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TABLE OF CONTENTS

ABOUT THE COVER: ARTIFACTS FROM THE HOLLEMBÆK SITE iv

COMMENTARY

PROBLEMS IN PROTOHISTORIC ETHNOGENESIS IN THE NAKNEK DRAINAGE:
AN UPDATE 6

BOOK REVIEWS

STEPHEN HAYCOX: ALASKA, AN AMERICAN COLONY - DON E. DUMOND 10

LISA FRINK, RITA S. SHEPARD AND GREGORY A. REINHARDT, EDS.: - MANY FACES OF GENDER:
ROLES AND RELATIONSHIPS THROUGH TIME IN INDIGENOUS NORTHER COMMUNITIES - ALICE B.
KEHOE 12

JUNE HELM, WITH CONTRIBUTIONS BY TERESA S. CARTERETTE AND NANCY O. LURIE: THE
PEOPLE OF DENENHED, ETHNOHISTORY OF THE INDIANS OF CANADA'S NORTHWEST TERRITORIES
- CAMILLE BERNIER 14

ARTICLES

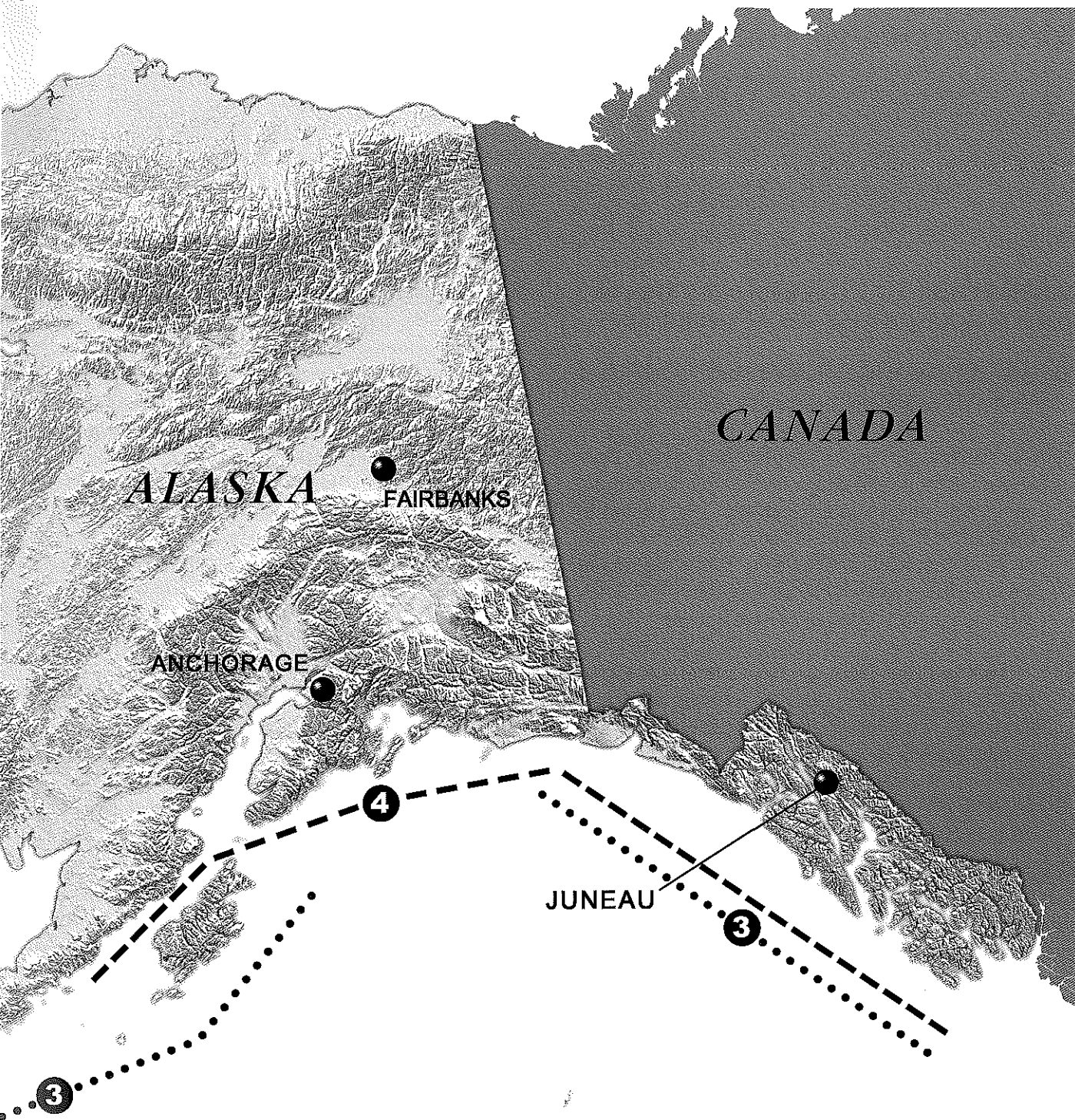
1 POSTGLACIAL CLIMATE AND VEGETATION OF THE WESTERN ALASKA PENINSULA - JAMES W.
JORDAN AND ANDREA KRUMHARDT 16

2 LITHIC RESOURCE ABUNDANCE AND EXPEDIENT TECHNOLOGY ON AGATTU ISLAND
- D. RANDALL COOPER 34

3 THE DEVELOPMENT OF LARGE CORPORATE HOUSEHOLDS ALONG THE NORTH PACIFIC RIM
- HERBERT D. G. MASCHNER AND BRIAN W. HOFFMAN 44

4 IMPLICATIONS OF "PUNCTUATED PRODUCTIVITY" FOR COASTAL SETTLEMENT PATTERNS:
A GIS STUDY OF THE KATMAI COAST, GULF OF ALASKA - ARON L. CROWELL, MARK
MATSON, AND DANIEL H. MANN 62





ABOUT THE COVER: ARTIFACTS FROM THE HOLLEMBAEK SITE

Notes by Patricia Browne¹

DESCRIPTIONS OF COVER IMAGES MOVING COUNTERCLOCKWISE FROM UPPER LEFT:

- (a) **Blue Ribbon Baking Soda Label:** Paper label from a "Blue Ribbon" baking powder tin.
- (b) **Gun Cartridge:** One of 12 spent shell casings contained within nested ginger and baking powder tins along with gun cleaning supplies. The casing is marked "W.R.A. 30 U.S.G." and was probably associated with a 30-40 Krag rifle. The Krag was in common usage by the U.S. military circa 1892-1903 and was a popular civilian firearm into the 1930s.
- (c) **Crystallized Egg Tin:** a LaMont's Improved Crystallized Egg Tin, surrounded by a Bright and lively lithograph. The label contains scrollwork and a flamboyant lettering style as well as color illustrations of chickens and an upturned egg box. Testimonials dating March and April, 1896, attest to the value of these eggs to those living in the Klondike. The condition of this tin is good. The screw lid to this tin is rusted shut. The contents of the tin appears full although remains undetermined.
- (d) **Cinnamon Spice Tin and Matches:** This small tin holds several packs of wooden matches. Microanalysis shows these matchsticks are pine (*Pinus* spp.). Evidently the tin was an excellent storage container as the matches were found dry and unharmed.
- (e) **Upper Right: Arm and Hammer Trade Card:** a small (4.76 cm by 7.3 cm—1 7/8" X 2 7/8") advertising trade card. Such cards were originally inserted by the manufacturer into a can of Arm and Hammer Soda. The card was part of a series and provided a consumer incentive to buy more cans of Arm and Hammer. The card is from the "Game Bird Series," number 18 of a set of 30. The front of the card features a chromolithograph of a Bufflehead

duck. The number 18 is imprinted on the top, left corner and on the bottom right is the copyright – "Copyright, 1904, Church & Dwight Co." This copyright date establishes the chronological marker for this site. A new series came out in 1906. The back of the card is a description of the series, advertising Arm & Hammer Soda, and a description of the Bufflehead duck. The condition is fair with a 1-inch tear on the right side.

Center:

- (f) **Small Glass Pharmacy Bottle:** bottle with cork stopper: a small (Height: 9.7 cm) colorless bottle with a cork stopper. The cork stopper is crumbling and remains are found inside the bottle. Lacking any maker's mark, its body is kidney-shaped in horizontal cross-section. The shoulders are sloped and the neck is tapered. The lip is flat on top and rounded on the sides.
- (g) **Pharmacy Bottle:** Odor suggests that this small medicine bottle contained gun cleaning solvent. It was plugged with a cotton rag that probably doubled as a bore swab. The bottle was contained within nested ginger and baking powder tins along with small rags and shell casings.

SITE DISCOVERY

In the spring of 2001, Scott Hollembaek, a Delta Junction farmer, his son and a family friend were hiking on State land along the Tanana River across from his farm (Fig. 1). Climbing a steep, rocky, bluff, they discovered a piece of coiled rope partially buried near the top of the trail. Upon further examination and a little digging, they uncovered several sections of telescopic stove pipe

¹These notes are excerpted from an unpublished report by Patricia Browne titled "The Hollembaek Site (XBD-201): An Early 20th Century Miner's Cache near Delta Junction, Alaska." The report was submitted to (and is on file at) the Alaska State Office of History and Archaeology, Anchorage.

that encased the remains of someone's personal belongings. In the process of removing the material out of its hiding place (Fig. 2) the Hollembaeks realized this was no ordinary find: it included antique spice tins with paper labels, a gold pan, a pair of Goodyear rubber mittens, two old-style shirts, a gun cleaning kit found secured inside a rusty baking soda can, a magazine article from the turn of the last century and two cans of LaMont's Crystallized Egg. In all, the three carried approximately fifty items back to Hollembaek's farm. Realizing this find was historically important and on state land, Mr. Hollembaek showed the site to Tanana Chiefs Conference Inc. archaeologists Bob Sattler and Tom Gillispie, who confirmed its significance. Mr. Hollembaek then contacted the Office of History and Archaeology (OHA) in Anchorage, a division of the Alaska Department of Natural Resources, to inquire about proper procedure. The artifacts were brought to the State Archaeology Lab in Anchorage and were analyzed for historical relevance. The artifacts have been accessioned to the University of Alaska Museum in Fairbanks (UAF), but will likely be displayed in the Sullivan Roadhouse Museum in Delta Junction through a loan agreement with UAF.

SITE LOCATION

The rocky bluff, where the miner's cache was discovered, is a striking presence along the Tanana River. Located on the east side of the mouth of the Volkmar River, 37 km southeast of Big Delta, this high bluff stands alone and is an obvious landmark for those traveling by boat or along the many area trails. Rising to an elevation of 501 m, this bluff is formed by igneous diorite and metamorphic quartz-biotite gneiss. This high point of land lies at the intersection of three rivers; the main Tanana, the Volkmar and the Gerstle. The Volkmar is a 53 km long northern tributary of the Tanana and curls along the east side of the bluff.

