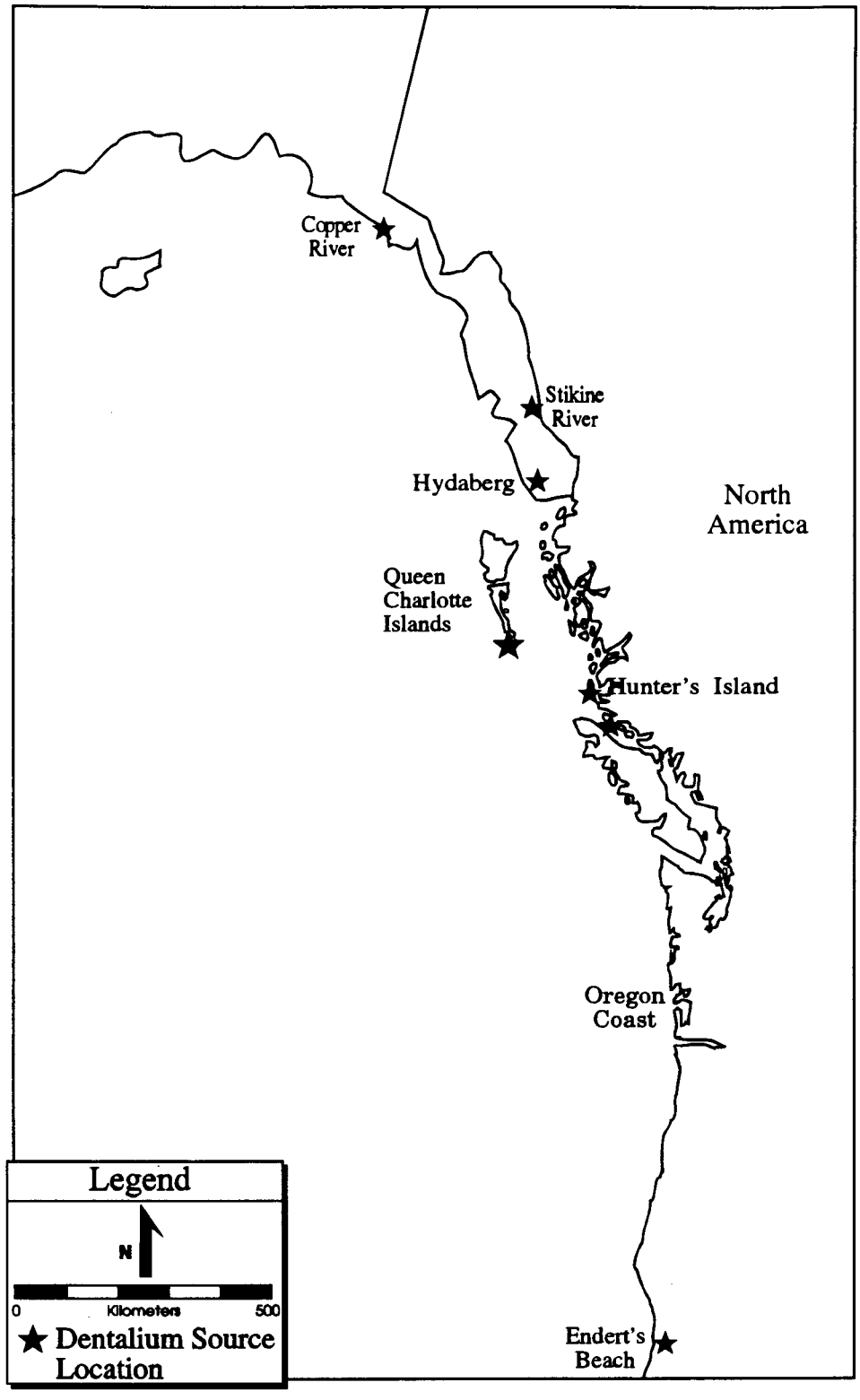

FIGURE 16: Location of identified *Dentalium* source locations along the west coast of North America excluding the west coast of Vancouver Island.

TABLE 15: Location of *Dentalium* procurement sources and the associated cultural group.

LOCATION			NAMED SITE	CULTURAL GROUP	TRIBE/BAND
Alaska		Copper River		Eyak	
		Stikine River		Tlingit	
		Hydaberg		Haida	
British Columbia	Mainland Coast	Hartley Bay		Tsimshian	
		Hunter Island		Bella Bella	
	Queen Charlotte Islands			Haida	
	Vancouver Island	Cape Scott		Kwakwaka'wakw	Nakomgilisala
		Cox Island	L_E'ml$_E$mxad e	Kwakwaka'wakw	Yutlinuk
		Quatsino Sound		Kwakwaka'wakw	
		Winter Harbour	a$_L$ade	Kwakwaka'wakw	Quatsino
		Forward Inlet	x.Ela'de	Kwakwaka'wakw	Quatsino
		Checleset Bay		Nuu-chah-nulth	Chickliset
		Nasparti Inlet		Nuu-chah-nulth	Chickliset
		Kyoquot Sound	Actis	Nuu-chah-nulth	Kyuquot
			Cahqos	Nuu-chah-nulth	Ehattesaht
		Nootka Island	Nuchatlitz	Nuu-chah-nulth	Nuchatlaht
		Nootka Sound		Nuu-chah-nulth	Mowachaht
		Hesquiat Harbour	mu7is	Nuu-chah-nulth	Hesquiaht
		Clayoquot Sound		Nuu-chah-nulth	Ahousaht-Manhousat-
		Flores Island	p'ats'aktl'a	Nuu-chah-nulth	Manhousat
		Flores Island	ch'ach'ap'iih	Nuu-chah-nulth	Manhousat
		Long Beach		Nuu-chah-nulth	Ucluelet
		Barkley Sound		Nuu-chah-nulth	Toquaht-Sheshaht-Ohiaht
Washington		Cape Flattery		Makah	
Oregon					
California		Crescent City		Tolowa	

A second type of historical writing that contains references to *Dentalium* source locations are historical travelogues, descriptions of western North America written by visitors to the area. These publications usually include observations of the native inhabitants of the "new" lands, describing what the writers considered unusual or noteworthy habits and customs. The use of *Dentalium* shell as an ornament and medium of exchange, and the location where it was procured, is frequently reported in these writings with reference to the exotic nature of such customs. Writers of these books often borrowed from earlier published accounts and in certain cases entire passages have been lifted verbatim (for example Dunn's 1844 account of bait fishing was copied word for word by Hazlitt in 1862).

Most of the ethnographic work on the northwest coast was conducted in the twentieth century between 100 to 200 hundred years after contact with Europeans. By the time trained ethnographers arrived, they were working with third or fourth generation descendants of people who had lived prior to cultural disruptions caused by contact, disease and government policy. Nevertheless, a number of *Dentalium* source locations are recorded in ethnographies written about groups inhabiting the northwest coast.

Documentary sources vary in the precision with which they describe the location of *Dentalium* procurement sites. *Dentalium* source locations are described in these documents either with reference to a general area or region, a restricted area or region, or a specific location.

References to general area or region tend to be reported in the historic travelogue writings, as well as in ethnographies when specific cultural groups are describing trade relations or the location from which certain objects were acquired. References of this type most often identify a rather large geographical area (such as the west coast of Vancouver Island, or the northern British Columbia Coast). These accounts are described and discussed but are only useful insofar as they serve as corroborative evidence to support the more specifically identified sites.

The identification of *Dentalium* procurement locations to a more restricted area or region tend to be the type of information that is contained in fur trade records and a small number of the travelogues. The writer identifies a location such as a village, sound or bay where the shell was obtained. Fur trade documents usually record trading incidents that identify a specific group or village location. Historical travelogues less frequently identify groups that use the shell, where they procure it from, and in some instances a description of the fishing method.

Documents that make reference to specific *Dentalium* procurement locations are not numerous and most identified sources have come from ethnographic studies. A number of *Dentalium* procurement sites have also been identified from geographical place names. These names either contain some reference to *Dentalium* procurement or in discussing the place name, informants have divulged information on *Dentalium* procurement that was associated with the site. Place name information would appear to be fairly conservative as several of the sites have been identified from information collected within the last twenty years.

The orthography of native place names for sites discussed in this chapter have not been standardized to any specific phonetic system (i.e. the International Phonetic Alphabet). The place names have been transcribed from the original using the character set and phonetic system that was used by the particular ethnographer who recorded the site.

There is not always agreement between historic sources on *Dentalium* fishing sites and the time at which the information was collected may have some bearing on this. Paul Kane (1925:165), who traveled in Washington state in the years between 1846 and 1848 recorded that the Makah fished for *Dentalium* at Cape Flattery, yet Swan (1857:158; 1868:31, 47), writing about the Makah only ten years after Kane's visit does not record *Dentalium* fishing for the Makah and notes that all their *Dentalium* was acquired further north. Swan (1857:158) does, however, record a description of fishing for the shell with

bait but does not identify the group to which this description is attributed. Similarly, Drucker (1951) records sources at Long Beach by Ucluelet and in Barkley Sound; Grant (1857) identifies Clayoquot Sound as a procurement location, while Newcombe, on the other hand, notes that *Dentalium* was not procured at either Clayoquot Sound or Barkley Sound (Newcombe n.d.). The discrepancies between these accounts can probably be attributed to the different informants from whom these authors obtained their information.

BRITISH COLUMBIA SOURCE LOCATIONS

Vancouver Island

The west coast of Vancouver Island is the area that has the greatest number of identified source locations, with most sites occurring within the territories of the Kwakwaka'wakw and the Nuu-chah-nulth (Figure 17). The historical and ethnographic literature consistently refer to the west coast of Vancouver Island as the source of the shell, some even stating that this was the only location where it was to be found.

George Simpson (1847:196), Governor-in-Chief of the Hudson's Bay Company, on a visit to the Company's western districts in the years 1841 to 1842 commented that the shell was "found only on the west side of Vancouver's Island". Walter Colquhoun Grant (1857:307), in an article describing Vancouver Island in 1857, observed that *Dentalium* were to be found in bays "along the north-west coast of the island". Ingersoll (1883:476), in an article on Aboriginal shell money noted that they were "gathered off the shores of Vancouver's...Island". Elmendorf (1960:212-218), discussing the trading contacts of the Twana, a Salish group living in Puget Sound in Washington, noted that the Twana believed that the shell originated "on the west coast of Vancouver Island".

There are several general references that specify that either the Kwakwaka'wakw or Nuu-chah-nulth were controlling the source locations for *Dentalium* shell. In his monograph on the Quinault Indians of the Olympic Peninsula in Washington, Olson

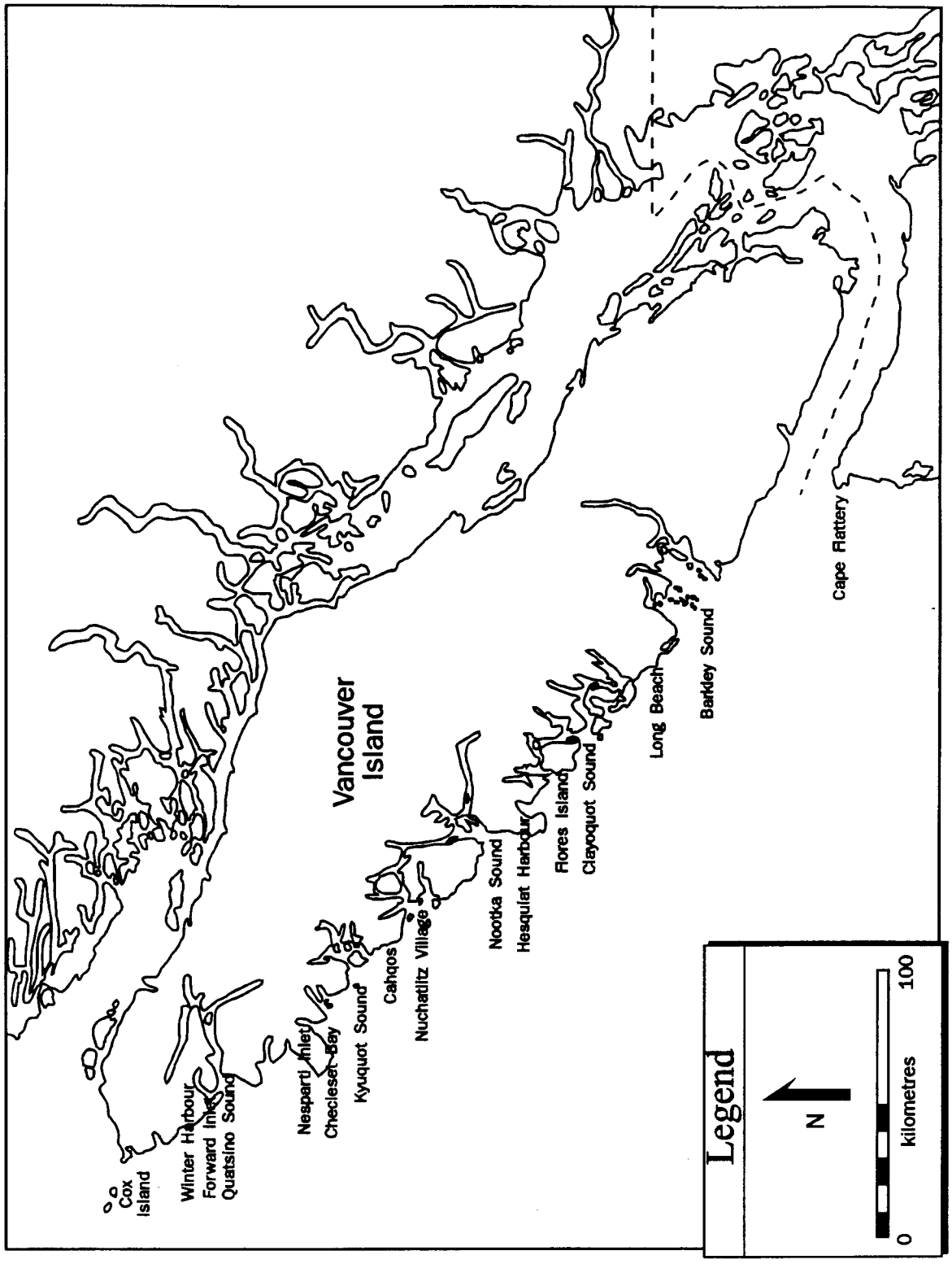

FIGURE 17: *Dentalium* source locations identified on the west coast of Vancouver Island and the Olympic Peninsula.

(1936:87) wrote that *Dentalium* shell was obtained by the Quinault "from the northern groups, especially Makah and Nootka". Pickering (1841:54) observed that the Hudson's Bay Company operation at Fort Rupert purchased "large quantities from the Koskeemo Indians, for the purpose of sending to San Francisco, from whence they are scattered by the American traders all through the interior". Lord (1866:20) noted that "the money shell, are procured upon the north end of Vancouver Island" and Swan (1868:47) also commented that the shell was procured "by barter with the Nootkan and other Indians of Vancouver Island".

William Tolmie, while posted at Fort McLoughlin in 1835, recorded demographic and statistical information about the native people in the region (1963:317). Tolmie documented the location of 29 villages in the area of Fort McLoughlin in the central coast and the area around Fort Rupert at the north end of Vancouver Island. He included in this information the village name, number of houses, and the name of the chief of the village, when known. He (1963:318) further stated that six of the villages (Table 16) on the north western shore of Vancouver's Island "fish the Hayaqua [*Dentalium*]". A map indicating the location of these village sites was not included in the published version of Tolmie's journal, nor did he give a written description of their exact location.

Cape Scott Area

Drucker's (1950:273) Koskimo informant Quatsino Sam reported that "Dentalia washed ashore and were picked up in the old tribal home of the Koskimo on Cape Scott". Robert Galois has identified two Koskimo village sites in the Cape Scott area (Figure 18), the village of Tsuwunhas at Shuttleworth Bight (1994:374) and the village of Kwanee at Experiment Bight (1994:371). It is probable that Quatsino Sam was referring to one of these two villages (Figure 18).

TABLE 16: The six villages identified by William Fraser Tolmie as those that fished for *Dentalium* shell (1963:317-318).