ASSEMBLAGE DATING

Dating this assemblage to 1905 is based on two important chronological markers; a magazine clipping and a baking soda trade card. One magazine article announces the Nov. 1, 1903 appointment of Rear Admiral William Capps. The other discusses the near completion of the Williamsburg Bridge. The bridge opened to traffic December 19, 1903. These two dates indicate the article was probably published mid-November or early December, 1903. The other chronological marker is the Arm & Hammer Soda trade card bearing the copyright date of 1904.

COMMENTARY

PROBLEMS IN PROTOHISTORIC ETHNOGENESIS IN THE NAKNEK DRAINAGE: AN UPDATE.

Roger K. Harritt, Environment and National Research Institute, University of Alaska Anchorage, 707 A St., Anchorage, Alaska 99501

Kerry Feldman's (2001) analysis of the bases for the King Salmon Traditional Council's application for tribal status is an important contribution to the anthropology of the northern Alaska Peninsula. It follows on the heels of several decades of focused research in this area by a number of researchers. Don Dumond is preeminent among the group. The comments presented here reflect my interest in late prehistoric ethnogenesis in the Naknek region and the relations between the human inhabitants of this period with those of surrounding environs.

Feldman's article illuminates the sociopolitical relations of the upper Naknek drainage people with those of adjacent areas, and it describes some of the characteristics of what is the recent end of a late prehistoric continuum of such relationships, that existed as early as AD 1500-1600. The study demonstrates the importance of combining different types of information from archaeology, sociocultural anthropology and archival records into a coherent evaluation of an issue now made prominent by the Traditional Council's claim. As a minor quibble, it is noted that Feldman's citations do not list important work on community histories in the area by Morris (1995), an effort that deserves mention in a study of this type.

The strengths of Feldman's analysis includes documentation of a traditional Yupik name for New Savonoski — '*Ulutluq*' or '*Ulutelleq*' — that he infers (pages 106-107) could be a part of the cultural baggage carried by refugees from Old Savonoski fleeing the 1912 eruption of Mt. Katmai (Novarupta) and who established New Savonoski. The location of the '*Ikak*' settlement along with one of the alternative names for Old Savonoski — Ukak — evokes speculation that some derivation of '*Ukakamiut*' also deserves some consideration as a possible name for the people of the upper drainage, based on patterns of Eskimo designations for groups, as many are derived from place names, and upon the identification of *Ukak* as one of the alternative names for Old Savonoski

(cf. Harritt 1997:Tab. 1). This possibility should be addressed in some future investigation. Such inquiries would do well to also expend efforts on determining whether group self designations can be established for other settlement locations in the drainage dating to the Bluffs phase and contact period, such as those located on Grosvenor Lake and the Grosvenor River (Harritt 1997:Tab. 3, Fig. 4). These suggestions are meant to encourage further investigation with an eye toward increasing the precision of distinguishing between groups in the region, thereby increasing the precision of our perceptions of them.

Feldman (pages 108-110) also presents examples of inter-group marriages and familial ties to the villages of the area include detailed accounts of marriages between former residents of Old Savonoski and Kodiak Island, one between residents of Old Savonoski and Ugashik, and a marriage between a residents of Old Savonoski and an immigrant *Alurmiut* (pages 108-110). This important information reflects a pattern in which marriages could occur between Old Savonoski residents and residents of territories as far away as Kodiak Island and the Kiatagmiut territory to the north and west. Also demonstrated is a mechanism in which marriages could occur between protagonists, in this case *Ullutellegmiut* and *Aglurmiut*, under circumstances where such relations would be mutually beneficial. The mechanisms and conditions in which systematic marriage exchanges between territories occurred that was initially suggested by Dumond (1994:110) is therefore demonstrated by specific cases. Marriages of persons from different territories relate directly to the existence of a definable late prehistoric-contact period society in the upper Naknek drainage (Harritt 1997, 2000). Examples of intersocietal unions have been documented in other Eskimo areas of Alaska and marriages between the upper drainage group and those of adjacent territories including Kodiak Island would be expected.

However, the nature of the interactions between the 'Alutiiq' of Kodiak Island and groups inhabiting areas of the Alaska Peninsula west of the Aleutian Range in other areas of social intercourse and matters related to day-to-day living have not yet been made clear. Such matters are important in establishing the ethnic integrity of the Old Savonoski group in the same way as the argument Feldman has made for the distinctiveness of that group from the *Aglurmiut*. The integrity of the inhabitants of Old Savonoski as a segment of a local, self-sustaining, operational ethnic unit – as a society – is necessarily part and parcel to the argument for tribal status for the King Salmon group. Otherwise, a claim to the King Salmon locality could also reasonably be made by the collective Alutiiq tribe, or Nation, whether their traditional homes were in the upper Naknek drainage, or on Kodiak Island, on the basis of a perception that King Salmon is simply traditional *Alutiiq* territory. In this respect the case of the King Salmon group is strengthened by demonstrating that specific families are associated with specific territories and locations.

In this regard anthropologist-proponents of the Alutiiqization of the inhabitants of the Bering Sea slope of the Peninsula in anthropological studies routinely point to broad correspondences in the material culture of Kodiak Island and the peninsula, and from there proceed to lump all together under the rubric of an 'Alutiiq' culture area (e.g., Clark 1984a:146-148; Steffian 2001:121-126). Presumably, if the suggested cohesiveness of Aluticisms were in effect across the region in late precontact times, the connections involved more than an occasional marriage between *Ullutellegmuiut* and a member of a similar type of Kodiak Island grouping, the *Qikexta ymiut* ('island people'; Clark 1984b:195), and more than simple trade relations. It is important to stress here that my reference is to terminology used by anthropologists, not to Native residents of the area who chose whatever designation they wish for themselves in modern times (cf. Leer 2001:31; Partnow 2001:68-69).

To this point, Dumond's (1994) assertions about connections between the Naknek drainage Bluffs phase and Kodiak Island Koniag cultures of 500-150 years ago have consisted of a suggestion of systematic marriage exchanges, inferences about declining use of pottery, an inference of shared symbolism and religion, and a general remark about sharing of material culture (Dumond 1994:110, 117; 2001:118). Steffian (2001:121-126) also suggests that trade provided much of the basis for relations between Kodiak residents and those of the Alaska mainland, however this interpretation reflects a geocentric perspective centered on Kodiak Island, rather than a

view from a pan-regional perspective that would give more equitable consideration to the residents of a given locality.

House form variations, another important element of the material culture of the region for this period, have been a topic of disagreements on distinctions between Kodiak Island houses and those of the upper and lower Naknek drainage (compare, Dumond 1994, 1998 and Harritt 1997). As Dumond (1998:71) rightly points out, virtually no houses have yet been excavated in the upper drainage for the period between the time the *Aglurmiut* arrived, around AD 1810, to the time the area was evacuated in AD 1912 due to the volcanic eruption. Presumably, the form of the upper drainage Ikak phase dwellings continued the pattern established during the Bluffs phase, but this suggestion requires testing through excavation of houses of this period in the upper drainage (*loc cit*). At this point in the debate I concur that the late pre-contact period, pre-*Aglurmiut* houses of Kodiak Island and the Naknek drainage possess similar elements in composition, including multiple rooms. Occasionally houses in the Naknek area also contain examples of the slab-lined hearths that appear to be common on Kodiak Island (Harritt 1988:Figs. 7 and 17; Dumond 1994, 1998). This concession does not, however, weaken my assertions concerning the existence of a Bluffs phase society, dating from ca. 500-90 years ago. I now believe, rather, that the characteristics and nature of the sociopolitical entity can be found more on the level of localized patterns and styles than in the qualitative attributes of the artifact assemblages. An avenue for addressing this problem is presented in the inaugural AJA issue, in an article by Steffian and Saltonstall (2001:1-27) in which labret forms and styles are used to investigate village affiliations and status on Kodiak Island. Presumably, their study could easily be expanded to include labrets from the Alaska Peninsula, with interesting results. The same type of fine-grained analysis should be applied to other artifact categories as well. Categories would include house design elements, to investigate the ethnic units that inhabited the Pacific Eskimo and Peninsula Eskimo areas, in order to define late prehistoric polities in the region or, at least, the cores of the interaction spheres (Steffian and Saltonstall 2001:4).

Alternatively, continuing the broad brush approach applied in early research efforts in the region, will perpetuate the perception that the late pre-contact inhabitants of the region were organized as concatenous social units that stretched across the Alaska Peninsula from Kodiak Island to the lower end of Naknek lake. But Feldman's analysis has demonstrated that the inhabitants

of a part of this region had a much more refined and specific group identity. And, given the modern import of this most recent investigation of Naknek region ethnogenesis, the ethnic identity of the members of a group such as the Katmai Descendants, is also of crucial importance in modern society. Their identity has been inherited from ancestors who resided in the Naknek Lake environs over the course of several centuries.

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2001 Markers of Identity: Labrets and Social Organization in the Kodiak Archipelago. *Alaska Journal of Anthropology* 1(1):1-27.

BOOK REVIEWS

ALASKA, AN AMERICAN COLONY

BY STEPHEN HAYCOX. (SEATTLE: UNIVERSITY OF WASHINGTON PRESS, 2002, ISBN: 0295982497, \$29.95). CLOTH, 392 PP., ILLUS., MAPS, BIBLIOG.,

Reviewed by Don E. Dumond, University of Oregon

After I began seasonal visits to rural Alaska more than four decades ago, I was telling myself that local social dynamics involved the interrelationship of three communities that were separable in at least ideal classificatory terms. These were, first, the completely permanent residents, including both Native and others who had come to identify themselves with the country, all of whom based their entire living on local conditions; second, members of active exploitative enterprises — chiefly canneries, in the area I was familiar with — who identified with the local region as they provided the capital that benefited themselves and the villages, but who seasonally withdrew profits to the lower forty-eight or elsewhere; and third, what I called to myself the remittance people, those who served locally and identified with local welfare, but were paid from outside the local economy and in most cases would leave after their terms of employment ended. These latter included the bulk of federal employees, but also many employed by the state, including schoolteachers. As I came to know them, members of the first two categories were heavily tilted toward development, the third more oriented toward conservation.

This book, a new history of Alaska, is a history in a relatively global framework of the development of an Alaska that could be described in that oversimplified way.

An introductory chapter sets out the geography of the north pacific region, including the distribution of Alaska's Native people when Russians arrived. Parts of this may seem the weakest of the book, although it is certainly not its real focus and can be thought a necessary orientational bow to the reading public, including Alaska Natives. I confess to some surprise at being told that except on St. Lawrence Island the Yupiit people (Yuit in the author's term) were matrilineal — an obvious misunderstanding, but a point of no particular importance to the intended thrust of the work.

Chapters that follow present the relatively familiar story of the Russian discovery of land and furs, their ex-

pansion through the Aleutians to Kodiak with incorporation of Natives as hunters, and on to Sitka and problems with the more recalcitrant Tlingit. Then, the competition between Russian entrepreneurs and the foundation of the Russian American Company and its monopoly. There are the relations with England, Spain, and the United States, the marginal attempts to develop an agricultural base to the Russian colony, including establishment of the short-lived Ross settlement in California, and some success in exporting ice. With the extended supply route, over-hunting of furbearers, and concurrent failure to pursue successfully avenues of exploitation such as local (but poor quality) coal and a whale fishery, by the mid-nineteenth century revenues began to be outstripped by costs. With Russian weakness demonstrated by the Crimean War, with the end of the U.S. Civil War and the expectation that the United States would continue its westward expansion with a shift to the Northwest, Russian America was put up for private sale to the U.S. — as a neighbor less objectionable to Russia than her Crimean War enemies, the British.

The lesson brought out here, in the context of international relations, is the difficulty of economic success in an exploitative enterprise with an over-extended supply line and an equally extended pathway to lucrative markets. But these problems to Alaska certainly did not vanish with the American purchase.

With almost no Americans resident in the newly bought territory, there was no incentive to provide the administrative infrastructure it would require. These investments were not made until after the discovery of gold, which not only provided some exportable wealth — although never very much in terms of the costs of government expansion — but also attracted settlement. As the population grew with outsider non-Natives, measures toward infrastructural development were finally taken, and Alaska came to be governed as a part of the United States. This was at the beginning of the twentieth century, concurrent with the developing fishing industry in southern

and southwestern Alaska that quickly outstripped gold as a source of exploitative revenue and attracted additional population. World War II brought even greater governmental expansion in the need to protect American shores.

The final expansionist jump was the discovery of oil and the establishment of means of its exploitation. Attendant on it, and not unrelated, the Alaska Native Claims Settlement Act pacified land claims, at least for a while, and ANILCA divided lands between those to be developed and those to be conserved.

And so the situation arrives that we are all familiar with: burgeoning non-Native population; oil revenues plowed into the Permanent Fund, channeled into village education networks, and directed to more and more administrative infrastructure as the former pre-oil tax base is abolished. Then the cost of state government expansion comes to exceed revenue from the dwindling oil cow, but is coupled with insistence on retention of the annual per-capita distribution of Permanent Fund income and resistance to the reestablishment of an income tax. Meanwhile, the value of the wild fishery resource shrinks in the face of international competition and fish farms.

A majority of permanent residents and members of exploitative enterprises combine to fight for more development; some permanent residents and probably a majority of those employed in the corps of federal employees stand up for less development and more conservation. At the same time, unlike the situation under the Russians in which the rural villages remained at a subsistence level, modern villagers crave everything the urban residents have in the level of living and services — for they, like all of us, are members of the modern world.

And Alaska? It continues with a sole economic hope pinned on development through capital imported from outside. There are still rural-urban differences, brought clearly to the fore by the subsistence issue and arguments about whether rights to its resources belong especially to rural people or equally to all Alaskans. And, of course, there is the fight over possible oil exploration in the Alaska National Wildlife Refuge — a dispute in the gulf between exploitation and conservation. These disputes so tellingly illustrated by the author are among the communities I thought I recognized in the 1960s, and that they must ultimately be settled for the Alaskan good is clear.

But their settlement will do nothing to change the colonial status assigned by Stephen Haycox to Alaska as a peripheral fragment of the United States — and so, the profound import of his title.

MANY FACES OF GENDER: ROLES AND RELATIONSHIPS THROUGH TIME IN INDIGENOUS NORTHERN COMMUNITIES.

EDITED BY LISA FRINK, RITA S. SHEPARD, AND GREGORY A. REINHARDT. (BOULDER: UNIVERSITY PRESS OF COLORADO, 2002, ISBN 0-87081-677-2). CLOTH \$45.00, 0-87081-687-X; PAPER \$19.95, 257 PP., TABLES, FIGURES, ILLUSTRATIONS, NOTES, REFERENCES, INDEX.

Reviewed by Alice B. Kehoe, University of Wisconsin-Milwaukee

Following the editors' good overview of gender research by anthropologists working in the North, this volume is divided into three sections and a synthesizing discussion. Part I, "Contemporary Research" presents Henry Stewart discussing Netsilik *kipijuituq*, a hitherto-unreported variant on Inuit beliefs about the malleability of gender; Lillian Ackerman stretching the geographic range a bit with a report on the independence of Plateau women (drawn from her new book, *A Necessary Balance: Gender and Power Among Indians of the Columbia Plateau* [University of Oklahoma Press]); and Carol Zane Jolles using the life of Linda Womkon Badten to illuminate St. Lawrence Island Yup'ik. Part II, "Historical and Ethnoarchaeological Approaches," gives us Rita Shepard on Unalakleet River and Jennifer Ann Tobey on Deg Hit'an house changes concomitant with Christian mission intrusions, and Lisa Frink on Chevak Yupiit women's management of resources. Part III, "Material and Spatial Analysis", a label that could include Shepard's and Tobey's chapters, has Barbara Crass surveying and analyzing child and infant burials in the Arctic; Greg Reinhardt questioning how "women's" and "men's" tools came to be located within an archaeologically excavated house; Brian Hoffman explaining that Aleut women gave up eyed bone needles for ones with a grooved end which caught the thread, in order to do finer embroidery; and Peter Whitridge discussing Late Prehistoric metal use in the Central Canadian Arctic, where men more often than women had iron-bladed tools.

Hetty Jo Brumbach and Robert Jarvenpa's concluding discussion emphasizes the late and limited colonization of the Arctic, allowing persistence of indigenous cultural patterns that makes the region, in their words, a "laboratory of change." Issues they point to include: a prevalent lack of attention to indigenous children, a topic which Crass and Stewart address in this volume; the importance of focusing on processing and storage rather than merely on subsistence procurement among non-agricultural societies; and Ackerman's perspective that matrilineal com-

munities' in-marriage men found a refuge in *qasgis/kashim*. The buildings' central position may translate not as dominance but as marginal. Brumbach and Jarvenpa nuance the argument by asking whether the Central Inuit *qargi*, with whaling materials described by Whitridge, might have seemed more important to the men who used it (as well as to ethnographers) than to the community women working in their own houses. One thinks of nineteenth-century American convention that men away from the home were more important to public life, while women ultimately would be more influential through bringing up sons. There is a psychological angle here, too, in that pulling boys away from women's homes gave them some breathing space. The most parsimonious interpretation is simply that whaling requires crews of men (upper-body strength was really vital before rifles) and heavy equipment needs storage space, therefore, *qargi* workshops. I would also suggest that because flintknapping can endanger small children whose eyes are on the level of flying chips (personal observation when standing with a two-year-old near a knapper), knapping is more safely done away from dwellings.

Brumbach and Jarvenpa contribute, from their own research in subarctic Saskatchewan, the observation that "increased settlement centralization" required an increase in storage facilities, which appear in the archaeological record as smaller structures lacking a range of domestic refuse. Their ethnographic inquiries indicate storage structures are labeled as women's or men's storehouses. Brumbach and Jarvenpa take issue with Whitridge's notion that detached kitchens in his Thule whaling community "conceal" and "marginalize" women's work, whereas the *qargi* elevates men's work. They argue that increased specialization of tasks may lead to separation of activity loci but there is no inherent ranking of dominance or marginalization. They suggest we should not laugh off the common experience that while men boast of their importance, women firmly exhibit the crucial value of their own contributions.

This volume is quite fascinating to read. Each chapter contains good data, carefully presented and explicitly argued. The editors' guiding hands can be glimpsed, producing a high level of compatibility across a broad range of research. Because each author clearly discusses the leap from data to interpretation, the volume can be recommended as a textbook, although that was probably not the editors' chief goal. The mix of archaeological and ethnographic studies makes it a fine example of anthropology's holistic approach. Note, incidentally, that the volume is co-published in the U.S. and Canada.

THE PEOPLE OF DENENDEH, ETHNOHISTORY OF THE INDIANS OF CANADA'S NORTHWEST TERRITORIES

BY JUNE HELM WITH CONTRIBUTIONS BY TERESA S. CARTERETTE AND NANCY O. LURIE.

(IOWA: UNIVERSITY OF IOWA PRESS, 2000. ISBN: 0877457352, \$39.95). CLOTH, 387PP., MAPS, BIBLIO., INDEX.

Reviewed by Camille Bernier, University of Wisconsin-Madison

The People of Denendeh is the culmination of fifty years of detailed research by June Helm among the Dene of the Northwest Territories, Canada. The book is a compilation of self-contained essays drawn from previously published writings; her unpublished field notes and those of her field companions, Nancy O. Lurie and Teresa Carterette; nineteenth century writings; and narratives by several Dene themselves. Helm's objective is "to offer a record of ways of life that, for all of us, grow dimmer as they recede year by year into the past" (p.xi).

The volume is organized into three parts. Part one includes concise analyses of social organization, community and daily life as it existed fifty years ago for the Mackenzie Dene. Helm outlines the routines, rhythms and rigors of seasonal bush living – hunting, gardening and snaring practices, settlement patterns, trading fort congregation, and the economics of the fur market. She considers the intricacy of European-Indian relations, specifically the impact of a fluctuating fur market and the desire for Western goods.

In part two, Helm reviews the history of the Dene from early contact to the stabilization of the fur trade. In the final chapter, she returns to the 1970's with a critical look at Dene-government relations. She demonstrates the complementarity of archival history and oral tradition by interweaving the accounts of missionaries, fur traders, and early explorers – obtained from published and archival sources – with the words of Dene individuals discussing their memories of "the old time way," mission life, and early treaty years. In the final chapter of this section, the author presents the testimony of scores of Dene people given during the 1975-76 hearings of the Mackenzie Valley Pipeline Inquiry. Their poignant comments focus primarily on the personal and communal struggles encountered by the Dene following contact and the subsequent imposition of western systems of governance and education. Many Dene reflect on the loss of

self-reliance in the wake of assimilation and lament the dependency fostered by the western system.

In Part three, entitled 'Being Dene,' Helm considers traditional knowledge and customs. She attends to the meaning and manifestation of *in'kon* or power; concerns and practices regarding blood and femaleness; and *nakan*, or 'bad Indians' who are believed to prowl the bush in springtime. Four well-known Dene legends – *Always Walking*, *The Copper Woman*, *The Origin of the Dogribs*, and *The Captive Woman* – are included to impart salient Dene cultural understandings. There is also a detailed discussion of the Dogrib hand game and the tradition of brew drinking.

Helm combines her use of archival materials, tribal oral tradition and histories, and documented accounts of Indian life in the subarctic to shed light on decades of both change and continuity before and after contact. This holistic approach not only provides the reader with an excellent ethnological understanding of the Mackenzie Dene, but also a perspective on the processes of culture change from the standpoint of the *longue durée* in Dene culture. The essay entitled *Dogrib Oral Tradition as History: War and Peace in the 1820's*, stands out as an exemplary contribution to understanding Indian historicity. The essay synthesizes written historical accounts with the oral accounts of twelve Dogrib individuals underscoring the importance of oral tradition to comprehending and interpreting events of the past.

This book is remarkable for the breadth and depth of the ethnographic research on which it is based. Helm's research activities in the region spanned the period from 1951-1975, providing her with a comprehensive and longitudinal perspective on the Dene. Although the historical run of the text ends with the 1970s, Helm provides current updates on several issues. For example, in part one, detailed discussions of fall caribou hunting in 1820

and in the 1960's is followed with commentary on caribou hunting in 1999 that now can include the use of satellite maps. Helm also adds contextual documentation throughout the book in the form of brief explanatory notes to clarify and enrich the readers understanding.