Village	Houses	Chief	Remarks
Nekumkilish	4 houses	Kaaleet	Nakumkilis (Dawson 1887), a'waxste' (Galois 1994:287)
Quatsenoch	15 houses	Munooguish	Quatsino, Forward Inlet or Winter Harbour
Kowskeemich	23 houses	Klaguageilah	Koskimo
Klashkalinoch	4 houses		
Tseeklisheeloch	10 houses	Tootanoosh	
Naspatte			Nesparti Inlet - Chickliset

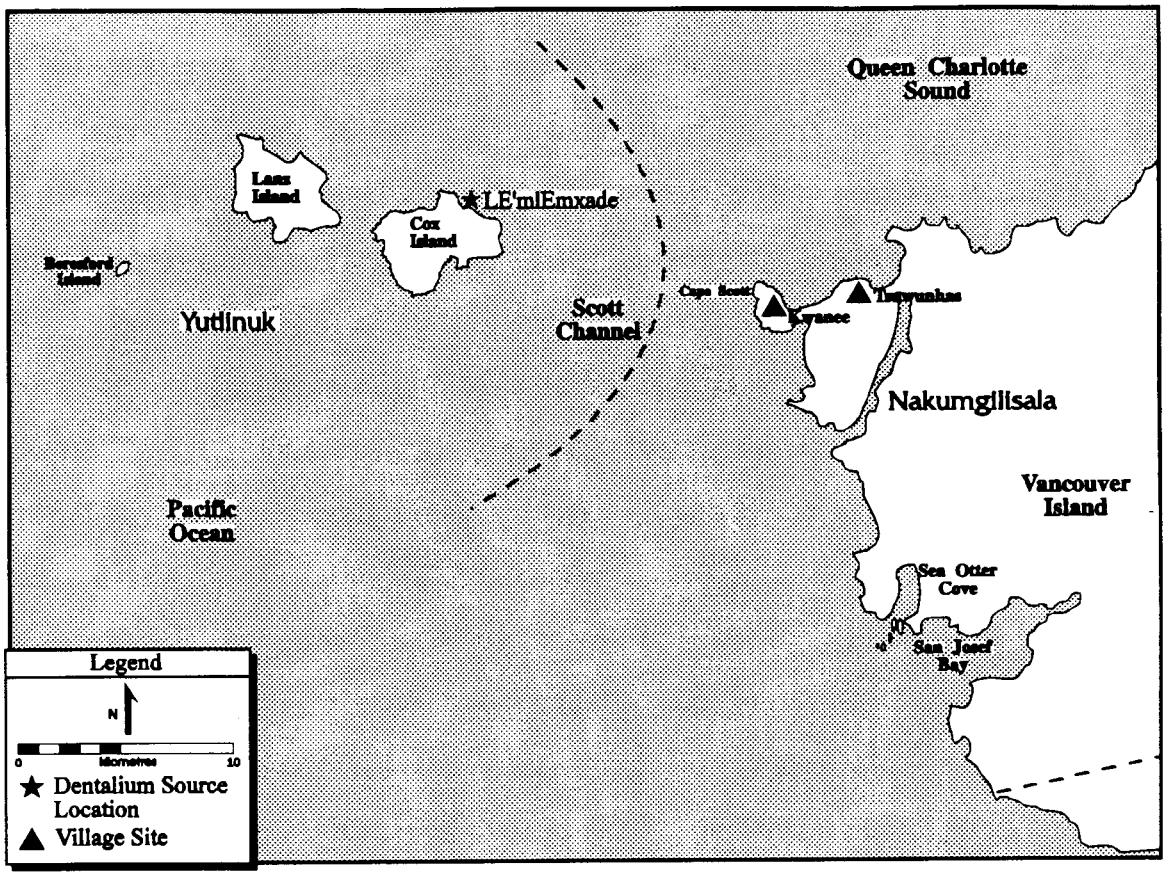

FIGURE 18: Cape Scott area on the north west side of Vancouver Island showing the location of the *Dentalium* fishing site of lE'mlEmxade on Cox Island and the village of Tsuwunhas and Kwanee around Cape Scott.

Cox Island

Cox Island is located in the Scott Archipelago, off Cape Scott at the northwest end of Vancouver Island. During the early historic period (circa 1775), Cox and Triangle Islands in the Scott Archipelago were the territory of the Yutlinuk, a tribe of the Kwakwa̲ka̲'wakw. Little is known of this tribe as the area was not extensively visited by Euroamericans during the maritime fur trade period; by the middle of the nineteenth century the Yutlinuk had joined with the Nakomgilisala, a Kwakwa̲ka̲'wakw tribe living on the northwest corner of Vancouver Island in the area of Cape Scott (Galois 1994:303).

Boas (1934:79, Map 1:33) recorded a place name on Cox Island, lE'mlEmxade`, which he translated as meaning "having beating of sides of canoe with paddle (in fishing dentalia)". This site is located off the northeast coast of the island in a small cove (Figure 18). The water at this location ranges between 1.8 m to 27.4 m in depth. While this place name does not explicitly state that *Dentalium* shells were procured at this location, the translation of the name does make reference to fishing for the shell. There is corroborative evidence from fur trade records that point to Cox Island as a source location for the shell. While anchored at Shushartie Bay in 1825, William McNeill of the Hudson's Bay Company, reported the arrival of six canoes "of the Newittee tribe, who informed me that they were living on one of the Scott Islands" (as cited in Galois 1994:303). They had brought skins and *Dentalium* shell to trade (Galois 1994:303).

Quatsino Sound

Quatsino Sam, Drucker's Koskimo informant, commented on two *Dentalium* fishing locations around Quatsino Sound. Drucker concluded:

> The data on dentalia fishing are not really Koskimo. The two dentalia grounds near Quatsino Sound belonged to the Klaskino, and the informant owns them in his place as Klaskino chief [1950:273].

Tolmie (1963:317-318) recorded a village which he called Quatsenoch that fished for *Dentalium* shell. Both sources probable refer to villages located next to the two named *Dentalium* fishing locations in the Winter Harbour/Forward Inlet area.

Forward Inlet

Forward Inlet, located off the north side of Quatsino Sound, was the territory of the Quatsino tribe from the mid-nineteenth century onward (Galois 1994:375-376). George Dawson was engaged in on geological survey of the northern end of Vancouver Island in 1885 and, as part of the survey, collected a series of marine sea bed samples from Forward Inlet and Winter Harbour. These samples were later analyzed by J.F. Whiteaves. At Station 20, in Forward Inlet, a sample collected in 10 to 20 fathoms of water on a mud bottom contained an abundance of a scaphopod mollusc classified by Whiteaves (1886:112, 124) as *Cadulus aberrans*. He went on to state that:

> This little shell, which is nevertheless of large size for the genus, looks not unlike an immature Dentalium, and, at first sight, specimens of it might be easily mistaken for half-grown examples of *D. pretiosum*, Nuttall, which the Indians say occurs at the same locality [1886:124].

Whiteaves, unfortunately, does not provide a location for Station 20 within Forward Inlet.

Boas (1934:77, Map 4:Location 8) recorded a place name in Forward Inlet, x·Ela'de`, which he translated as meaning "having dentalia fishing, or having drying". x·Ela'de` is located on the east side of Forward Inlet approximately 1.5 km north of Montgomery Point (Figure 19). The area identified by Boas is a small cove fronted by extensive intertidal reefs. The water in this area ranges between .6 m to 16.8 m in depth on modern hydrographic charts. The site of x·Ela'de` is located near the Quatsino village of Owiyekumi (Galois 1994:378) which Dawson (1878:68) noted was near an important *Dentalium* fishing location.

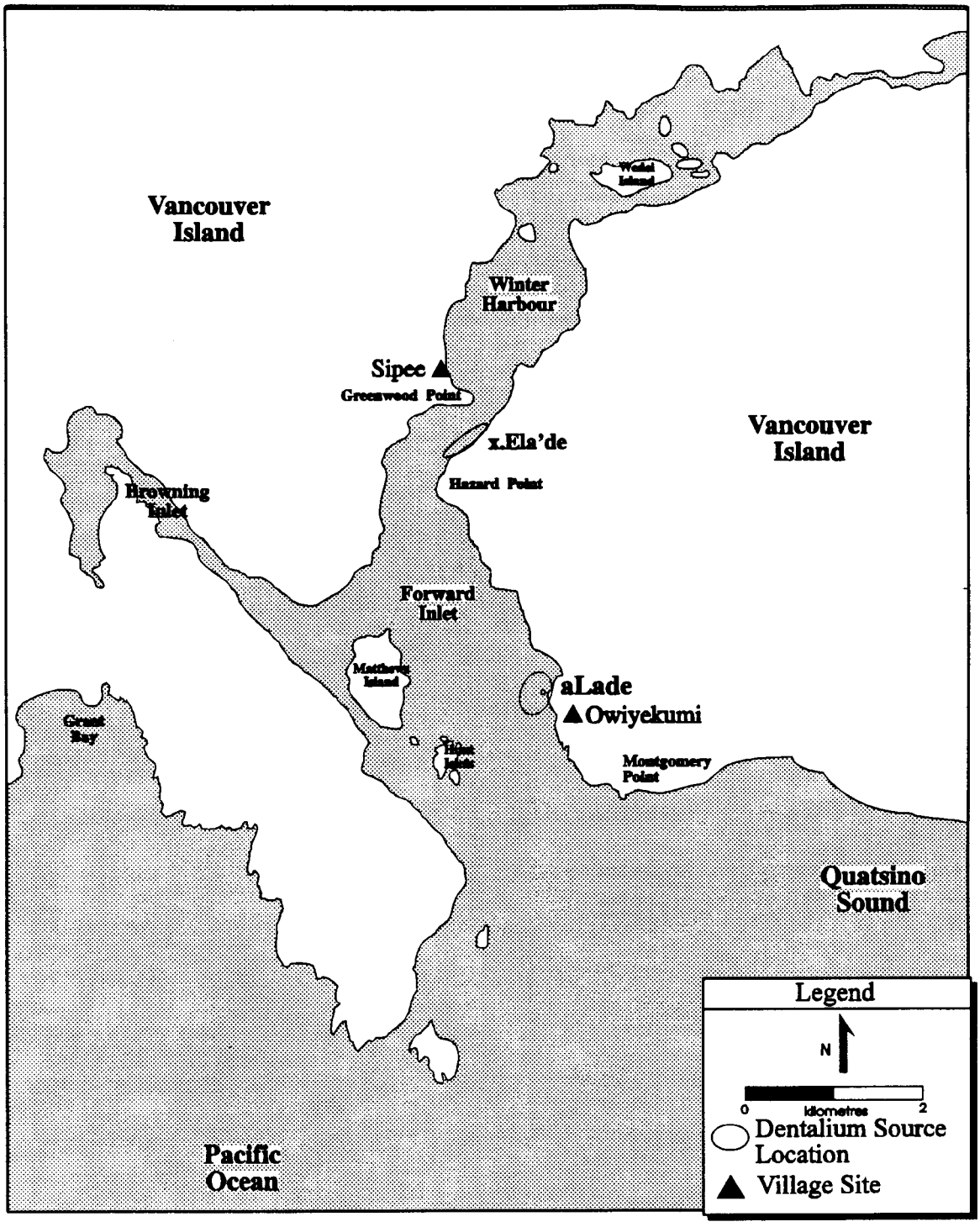

FIGURE 19: Location of the *Dentalium* fishing sites of x.Ela'de in Forward Inlet and aLade in Winter Harbour.

Winter Harbour

Curtis (1915:44-45) recorded that *Dentalium* shell were fished by the inhabitants of the village at Winter Harbour and provided a detailed description of the fishing implement and its method of used. His description of the fishing implement differs in some details from one described by Tolmie in 1835 from the same area. Curtis did not provide a specific location where the shell was procured.

Boas (1934:39, Map 4/Location 6b) reported a place name in Winter Harbour called aʟade`, translated as "having dentalia". The site of aʟade` is located approximately .5 km northwest of Hazard Point on the south side of the passage that lies between Forward Inlet and Winter Harbour (Figure 19). Modern hydrographic charts show a muddy foreshore with water depths that range between 1.5 m and 15.2 m at this location.

Checleset Bay and Nasparti Inlet

The area around Checleset Bay and Nasparti Inlet, located just south of the prominent west coast landmark of Cape Cook, was the territory of the Chickliset, a Nuu-chah-nulth people. There are a few references to this area being a source location for *Dentalium* shell, but none identify a specific fishing or collecting locale. Newcombe's collection notes for the *Dentalium* fishing spear collected at Kyuquot indicated that *Dentalium* were found in the area of the Tchihucklesit [Chickliset] north of Kyuquot, near Cape Cook (Newcombe n.d.). Alexander Henry (1897:753), who was stationed at Fort Astoria in the years 1813 to 1814, stated that the shell was "gathered northward, somewhere about Woody Point [Cape Cook], N. of Nootka, in the sand, at low water".

Tolmie (1963:318) identified a village called "Naspatti" as one of six villages on the northwest coast of Vancouver Island that collected *Dentalium*. Since there is no village name recorded for the area, he would appear to be referring to the people that lived in the area of Nesparti Inlet. Jewitt recorded a visit on September 23, 1804 by the

TABLE 17: Origin of the *Dentalium* brought into Mowachaht territory as recorded in Jewitt's (1807) *Journal*.

Year	Date	Origin	Description of the Transaction
1803	October 31	Nuchatlaht	Canoe arrives at Tahsis from the village of Newchadkate with *Dentalium* for Maquinna (p. 11)
	November 15	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 12)
	November 19	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 12)
	November 20	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 12)
1804	January 29	Ehattesaht	Canoe arrives at Kupti from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 16)
	March 17	Ehattesaht	Canoe arrives at Yuquot from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 18)
	September 16	Ehattesaht	Maquinna goes from Tahsis to the Ai-ti-zarts to buy *Dentalium* (p. 30)
	September 21	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 31)
	September 23	Chickliset	Canoe arrives at Tahsis from the Cheach-clitz-arts with *Dentalium* (p. 31)
	September 27	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 31)
	October 21	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 32)
	December 4	Ehattesaht	Canoe arrives at Tahsis from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 34)
	December 27	Hesquiaht?	Jewitt accompanies Maquinna on a trip from Kupti, 20 miles south to buy *Dentalium* with European trade goods (p. 36)
	December 29	Ehattesaht	Canoe arrives at Kupti from the Ai-ti-zarts with *Dentalium* (p. 36)
1805	January 18	Ehattesaht	Canoe arrives at Kupti from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 37)
	March 7	Ehattesaht	Canoe arrives at Yuquot from the Ai-ti-zarts with *Dentalium* (p. 39)
	April 9	Ehattesaht	Canoe arrives at Yuquot from the Ai-ti-zarts with *Dentalium* for Maquinna (p. 41)
	July 10	Nuchatlaht	Canoe arrives at Yuquot from the Newchadkates with *Dentalium* for Maquinna (p. 46)

Group	Number of Transactions
Chickliset	1
Ehattesaht	14
Hesquiaht?	1
Nuchatlaht	2
Total	18

"Cheach-clitz-arts" [Chickliset] (Table 17), who arrived at the village of Tahsis with *Dentalium* shell while Maquinna was relocated there for the fall salmon harvest.

Kyuquot Sound

Newcombe collected a *Dentalium* fishing spear at Kyuquot in 1903. His field notes, recorded when he collected the specimen, indicate that *Dentalium* fishing occurred in the Kyuquot Sound area but he did not note a specific location (Newcombe n.d.).

Susan Kenyon (1980) conducted ethnographic field work among the Kyuquot in the summers of 1972 and 1974. In a section discussing traditional crafts still performed among the Kyuquot, Kenyon observed that shell work was less common but was still performed by a number of the older women. The shells used in the crafts were abundant and collected around Actis Island. Kenyon (1980:83) found that *Dentalium* shells were not currently used for any decorative or ornamental purposes by the Kyuquot people but that "the shell worker...has a collection of these which she found on the outer beaches of Actis".

Actis Island is part of the Mission Island Group, which is composed of five major islands and numerous smaller islets all located within an extensive reef system (Figure 20). The village of Actis is located on the east coast of the Island and served, historically, as the summer village for all groups within the Kyuquot Confederacy. The Mission Islands are surrounded by relatively shallow waters within the offshore reef system and the waters around Actis ranges in depth from 1.4 m to 7.6 m.

Drucker (1951:111, 223, 226, 256) has stated that one of the main sources for *Dentalium* shell is from the site of cahqos. This was located within the territory of the Ehattesaht although individual chiefs from three adjacent groups also owned rights to use the grounds. Mills (1955:77), who conducted field work in Nootka Sound 20 years after Drucker also was informed about the "presence of dentalia beds in the waters fronting

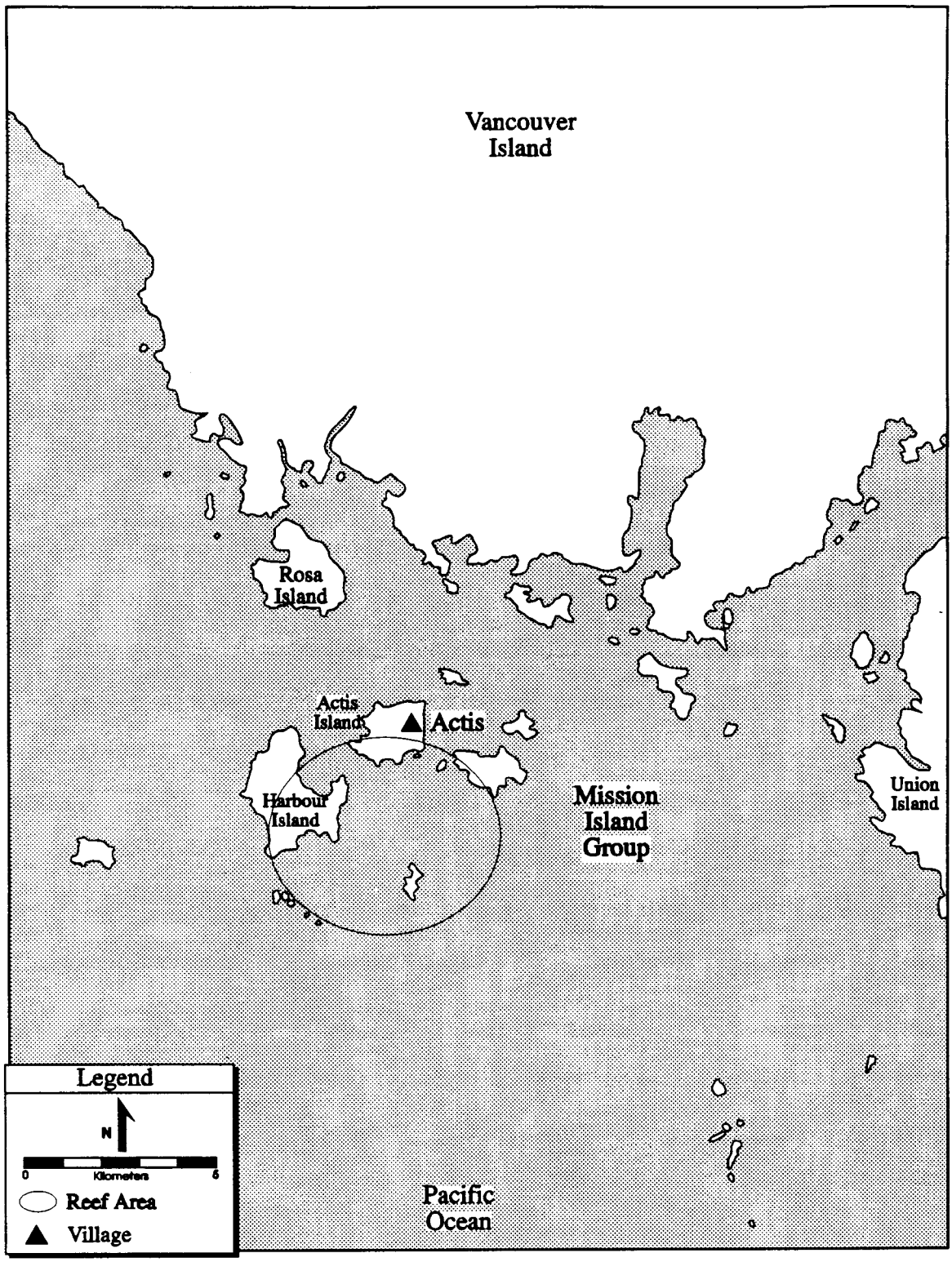

FIGURE 20: Kyuquot Sound area with the location of the island an and summer village site of Actis. Dentalium shell is recorded on the west facing beach.