This corpus of work is very accessible, generally free from fashionable jargon. The essays will undoubtedly be of interest to any anthropologist or historian seeking to understand the Canadian Subarctic, and are also useful to scholars studying North American Indian peoples for the ethnological and ethnohistorical information they provide. In addition, this corpus of work will be of value to anthropologists working farther afield who have an interest in processes of culture change. Finally, Helm's work is a wealth of knowledge for Dene themselves, as it provides tremendous insight into the persistent identities and richly textured lives of their ancestors.

POSTGLACIAL CLIMATE AND VEGETATION OF THE WESTERN ALASKA PENINSULA

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Abstract: Pollen analysis of a sediment core at Cold Bay, Alaska, indicates a sequence of four vegetation zones representative of trends in postglacial climate. The sequence suggests cool, relatively dry conditions from 9000 – 6200 yr B.P. (^{14}C years); warmer, moister conditions from 6200 – 3200 yr B.P.; cool, moist conditions from 3200 – 2100 yr B.P.; and cool, wet conditions from 2100 – 0 yr B.P. Vegetation throughout the record consisted of treeless tundra dominated by shrubs, herbs, and grasses. Regional pollen records are influenced both by climatic factors and volcanism. The lack of visible volcanic ash deposits in the core described here, and its evidence of a regionally documented shift toward sedge-dominated vegetation about 3000 yr B.P., suggest that the site provides a good approximation of regional climate change during the Holocene. The transition to cooler moister conditions after 3200 yr B.P. is also recorded by coastal dune stabilization on the western Alaska Peninsula, and is broadly correlative with Neoglacial indicators in southern and western Alaska. Changes in solar radiation and shifts in the position and intensity of the Aleutian low-pressure and North Pacific high-pressure centers are the dominant mechanisms of postglacial climate change.

Key words: Disturbance, Effective Moisture, Neoglacial Climate

INTRODUCTION

Investigations of paleoclimatic change are important for understanding the mechanisms and consequences of global environmental change. Reconstructions of Holocene environmental conditions in southern Beringia (western Gulf of Alaska through the Aleutian Islands, Figure 1) emphasize the spatial complexity of vegetation change and the variable influences of postglacial climate on regional biogeography (Anderson and Brubaker 1993; Barnosky et al. 1987; Hu et al. 1995). Paleoenvironmental interpretations based on pollen records have stressed both climatic (Ager 1982; Anderson and Brubaker 1993; Hu et al. 1995) and edaphic (Heusser 1983, 1990) controls. Postglacial flooding of the Bering platform and latitudinal shifts in the position of the Aleutian low-pressure and North Pacific high-pressure systems during the Holocene have influenced temperature, cloud cover, and the distribution and intensity of precipitation. But pervasive Holocene volcanic and seismic activity in the eastern Aleutian arc (Begét and Nye 1998; Carson 1998; Coats 1950; Miller and Smith 1987) complicates interpretations of vegetation–climate relationships because this activity influences sedimentation, pedogenesis, and topography.

This paper presents new pollen data from a sediment core in marsh deposits at Cold Bay on the western Alaska Peninsula (Figure 2). The 9000-year pollen record is

compared with previous records from the nearest sites in the region – Umnak Island in the eastern Aleutian chain and the Shumagin Islands and adjacent Alaska Peninsula (Heusser 1973, 1983). These paleoclimatic data are important because they fill a geographic gap in the environmental history of eastern Beringia (Hu et al. 1995) and add to our understanding of the relationship between postglacial vegetation and dynamic environmental change in southern Beringia.

SETTING

The study area extends from Unimak Island in the west, and includes the western Alaska Peninsula as far east as Port Moller and the Shumagin Islands in the east. It is centered at about 55° N/163° W. A maritime climate prevails over the region and vegetation consists of treeless tundra. Average annual precipitation ranges from 850 to 1500 mm (increasing to the west) with annual air temperatures averaging 4°C. Annual wind speed from all sectors averages 30 kph with highest velocities exceeding 130 kph in winter. Grasses (Poaceae), sedges (Cyperaceae), crowberry (*Empetrum*) and lichen dominate coastal tundra vegetation, with willow (*Salix*, sp.), dwarf birch (*Betula nana*) and alder (*Alnus crispa*)

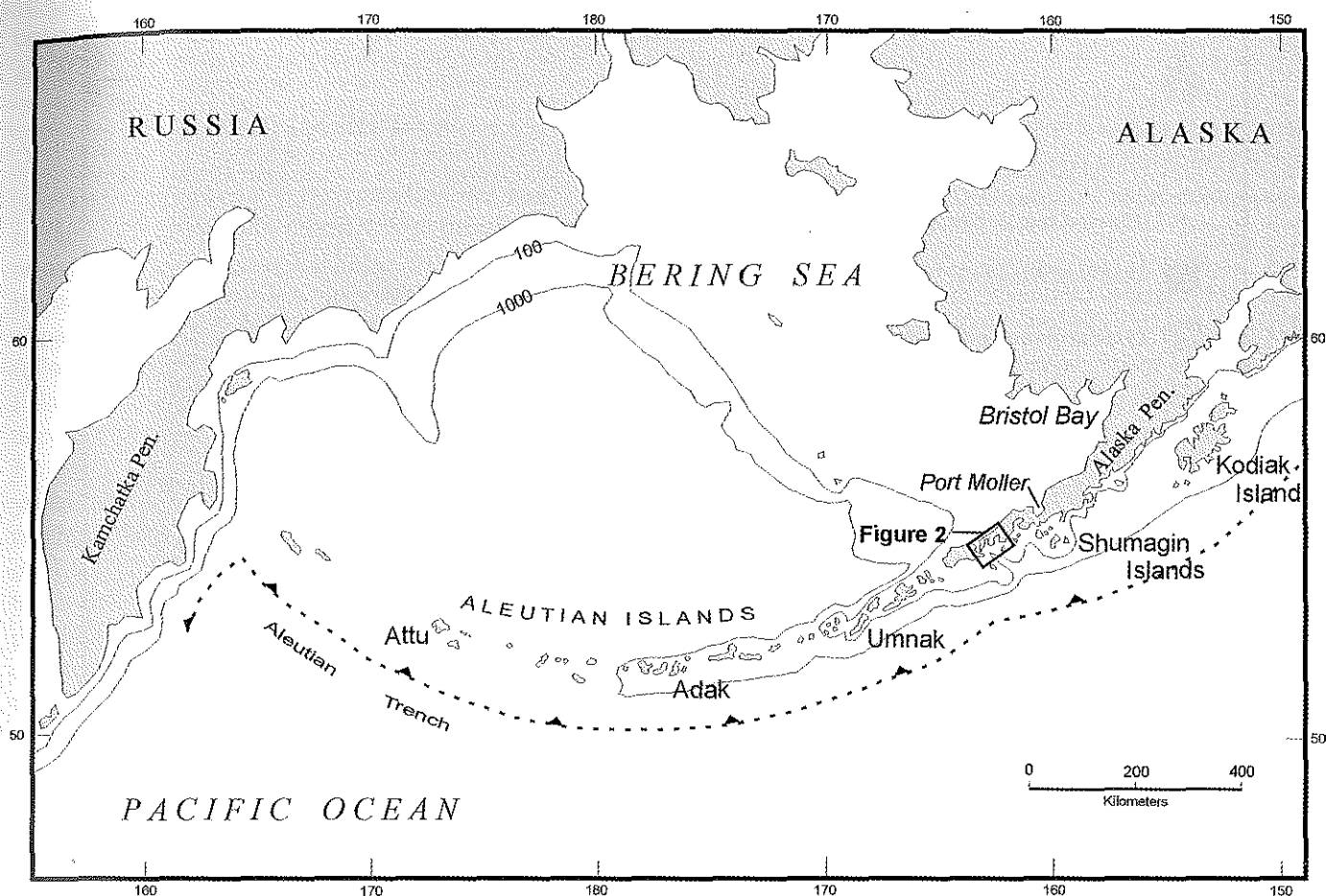


Figure 1. Map of the Aleutian arc showing places mentioned in text. 100 m isobath roughly corresponds to limit of subaerial exposure of the Bering platform during the Last Glacial Maximum.

occurring in more sheltered areas (Viereck et al. 1992). Vegetation cover thins rapidly with elevation because of exposure to persistent wind. Bluff edges and moraine crests higher than about 30 m above sea level (asl) are typically drier and deflated, and support only limited soil cover and restricted patches of *Empetrum* or dwarf willow.

The western third of the peninsula and eastern Aleutian Islands are relatively isolated from the Alaskan mainland and separate the relatively warm waters of the north Pacific Ocean from the colder shelf waters of the eastern Bering Sea. The position of the eastern Aleutian arc between seas with such differing physiographic and climatologic characteristics means that frequent and often violent cyclonic storms are generated along its axis. The Aleutian low-pressure anomaly is centered over the archipelago, and is responsible for much of the cyclogenesis over northwest North America (Hare and Hay 1974; Terada and Hanzawa 1994).

Lowland physiography is inherited from late Wisconsin glaciation of the Alaska Peninsula, when a nearly continuous ice cap was centered on the Pacific side of the Alaska Peninsula and on the eastern Aleutian

Islands. Alpine and continental ice of the Alaska Peninsula Glacier complex (Mann and Peteet 1994) flowed north across the peninsula, depositing moraine complexes and outwash on the Bering Sea shelf (Funk 1973; Waldron 1961). Ice-rafted glacial erratics on the narrow Pacific shelf (Kent et al. 1971) indicate that glaciers terminated at tidewater south of the peninsula. Ice retreated rapidly between 14,000 and 11,000 radiocarbon yr B.P. (Black 1976; Detterman 1986; Dochat 1997; Mann and Peteet 1994). Rapid deglaciation is attributed to warming of the North Pacific Ocean following an increase in global temperature between 14,000 and 12,000 yr B.P., with the subsequent rise in eustatic sea level accelerating the disintegration of tidewater glaciers. Peaks above about 1500 m carry alpine glaciers today, many showing evidence of advance and retreat during the Holocene (Black 1979). Glacial sediments form the heads of bays on the Pacific coast, and are reworked locally into spits and beach ridge complexes. Ground moraine is extensive and connects former volcanic islands at Pavlof, Cold, and Morzhovoi bays (Wilson et al. 1992). Lag deposits of glacial cobbles and boulders occur in many intertidal settings and reflect marine erosion of moraine and outwash deposits.

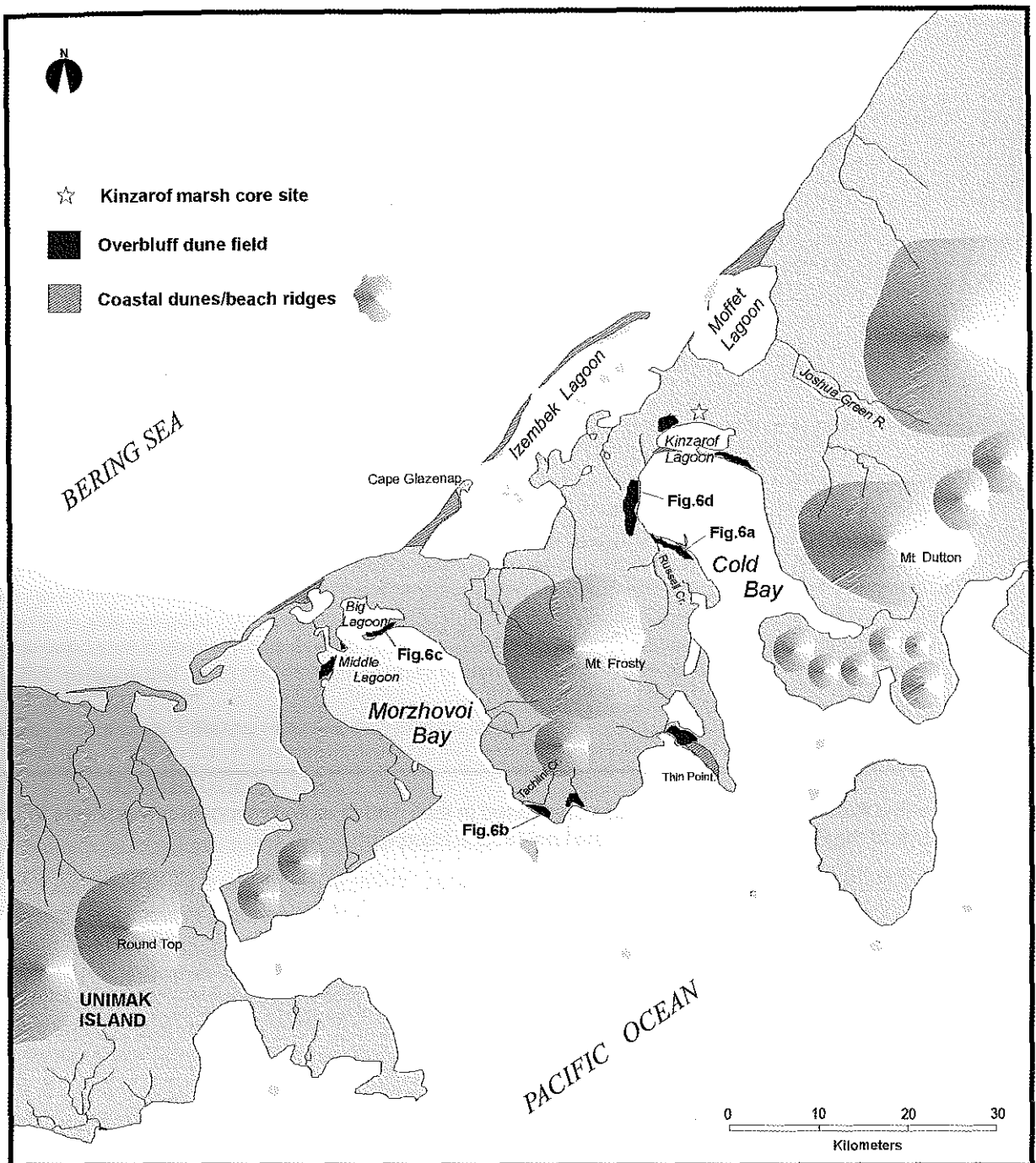


Figure 2. Map of the western Alaska Peninsula showing locations of the Kinzarof marsh core site and major eolian deposits.

Unconsolidated surficial deposits consist of primary airfall tephra and wind-blown glacial, volcanic, and littoral sediments. Lahar or ash flow deposits are locally important parent materials (Miller and Smith 1977; Ping et al. 1988). Tephra deposits vary in thickness because of proximity to source, prevailing winds, and eruption intensity. Only one tephra, associated with the eruption and formation of Fisher caldera on Unimak Island, can be correlated visually across the western Alaska Peninsula (Carson 1998). Radiocarbon ages on the Fisher ash cluster

around 9100 yr B.P. (Carson 1998; Dochat 1997; Funk 1973; Jordan 2001) and provide an important early Holocene chronostratigraphic marker.

Soils in the Cold Bay area formed in volcanic parent material that is basic relative to islands farther east (cf. Everett 1971; Ping et al. 1988), and a high proportion of colored volcanic glass indicates the intermediate to mafic composition of source materials (Shoji et al. 1993). Permafrost is absent in coastal plain soils, which have

SITE DESCRIPTION

The establishment of vegetation on deglaciated terrain throughout the eastern Aleutian arc is time-transgressive, occurring earlier with proximity to the mainland. A minimum age estimate for initial vegetation of parts of the upper Alaska Peninsula and Kodiak Island following deglaciation is 14,000 yr B.P. (Detterman 1986; Peteet and Mann 1994). Radiocarbon ages on basal peat deposits overlying glacial till on the western Alaska Peninsula and the Shumagin Islands cluster around 10,500 yr B.P. (Funk 1973; Heusser 1983; Jordan 2001; Jordan and Maschner 2000; Winslow and Johnson 1989). A date of $11,530 \pm 100$ yr B.P. (BETA-96829) on plant macrofossils that overlie till at Cold Bay (Dochat 1997; Jordan 2001) provides the earliest local evidence that shrub tundra was colonizing lowlands shortly after 12,000 yr B.P. None of the radiocarbon ages that have bearing on the timing of widespread deglaciation of the western Alaska Peninsula exceed the 11,500 yr B.P. age from Cold Bay, but evidence from adjacent areas of southern Alaska suggests that coastal areas were ice-free several thousands of years earlier (Mann and Peteet 1994; D.H. Mann, pers. comm. 1999).

As relative sea level rapidly fell during the early Holocene in response to isostatic adjustment to ice sheet disintegration, two prominent shorelines were cut in till and outwash at 25 m and 16 m asl on the western peninsula (Jordan 1997, 2001). Kinzarof marsh (informal name) occupies a basin 16 m asl, landward of the 5 km long marine terrace that rises 25 m above the inner margin of Kinzarof Lagoon at the head of Cold Bay (see Figure 2). The Kinzarof terrace (informal name) is mantled with wave-sorted pebbles and gravel and represents the local postglacial marine limit. It lies at a consistent elevation of 25 m asl, except where it is crosscut by presently underfit stream valleys. The lobate, landward edge of the terrace slopes steeply down into a narrow basin that backs most of the length of the feature. Kinzarof marsh has infilled this basin, which probably formed as a backbarrier lagoon that was impounded behind the emergent barrier bar during the early Holocene. Diatoms identified from organic sandy silt at the base of a 1.35 m core on the margin of the basin immediately landward of the terrace are dominated by *Fragilaria construens* spp., *F. pinnata*, *F. cf. nitzschoides*, *F. capucina* v., and *Fragilaria virescens* v. *exigua* (M. Winkler, pers. comm.), suggesting that the lagoon was freshwater.

METHODS

Sediment cores were recovered from several marshes in the Cold Bay area with a Russian peat sampler (Jowsey 1966). Core lithology was noted in the field and logged in detail prior to subsampling in the laboratory for pollen, diatom, and radiocarbon analyses. Twenty-seven samples were taken at 5 cm intervals from the 135 cm-long core obtained at Kinzarof marsh (Figure 3). Subsamples of 1 cm³ were prepared for pollen analysis following standard methods (Faegri and Iversen 1992; Shane 1992). *Lycopodium* tablets (Stockmarr 1972) were added to each sample prior to counting in order to calculate influx. Sample counting and pollen identification were conducted at the University of Alaska Fairbanks. All samples produced abundant pollen and spores. Samples were examined under 400x and 1000x (oil immersion) magnification until at least 300 terrestrial pollen grains were counted. The delineation of pollen zones was based on visual inspection of diagrams of pollen percentages and pollen accumulation rates (PAR).

Two samples from the core were submitted for radiocarbon dating. Ages are reported in ¹⁴C yr B.P. to facilitate comparison with radiocarbon ages reported from other pollen sections in the region. The lowest sample (130-133 cm) was taken from a lens of peaty fine sand and provided a ¹⁴C age of 8620 ± 60 yr B.P. (CAMS-41437). A horizon of sandy peat in the upper part of the core (41-43 cm) yielded a ¹⁴C age of 3650 ± 40 yr B.P. (CAMS-41438). Pollen accumulation and sedimentation rates (Figure 4) are based on linear interpolation between these dates. Maximum ages on peat stringers that overlie till in Cold and Morzhovoi bays predate the basal age of the Kinzarof marsh core by 1500 to 2000 years, but synchronous changes in pollen spectra that occur in other cores from the region (Heusser 1973, 1983, 1990; Hu et al. 1995) suggest that pollen stratigraphy is in general chronological agreement with regional palynological data.

VEGETATION AND CLIMATE HISTORY

Early postglacial vegetation assemblages in southern Alaska were dominated by herbaceous taxa (Ager 1982; Anderson and Brubaker 1993; Heusser 1985, 1990; Peteet and Mann 1994). On the Alaska Peninsula and eastern Aleutian Islands, pioneer taxa are indicative of local mesic and hydric habitats and included Cyperaceae, *Artemisia* and other members of the Tubuliflorae, prostrate shrubs such as *Empetrum*, as well as ferns, and *Equisetum*, with *Salix* and Poaceae as important secondary components (Heusser 1983; Peteet and Mann 1994). While most of these taxa are represented in basal