Ehetisat territory". Drucker describes the location of the fishing grounds and hereditary rights to the site as follows:

> Chiefs of the four tribes, Nuchatlet, Ehetisat, Kyuquot, and Chickliset shared the right to fish dentalia at the dentalia grounds off Tachu Point. They camped at a place called cahqos where they had places for temporary houses. The olaktciath chief (Nuchatlet) was the head owner. Not all the chiefs had rights there. Of the Kyuquot, for instance, only the hopsitasath, qwcwinasath, tacisath, and qaqcilath chiefs could send men out to "fish" for the shells [1951:256].

It is interesting to note that Drucker's written description (page 256) does not correspond to the information contained on his map (page 226). On the map, he places the location of the fishing grounds some distance north of Tachu Point in an area bounded by Rugged Point to the north and Mushroom Point to the south, in an area with an outer chain of small islets and reefs with a protected centre passage [Clear Passage] (Figure 21). The fishing grounds are identified as cahqos and he records three unnamed campsites that are associated with the *Dentalium* fishery. Two of the camps are located on the mainland, one just south of Rugged Point in a small southerly facing bay, and one in a small northerly facing bay just north of Kapoose Point. The third camp is located on Grassy Island, a small islet located in the island/reef complex that lies in front of the site of cahqos to the west. Modern hydrographic charts indicate depth of water in central channel area ranges from a minimum of .9 m to a maximum of 33 m, the shallow areas around the outer islets ranges between 5 m and 9 m.

The importance of cahqos as a source for *Dentalium* shell is emphasized in Jewitt's *Journal* where, over his three year period of captivity, he recorded 14 transactions involving *Dentalium* shell between the "Aitizzarts" [Ehattesaht] and the Mowachaht chief Maquinna (Table 17). In 13 of the entries, Jewitt reported that the Ehattesaht arrived by canoe at either the villages of Tahsis, Kupti, and Yuquot with *Dentalium* shell for Maquinna. In one instance, Maquinna traveled from the village of Tahsis to Ehattesaht territory to purchase the shell.

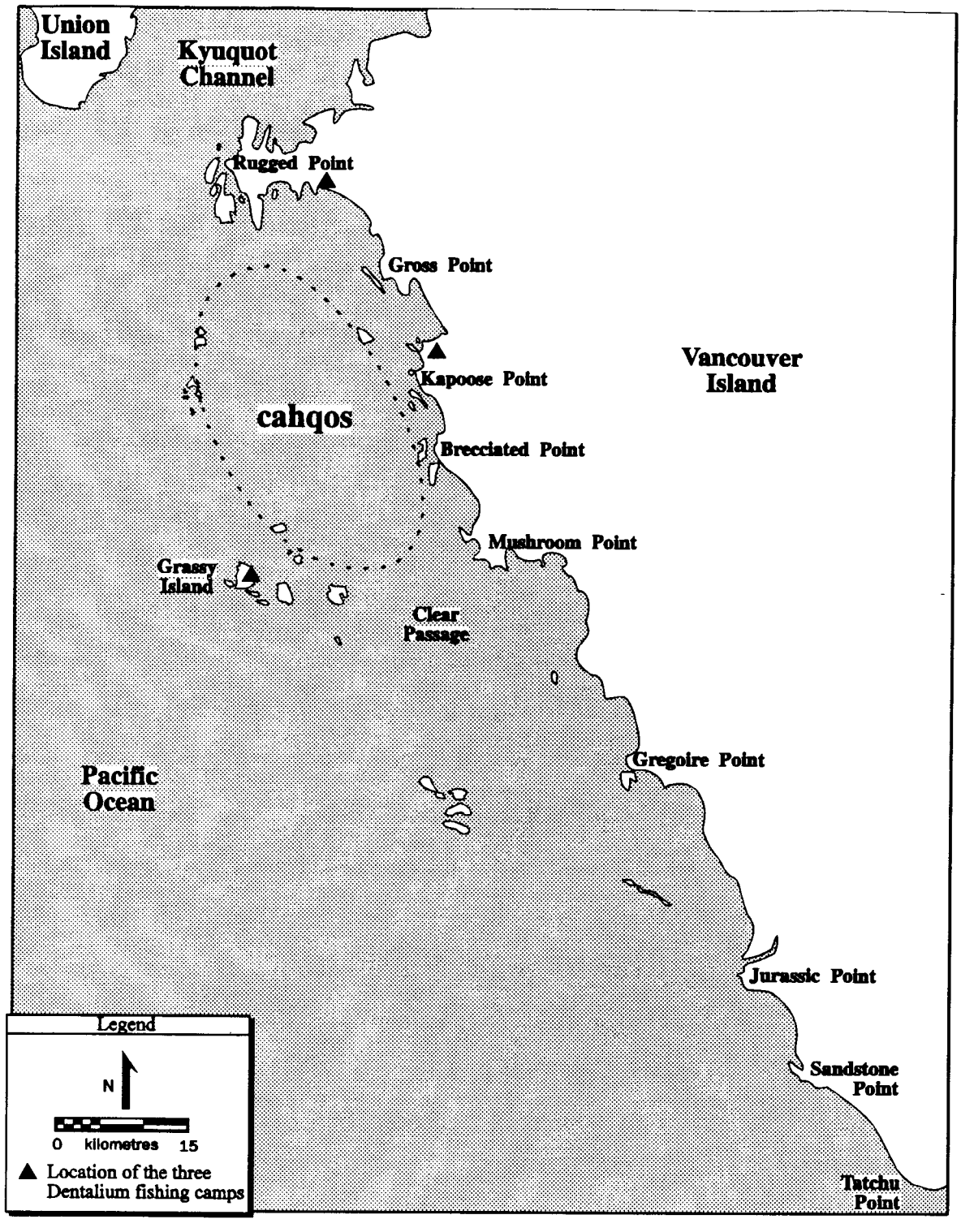

FIGURE 21: The Ehattesaht site of cahqos. The three camp sites, identified by Drucker associated with the *Dentalium* fishery at cahqos are indicated on the map.

Nootka Island

The north end of Nootka Island is within the territory of the Nuchatlaht and the modern village of Nuchatlitz is situated on Nuchatlitz Island which is located off Esperanza Inlet in a sheltered lagoon with an extensive offshore reef and island system (Figure 22). Kenyon (1980:42) noted that the main *Dentalium* beds were located "on Tachu Point", but when visiting Nuchatlitz in 1974, she was "shown a spot near the modern village where they are still found". Jewitt (1807:11, 46) recorded two visits from the village of Newchadkate (Table 17), one while at Tahsis on October 31, 1803 and the other while at Yuquot on July 10 1805, when canoes arrived bringing *Dentalium* shell for Maquinna.

Nootka Sound

Nootka Sound, located between Nootka Island and the Escalante Coast on Vancouver Island, was the territory of the Mowachaht people. In 1844, Dunn (1844:134) described a method of fishing for *Dentalium* shell with bait, and specified that this was practiced in Nootka Sound as well as at other locations along the coast of Vancouver Island. Hazlitt (1862:49) also noted that *Dentalium* shells were procured by bait fishing in the Nootka Sound area but it is obvious from his description that it was quoted verbatim from Dunn's earlier reference. Ross Cox (1832), traveling among the Flathead Indians in 1814, recorded that the *Dentalium* shell in use among this group were procured, originally, "in the neighbourhood of Nootka". Cox does not specify, however, if he is referring to Nootka Sound or rather to the territory of the Nuu-chah-nulth people along the west coast of Vancouver Island.

John Jewitt was captive among the Mowachaht for three years but did not report seeing them ever fishing for the shell themselves. Jewitt was familiar with the fishing implement and its use, having described it in his *Narrative* (1815:75-76); in his *Journal*, he further recorded 18 occasions when *Dentalium* shell was brought into the villages where

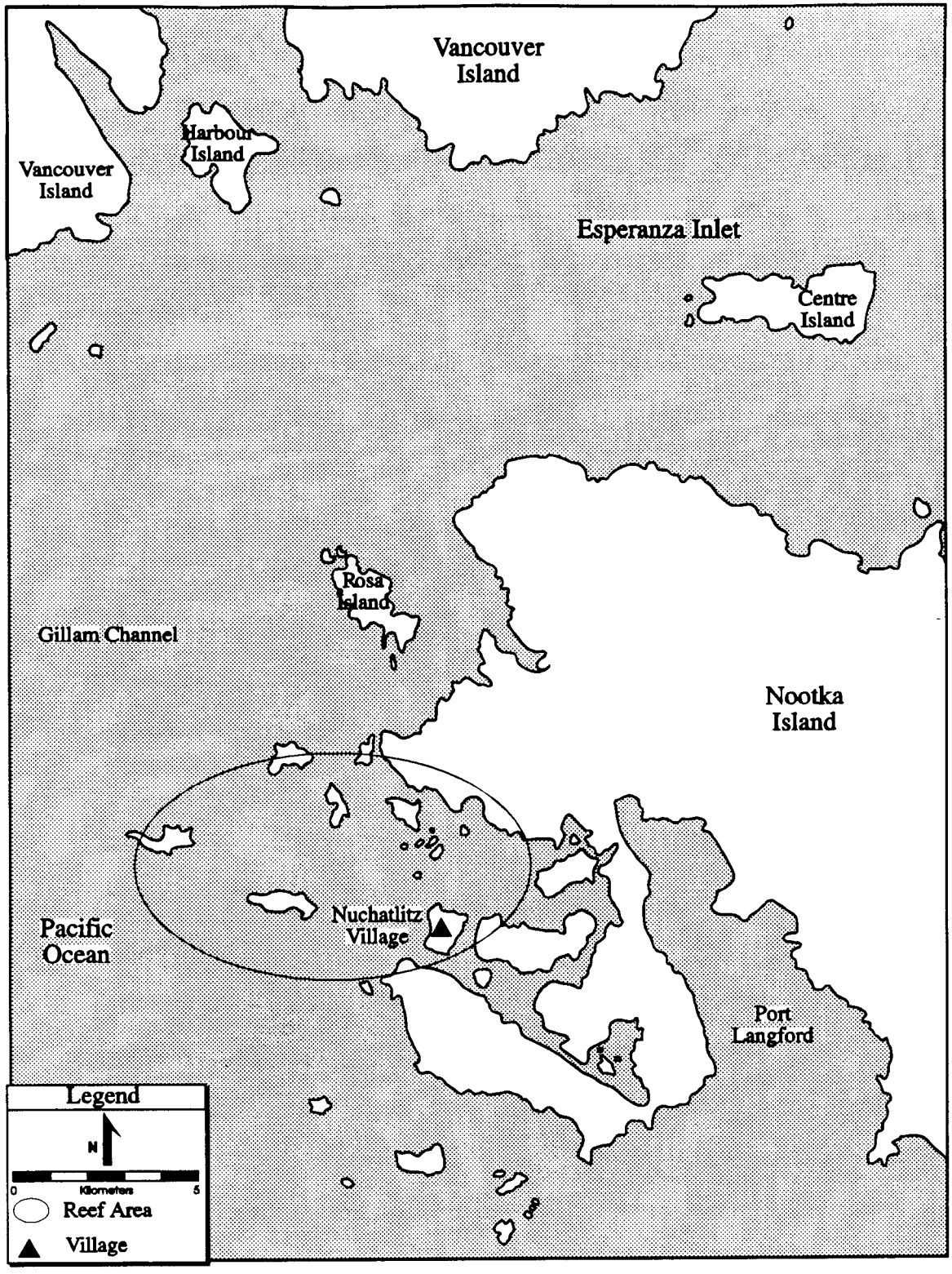

FIGURE 22: The village of Nuchatlitz located on the northwest side of Nootka Island.

he was staying (Table 17). Jewitt was also familiar with the use of the shell in ceremonial contexts, as he described on one occasion, the funeral of Chief Maquinna's sister's son where "eighty fathoms of ifraw [*Dentalium* shell]" (1807:19) were buried with the boy, and on another occasion, the marriage of Maquinna's niece to the Chief of an unspecified group where "twenty fathoms of ifraw" (1807:45) were presented to Maquinna as part of the marriage ceremony.

In 1914, Newcombe collected a *Dentalium* fishing spear for the British Columbia Provincial Museum in the Nootka Sound area. Newcombe did not indicate whether the spear was in use at Nootka Sound or not.

While engaged in archaeological survey work in Nootka Sound in the summer of 1990 and 1991, I collected whole and fragmented *Dentalium* shells off the beach facing the village of Yuquot. These shells may have eroded out of the midden facing the beach but their presence might also indicate the location of *Dentalium* shell beds off shore. During the winter months, the west coast of Vancouver Island experiences quite severe winter storms. At Yuquot, the beach can be extensively remodeled after one of these storms, and material off the sea bed in front of the site is often cast up on shore, possibly providing a chance source for the procurement of the shell.

Hesquiat Harbour

Bouchard and Kennedy (1990: 64) recorded a Hesquiat place name, mu7is, which is translated as "burned beach" and refers to a beach located on the north side of Hesquiat Harbour at apkwuu7is point just south of Antons Spit (Figure 23). Alice Paul, a Hesquiaht elder, identified Antons Spit as a location where dentalia were gathered. Depth of the water at this location varies from 3 m to 4.6 m on modern hydrographic charts.

There is corroborating evidence from John Jewitt's journal that Hesquiat Harbour may have been a source location for *Dentalium* shell. Jewitt (1807:36) recorded in his *Journal* that on December 27, 1804, while wintering at the village of Kupti, he

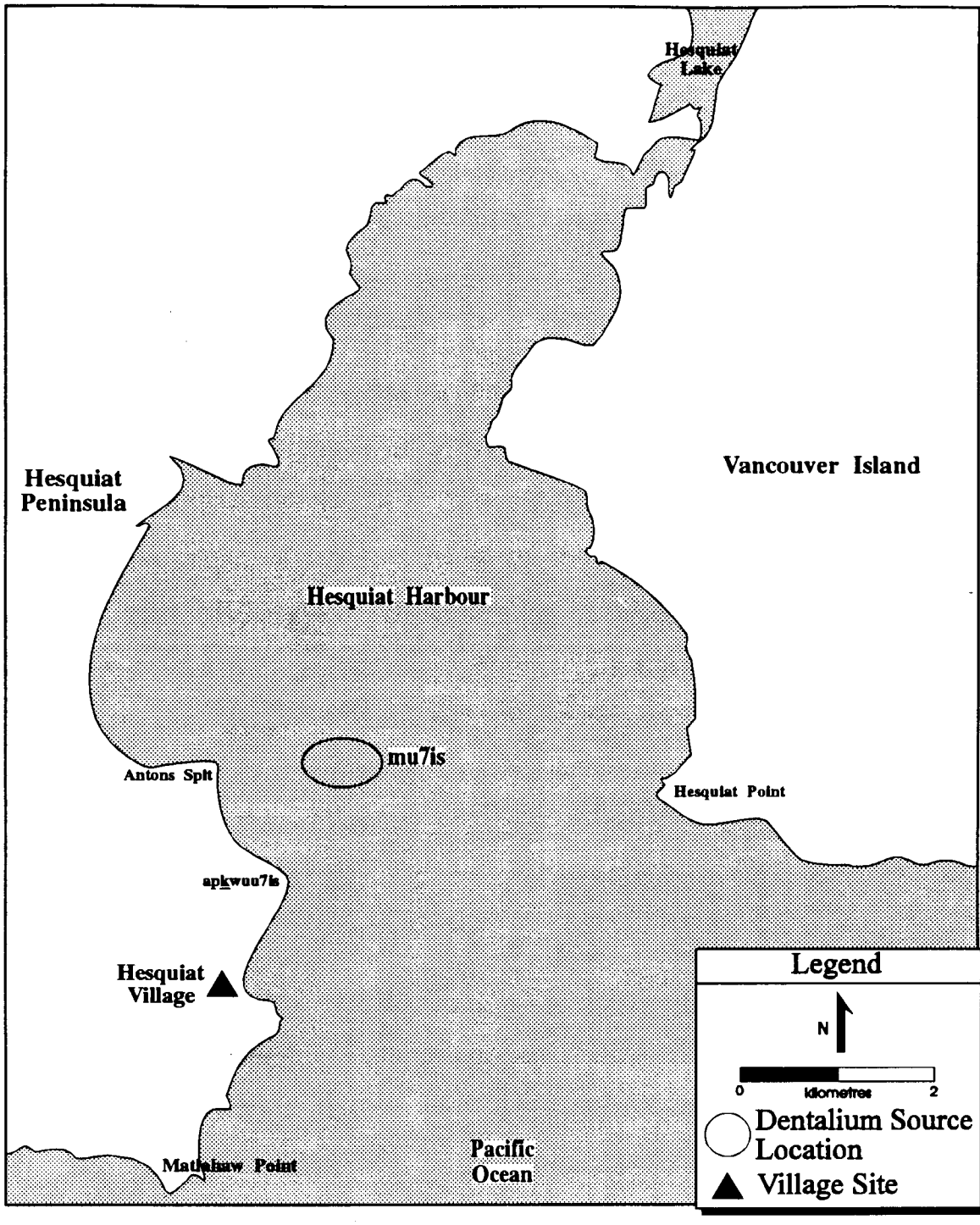

FIGURE 23: Hesquiaht site of mu7is, located in Hesquiat Harbour on the west coast of Vancouver Island.

accompanied Maquinna on a trip "about twenty miles down the sound, to buy ifraw [*Dentalium*], with cloth, powder, muskets, &c.". A journey from the village of Kupti down the sound would indicate a southerly route along the Escalante coast and past Estevan Point. If Jewitt's estimate of 20 miles is correct, this would place their destination in the territory of the Hesquiaht, specifically, Hesquiat Harbour where the village of Hesquiat and the fishing site of mu7is are located.