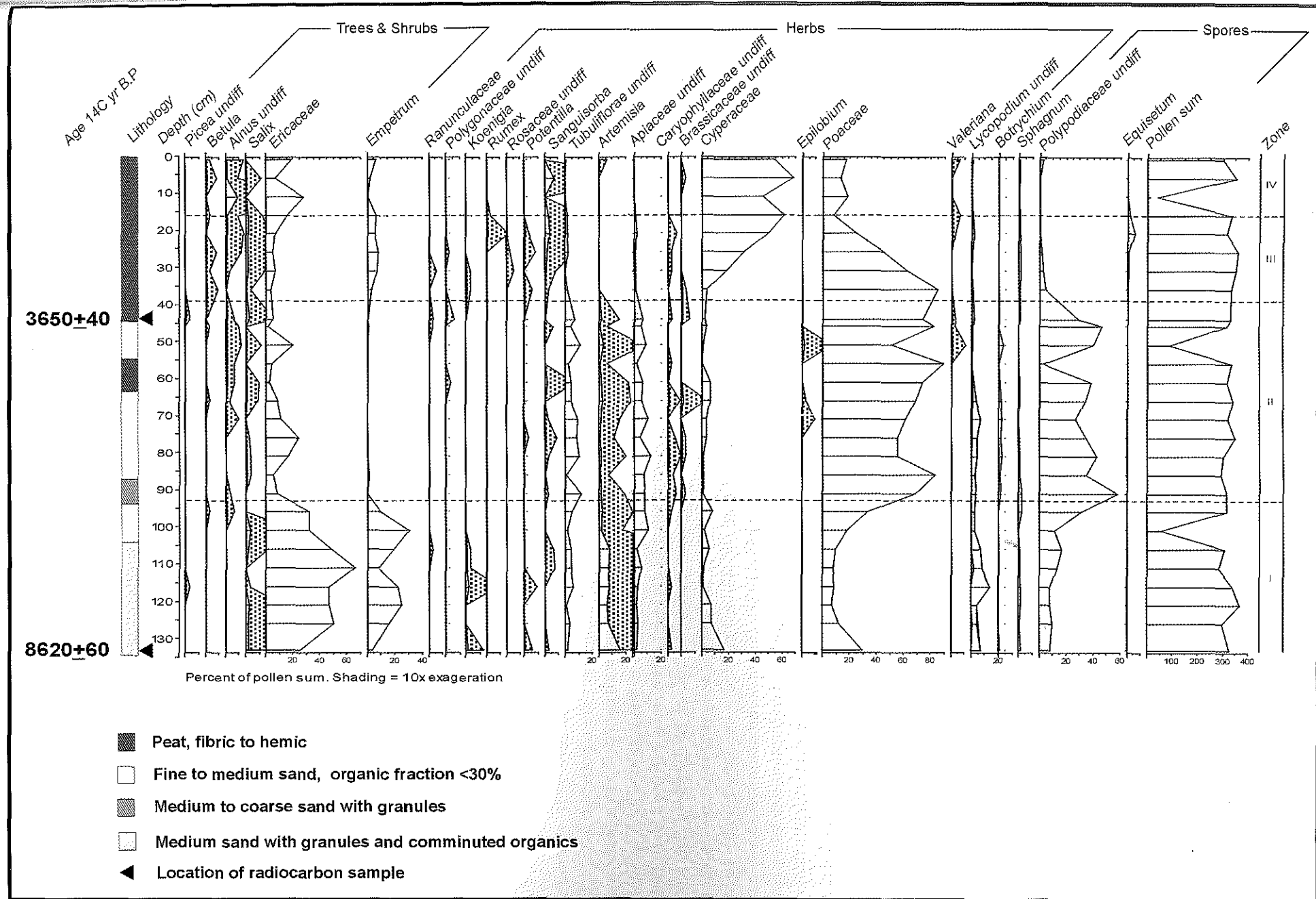


Figure 3. Pollen percentages, core lithology, and radiocarbon ages at Kinzarof marsh.

levels at all sites, differences in their relative abundance indicate strong microclimatic control on vegetation composition (cf. Matthews 1992).

Pollen stratigraphy at Kinzarof marsh records the development of vegetation communities near this site over time. The following zonation provides a framework to interpret vegetation characteristics from pollen abundance throughout the core. Vegetation – climate inferences are made based on the identification of pollen zones and are presented in a separate section.

Zone I (9000 – 6200 yr B.P.) *Empetrum shrub tundra*

A shrub tundra dominated by *Empetrum* and other Ericales and various forbs and grasses characterized the vegetation cover of the early Holocene landscape. High percentages of Ericales, particularly pollen of *Empetrum*, suggest that a dwarf shrub tundra occupied a variety of sites at mid- and low elevations (100 m to sea level). Poaceae and *Artemisia* are notable elements of the early landscape, and probably occupied more xeric upland sites. Minor amounts of Cyperaceae pollen and fern spores suggest that mesic-tundra communities may have been present locally. *Salix* pollen, while present in relatively low amounts throughout the core, reaches its highest percentages and PAR during this period. This suggests that shrub tundra communities containing significant amounts of willow probably were not common near Kinzarof marsh, but were appearing on the eastern Aleutian arc in the early Holocene (cf. Heusser 1973, 1983).

Zone II (6200 – 3200 yr B.P.) *Graminoid-forb and fern tundra*

The dramatic increase in pollen of Poaceae and Polypodiaceae (fern spores) indicates the appearance of tundra dominated by grasses and ferns about 6200 yr B.P. Tubuliflorae and Apiaceae reach their highest percentages and PARs during this period, suggesting that a variety of forbs and herbs became important components of tundra communities. Ericales drop in abundance but probably were common in exposed locations based on modern distributions. An increase in fern spores may indicate mesic tundra communities in coastal lowlands (Peteet and Mann 1994). Increased PARs among all of the dominant taxa of this zone suggest that vegetation cover became more continuous during the mid-Holocene than at the end of Zone I. The increase of *Alnus* seen in the PAR diagram in Zone I probably indicates its expansion on the eastern Alaska Peninsula and Shumagin Islands, but because of its capacity for long-distance wind transport it probably did not grow locally (Colinvaux 1981).

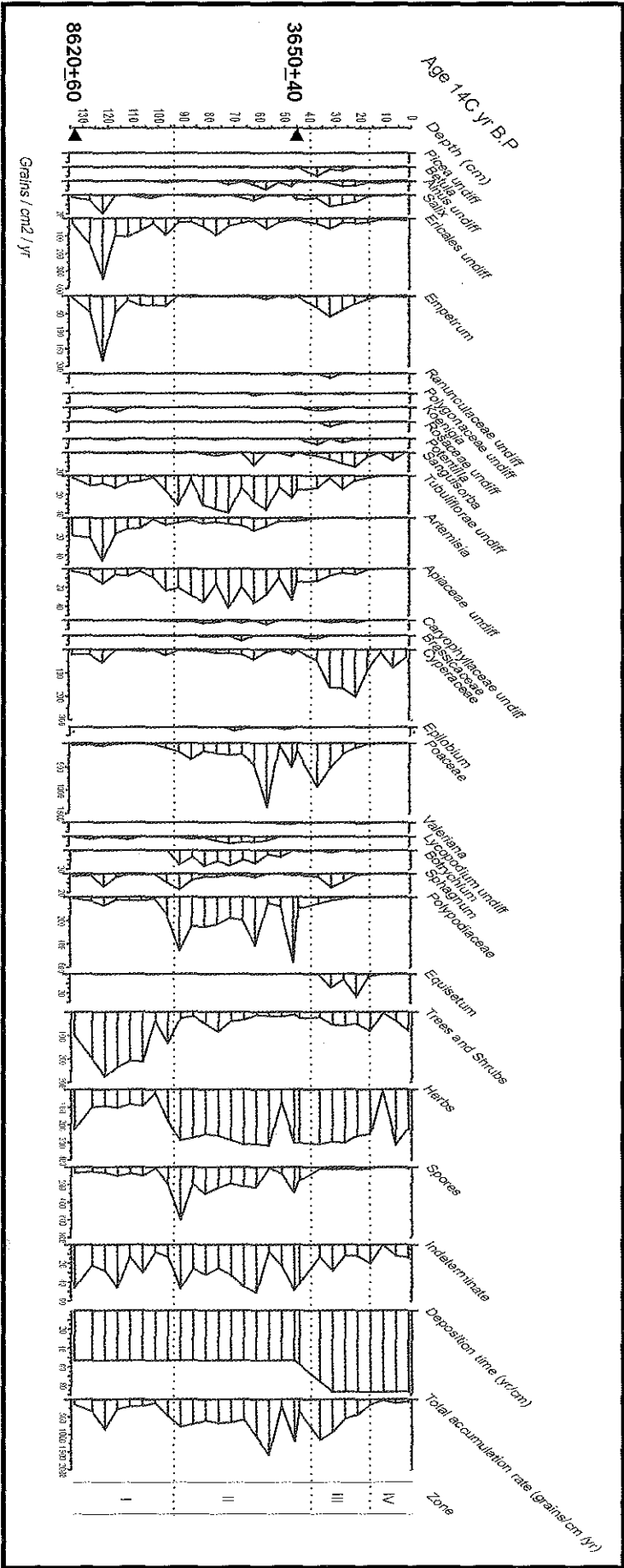


Figure 4. Pollen accumulation rates at Kinzarof marsh.

Zone III (3200 – 2100 yr B.P.) Sedge-Graminoid-*Empetrum* shrub tundra

This period marks a transition in tundra communities that spanned a thousand-year interval between the middle and late Holocene. It is represented by a major shift in the ratio of grasses to sedges and by a decline in ferns. Cyperaceae rose abruptly as Poaceae became a secondary component, suggesting local, comparatively wet edaphic conditions (Heusser 1989). Ericaceae and *Empetrum* pollen became more abundant, as did taxa common in mesic to hydric environments such as *Sanguisorba*, *Equisetum*, and *Sphagnum*. *Betula*, *Alnus* and *Salix* shrubs probably underwent regional expansion at this time based on their accumulation rates.

Zone IV (2100 – 0 yr B.P.) Sedge-*Empetrum* tundra

By about 2100 yr B.P. a tundra characterized by sedges and Ericales had replaced the grass and forb-dominated vegetation of the middle Holocene. Increased moisture availability is also suggested by an increase in pollen of *Sanguisorba*. Ericaceae and *Empetrum* became more abundant on the landscape and a relatively high percentage of *Alnus* pollen probably indicates the arrival of this shrub in the region.

In summary, pollen spectra at Kinzarof marsh indicate a vegetation succession that begins in the early Holocene with the dominance of Ericaceae and lesser amounts of Poaceae and *Artemisia*, followed by an abrupt rise of Poaceae and ferns from 6200-3200 yr B.P. A pronounced transition to vegetation dominated by sedges occurs after 3200 yr B.P., with the modern sedge and shrub tundra being established after about 2100 yr B.P.

DISCUSSION

Disturbance mechanisms

Substantial variability in the pattern of change among species assemblages in coastal tundra communities led Heusser (1990) to identify volcanism as a disturbance mechanism that can overshadow climate as the primary control on succession. The effect of volcanism on vegetation varies widely among sites in the region. Geochemical composition, frequency, magnitude and season of eruption, mean annual precipitation, and postdepositional reworking are all factors that can influence site conditions and complicate interpretations of vegetation history. Topography, exposure, and substrate also will influence the response of vegetation to burial by tephra. Pollen sections of Holocene age on the central Aleutian islands of Adak and Atka, for example, record 24 and 17 tephra horizons, respectively (Heusser 1990). Vegetation assemblages at these sites have experienced

frequent and continuous successional disturbance. By contrast, 11 sites distributed between Umnak Island, the Shumagin Islands and adjacent Alaska Peninsula record between one and five tephras deposited during the Holocene (Heusser 1983, 1990). Because eruptions can produce thin tephra deposits that may not be visible in outcrop, these numbers should be considered as minimums.

In instances where tephra deposition is infrequent or light, the effect of inputs of volcanic material are transitory and are not differentiated from vegetation change due to climatic variations (Heusser 1985). Pollen sites that appear to be least affected by volcanism occur on the Shumagin Islands and portions of the Alaska Peninsula adjacent to them. The stratigraphy of the Kinzarof marsh core lacks visible horizons of volcanic ash (see Figure 3) and the basal age of 8600 yr B.P. postdates the major caldera-forming eruption of Fisher volcano by several centuries. Disturbance due to volcanism is probably not a significant factor influencing the sequence of vegetation changes at Kinzarof marsh. To better understand the significance and mechanisms of postglacial climate change recorded at Kinzarof marsh, it is therefore useful to compare it with paleoclimatic proxy data from the region.

Climatic reconstruction at Kinzarof marsh

Shrubs represented by the Ericales and *Salix* and *Betula* dominated or formed a significant part of early Holocene vegetation communities in the Aleutian Island region, reflecting a widespread warming trend following deglaciation of the North Pacific coast (Heusser et al. 1980). Basal pollen samples from Kinzarof marsh record a vegetation assemblage that is consistent with this pattern. The dominance of Ericales and relatively high percentage of *Artemisia* pollen in Zone I suggest that well drained substrates and relatively cool, dry climatic conditions prevailed in the region, especially in upland areas. Their occurrence is broadly indicative of heath communities adapted to persistent wind and variable amounts of precipitation (Heusser 1990; Hultén 1968). The presence of *Sphagnum*, Cyperaceae and Polypodiaceae are indicative of lowland meadows today and suggest that moist meadows were also present in the shrub tundra.

The dramatic increase of grass and fern pollen during Zone II suggests climatic amelioration and mesic conditions at Kinzarof marsh. Hu et al. (1995) note that modern meadow communities dominated by Apiaceae and ferns in the Bristol Bay area are indicative of relatively warm summer temperatures and abundant winter

precipitation. Heusser (1973) infers that climatic or edaphic drying accompanied the appearance of tundra dominated by grass and willow on Umnak Island between 8500 and 3500 yr B.P., while noting that earlier sedge tundra communities containing abundant pollen of *Apiaceae* were wet and poorly drained. Given the lack of taxa indicative of hydric conditions (e.g., *Cyperaceae*, *Sphagnum* and *Equisetum*), the dominance of grass and ferns with mesic forbs and herbs as secondary components suggests that climate was relatively warmer and perhaps moister than the preceding period.

The increase in sedges during Zone III coincides with the dominance of *Cyperaceae* in pollen records from the Shumagin Islands and central Alaska Peninsula after 4000 yr B.P. (Heusser 1983). This shift is indicative of wet, cool climatic conditions that prevailed for extended periods of time (Heusser 1983). *Empetrum* was an important secondary element of the tundra at this time, indicating the spread of heath communities in exposed and windy areas.

The shift in the ratio of *Cyperaceae* to *Poaceae*, the relative abundance of *Ericaceae* and *Empetrum*, and the appearance of *Alnus* in Zone IV marks the establishment of modern vegetation, and presumably climate, on the western Alaska Peninsula. This sedge-heath tundra is characteristic of cool, wet edaphic conditions but can occur in both wet and dry sites exposed to strong wind (Heusser 1985). Peat accumulation accompanied these conditions; many coastal bluff exposures of stratified sand, silt and peat stringers are capped by up to 1 m of sedge peat that must have accumulated during the past 2000 years.

COMPARISON OF KINZAROF MARSH WITH CLIMATE PROXIES OF THE NORTH PACIFIC

Regional pollen data

Pollen stratigraphy records the variable influences of climate, volcanism, and seismic activity as they condition the composition and distribution of vegetation in the eastern Aleutian arc, although factors such as island area and proximity to mainland source areas also affect dispersal effectiveness (Hu et al. 1995; Hultén 1968; Woodward 1987). Regional vegetation reconstructions based on pollen data do, however, share several comparable features. Maritime shrub and herb tundra prevailed throughout the Holocene, changing slightly in composition through time (Heusser 1973, 1978). At all sites, deglaciated terrain is typically colonized by pioneer taxa that include a variety of herbs represented by *Apiaceae* and *Artemisia*, by both sedges and grasses,

and by shrubs including *Salix*, *Empetrum*, and *Betula* (Heusser 1990). The assemblage of species that comprise pioneering communities are time-transgressive in the region, making their initial appearance over a 4000 year period of deglaciation that begins on the eastern Alaska Peninsula about 13,000 yr B.P. and ends in the western Aleutians possibly as late as 7000 yr B.P. (Black 1981).

Previous studies indicate that cool, moist, and windy periods from 10,000 to 8500 yr B.P. and from 3000 yr B.P. to the present favored the development of herb tundra dominated by sedges and grasses (Heusser 1973, 1983). A period of warmth during the mid-Holocene (8500 to 3000 yr B.P.) is regionally recognized and is represented by the development of shrub tundra dominated by *Salix* on Umnak and by *Betula* in the Shumagin Islands (Heusser 1990). Cooler and wetter conditions of the past 3000 years have resulted in a mixed tundra that is dominated by sedges, reflecting generally wet edaphic conditions throughout the region (Heusser 1983).

Pollen data from Kinzarof marsh generally conform to this pattern, with synchronous transitions in assemblages throughout the region occurring at 9000 yr B.P. and at about 3000 yr B.P. (Figure 5). The dominance of grasses and ferns (rather than shrub tundra) indicative of a warming trend between 6200 and 3200 yr B.P. may relate to microclimatic conditions that are evident in modern pollen rain (Peteet and Mann 1994). The abrupt vegetation shifts indicated at Kinzarof marsh at 6200 and 3200 yr B.P. may better reflect regional climate changes than some sites in the region because of the lack of volcanic influence.

Holocene glaciation

Early Holocene glacial deposits near Cold Bay suggest that a period of alpine glaciation occurred on the western peninsula between 11,000 and 6700 years ago, based on a minimum age of 6700 ± 330 yr B.P. (GX-2788) on peat overlying alpine moraines on Mt. Frosty (Funk 1973; Thorson and Hamilton 1986). A climatic mechanism for the "Russell Creek advance" (Funk 1973) is poorly documented as it is out of phase with the Holocene glacial chronology documented for southern Alaska. Its singular occurrence on the western Alaska Peninsula may instead relate to volcanic activity and geothermal warming of summit ice at Frosty volcano during the early Holocene (Thorson and Hamilton 1986).

Neoglacial advances are widely recognized in southern Alaska after 4000 yr B.P. (Calkin 1988; Wiles and Calkin 1994; Wiles et al. 1995). Alpine glacial advances occurred on higher peaks of the Aleutian Islands of Adak

and Umnak and on the western Alaska Peninsula after about 3000 yr B.P. (Thorson and Hamilton 1986). Alpine glaciers on Umnak Island apparently reached the coast during the Neoglacial (Black 1976, 1981). Advances of alpine ice during the Little Ice Age (LIA) typically extended less than 2 km beyond modern limits (Detterman 1986; Funk 1973) and occurred only on peaks above 1300 m (Thorson and Hamilton 1986).

The timing of Neoglacial activity at Cold Bay is constrained by a single minimum age of 1190±60 yr B.P. (BETA-96827) on soil organics overlying till in Russell Creek valley (Dochat 1997). Moraines on the flanks of

by the trend toward sedge-dominated tundra apparent in pollen Zone III at Kinzarof marsh around 3200 yr B.P.

Eolian stratigraphy

Eolian deposits occur in a variety of settings on the western Alaska Peninsula (see Figure 2). Coastal dunes cap beach ridges at Big Lagoon on Morzhovoi Bay, Thin Point, Cape Glazenap, and Moffet Point. Isolated dune fields occur in bluff head settings up to altitudes of about 40 m at Cold Bay, at the head of Kinzarof Lagoon, and at the mouths of rivers that drain the south face of Frosty Peak. Fine to medium sand derived from coastal erosion and inputs of volcanic material to the littoral zone provide

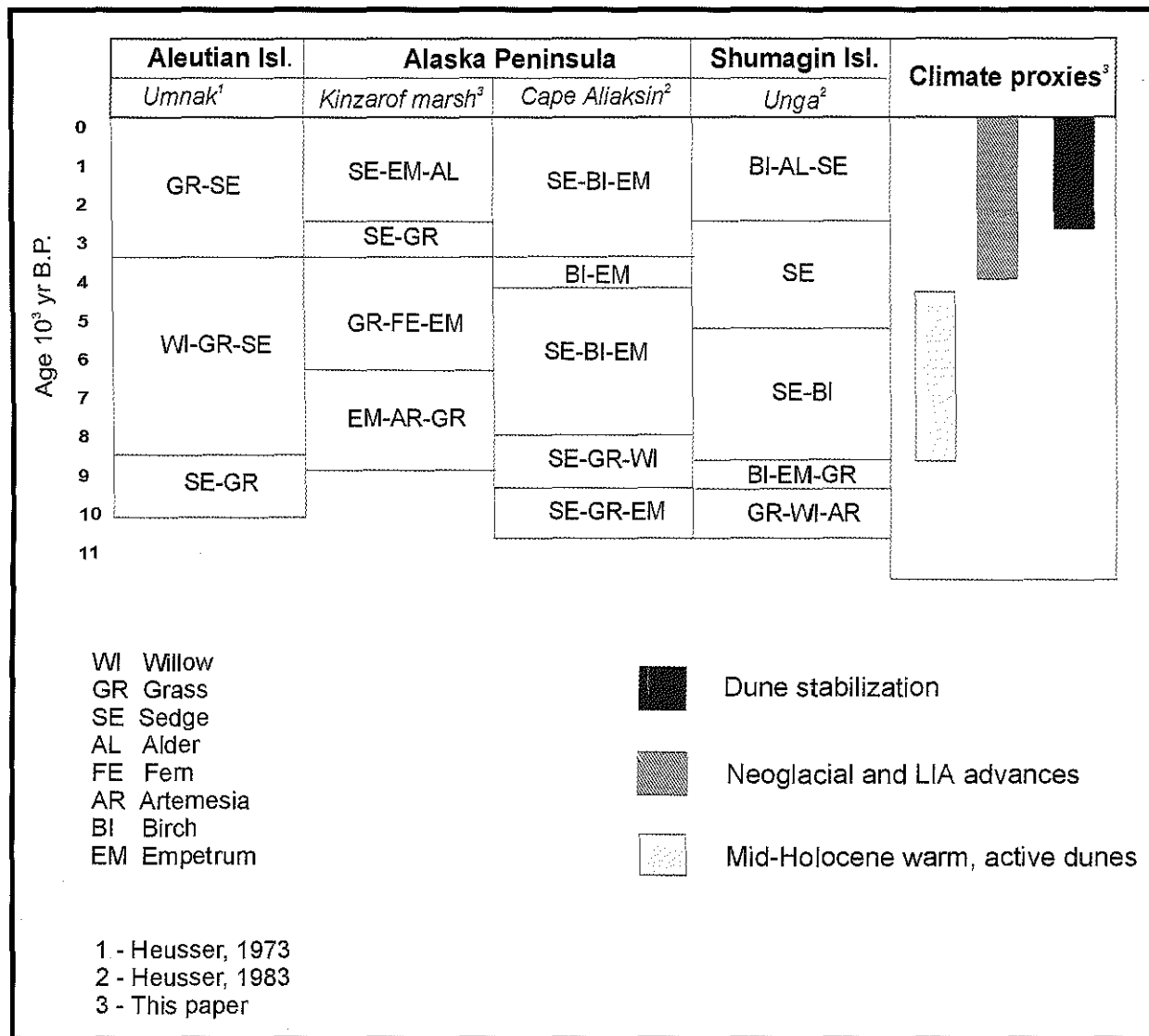
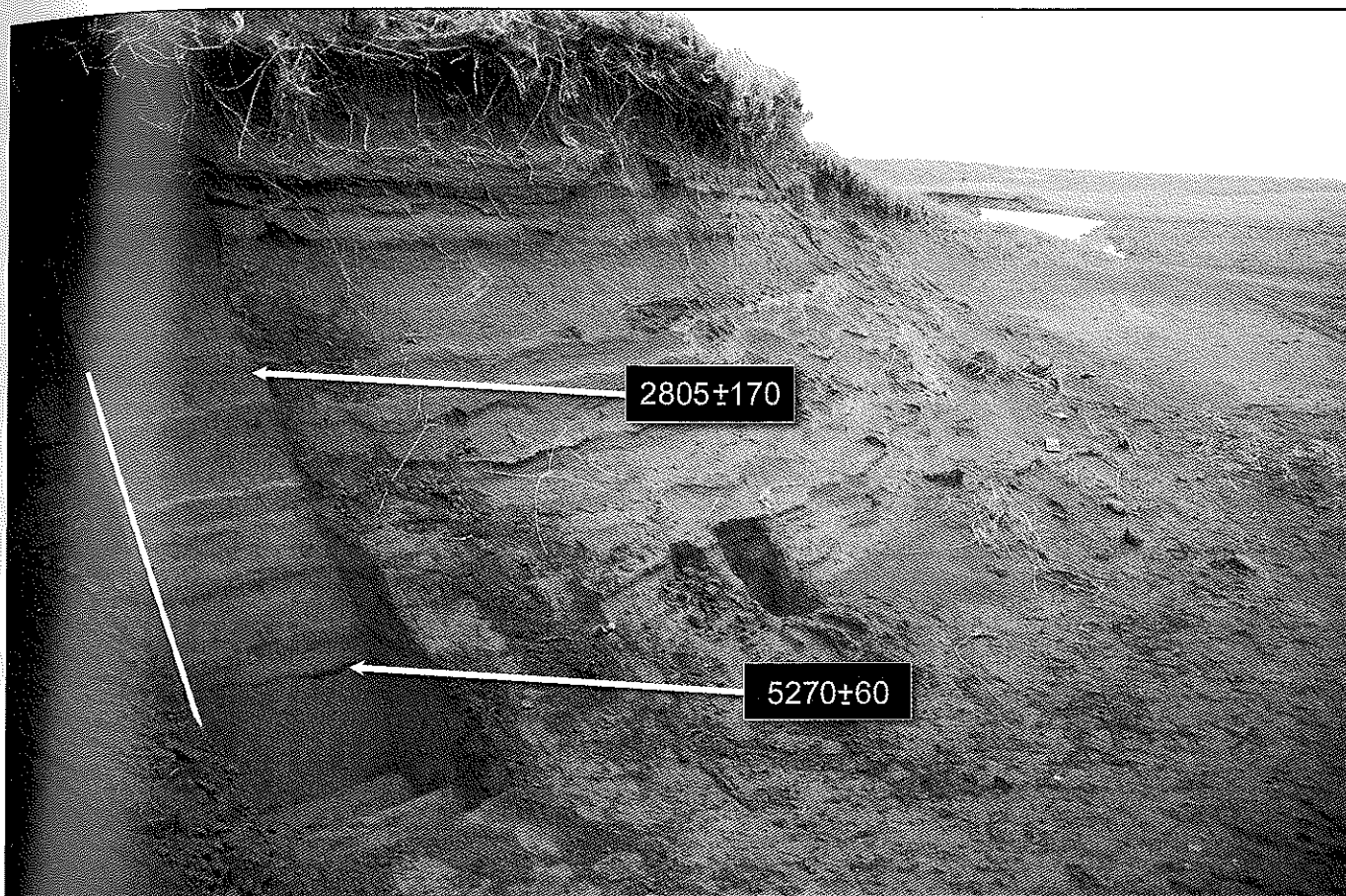