Clayoquot Sound

Clayoquot Sound falls within the territory of four different Nuu-chah-nulth groups, the Ahousaht, the Manhousaht, the Tla-o-qui-aht and the Otsosaht. Walter Grant (1857:307), in an article describing Vancouver Island, recorded that *Dentalium* were "found in the harbour of Clayoquot Sound and also in other bays along the north-west coast of the island". Jewitt identified Clayoquot Sound as a source area, noting in his *Narrative* that the shell was "brought in considerable quantity from the south" (1815:75) and that the Clayoquot Sound area, along with the Ehattesaht area, is where "the best I-whaw [*Dentalium* shell] and the greatest quantities was obtained" (1815:95). Two specific *Dentalium* fishing locations have been identified by Bouchard and Kennedy (1990) on Flores Island the traditional territory of the Manhousaht tribe.

Flores Island

Place name information and *Dentalium* source locations for Flores Island were given to Bouchard and Kennedy by George Louie, who is of Manhousaht and Ahousaht ancestry and James Swan Sr., who is of Manhousaht descent, when they worked on a study on Clayoquot Sound Indian land use and geographical place names.

The site of p'ats'aktl'a is located in a small bay located southeast of an island named tl'akakamilh (Figure 24). The name is derive from the word p'atsmis-`foam', and is called as such "because of the foam generated by the constant breaking of the surf here" (Bouchard and Kennedy 1990:213). George Louie stated that "dentalia shell used to be

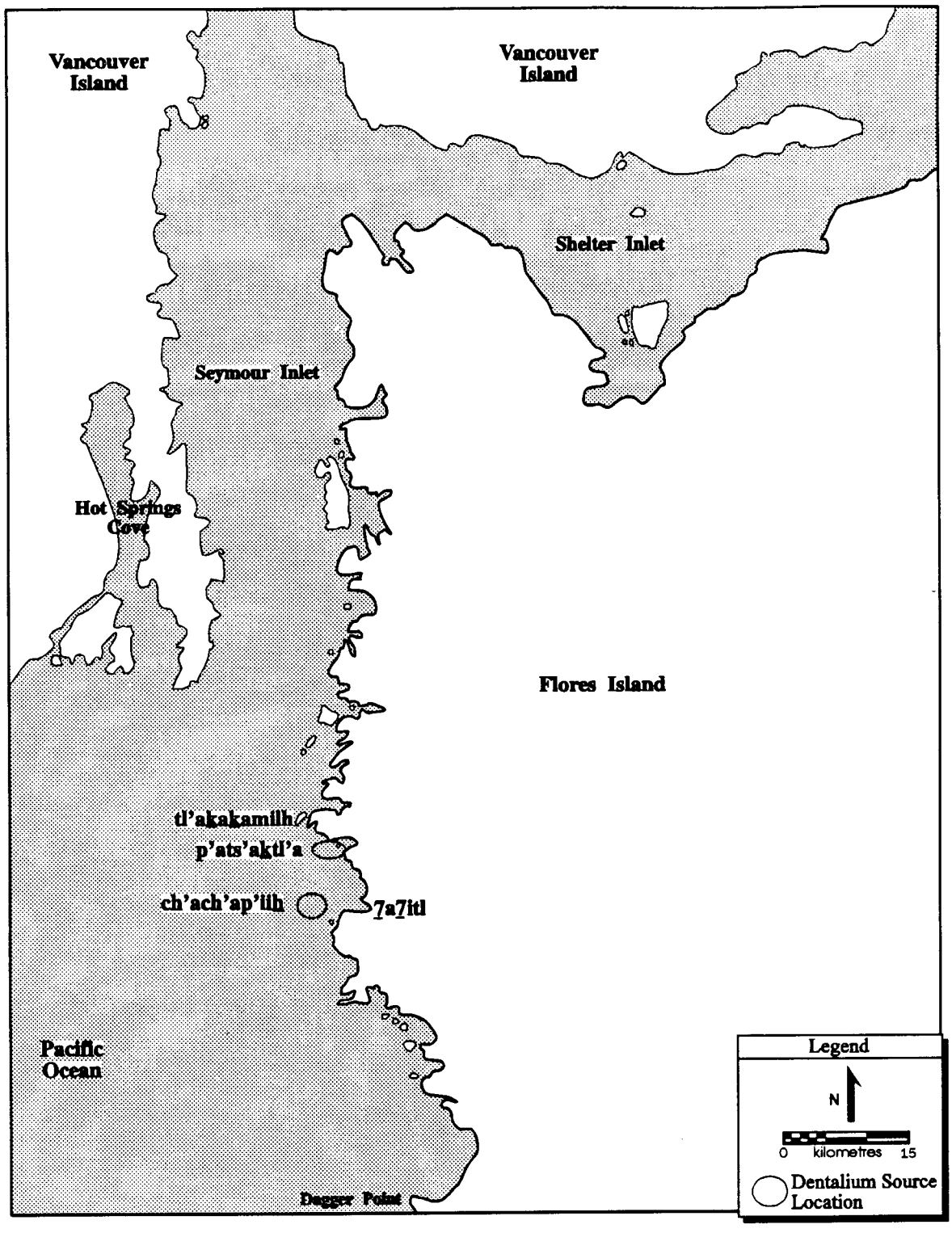

FIGURE 24: The Manhousaht *Dentalium* fishing sites of p'ats'aktl'a and ch'ach'ap'iih, located on the northwest side of Flores Island in Clayoquot Sound.

obtained here using a special device fixed to the end of a long pole" and noted that "this had not been done here since his grandparent's time" (Bouchard and Kennedy 1990:213-214). James Swan had also reported that *Dentalium* shell was gathered at this site (Bouchard and Kennedy 1990:213). Modern hydrographic charts show that the water in this area varies from 1.4 m to 7.3 m in depth.

George Louie and James Swan applied the name ch'ach'ap'iih to a reef not too far offshore from ʔaʔitl, a bluff on the west coast of Flores Island (Figure 24). The meaning of ch'ach'ap'iih refers to the manner in which the waves break (Bouchard and Kennedy 1990:214). George Louie stated that "because of this, several canoes have been lost here" and went on to note that "dentalia shells used to be obtained in the vicinity of this reef" (Bouchard and Kennedy 1990:214). Modern hydrographic charts water depth in this location varies from 4 m to 8.2 m.

The identification of two *Dentalium* fishing location in Manhousaht territory conflicts with statements made by Luke Swan in *Teachings of the Tides*, a monograph on Manhousaht food procurement and use. In this publication Swan stated that *Dentalium* shell "were not found within the territory of the Manhousat people" (Ellis and Swan 1981:73). Swan also stated that *Dentalium* shells were washed ashore at locations all along the west coast of Vancouver Island and that the "local dentalia were said to be characteristically small" (Ellis and Swan 1981:73). Bouchard and Kennedy (1990:13) noted in the Clayoquot Sound study, however, that where there are disagreements between the Clayoquot Sound place name study and information in the Ellis and Swan publication, the Clayoquot study should take precedence, as it had been more extensively cross-checked and corroborated.

Long Beach

Long Beach, located on the outside coast of Vancouver Island just south of Clayoquot Sound, was within the territory of the Ucluelet people. At Long Beach,

Drucker (1951:112) observed that *Dentalium* shell were washed ashore on the beach where they were presumably collected by hand.

Barkley Sound

Barkley Sound, located immediately south of Long Beach, was within the territory of four Nuu-chah-nulth groups; the Ucluelet, the Toquaht, The Sheshaht and the Ohiaht. Drucker (1951:111-112) stated that there was a reported *Dentalium* fishing ground in Barkley Sound, although he was not able to identify a specific location. Mills (1955:77) also noted that "another dentalia bed in Barkley Sound was mentioned by Moachat informants, and if one were so located it would explain the dentalia trade of the Clayoquot and locate the southern center of distribution mentioned by Jewitt". It is not clear from Mills comments if he is referring to informants that he talked to during his field work or if he is referring to the information given by Drucker's informants. Recent place name work in the Barkley Sound area done by St. Claire has not identified a specific location for a *Dentalium* fishing site although he noted that many of the Toquaht elders that may have had information on those locations had passed away within the last 10 to 15 years (1994:per comm.).

East Coast of Vancouver Island

Alexander Anderson (1868) has stated that "they are procured chiefly, if not entirely from the Strait between V.[Vancouver] Island and the Mainland, the natives fishing for them in deep water with baits to which the inmates of the shells adhere". He goes on to say that:

> the demand for these shells extends over a very large tract of country, for some years ago I noticed that my brother, the late Chief Factor James Anderson, of the H.B.C., when in charge of the Mackenzie's River wrote to the Columbia for a supply for the purposes of that remote District, the natives not being able to procure a sufficing for their wants by intermediate barter [Anderson 1868].

Anderson does note cite a specific site for *Dentalium* fishing although it appears that he is referring to the northeast end of Vancouver Island near Fort Rupert. His observations are intriguing as it is one of the few reported fish locations for the shell that have been identified as occurring in inside waters between Vancouver Island and the mainland British Columbia coast.

Queen Charlotte Islands

Ferdinand Wrangell during his term as Governor of Russia America between 1829 and 1835 made detailed observations on the inhabitants of Alaska which were published in St. Petersburg in 1839. In a chapter discussing contact and interaction between different cultural groups in Russian America territories and other groups along the northwest coast, he commented that:

> there are many shellfish of the *Dentalium* species in the neighbourhood of the Queen Charlotte Islands, which are used for ornament by all the coastal natives. All these articles were transported by these peoples and became the subject of a continuous and lively trade, so that before the arrival of Europeans, when iron was still unknown, the Queen Charlotte Islanders made their axes from copper which they received from the Copper River and the Kuskokvim tribe wore dentalium ornaments which had been collected in the Queen Charlotte Islands [Wrangell 1980:32].

Lieutenant Lavrenti Zagoskin, a Russian naval officer who conducted survey work in the interior of Alaska between the years 1842 and 1844 also singled out the Queen Charlotte Islands as a major source of the shell. In a glossary of special terms that he appended to published descriptions of his travels, he included an entry on tsukli, the Russian term for *Dentalium* shell. He noted that the shell was:

> A popular trade commodity along the coast, these were a favorite decoration among Alaskan natives who wore them in their ears and noses. These shells were obtain from the sea bottom at the Queen Charlotte Islands, and from there were distributed throughout the territory. Russian bought them from the Indians at Novoarkhangelsk [New Archangel] for trade with the northern tribes, Eskimos and Athabascans [Zagoskin 1967:332].

Krause (1956:137) made a similar observation when discussing the Tlingit trade networks noting that *Dentalium* shell came "from the south, principally from the Queen Charlotte Islands". He also made reference to the Russian trade noting that they obtained it "in the market at Sitka thirty rubles for one hundred pieces".

Lord (1866:20) and Ingersoll (1883:476) both reported that the shell was gathered off the shores of the Queen Charlotte Islands by the Haida and Drucker (1951:112) noted that the Haida "claim to have found dentalia occasionally washed up on the beaches". In *Robes of Power*, Flossie Lambly, a Haida Elder, stated that *Dentalium* shell could be found in certain places at low tide, although it was scarce (Jenson and Sargent 1986:56).

Drucker (1950:273) was informed by two of his Haida informants, Andrew Brown from Massett and Henry Moody from Skedans, that the shells were collected off the beach in the Queen Charlotte Islands. Both stated that:

> The Queen Charlotte Islands were an important center of distribution for dentalia, which washed up on certain beaches, especially on the west coast. In addition, the tastlanas ("sand village") chief is supposed to have owned a sand bank (up above tideline) in which the shells were quite plentiful, and he "mined" them there (1950:273).

Swanton (1905:268, 282-283) identified a Raven clan family named Ta'jdi la'nas ("sand-town-people") who had three houses at the village of Ninstints, on Anthony Island located in the island archipelago at the southern tip of the Queen Charlotte Islands. The named village that this family originated from was called Qai'dju lnaga'-i ("songs-of-victory-town) (Swanton 1905:277) which is located south of Anthony Island on the west coast of Kunghit Island (Figure 25). It is probably the village of Qai'dju lnaga'-i that Brown and Dixon are referring to as "sand village".

Mainland Coast

The mainland coast of British Columbia is occasionally cited as a source of *Dentalium* shell although the claims for this area are not well corroborated and the locations are usually not specific. Lord (1866:20), stated that in addition to Vancouver

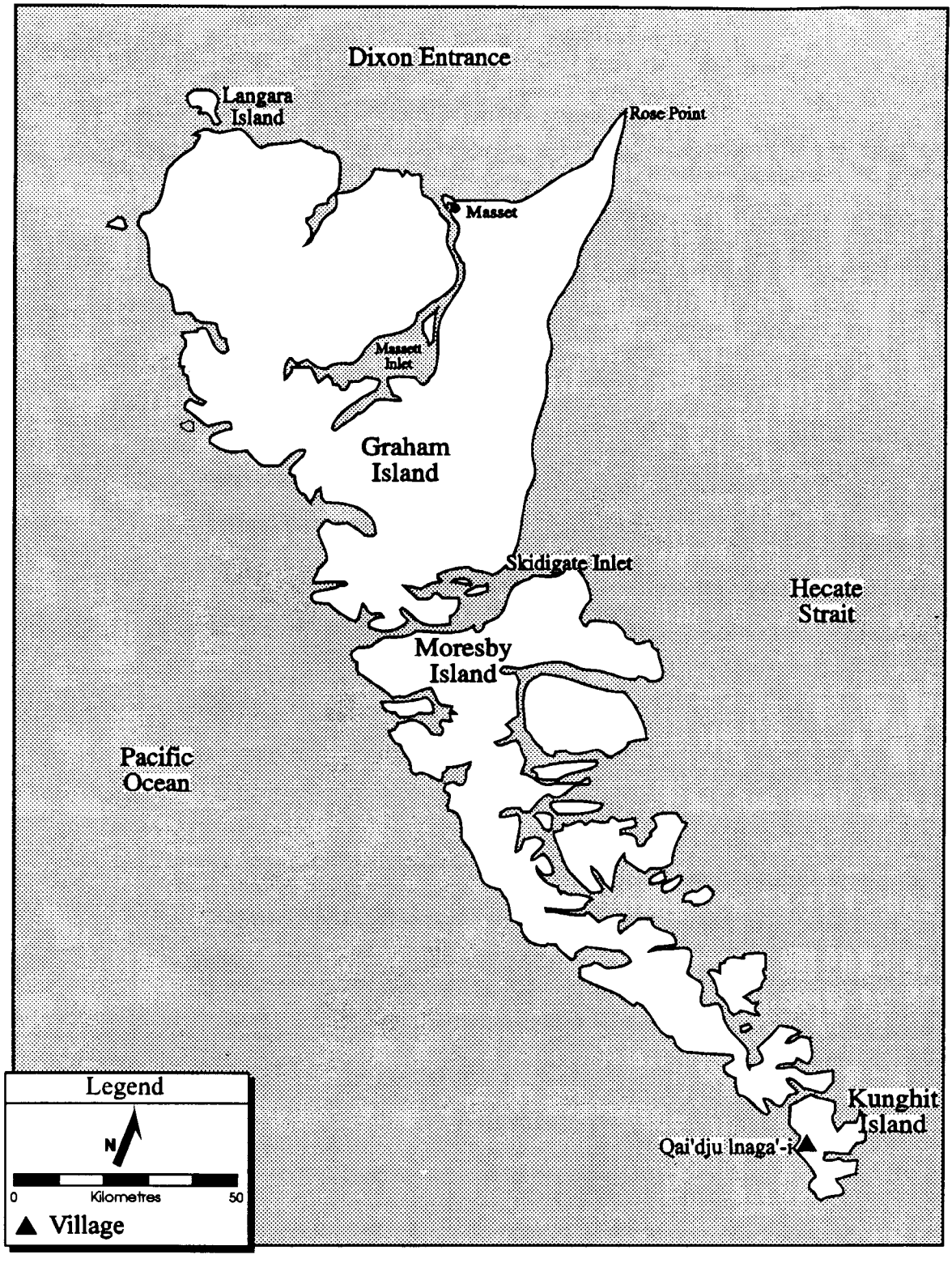

FIGURE 25: Location of the Haida *Dentalium* source located at the Village of Qai'dju lnaga'-i on Kunghit Island, Queen Charlotte Islands.

Island and Queen Charlotte Islands, *Dentalium* shell was also procured "in the bays and inlets along the mainland coast north of latitude 49° to Sitka".

Drucker (1950:273) recorded beach collection of *Dentalium* shell from two of his informants, Peter Bates, a Tsimshian from Hartley Bay and William Dixon a Bella Bella of the oyalitH tribe in the central coast. Drucker did not report a specific location where the beach collection occurred but it is presumed that the location was in the general area where the informant lived. The oyalitH tribe's traditional village site is located "on the southern end of Hunter's Island, in early historic times" (Drucker 1950:159) which is probably the village identified by Hilton (1990:313) as núlú. Drucker (1950:273) had reservations about the accuracy of information on beach collection of shell by Bates and Dixon noting that "both informants thought that dentalia were a variety of toredo, which washed ashore stuck in rocks and water-soaked logs".

WASHINGTON SOURCE LOCATIONS

Cape Flattery

Cape Flattery is located on the northwestern tip of the Olympic peninsula and is the territory of the Makah, a Wakashan speaking people culturally affiliated with the Nuu-chah-nulth (Figure 17). Kane, traveling in the area between the years 1846 to 1848, provided a description of a *Dentalium* fishing spear that was related to him by the Makah. He (1925:165) also noted that *Dentalium* was "a small shell found at Cape Flattery, and only there, in great abundance". Olson (1936:87), describing the trading relationships of the Quinault Indians, a group located to the south of the Makah, recorded that they obtained *Dentalium* from the northern groups, "especially the Makah and Nootka". Olson (1936:86) further noted that the Makah fished for the shells "by means of a long pole with small sticks at the end which entered the open mouth of the shell".

Early historical accounts also point to Cape Flattery as a source location for *Dentalium* shell. Thomas Manby, Master's Mate on the *Chatham*, the Tender to Cook's *Discovery* recorded a visit made by the Makah Chief Tatoosh to see Maquinna at the village of Yuquot in Nootka Sound in 1793. Manby (n.d.:156) noted that Tatoosh had brought several bags of *Dentalium* shell to trade for sea otter, wolf and fox skins. After Tatoosh departed, Maquinna immediately dispatched a party of men in a canoe to deliver the shells to the Kwakwaka'wakw in Alert Bay via the Tahsis trail. On October 9, 1828, William Tolmie, posted at Fort Nisqually in Puget Sound, reported the visit of 30 Makah who had come to the fort to trade beaver and *Dentalium* shell (as cited in Ruby and Brown 1981:64).

OREGON SOURCE LOCATIONS

The Oregon coast has been identified as source area for *Dentalium* shell by a number of authors, although the attribution of the shell is anecdotal and none of the authors names a specific location. Richardson (1851:382) noted in 1851 that "the shells, being several species of *Dentalium* and *Arenicola*, are collected in the Archipelago lying between Oregon and Cape Fairweather, and passed by trade from tribe to tribe". He (1851:382) goes on to state that the "large-ribbed *Dentalium* is most prized" indicating that *Dentalium neohexagonum* was being traded during the historic period in addition to *Dentalium pretiosum*. The procurement of *Dentalium neohexagonum* from Oregon is improbable as this species' range does not extend up along the Oregon coast. *Dentalium neohexagonum*, if in use, is more likely being procured from southern California.

Oberg in a discussion of historic period trade between the Tlingit and Europeans identified the Columbia River area as a source location for *Dentalium* shell, noting that:

> Dentalium Shells, which the Russians introduced as a medium of exchange, offer another example of supply and demand. When English and American traders discovered that dentalium shells were used as money, they

> immediately brought in vast quantities from the coast of California and the Columbia River region where these shells abounded [1973:112].

Holmberg (1985:81-82) also implied an Oregon location when he wrote that the shell did not occur in "Russian America but go by trade from the more southerly peoples on the Columbia River the length of the whole coast to Kadjak and even still further to the Aleutian Islands". Drucker (1951:112) stated that the "Oregon Indians...claim to have found dentalia occasionally washed up on the beaches" but went on to state that such beach collected shells were "often damaged and lusterless" and therefore of little value. A source on this section of the coast is also alluded to by Haida Elder, Flossie Lambly who noted that the Haida occasionally obtained *Dentalium* shells from the "American coast" (Jenson and Sargent 1986:56) although she does not identify a specific location.

CALIFORNIA SOURCE LOCATIONS

The northern California groups made extensive use of *Dentalium* shell incorporating it and other wealth items into an elaborate social exchange system (Kroeber 1925; Powers 1877). The source for the shell is always ascribed to a location north of California, usually the west coast of Vancouver Island. There is evidence that indicates that the shell was available and was occasionally collected from local sources in California during the historic period.

Alfred Kroeber and Samuel Barrett make reference to *Dentalium* shell collection from a beach in northern California by a Yurok informant. In their discussion of this information, they stated that:

> Dentalium shells used as money came from the far north. Occasionally pieces of dentalium would be found on the beach and were called a-srärul. They consisted only of upper or open ends. The diameter was that of a large shell, but they were mere fragments, an inch or less long [and therefore valueless as money; and they were too few to amount to anything as necklace beads]. Only Spott's father, Captain Spott, once found a whole one at Smetskéu weroi, the creek at the north end of Enderts beach, 3/4 mile south of Nek'el, Nickel or Cushion Creek [in Tolowa territory]. He

found that this shell brought him good luck for gambling, but not for more wealth or money [1960:112].

Arnold and Patricia Pilling conducted ethnographic fieldwork among the Trinidad Yurok of Crescent City in northern California in the late 1960s. The Pillings noted that the Yurok had traditionally received their *Dentalium* shell from two sources, the first by trade from northern groups, where they obtained the majority of the shell, and the second source was off local beaches.

> A few shells were washed up on the local beaches after large storms. Older informants still talk of how old Bill Norris found a large number of shells after a big storm, and at least speculate about the likelihood of a yield if they troubled to walk the beaches just north of Crescent City after modern storms. In 1969, one Kurok informant mentioned how she drives some 90 miles to the coast to hunt for dentalia after Alaskan earthquakes and their accompanying Northern California Tsunamis, in anticipation of the shells gouged out and brought up by these freak deep ocean currents. But the major source of dentalia was always trade [Pilling and Pilling 1970:101].

Oberg (1973:112) cited California as a source for the shell during the fur trade period in Alaska. Noting the Russian-American Company's attempts to acquire *Dentalium* shell for trade in the interior of Alaska, "English and American traders... immediately brought in vast quantities from the coast of California and the Columbia River region where these shells abounded".

There is archaeological evidence that points to California as a source for *Dentalium* shell during prehistory. Shell identified as *Dentalium neohexagonum* has occasionally been recovered from archaeological sites with examples at Flagstaff, Arizona (Colton 1941:313) and on San Migal Island and San Luis Obispo in California (Stearns 1889:321). The range of *Dentalium neohexagonum*, based on modern zoogeographical data, has a northern distribution that is limited to the central California coast.

ALASKA SOURCE LOCATIONS

On the northern northwest coast, along the Alaska Panhandle, three putative locations have been identified in ethnographic studies as *Dentalium* sources. de Laguna

recorded two sites where the Tlingit stated that *Dentalium* was procured by fishing and Eells reported a location from which shells were presumably acquired in trade by the Puget Sound Salish groups.

Copper River

The area around the mouth of the Copper was inhabited by the Eyak, a group that de Laguna (1990:187) has characterized as "remotely related to the Tlingit". In a discussion on Tlingit trade with neighbouring groups, one of de Laguna's informants described trading trips the Tlingit made to Copper River annually in June, primarily to obtain native copper that was found in the area, but also to obtain other items including *Dentalium* shells. The Eyak, according to de Laguna's informant:

> used to fish for ivory worms [dentalia] at Copper River...They get them from the Copper River. They got places where they grow, in the lakes. The Copper River people got them, trim their clothes with them....They are all different sizes, but all come matched [de Laguna 1972:349].

de Laguna (1972:349) has discounted this area as a source for the shell noting that the shells "are known to grow only much further south, in salt water, where the Nootka use to fish them for export". She suggested that the Eyak *Dentalium* shells may have traded from the south through the interior of British Columbia and the Yukon until finally reaching their destination at the mouth of the Copper River.

Stikine River

Eells identified the Stikine River area as the location where the Puget sound Salish obtained their *Dentalium* shell. In a section on commerce and trading relationship of the Puget sound Salish groups, he noted that:

> They have dishes made from the horn of the mountain sheep, which are said to have come from the Stikine Indians of British Columbia, six or eight hundred miles to the north; the dentalia shell, their ancient money, also came from the same region [1985:203].

Hydaberg

The second location noted by de Laguna's Tlingit informants as a source for *Dentalium* shell was in the vicinity of Hydaberg at the southern end of the Alaskan Panhandle. In a discussion on beads de Laguna was told that the shells were procured:

> from the bottom of the water, by sinking a piece of meat for bait. The taxxe [*Dentalium*] are supposed to be alive, so they "clean out the living things inside."..."They get them from the water--around Hydaberg someplace, in the deep water" [1972:445].

SUMMARY

The historic and ethnographic literature indicates that *Dentalium* shell was procured from specific localities in an area extending along the west coast of North America from Northern California in the south to an area around the Copper River in Alaska (Figure 17). A review of this literature suggests that, in addition to the west coast Vancouver Island, other locations may have supplied varied amounts of the shell into the exchange networks extent in the western North America during the proto-historic and historic periods. An examination of recorded water depths at specific fishing sites indicates that the depth varies from quite shallow to moderately deep waters (Table 18).

The most intensive *Dentalium* fishery occurred on the west coast of Vancouver Island, being conducted by two different cultural groups, the Kwakwaka'wakw and Nuu-chah-nulth including the Makah at Cape Flattery. The procurement area for the shell extended from Cape Scott on the northern end of Vancouver Island to the area around Barkley Sound and the area around Cape Flattery on the Olympia Peninsula. The development of a fishing implement to procure the shells from deep waters, and the possible use of a method of bait fishing for dead shells inhabited by hermit crabs would account for the intense exploitation of the shell in this area. Procurement of the shell may have been augmented by the fur trade during the first half of the nineteenth century, with

numerous accounts of fur traders obtaining the shell from the Kwakwaka'wakw groups living on the north end of Vancouver Island. Nuu-chah-nulth groups may have also been supplying the fur trade companies with the shell indirectly through intermediary trading partners.

A secondary area for intensive *Dentalium* shell procurement is identified from the Queen Charlotte Islands during the historic period. There are numerous historic accounts that note the Queen Charlotte Islands as the origin point of the shells and these references usually specify that the shells were collected there, rather than passing through from other areas to the south. Russian sources are specific in identifying the Queen Charlotte Islands, and it would appear that they were acquiring the shells from this location, if not directly, at least through trade with intermediary native groups in the Alaskan Panhandle area. The Russian interest in this shell was generated by the demand for it by native groups in the interior of Alaska and the Yukon District where the Russian-American Company was in direct competition with the Hudson Bay Company for the furs in this area in the mid-nineteenth century.

Anecdotal ethnographic evidence from two of the northern California groups, the Tolowa and the Yurok, indicates that *Dentalium* shell was available locally in California. This has led anthropologists Arnold and Patricia Pilling to re-examine the accepted exchange model describing a northern (Vancouver Island) origin for *Dentalium* shell in use among Northern California groups. Discussing the results of their field work among the Tolowa, they have stated that;

> A review of these data and the statements made to us by informants suggest that the ethnographic assertion of the major route of entry having been from the Oregon Coast may be no more that a logical conclusion by ethnographers, especially those unaware of the occasional local coastal origin of the actual points of introduction of new "money" dentalia [1970:113].

The archaeological recovery of *Dentalium neohexagonum*, a species with a northern range limited to the central California coast, also suggests a southern origin for the shell.

TABLE 18: The water depth range at specific *Dentalium* fishing locations.

Location	Site Name	Latitude	Longitude	Minimum Depth[1]	Maximum Depth[1]
Cox Island	lɛ'mlɛmxade`	50° 48' 08"	128° 35' 06"	1.8	27.4[2]
Forward Inlet	x·ɛla'de`	50° 28' 07"	128° 00' 09"	.6	16.8[3]
Winter Harbour	aʟade`	50° 30' 02"	128° 01' 07"	1.5	15.2[3]
Kyuquot Sound	Actis	50° 00' 04"	127° 25' 00"	1.4	7.6[4]
	cahqos	49° 52' 08" to 49° 57' 08"	127° 10' 07" to 127° 15' 07"	.9	32.9[5]
Nootka Island	Nuchatlitz	49° 45' 05"	127° 58' 00"	.9	11[6]
Hesquiat Harbour	mu7is	49° 15' 00"	126° 26' 09"	3	4.6[7]
Flores Island	p'ats'aktl'a	49° 19' 18"	126° 14' 03"	1.4	7.3[8]
Flores Island	ch'ach'ap'iih	49° 19' 05"	126° 14' 05"	4	8.2[8]

[1] All depth measurements are given in metres and have been converted from fathoms or feet from Canadian Hydrographic Service (CHS) charts.

[2] CHS, Chart #3625 (1968b); [3] CHS, Chart #3618 (1968a); [4] CHS, Chart #3683 (1969b); [5] CHS, Chart #3682 (1968c); [6] CHS, Chart #3663 (1974); [7] CHS, Chart #3640 (1976); [8] CHS, Chart #3648 (1969a)

There are sufficient references from other locations along the west coast of North America to suggest that *Dentalium* shell was collected along the length of the coast. These procurement locations may not have produced shell in the volume attributed to the sites on Vancouver Island but evidence for their existence has implications for the interpretation of prehistoric exchange networks in which *Dentalium* shell was being traded.

CHAPTER SIX

CONCLUSION

> *From the early 1800s on there seem to have been some fairly substantial changes in the amount, kind, and distribution of shell beads or money in California Indian societies. It seems possible that much of what we read about "aboriginal" uses and values of shell beads recorded by ethnographers in the first half of the twentieth century may not, in fact, be an accurate record of ancient practices but rather ones which had been developed in response to new and different conditions of availability resulting from the presence of whites [Heizer 1975:109].*

BIOLOGICAL INFORMATION

An examination of the biological information for scaphopod molluscs indicates that there are roughly nine species found along the coast of North America that occur within a geographical range and water depth that would have allowed them to be exploited by prehistoric peoples. Not all of these species would have fit the esthetic parameters of what would be considered a proper Dentalium shell. However, previous biological work identified a subspecies of *Dentalium pretiosum* with a restricted southern range. This subspecies was identified on the basis of characteristics of the shell morphology. Recent taxonomic work on the Class Scaphopoda, based on internal soft tissue morphology, has resulted in the designation of this subspecies of *Dentalium pretiosum berryi* as a separate species. Therefore, there are two species of scaphopod mollusc, found along the west coast of North America, that are virtually identical on the basis of shell morphology. The identification of scaphopod molluscs recovered from archaeological sites to species level is unwarranted given the inability of distinguishing between these two species on the basis of characteristics of the shell morphology.

SOURCE LOCATIONS

The historic and ethnographic literature contains numerous descriptions of *Dentalium* procurement techniques which can be classified into three categories; fishing with the use of some form of fishing implement, fishing using bait, and collection off the beach. These procurement technologies have been associated with specific procurement locations in certain cases. The locations identified with these specified procurement technologies along with sources identified by writers during the historic fur trade period indicate a wider range of source locations than is usually acknowledged in the ethnographic literature.

There would still appear to be intensive exploitation of the shell off the west coast of Vancouver Island among two groups, the Nuu-chah-nulth and the Kwakwaka'wakw but the Haida of the Queen Charlotte Islands may have also contributed significant amounts of the shell into the trade networks. The historic and ethnographic literature also indicates that *Dentalium* shell was procured from specific localities in an area extending along the west coast of North America from Northern California in the south to an area around the Copper River in Alaska. A review of this literature suggests that in addition to the west coast Vancouver Island sources usually cited as the source for this shell, these other locations may have supplied small to significant amounts of *Dentalium* shell into the exchange networks extent in the western North America during the proto-historic and historic periods. The existence of greater number of procurement sites would also help to account for volume of *Dentalium* shell in circulation during the historic period.

There was an intensive *Dentalium* fishery on the west coast of Vancouver Island conducted by two different cultural groups, the Kwakwaka'wakw and Nuu-chah-nulth including the Makah at Cape Flattery. The procurement area for the shell extended from Cape Scott on the northern end of Vancouver Island to the area around Barkley Sound and the area around Cape Flattery on the Olympia Peninsula. The development of a

fishing implement to procure the shells from deep waters, and the possible use of a method of bait fishing for dead shells inhabited by hermit crabs would account for the intense exploitation of the shell in this area. Procurement of the shell may have been augmented by the fur trade during the first half of the nineteenth century, with numerous accounts of fur traders obtaining the shell from the Kwakwaka'wakw groups living on the north end of Vancouver Island. Nuu-chah-nulth groups may have also been supplying the fur trade companies with the shell indirectly through intermediary trading partners.

A secondary area for intensive *Dentalium* shell procurement is identified from the Queen Charlotte Islands during the historic period. There are numerous historic accounts that note the Queen Charlotte Islands as the origin point of the shells and these references usually specify that the shells were collected there, rather than passing through from other areas to the south. Russian sources are specific in identifying the Queen Charlotte Islands, and it would appear that they were acquiring the shells from this location, if not directly, at least through trade with intermediary native groups in the Alaskan Panhandle area. The Russian interest in this shell was generated by the demand for it by native groups in the interior of Alaska and the Yukon District where the Russian-American Company was in direct competition with the Hudson Bay Company for the furs in this area in the mid-nineteenth century.

Anecdotal ethnographic evidence from two of the northern California groups, the Tolowa and the Yurok, indicates that *Dentalium* shell was available locally in California. It was known to occur locally by the groups that lived in the area and during the historic period there are records of the shell occasionally being collected by them. This has led anthropologists Arnold and Patricia Pilling to re-examine the accepted exchange model describing a northern (Vancouver Island) origin for the *Dentalium* shell in use among the Northern California groups. Discussing the results of their field work among the Tolowa, they have stated that;

> A review of these data and the statements made to us by informants suggest that the ethnographic assertion of the major route of entry having been from the Oregon Coast may be no more that a logical conclusion by ethnographers, especially those unaware of the occasional local coastal origin of the actual points of introduction of new "money" dentalia [1970:113].

The archaeological recovery of a species of *Dentalium* shell (*Dentalium neohexagonum*) with a northern range limited to the California coast, would tend to support a California origin of the shell, during prehistory

ARCHAEOLOGICAL IMPLICATIONS

There are sufficient references from other locations along the west coast of North America to suggest that Dentalium shell was collected along the length of the coast. These procurement locations may not have produced shell in the volume attributed to those sites on identified on west coast site of Vancouver Island but evidence for their existence has implications for the interpretation of the archaeological occurrence of *Dentalium* shell and the reconstruction of prehistoric exchange networks.

While the attribution of the west coast of Vancouver Island as a source location for Dentalium at, or near contact is certainly justified, extending that analogy back into the past may well be tenuous. In the absence of any method of physically testing the shell to determine source locations, such as methods employed for determining the source of obsidian, the precise source for a given species of marine shell with an extensive range, such as *Dentalium*, will remain somewhat speculative.

APPENDIX I

SCAPHOPOD MOLLUSC SPECIES DESCRIPTIONS

Class: **Scaphopoda** Bronn, 1862

Order: **Dentaliida** Da Costa, 1776

Family: Dentaliidae Gray 1834

Genus: *Antalis*
Species: *berryi*
Author: (A.G. Smith and Gordon, 1948)
Synonymy: *Dentalium pretiosum berryi* A.G. Smith and Gordon, 1948[1]
Common Name: Berry Tuskshell
Original Description:
Description:
Size: length 51-55 mm[1]
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour:
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality: California, Monterey County, Monterey Bay Humpback Reef, 73 m
Geographical Range: Monterey, California to the Gulf of Mexico
Depth Range: 37-298 metres[1]
Habitat: fine muddy sand and shale fragments[9]
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks: Abbott notes *Dentalium pretiosum berryi* is a southern subspecies of *Dentalium pretiosum*[1]
Figure: fig. 4513, p.386[1]
References: [1]Abbott 1974, [9]Scott et.al. 1990

Genus: *Antalis*
Species: *pretiosum*
Author: (Sowerby, 1860)
Synonymy: *Dentalium pretiosum* Sowerby, 1860; following *Entalis pretiosus* Nutt Lord 1864; *Dentalium indianorum* Carpenter 1864; *Dentalium columbianum* Clessin 1896[22]
Common Name: Wampum Tuskshell, Indian Money Tusk[1]
Original Description: shell longitudinally striate near apex (or in young specimens, throughout); rather solid and opaque; larger [than *semipolitum*]; unequally lirulate toward apes, [*pretiosum* var. *indianorum*]; no longitudinal sculpture; strong and

solid, young striated (p. xxi)[22]: shell rather long, moderately curved and solid; opaque white, ivory-like, often with some faint dirty buff rings or tinted with that color at the smaller end. Sculpture of fine irregular growth-striae and occasional deeper grooves caused by interrupted growth; usually with no longitudinal sculpture in adults, but sometimes showing longitudinal striae toward the apex, the young with numerous small riblets (but in southern specimens the longitudinal sculpture is more persistent). Aperture circular, oblique, the peristome thin. Apex rather broadly truncate, the orifice small, oblong, continued in a short notch on the convex side; often having a narrow raised rim. Length 55, diam. of aperture 5 of apex 2 mill. (Washington). Length 41, diam. of aperture 5, of apex 2.7. (Brit. Columbia). Length 41, diam. of aperture 3.8 of apex 1.5 mill. (Cerros I.) West coast of America from Sitka, Alaska to Cerros I., Lower California (p. 44)[22]; Very similar to *D. entalis*, of the North Atlantic and perhaps better ranked as a subspecies; but in general the pacific shell is larger, longer in proportion to the diameter, and whiter; and these differences, with the geographic separation, make it undesirable to unite the forms. Clessin's *D. columbianum* is merely a short form of typical pretiosum, utterly without specific or varietal characteristics different from pretiosum as ordinarily developed in British Columbian waters. Californian examples are decidedly smaller, and frequently lirate toward the tip. This form has been called Var. *indianorum* by Dr. Carpenter, who describes it as 'like *entalis*, with very fine posterior striae." Specimens from Monterey, San Pedro Bay, etc. are so sculptured. In the examples of this form before me the apex is unslit, the anal orifice circular with thin walls. Should these differences prove constant, *indianorum* may perhaps be elevated to specific rank; but in entalis the apical features are inconstant. Pl. 13, figs 6,7,8 are normal indianorum; figs. 4,5 are an older shell (p. 45)[22]. In some specimens of *D. pretiosum* before us the apical notch is eccentric, and in one it is directly lateral, as in *D. sericatum*, although having the form usual in pretiosum and entalis. We have observed similar inconstancy in the position of the slit in some other species (p. 46)[22].

Description: moderately curved and solid; opaque-white, ivory-like, commonly with faint dirty buff rings of growth; apex with a short notch on the convex side[1]

Size: length, 51-55 mm (2 inches)[1,6]

Apical Characteristics: short notch on convex side[1]

Apertural Characteristics:

Sculpture:

Apertural Characteristics:

Colour: opaque-white, ivory like, commonly with faint dirty-buff rings[1]

Radula:

Other Significant Morphological Characteristics:

Type Depository:

Type Locality:

Geographical Range: Alaska[1]-Forrester Island[3,7]; Southeastern Alaska[6] to Baja, California[1]

Latitude: 32-55 N[2]

Depth Range: 1.83[1] to 146.3[2] metres

Habitat:

Frequency of Occurrence: common[1]

Original Descriptions of Synonomized Specimens:

Remarks:

Figure: fig. 14.1, p. 290[5]; Plate 13, fig 1,2,3[22]

References: [1]Abbott 1974, [2]Bernard 1970, [3]LaRocque 1953, [5]Kozloff 1987, [6]Baxter 1983, [7]Dall 1921, [22]Pilsbry and Sharp 1897-1898

Genus: *Dentalium*
Species: *agassizi*
Author: Pilsbry and Sharp, 1897
Synonymy:
Common Name: Stained Tuskshell
Original Description: shell longitudinally strongly ribbed, 12 to 20 sharp riblets at apex, 25-48 at aperture, the interstices wider than the ribs, concave; length 29-65 mill., 9 to 15 times the diam. (p. xix-xxi)[22]; shell gently curved posteriorly, the later half nearly straight, tapering, solid, white and lusterless(often with black encrustation toward the apex, and reddish-brown on the larger end); sculpture - at the apex there are 12-20 rather sharp and well raised riblets separated by wider, concave intervals; at a varying distance from the apex an interstitial thread appears in these intervals, so that near the middle of the shell's length there are double that number of riblets and threads, alternately larger and smaller, and at the aperture there are 25-48 unequal riblets and threads, lower and blunter in larger examples; aperture somewhat oblique, subcircular, but the arc along the concave side is sometimes less curved than the remainder of the peristome, and the edge is irregular from breakage; anal orifice small, circular, no slit or notch, but often the inner layer projects tube-like from erosion of the softer, more chalky outer layer. (a) Length 65, diam. at aperture, 4.3, at apex 0.7 mill.(type). (b) length 31.7, diam. at aperture 3.2, at apex 1 mill. (c) length 30.7, diam. at aperture 3, at apex 0.7 mill. (d) length 29, diam. at aperture 3.1, at apex 0.7 mill. Gulf of Panama, 322 to 1020 fms.; off Acapulco, 660 fms.; Santa Barbara Is., California, 414 fms.; off San Diego, California, 822 fms. (U.S. Fish Commission) (p. 26)[22]; *D. pretiosum* var. *indianorum* is far less coarsely sculptured then this species, and the ribs do not crenulate the peristome. *D. occidentale* is very similar, but the sculpture developed between the primary ribs is unlike this Pacific form. *D. majorinum* and its variety *magellanicum* are also much like *agassizi*, but the latter has finer sculpture. The inner layer of shell substance is very dense and bluish-white, the outer layer being softer and more chalky, frequently eroded, often exposing the inside stratum which resists the solvent power, at the apex and elsewhere. The number of riblets is quite variable; thus the four specimens measured above have: (a) at apex 20, at aperture 48 riblets. (b) at apex 17, at aperture 40 riblets. (c) at apex 14, at aperture 29 riblets. (d) at apex 12, at aperture 25 riblets (off San Diego) The number of interposed riblets varies somewhat, but the number of apparently primary ribs at the apex is also subject to a wider range of variation than usual (p. 27)[22].
Description:
Size: length, 6.5 mm[6];
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour:
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality: Gulf of Panama[16]
Geographical Range: Southeastern Alaska[6,12] to Panama[1]
Latitude: 8-50 N[2]
Depth Range: 322[6] to 2,320[1] metres
Habitat:
Frequency of Occurrence:

Original Descriptions of Synonomized Specimens:
Remarks:
Figure: Plate 12, figs 90, 91, 92, 93, 94[22]
References: [1]Abbott 1974, [2]Bernard 1970, [6]Baxter 1983, [12]Austin 1985, [16]Bernard 1967, [22]Pilsbry and Sharp 1897-1898

Genus: *Dentalium*
Species: *neohexagonum*
Author: Pilsbry and Sharp, 1897
Synonymy: *Dentalium pseudohexagonum* Arnold, 1903[1]
Common Name: Hexagon Tuskshell, Six-sided Tusk[1]
Original Description: shell longitudinally strongly ribbed, ribs typically 6, decreasing anteriorly (p. xxi)[22].
Description: moderately curved, slender (length 12-14 times the greatest diameter)[1]
Size: length 25 to 35 mm
Apical Characteristics: roundly oval, without notch or split[1]
Apertural Characteristics: aperture 6-sided, but the angles so rounded that the orifice appears nearly circular[1]
Sculpture: six strong rounded ribs, which on the larger 1/2 or 1/3 of the adult shell become reduced to mere rounded angles[1]
Colour: white[1]
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality:
Geographical Range: Monterey, California to the Gulf of Mexico
Depth Range: 1.83[1] to 250[10] metres
Habitat:
Frequency of Occurrence: common[1]
Original Descriptions of Synonomized Specimens:
Remarks: larger specimens occur in deeper waters[1]
Figure: fig. 9.238, p. 199[10]
References: [1]Abbott 1974, [7]Dall 1921, [10]Brusca 1980, [22]Pilsbry and Sharp 1897-1898

Genus: *Dentalium*
Species: *vallicolens*
Author: Raymond, 1904
Synonymy: *Graptacme vallicolens* Raymond, 1904[1]
Common Name: Trench Tuskshell, Raymond's Tusk[1]
Original Description:
Description: rather slender, moderately curved posteriorly, the latter 1/2 nearly straight; shiny where not eroded, earlier portion dull and chalky[1]
Size: length, 51-64.5 mm (2 to 2 1/2 inches)[1,6]
Apical Characteristics:
Apertural Characteristics:
Sculpture: at the apex are 7 to 8 prominent low rounded longitudinal threads with 3 to 6 less prominent threads in each interspace; sculpture fades towards the apertural end except for numerous microscopic striae[1]
Apertural Characteristics:
Colour: cream-white, often yellowish towards the aperture[1]
Radula:

Other Significant Morphological Characteristics:
Type Depository:
Type Locality: Station 12, submerged valley off Redondo, Santa Monica Bay, California, 145 fms.[3]
Geographical Range: Washington[1]; Straits of Juan de Fuca[3] to the Gulf of California[1]
Latitude: 10-55 N[16]
Depth Range: 5[6] to 484.6[1] metres
Habitat: in fine sand and gravel[1]
Frequency of Occurrence: common[1]
Original Descriptions of Synonomized Specimens:
Remarks:
Figure: fig. 4520, p. 384[1]
References: [1]Abbott 1974, [3]LaRocque 1953, [6]Baxter 1983, [16]Bernard 1967

Genus: *Fissidentalium*
Species: *megathyris*
Author: (Dall, 1890)
Synonymy: *Dentalium megathyris* Dall, 1890
Common Name: Costate Tuskshell
Original Description: shell remarkably stout and solid, moderately curved; surface, when not eroded, shining; color yellowish white, generally with some dark extraneous matter lodged in the grooves of the sculpture; anal end circular, small, simple with a sharp edge, about 2 mm in diameter surface with strong flattened longitudinal threads about 1 mm from center to center, the interspaces sharply grooved in rather deep square-sided channels; about the middle of the shells the ribs begin to bifurcate so that the anterior sculpture, though of the same character, is some two or three times as fine as the posterior; in old age the sculpture is interrupted around the aperture; transverse sculpture only of fine incremental lines; oral aperture sharp edged, a little oblique, nearly circular, slightly flattened in an antero-posterior sense; interior milk-white; texture of the shell porcellanous with an external chalky stratum under the smooth exterior, which is frequently much eroded even in life; maximum longitude of shell, 95[13]; shell remarkably stout and solid, rapidly enlarging; the earlier third moderately curved, the remainder much straighter. Surface where not eroded shining; texture of shell porcellanous within., with an external chalky stratum under the smooth exterior; the posterior half generally much eroded even in living specimens. colour yellowish-white, generally with some dark extraneous matter lodged in the interstices. Sculpture; numerous (about 50) strong longitudinal riblets and threads, the latter rather sparsely and irregularly interposed; the intervals deep and generally somewhat narrower than the riblets; longitudinals rather abruptly losing in strength near the aperture in aged shells. Aperture decidedly oblique, somewhat wider than long, the peristome subsinuous, acute. Apex with simple, circular, sharp-edged orifice. no slit or notch (p. 67)[22].
Description: shell longitudinally strongly ribbed, about 50 riblets and threads; shell very large, strong and solid; aperture oblique; length 90-99 mill., 5 50 5 1/2 times the diam.(p. xix)[22].
Size: maximum length, 95 mm; diameter of aperture, 17.5 mm; anterior-posterior diameter of aperture, 15.5 mm[13]
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:

Colour:
Radula: the radula is short with the formula 1/1+1 1+1; median tooth is wide, subrectangular, arched a little in front; laterals on each side have a projecting stout cusp; the uncini are flat rhomboidal plates[13]
Other Significant Morphological Characteristics:
Type Depository:
Type Locality: Pacific Ocean, Galapagos Islands, U.S. Fish Commission Station 2807, 812 fms.[13]
Geographical Range: California[1] to the Gulf of California[1] and to Chile[1] and Galapagos Islands[13]
Depth Range: 1,467[1] to 2,080[1] metres
Habitat: globigerina ooze; bottom temperature 38.4 deg F.; stomach stuffed with foraminifera[13]
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks: Abbott notes (?Fissidentalium)[1]
Figure: Plate IX, fig. 1[13]; Plate 15, figs. 29, 30, 31[22]
References: [1]Abbott 1974, [3]LaRocque 1953, [13]Dall 1890, [22]Pilsbry and Sharp 1897-1898

Genus: *Graptacme*
Species: *inversa*
Author: (Deshayes, 1826)
Synonymy: *Dentalium inversum* Deshayes, 1825
Common Name: Turned Tuskshell
Original Description:
Description: shell longitudinally strongly ribbed, apex with slit on concave side; shell translucent whitish with opaque rings; length 30 mill., 16 times the diam. (p. xix)[22]; shell rather lightly curved, small, extremely slender, the length about 16 times the greatest diameter; translucent white, clouded with opaque white, and becoming reddish toward the apex; *very glossy*. Sculpture, *very fine and regular longitudinal striation near the apex*, the greatest part of the shell smooth, free from sculpture,, with very slight variceal rings as in *D. eburneum* but far less marked. Aperture circular, the peristome thin. Anal orifice minute, round, with a deep *narrow slit or a shorter notch, in the middle or eccentric on the concave side*. Length 30, diam. of aperture 1.9, or apex 0.6 mill.; length of slit 1.8 mill. Gulf of California (W. Newcombe, in coll Acad.); Habitat unknown (Desh., Sowb.). Remarkable for having the slit on the concave side. Otherwise the species is not very unlike *D. semipolitum*. *D. sectum* Desh. differs in being less attenuated posteriorly, with differently formed apex and slit. One specimen from the Gulf of California, which we refer to this species, has the apical notch formed as in many *D. entalis*, with a slightly projecting rim around the ovate orifice, slit not median, but decidedly eccentric on the concave side. This specimen occurred with *D. semipolitum* (p. 95)[22].
Size: length, 30 mm[6,11]; diameter at aperture, 1.9 mm[11]
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour:
Radula:
Other Significant Morphological Characteristics:
Type Depository:

Type Locality: not known[3]
Geographical Range: Alaska-Bering Sea[1];Aleutian Islands/northern Gulf of Kodiak[6] to Panama[1]; Equador[11]
Latitude: 8-58 N[16]
Depth Range: 18[6] to 1463[16] metres
Habitat:
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks:
Figure: fig. 2, p. 239[11]; fig. 4c and 4d, p. 342[21]; Plate 21, figs. 47, 48, 49[22]
References: [1]Abbott 1974, [3]LaRocque 1953, [6]Baxter 1983, [11]Keen 1958, [16]Bernard 1967, [21]McFadien 1973, [22]Pilsbry and Sharp 1897-1898

Genus: *Graptacme*
Species: *semipolita*
Author: (Broderip and Sowerby, 1829)
Synonymy: *Dentalium semipolitum* Broderip and Sowerby, 1829; *Dentalium hannai* Fred Baker, 1925[1]
Common Name: Half-smooth Tuskshell, Semi-polished Tusk[1]
Original Description: shell longitudinally striate near apex (or in young specimens, throughout); thin, closely, finely and evenly engraved toward apex, smooth and polished toward aperture; length 25-30 mill. (p. xxi)[22] shell longitudinally strongly ribbed, apex simple; length 25-30 mill., 10 times the diam., (p. xix)[22]; shell slender, moderately or decidedly curved, attenuated toward the apex; rather thin, milk white and very glossy. Sculpture : *deeply engraved with very numerous, fine, close, subequal, longitudinal striae, extending from the apex downward one-third to two-thirds the shell's length* (and of course covering the entire length of young shells); the *remaining one- or two-thirds smooth and polished*, brilliant, scarcely showing growth-lines. Aperture circular, the peristome thin. Anal orifice minute and round, *no notch or slit*. Length 26, diam. of aperture 2.6 mill. Length 29.5. diam. of aperture 2.9 mill. La Paz; Acapulco; Mazatlan; north to Mulevge Bay, Boca de Los Piedras and San Ignacio Lagoon, Lower California, and San Diego, California (p. 91)[22]; Compared with *D. acieulum* of the same length, a larger part of the surface of *D. semipolitum* is seen to be striated. It is a very beautiful shell, quite constant in the fine sculpture of the smaller end, though, as in all species, with diverse ornamentation at the two ends, the extent of the sculptured and smooth portions varies regularly with age, and somewhat among adults. Quite young and half-grown shells are striate throughout; and in some of the old ones less than a third of the shell is sculptured. In form there is also considerable variation, occasional examples fully justifying Philippi's term "subrecta," while others are very markedly arcuate We have noted the essential identity of this form with the Antillean *D. semistriatum* Turton. In the average, a greater portion of the tube is striated in this than in *D. semistriatum*, but in many individual specimens this does not hold, and they are quite indistinguishable. The west coast for is, at most, only a sub-species. The original description of this species is as follows: "shell whitish, polished; posterior end somewhat recurved, very finely striated; no posterior slit. Length 1.4, diam. 0.1 inch. The very fine striae continue about half the length of the shell, which is rather narrower in proportion than *D. nebulosum*" (*B.&S.*). The habitat of the type was unknown, but as a large number of the shells described in Broderip and Sowerby's paper, cited above, were from the west coast of Mexico, it is very probable that the original *semipolitum* came from thence, especially as their description agrees perfectly with specimens from that region. It

has also been well-described by Philippi as *D. hyalinum*, and young shells, in which the striae extend from end to end, have received the names lirulatum Morch and liratum Carpenter. All published information upon the latter two forms is given below (pp. 91-92)[22].

Description: slender, round in cross-section, curved, thin-shelled, very glossy[1]; narrower in proportion than *Dentalium nebulosum*[11]

Size: length, 26-38 mm (1-1 1/2 inches)[1,6]; diameter at aperture, 3 mm[11]

Apical Characteristics: minute, round and unnotched[1]

Apertural Characteristics: circular[1]

Sculpture: numerous , fine, close, subequal, longitudinal striae, extending from the apex to 1/2 to 2/3 the shelf's length. Large 1/3 of shell smooth, brilliantly polished[1]; the very fine striae continue about half the length of shell[11]

Colour: milk white[1]

Radula:

Other Significant Morphological Characteristics: peristome thin

Type Depository:

Type Locality:

Geographical Range: Alaska-Kenai Peninsula, Cook Inlet[6] to Costa Rica[1]; Nicaragua[11]

Depth Range: 2[6] to 64[1] metres

Habitat:

Frequency of Occurrence: common[1]

Original Descriptions of Synonomized Specimens:

Remarks:

Figure: fig. 4514, p. 386[1]; fig. 6, p. 239[11]; Plate 16, fig. 54[22]

References: [1]Abbott 1974, [6]Baxter 1983, [11]Keen 1958, [22]Pilsbry and Sharp 1897-1898

Family: Laevidentaliidae Palmer, 1974

Genus: *Rhabdus*

Species: *dalli*

Author: (Pilsbry and Sharp, 1897)

Synonymy: *Dentalium dalli* Pilsbry and Sharp, 1897

Common Name: Dall Tuskshell

Original Description: less straight, decidedly wider; length 45-69 mill., 11-14 times the diam. (p. xx)[22]; no longitudinal sculpture; quite thin; deep water species; no apical notch; slender, with very slight curvature, and slow increase; curvature regular but slight; length 45-69 mill., 11 to 14 times the diam., Shell regularly but only slightly curved, evenly tapering, *thin and fragile*; opaque, slightly bluish-white. Surface brilliant, glossy and polished; but in all specimens seen, *mainly dead or lusterless whitish, from loss of greater part of the superficial gloss, which remains near the aperture only*, or sometimes in patches or irregular rings elsewhere. *Growth-striae faint; no other sculpture*. Aperture circular, not oblique. Apex rather large, with simple, circular, thin edged orifice; no slit or notch. Length 45, diam. at aperture 4, at apex 1.5 mill. (Type). Length 50, diam. at aperture 3.8, at apex 1.8 mill. (Bering Sea). Length 69, diam. at aperture 4.9, at apex 2.5 mill. (Acapulco). This species is most nearly related to *D. rectius* Cpr., but it is larger, less slender and more curved. The outer varnish or gloss seems to be caduceus, and is largely lost, leaving a mat white surface, in the specimen seen. *D. pretiosum* often occurs with almost the size and figure of *D. dalli*, but it is a very solid shell, while our new form is one of exceptional fragility, and moreover lacks the apical striation of

young pretiosum. The range of Dall's tusk-shell extends in deep water the entire length of the North American continent, thought apparently more numerous in the north. We have distinguished it by a specific name which so long as West Coast shells are studied, will be an honored one among naturalists. Imperfect specimens, apparently in the Gulf of Panama. Types are no. 107696 U.S. Nat. Museum (pp. 114-115)[22].

Description:

Size: length, 69 mm[6]

Apical Characteristics:

Apertural Characteristics:

Sculpture:

Apertural Characteristics:

Colour:

Radula:

Other Significant Morphological Characteristics:

Type Depository:

Type Locality: Bering Sea[3]

Geographical Range: Bering Sea[1]-Pilbrof Islands[7];Aleutian Islands/northern Gulf of Kodiak[6]; north of Unalaska, off Tillamook Bay, Oregon[3] to Peru-Point Aguja[7]

Latitude: 6-60 N[16]

Depth Range: 9[6] to 1895[6] metres; 27.4 - 54.9 metres in Alaska[1]

Habitat:

Frequency of Occurrence:

Original Descriptions of Synonomized Specimens:

Remarks:

Figure: Plate 21, fig. 46[22]

References: [1]Abbott 1974, [3]LaRocque 1953, [6]Baxter 1983, [7]Dall 1921, [16]Bernard 1967, [22]Pilsbry and Sharp 1897-1898

Genus: *Rhabdus*

Species: *rectius*

Author: (Carpenter, 1865)

Synonymy: *Dentalium rectius* Carpenter, 1864[1]; *Dentalium watsoni* Pilsbry and Sharp, 1897[1]; *Dentalium dalli* Pilsbry and Sharp, 1897[5]

Common Name: Straight Tuskshell, Western Straight Tusk[1]

Original Description: no longitudinal sculpture; quite thin; deep water species; no apical notch; slender, with very slight curvature, and slow increase; almost straight, very glossy; length 30-40 mill., 12-15 1/2 times the diam. (p. xxi)[22]; Shell *almost straight*, slender and long, attenuated toward the apex, thin and fragile,, bluish-white, somewhat translucent, with some opaque white flecks or rings, often encrusted near the aperture with a reddish deposit. *Surface very glossy, polished*, growth- marks being only faintly seen, and sculpture absent. Aperture not oblique,, almost circular, but the tube is a little compressed laterally; peristome thin. Apical orifice small, circular, without notch or slit, but from its extreme fragility the end is often is often nicked or broken. Length 40, diam. at aperture 2.6, at apex 1 mill. Length 30, diam. at aperture 2.5, at apex 0.6 mill. Near Victoria, Vancouver Island, 60 fms. (Newcombe); Puget Sound (Kennerley, and U.S.F.C. in 82-135 fms.); off Tillamook Harbor, Oregon, 786 fms.; California, off point Reyes, 50 fms., off Bodega Head, 62 fms., off Cortes Bank, 984 fms., Santa Barbara Channel, 205-233 fms., Monterey Bay, 13 and 37 fms. (U.S. Fish Commission). *C. rectius* Cpr., Per. Brit. Asso. Adv. Sci., for 1863, pp. 603, 648 (no description). Allied to *D. watsoni* and *D. aequatorium*, species decidedly

more slender , and to *D. dalli*, a stouter, larger, more curved species. The whole series is remarkable for the tenuity of the smooth shell, and its unusual straightness. The specimen figured is no. 107707, U.S. Nat. Mus., from Monterey Bay, 37 fms. Carpenter's type was from Puget Sound, and measured 12.9 inch. in length (pp. 113-114)[22].

Description: almost straight, glossy, smoothish, slender and long, attenuated toward the apex; thin-shelled and fragile[1]

Size: length, 26-38 mm (1 to 1 1/2 inches)[1]; 67 mm[6]

Apical Characteristics: apical orifice small, circular, unnotched[1]

Apertural Characteristics: often encrusted near the aperture with a reddish deposit[1]

Sculpture:

Apertural Characteristics:

Colour: bluish white, somewhat translucent, with some opaque white flecks or rings[1]

Radula:

Other Significant Morphological Characteristics:

Type Depository:

Type Locality: Puget Sound

Geographical Range: Alaska[1]-Stephens Passage[7] to Panama[1]-Panama Bay[7]

Latitude: 8-60 N[2]

Depth Range: 13[6] to 1799[6] metres

Habitat:

Frequency of Occurrence:

Original Descriptions of Synonomized Specimens:

Remarks:

Figure: fig. 4524, p.386[1]; fig. 14.2, p. 290[5]; Plate 21, fig. 45[22]

References: [1]Abbott 1974, [2]Bernard 1970, [5]Kozloff 1987, [6]Baxter 1983, [7]Dall 1921, [22]Pilsbry and Sharp 1897-1898

Genus: *Rhabdus*

Species: *watsoni*

Author: (Sharp and Pilsbry, 1897)

Synonymy: *Dentalium watsoni* Pilsbry and Sharp, 1897

Common Name: Watson Tuskshell

Original Description: no longitudinal sculpture; quite thin; deep water species; no apical notch; slender, with very slight curvature, and slow increase; very slightly curved, very slender; length 30 mill., 16-19 times the diam. (p. xxi)[22]; Shell *very slightly curved*, long, extremely slender, not much tapering, thin, white; surface shining, *wholly free from longitudinal* sculpture, the growth lines fine and inconspicuous. Aperture circular, hardly oblique. Anal orifice small and circular, simple; no slit or notch. Length 31, diam. at aperture 1.6 at apex 0.75 mill. Length 29.3, diam. at aperture 1.8 at apex 0.75 mill. Off Tillamook Bay , Oregon, in 786 fms. (U.S.F.C., sta. 3346); off San Diego, California (U.S.F.C., Sta. 2923). Straight as *D. rectius* Cpr., but very much more slender. It is more curved than the closely allied *D. aequatorium* from off Ecuador, and slightly larger at the aperture. The specimens are but slightly translucent, one being quite and the other almost opaque; but they are both dead shells, and may have been more transparent in life (p. 113)[22].

Description: length is 16 to 19 times the diameter[1]

Size: 38-55 mm

Apical Characteristics:

Apertural Characteristics:

Sculpture:

Apertural Characteristics:
Colour:
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality:
Geographical Range: Washington[6] to California[6]-San Diego[7]
Depth Range:
Habitat:
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks: Abbott notes *Dentalium watsoni* is an extra long *Dentalium rectius*[1]
Figure: Plate 21, fig. 44[22]
References: [1]Abbott 1974, [6]Baxter 1983, [7]Dall 1921, [22]Pilsbry and Sharp 1897-1898

Order: **Gadilida** Starobogarov, 1974

Family: Gadilidae Stoliczka, 1868

Genus: *Gadila*
Species: *fusiformis*
Author: (Pilsbry and Sharp, 1898), *Cadulus hepburni* Dall, 1897[2]
Synonymy: *Cadulus fusiformis* Pilsbry and Sharp, 1898
Common Name: Fusiform Toothshell, Fusiform Cadulus[1]
Original Description: Shell but little curved, long and slender, the greatest diameter contained about 9 times in the length of the shell; swelling hardly perceptible, the tube very gradually enlarging from the small apex to the beginning of the last third of the length, thence an equal size is maintained almost to the aperture, just before which it is gently but quite perceptibly contracted on all sides. Surface smooth and glossy, bluish-white, scarcely translucent, with oblique rings of more opaque white, and near the apex some longitudinal white lines; a pellucid ring bordering the lip-edge, behind which there is a short, opaque white tract, passing gradually into the bluish and banded general color. Tube a mere trifle compressed vertically at the widest part. Aperture oblique , and (measured obliquely) a trifle longer than wide (in the ration of 35:33); lip thin, sharp. anal orifice circular and simple. Length 10.37 mill.; anteroposterior diameter at aperture 1.0, at widest 1.14, at apex 0.37 mill., greatest transverse diameter 1.17 mill. Closely allied to *C. hepburni* Dall, and *C. aberrans* Whiteaves; but it is decidedly slenderer than the first, and less curved than the other of these species. The type is a specimen collected alive, No. 133,809, U.S. Nat Mus.; other and fossil specimens from a Sand Diego well (Pliocene) have been collected by Henry Hemphill. The specific name "*fusiformis* Phil." seems to have been unable to find it in Philippi's writings, or, in fact, in any printed works. There is also a dead shell, perhaps Pliocene, in the U.S. Nat. Mus., with the name "*C. intentior* Cpr.," identical with this species (pp. 193-194)[22].
Description: shell long and slender at the anterior 1/2; greater diameter 9 times the shell's length, glossy surface[1]; slightly arched; robust; widest beyond anterior orifice[10]
Size: length, 10 mm[1,10]

Apical Characteristics: circular, smooth, unnotched[1]
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour: bluish white
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality:
Geographical Range: British Columbia[2] to Baja, California[1]
Latitude: 27-60 N[2]
Depth Range: 1 metre/subtidal[10] to 365[10] metres
Habitat: sandy bottom[1]
Frequency of Occurrence: common[1]
Original Descriptions of Synonomized Specimens:
Remarks: Bernard cites author as Pilsbry and Sharp 1987[2]
Figure: fig. 9.243, p. 202[10]; fig. 1c, p. 234[19]; Plate 35, fig 14[22]
References: [1]Abbott 1974, [2]Bernard 1970, [10]Brusca 1980, [19]Shimek 1989, [22]Pilsbry and Sharp 1897-1898

Genus: *Gadila*
Species: *hepburni*
Author: (Dall, 1897)
Synonymy: *Cadulus hepburni* Dall, 1897
Common Name: Hepburn Toothshell
Original Description: Shell small, polished, smooth, white, nearly straight; apertures circular, their margins simple; in some lights appears to have longitudinal streaks of more or less opaque white, but there is no development of longitudinal sculpture[8]; Shell slightly arcuate, the latter half nearly straight, narrow, the greatest diameter contained about 7 times in the length of the shell; caliber gradually, increasing from the apex to within about a millimeter of the aperture, then quite perceptibly contracting. A trifle compressed between the concave and convex sides. Surface polished, smooth, white. Apertures subcircular, their margins simple. Length 10 mill.; antero-posterior diam. at aperture 1.11, at greatest 1.33, at apex, 0.45 mill.; lateral diam. at aperture 1.23, at greatest 1.4, at apex 0.5 mill. Type measurements: length of shell, 11; diameter at anterior end, 1.25; at posterior end, 0.75 mill. The contraction toward the aperture is very slight, and mainly confined to the convex side. The surface is eroded near the apex in all the specimens collected, so the measurements of apex are approximate. While quite slender, it is still somewhat stouter than *C. aberrans*; and *C fusiformis* is less constricted at the aperture. Our description and figures of this species and *C. tolmiei* are from part of the original specimens, kindly transmitted by Dr. C.F. Newcombe. Dall writes:--"This shell, in some lights, appears to have longitudinal streaks of more or less opaque white, but there is not development of longitudinal sculpture. "The only other species described from this region is *Cadulus aberrans* Whiteaves, which is larger and more arcuate. An apparently undescribed species from the east coast of North America, near Cape Hatteras, North Carolina, is very close to *C. hepburni*, though the slight differences observable may be thought sufficient, taking the habitat into consideration, to separate it specifically. I have named the Columbian species in honor of the late James Hepburn, Esq., on of the earliest collectors of British Columbian mollusks, and who is well known for his contributions to the herbaria of European botanists" (pp. 194-195)[22].

Description: Shell small, polished, smooth, white, nearly straight
Size: length of shell, 11 mm; diameter at anterior end, 1.25 mm; diameter at posterior end, .75 mm[8]
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour: white[8]
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality: Near Victoria, British Columbia, 60 fms.[8]
Geographical Range: Alaska-Knight Island[1]; Southeastern Alaska/Prince William Sound[6] to California-Catalina Island[1]; Baja California[12]
Latitude: 37-61 N[16]
Depth Range: 37 m[6] to 200 m[6]
Habitat:
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks:
Figure: plate 1, fig. 13[8]; fig. 1b, p. 234[19]; Plate 35, figs. 19, 20[22]
References: [1]Abbott 1974, [6]Baxter 1983, [8]Dall 1897, [12]Austin 1985, [16]Bernard 1967, [19]Shimek 1989, [22]Pilsbry and Sharp 1897-1898

Family: Pulsellidae Scarabino, 1982

Genus: *Compressidens*
Species: *stearnsii*
Author: Pilsbry and Sharp, 1897
Synonymy: *Cadulus stearnsii* Pilsbry and Sharp, 1898; *Dentalium simplex* Pilsbry and Stearns, 1897; non Michelotti, 1861[1]
Common Name: Stearns Toothshell
Original Description: no longitudinal sculpture; quite thin; deep water species; no apical notch; short, decidedly curved, very rapidly tapering; tube vertically compressed; length 8-6 mill., 4 1/2 times the greatest diameter (p. xxi)[22]; Shell short, decidedly curved, the bend mainly in the posterior half, very rapidly enlarging, tapering regularly from the large aperture to the apex; thin bluish-white, a little translucent, more or less flecked with opaque white (by incipient surface decay), or with eroded spots. Glossy, with close, fine, distinct growth-striae, very obliquely passing around the tube, bending backward on the convex, forward on the concave side; in most specimens also showing faint, low traces of longitudinal cords on the convex side. Aperture somewhat wider than long, white oblique, the peristome thin. Anal orifice circular, simple when perfect, but often with irregular, broken edge. Length 8.6, diam. at aperture antero-posteriorly 1.;7, laterally 1.9 mill.; diam. at apex 0.7 mill. Off Tillamook Harbor, Oregon, in 786 fms. (U.S. Fish Commission). Less compressed and much more arcate than *D. brevicornu*, and more distinctly striated circularly. It tapers more rapidly than *D. pressum* and is less compressed. *D ophiodon* and *D. platyceras* are conspicuously slenderer. The longitudinal cords are variable in prominence, sometimes hardly noticeable. When well developed they are rather coarse, and of the same character as in *D. pressum*.

Type no. 107700 U.S. Nat. Mus. (pp. 125-126)[22]; Shell strongly curved, but little compressed, densely obliquely striated, the length 8.5 mill., about 4 1/2 times the greatest diameter, West American (p. 124)[22].

Description:

Size: length, 8.6 mm[6]

Apical Characteristics:

Apertural Characteristics:

Sculpture:

Apertural Characteristics:

Colour:

Radula:

Other Significant Morphological Characteristics:

Type Depository:

Type Locality: Off Tillamook Harbour, Oregon, 786 fms.[3]

Geographical Range: British Columbia[1] to Baja, California[1]

Latitude: 30-54 N[16]

Depth Range: 73[6] to 1437[6] metres

Habitat:

Frequency of Occurrence:

Original Descriptions of Synonomized Specimens:

Remarks:

Figure: Plate 22, figs. 53, 54, 55[22]

References: [1]Abbott 1974, [3]LaRocque 1953, [6]Baxter 1983, [16]Bernard 1967, [22]Pilsbry and Sharp 1897-1898

Genus: *Pulsellum*

Species: *aberrans*

Author: (Whiteaves, 1887)

Synonymy: *Cadulus aberrans* Whiteaves, 1887; *Cadulus hepburni* Dall, 1897[5,19]; *Cadulus fusiformis* Pilsbry and Sharp, 1898[19]; *Cadulus nitentior* Arnold, 1903[19]

Common Name: Aberrant Toothshell

Original Description: shell slender, moderately but distinctly curved, large and much elongated for the genus, increasing very slowly but regularly in diameter, not distinctly (if at all) swollen in advance of the middle, and very slightly and scarcely perceptible constricted immediately behind the aperture; test extremely thin, surface polished, very glossy and shining, smooth to the naked eye, but under a lens it is seen to be marked with minute and transverse but somewhat oblique lines of growth[15]: Length of an average full-sized example 3.5 mill., greatest breadth of the same near the anterior end 1.3 mill. (Whiteaves); This little shell, which is, nevertheless, of large size for the genus, looks not unlike an immature *Dentalium*, and , at first sight, specimens of it might be easily mistaken for half-grown examples of *D. pretiosum* Nuttall, which the Indians say occurs at the same locality. It may, however, be distinguished from any *Dentalium* by its thin test and highly polished outer surface, though the swelling of the shell in advanced of the middle and the constriction behind the aperture which are usually marked characteristics in the genus *Cadulus*, are reduced to a minimum in this species, and in most specimens are quite imperceptible (Whiteaves) (p. 193)[22].

Description:

Size: length, 13.5 mm; greatest breadth, anterior end, 1.3 mm[15]

Apical Characteristics: aperture oblique, round[19]

Apertural Characteristics: aperture round, not lobed[19]

Sculpture:

Colour: lustrous, translucent white[19]
Radula: formula: 1-1-1-1-1[19]
Other Significant Morphological Characteristics:
Type Depository:
Type Locality:
Geographical Range: Prince William Sound, Alaska[19]; Southeastern Alaska[6,19] to San Clemente Island, California[1]
Latitude: 50-52 N[2]
Depth Range: off shore/1[1] to 300[1] metres
Habitat: mud bottom sediments[15]; clean well sorted sand[19]
Frequency of Occurrence: Abundant[15]
Original Descriptions of Synonomized Specimens:
Remarks:
Figure: fig. 2, p. 124[15]; fig. 1a, p. 234[19]: Plate 35, fig 16[22]
References: [1]Abbott 1974, [2]Bernard 1970, [5]Kozloff 1987, [6]Baxter 1983, [12]Austin 1985, [15]Whiteaves 1887, [19]Shimek 1989, [22]Pilsbry and Sharp 1897-1898

Genus: *Pulsellum*
Species: *salishorum*
Author: E. Marshall, 1980
Synonymy: none[4]
Common Name: Salish Toothshell
Original Description:
Description: shell moderately curved; adult shell dull with a great deal of erosion, juvenile shells are glossy; widest diameter of the shell is at the apertural end
Size: maximum length 10 mm; average length 8.5 mm[20]; length, 10 mm[4]; 13.8 mm[6]
Apical Characteristics: circular, diameter 0.5 mm[4]
Apertural Characteristics: circular, diameter 1.3 mm[4]
Sculpture: none, growth rings are faintly visible under magnification[4]
Colour: white[4]
Radula: lateral tooth-hood-shaped with three moderately sharp cusps; central tooth-trapezoidal with a concave lower margin; marginal tooth-parallelogram shape with an anterior projection and a corresponding posterior socket[4]
Other Significant Morphological Characteristics:
Type Depository:
Type Locality: East Sound, Orcas Island, San Juan Islands, Washington (48°35'N, 122°51'W): 18-22 metres[4]
Geographical Range: Alaska - Prince William Sound/Kenai Peninsula, Cook Inlet[6,12] to South Lopez Island, San Juan Islands, Washington[4]
Depth Range: 3[4] to 426[6] metres
Habitat: sandy mud or gelatinous mud[4]
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks:
Figure:
References: [4]Marshall 1980, [6]Baxter 1983, [12]Austin 1985, [20]Shimek 1988

Family: Siphonodentaliidae Simroth, 1894

Genus: *Polyschides*
Species: *californicus*
Author: (Pilsbry and Sharp, 1898)
Synonymy: *Cadulus californicus* Pilsbry and Sharp, 1898
Common Name: California Toothshell, California Cadulus[1]
Original Description: Shell large and solid, well curved; smooth and glossy, growth-lines being very faintly indicated; opaque white, the posterior half bluish, subtranslucent, with a similarly colored rim at the mouth, or sometimes slightly bluish throughout. Stout, decidedly swollen anteriorly, the greatest diameter contained 4 1/5 to 4 2/3 times in the length of shell; the equator about at the anterior fourth, either oblique, well-marked and slightly subangular or less distinct and gently rounded, tapering rapidly toward both ends; outline of concave side noticeably convex in the region of greatest swelling. Section of tube a trifle flattened between the convex and concave sides at the equator or throughout. Aperture subcircular, somewhat oblique. Anal orifice rather large, slightly oval with no noticeable callus within, its edge irregular from breakage, but possibly two lateral nicks (see fig. 7) may be normally present. Length 14.3 mill.; antero-posterior diam. at aperture 2.25, at largest 3.33, at apex 1.0 mill.; lateral diam. at aperture 2.3, at largest, 3.4, at apex 1.1 mill. A more slender specimen measures: length 14.6, diam. at aperture 2.3 x 2.5, at largest 2.9 x 3.1, at apex 1.2 x 1.4 mill. Off Tillamook Bay, Oregon, in 786 fms., bottom temp., 37.3 deg F; off Cape St. Martin, California, in 218 fms., temp 43.2 deg F; off San Luis Obispo Bay, 252 fms.; off Santa Barbara Island, 414 fms.; off San Diego, in 822 fms., temp 39 deg F; also Gulf of Panama,, in 1,270 fms., temp., 36.4 deg F (U.S. Fish Commission). A large stout species, much exceeding *C. tolmiei*, *C. elavatus* and *D. dalli* in size, and more swollen and robust than either. The equator is nearer the aperture and more pronounced than in *C. tolmiei* Dall. The Atlantic forms *C. grandis* and *C. spectabilis* Verrill are somewhat similar, but the former is stouter, the latter longer them *C. californicus*. It varies considerable in inflation, some specimens (figs. 7, 8) being decidedly less swollen than that selected as type (figs. 5, 6). Type specimens are No. 107,698, U.S. Nat Mus. (pp. 180-181)[22].
Description: solid, stout (4 times as long as wide), swollen anteriorly; equator about at the anterior 1/4[1]
Size: length, 14-16 mm[1]
Apical Characteristics: large, slightly oval, margin of orifice is usually irregular from breakage but 2 lateral nicks are usually present[1]
Apertural Characteristics: subcircular, oblique[1]
Sculpture:
Apertural Characteristics:
Colour: bluish white[1]
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality:
Geographical Range: Alaska[1]-Clarence Strait[3,7] to Ecuador[1]-Manta[3,7]
Latitude: 1-56 N[16]
Depth Range: 109.7[1] to 1503[9] metres
Habitat:
Frequency of Occurrence: common[1]
Original Descriptions of Synonomized Specimens:
Remarks:

Figure: fig. 4551, p. 388[1]; Plate 34, figs. 5, 6, 7, 8[22]
References: [1]Abbott 1974, [3]LaRocque 1953, [7]Dall 1921, [9]Scott et.al. 1990, [16]Bernard 1967, [22]Pilsbry and Sharp 1897-1898

Genus: *Polyschides*
Species: *tolmiei*
Author: (Dall, 1897)
Synonymy: *Cadulus tolmiei* Dall, 1897; var. *Cadulus newcombei* Pilsbry and Sharp 1898[1]
Common Name: Tolmie Toothshell
Original Description: Shell small, thin polished, translucent bluish white, rather arcuate and rapidly tapering behind, the anterior orifice oblique, nearly circular, the posterior orifice circular, simple; sculpture none or only of obscure incremental lines[8]; Shell thin, polished, slightly bluish-white, a trifle translucent, rather arcuate; moderately swollen, the greatest diameter contained about 5 times in the length, situated about at the anterior third, thence tapering at first gradually and then rapidly to the apex, only slightly contracting toward the aperture; convex side strongly and evenly arched, opposite outline straight along the anterior half, concave posteriorly. Tube a trifle compressed vertically in the middle and anteriorly; sculpture none, or only of obscure, incremental lines. Aperture oblique, nearly circular; anal orifice subcircular, simple. Length 10.7, antero-posterior diameter at aperture 1.65, at greatest bulging 2.0, at apex 0.77 mill.; lateral diam. at aperture 1.72, at greatest 2.1, at apex 0.72 mill. Type measures: length of shell; 12.0; max. diam., 2.0; min. diam., 0.7 mill. Near Victoria, Vancouver Island, in 60 fms., with *C. hepburni* (Nat. Hist. Soc. Brit. Columbia). "This species is markedly different, both in arcuation and the inflation of the anterior part, from either *C. aberrans* or *C. hepburni*. I have named it in honor of the late Dr. William Tolmie, of Victoria, sometime officer of the Hudson's Bay Co., who for many years contributed valuable material to the students of the ethnology and natural history of British Columbia, both in America and England." (Dall). *C. tolmiei* is smaller and less inflated than *C californicus* Pils. & Sharp, and the equator is less distinct. It is very similar to *C. rushii* from the Hatteras region in the Atlantic, but that is more attenuated posteriorly. with the type a specimen occurred differing in several respects, and probably at least varietally distinct. *C.* (*tolmiei* var.?) Newcombe. P.&S., n. var. About the length of tolmiei, but decidedly more slender, greatest diameter contained nearly 6 times in length, section of the tube markedly oval, compressed vertically throughout; aperture oval. Length 11.0; antero-posterior diam. at aperture 1.45, at greatest bulging, 1.66, at apex 0.66 mill,; lateral diam. at aperture 1.55, at largest 1.9, at apex 0.75 mill. (pp. 181-182)[22].
Description:
Size: length of shell, 12.0 mm; maximum diameter, 2.0 mm; minimum diameter 0.7 mm[8]
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour:
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality: Near Victoria, British Columbia, 60 fms.[8]

Geographical Range: Alaska - Prince William Sound/Kenai Peninsula, Cook Inlet[6,12] to Baja California[1]
Latitude: 27-51 N[2]
Depth Range: 104[6] to 1000[2] metres
Habitat:
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks: Abbott notes *Dentalium tolmiei* var. *newcombei* for British Columbia[1]
Figure: fig. 14.3, pg. 290[5]; Plate 1, fig. 8[8]; Plate 34, figs. 3, 4[22]; newcombei Plate 34, figs. 1, 2[22]
References: [1]Abbott 1974, [2]Bernard 1970, [5]Kozloff 1987, [6]Baxter 1983, [8]Dall 1897, [12]Austin 1985, [22]Pilsbry and Sharp 1897-1898

Genus: *Siphonodentalium*
Species: *quadrifissatum*
Author: (Pilsbry and Sharp, 1898)
Synonymy:
Common Name: Fourslit Toothshell
Original Description: Shell slowly tapering, hardly inflated, the apertural contraction slight and short; apex large, cut into 4 beveled teeth by 4 subequal slits; length 6 1/2-10 mill., about 7 times the greatest diameter (p. 147)[22]; shell arcuate, the bend greater posteriorly, slender, but slightly tapering, not swollen, subtransparent bluish, with a milky band near the larger end; smooth and rather glossy, the growth lines hardly visible; posterior third slowly tapering, the tube then nearly cylindrical almost to the aperture; quite near the latter it is contracted, the contraction greatest on the convex side. Greatest diameter contained about 7 times in the length of the shell. Aperture oblique, transversely oval; apex cut into four conical teeth by the same number of short slits; the tooth on convex side slightly longest the other three subequal in length, that on concave side wider and obtuse; edges of the teeth somewhat beveled distally. Length 8.6 mill., diam. at aperture 0.854 x 1.0 , at largest 1.12 x 11.22, at apex 0.65 x 0.7 mill. San Diego, California, 10 fms. (Henry Hemphill, in Acad. coll.); San Pedro (Smithsonian Institution). *Siphonodentalium 4-fissatum* Carpenter, *mss.* label in Smithsonian Institution collection. Extremely similar to *C. quadridentatus* of the Antillean fauna; but in the Californian species the aperture is somewhat less oblique, the apical slits are shorter, the teeth all more conspicuously beveled and the tooth on the convex side less elongated. These differences we would hardly hold of specific value were it not for the geographic separation of the two species; still they seem constant so far as our material goes (pp. 150-151)[22].
Description:
Size:
Apical Characteristics:
Apertural Characteristics:
Sculpture:
Apertural Characteristics:
Colour:
Radula:
Other Significant Morphological Characteristics:
Type Depository:
Type Locality:
Geographical Range: California-Monterey Bay[1,12] to Baja California[1,12]
Depth Range: 4[1] to 365[1] metres

Habitat:
Frequency of Occurrence:
Original Descriptions of Synonomized Specimens:
Remarks:
Figure: Plate 29, figures 10, 11, 12, 13[22]
References: [1]Abbott 1974, [12]Austin 1985, [22]Pilsbry and Sharp 1897-1898

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