Figure 5. Correlation diagram of pollen assemblage zones from sites on Umnak and Unga islands and the Alaska Peninsula.

Mt. Frosty indicate that alpine glaciers advanced on several occasions during the late Holocene. While age control on Holocene glacial activity remains equivocal for the Cold Bay area, cooler wetter conditions that initiated Neoglaciation elsewhere in southern Alaska are reflected

source materials for dune building along the present coast. The Fisher ash underlies thick deposits of wind-blown sand at Cold Bay, indicating the persistence of eolian processes throughout the Holocene. A maximum age estimate for the beginning of deposition of sandy loess that



Figures 6a through 6d. Eolian stratigraphy at selected sites on the western Alaska Peninsula. Figure 6a above is the Russell Creek dunes showing stratigraphy and 14C ages, scale = 2 m. Refer to Figure 2 for location of Figures 6a through 6d.

mantles till at the head of Morzhovoi Bay is $10,830 \pm 60$ yr B.P. (CAMS-41410), the date obtained on peat overlying till in the same exposure (Jordan 2001).

Stratigraphic evidence of dune stabilization occurs in all units mapped as overbluff deposits on the western Alaska Peninsula. Buried A horizons or weakly-developed paleosols are exposed in two blowouts along the eastern margin of Cold Bay, at Tachilni Creek, and on the spit that embays Big Lagoon at the head of Morzhovoi Bay (Figure 6a-d). Three Ab horizons occur in a 3-m deep dune exposure above the mouth of Russell Creek (Figure 6a). One of these underlies a 2-cm thick tephra, to which it is probably related pedogenically (cf. Ping et al. 1988, 1989). The other two are not associated with tephra deposits and probably reflect changes in moisture regime that fostered vegetation growth, stabilization of the dune surface, and trapping and deposition of fine sand and silt. A bulk soil sample from an Ab horizon 1.7 m below the surface (Figure 6a) provided a conventional 14C age of 2805 ± 170 yr B.P. (A-9337). Radiocarbon analysis of the basal Ab horizon from the overbluff dune field at Tachilni Creek (Figure 6b) provided an AMS age of 2735 ± 50 (AA-31981). The initiation of dune stabiliza-

tion at Cold and Morzhovoi bays (Figure 6c-d) is not dated, but is provisionally correlated with records at Russell and Tachilni creeks based on stratigraphic evidence.

The timing of dune stabilization and development of paleosols at Russell Creek and Tachilni Creek correlates with increasingly cool and moist conditions suggested by pollen Zone III from Kinzarof marsh. The only additional age control on eolian deposits is an AMS radiocarbon age of 5270 ± 60 yr B.P. (AA-22422) obtained on a widespread charcoal horizon 3.5 m below the surface at Russell Creek. This horizon is not associated with volcanic activity or archaeological materials and may have resulted from a natural grass fire under conditions of relatively warmer and drier conditions during Zone II.

Eolian deposits are common in coastal lowlands throughout the Aleutian Islands (Black 1981) and many show similar stratigraphic evidence of episodic stabilization. A 15 m section of eolian sand on Adak Island preserves evidence of three buried soils that represent periods of increased moisture and dune stabilization (Judson 1946) and may correlate with the record of increased late Holocene moisture at Cold Bay.

MECHANISMS OF HOLOCENE CLIMATE CHANGE

Local and regional proxy data support the contention that vegetation changes evident at Kinzarof marsh result from shifts in the location and intensity of dominant pressure systems over the North Pacific Ocean and southern Bering Sea. The present climate of the Alaska Peninsula is dominated by atmospheric and oceanic circulation between these basins. The Aleutian low-pressure system is centered over the Aleutian arc and is strongest in winter. Cyclonic circulation commonly develops over the northeast Pacific during winter, steering storm systems toward southern Alaska and northwest North America because of increased zonal circulation and interaction of the Aleutian low with the Arctic front. In summer the North Pacific high-pressure system dominates increased meridional atmospheric circulation in southern Alaska and storm systems associated with a weaker Aleutian low occur farther north. Decadal scale weather patterns in the North Pacific show strong teleconnection effects on the atmospheric, oceanic, and sea ice environments of the Bering Sea, with the dominant forcing coming from the atmosphere and the winter position of the Aleutian low-pressure system (Hare and

Francis 1995; Niebauer and Day 1989). At longer time scales, the latitudinal position of the Aleutian low may be reflected in the geographic distribution of precipitation, long-term trends in mean annual air and sea surface temperatures (SST), and coastal storminess (Mason and Jordan 1993; Mock et al. 1998; Sabin and Pias 1996).

During the last glacial maximum, the presence, thickness, and geographic extent of Laurentide ice strongly influenced the location, strength, and motion of pressure centers over the North Pacific and Bering Sea. Atmospheric circulation was zonal, with the North Pacific high displaced south of its present position and a strong winter Aleutian low associated with heavy precipitation and glacier expansion in southern Alaska and the western United States (Barnosky et al. 1987; Thompson et al. 1993). Following deglaciation, global circulation models stress the role of seasonal radiative heating of the ocean surface in controlling the position and latitudinal migration of cyclonic and anticyclonic centers (COHMAP Members 1988; Kutzbach et al. 1993). During the early Holocene, peak summer insolation and rising SST resulted in a weakening of the Aleutian low and strengthening and northward migration of the subtropical North Pacific high. July temperatures were warmer and precipitation was lower than



Figure 6b. Tachilni Creek dunes showing basal ^{14}C age and lateral extent of paleosol complex.



Figure 6c. Paleosol complex at Morzhovoi spit dunes, person = ca. 2 m.

present conditions in southern Alaska (Heusser et al. 1985).

The vegetation and climate record at Kinzarof marsh is in agreement with climate models that suggest a general weakening of the Aleutian low between 9000 and 6000 yr B.P. (Kutzbach et al. 1993). This would have resulted in relatively drier and warmer conditions in the Aleutians and Gulf of Alaska during the early to mid-Holocene, which correlates well with pollen data from the region (Heusser 1985; Peteet and Mann 1994). Storm tracks generated by the Aleutian low were also more zonal during the early to mid-Holocene because the remnant Laurentide Ice Sheet in north central Canada continued to steer atmospheric circulation primarily around its southern margin (Kutzbach et al. 1993). A shift in the distribution of radiolarian assemblages after 4000 yr BP indicates a drop in sea surface temperatures which coincides with the southward migration of the North Pacific high and intensification of the Aleutian low-pressure system over the northeast Pacific Ocean (Sabin and Pisias 1996). The Aleutian low has intensified during the late Holocene, resulting in cooler and wetter conditions that are widely represented in pollen records around the North Pacific (Heusser et al. 1985) and an increase in the in-

tensity of coastal storms in the Bering and Chukchi Seas (Jordan and Mason 1999; Mason and Jordan 1993). Precipitation maxima are also indicated by lowered snow lines and Neoglacial ice advances in the Gulf of Alaska (Wiles and Calkin 1990, 1994) and dune stabilization on the western Alaska Peninsula.

KINZAROF MARSH IN THE CONTEXT OF BERINGIAN AND NORTH AMERICAN RECORDS

The size and climatic variability of Beringia results in great spatial and temporal variability of late Quaternary vegetation patterns (Hu et al. 1999). Linkages between vegetation and climate can also be problematic because of the broad ecological tolerances of major taxa (Lozhkin et al. 1993). But the timing of postglacial vegetation change apparent at Kinzarof marsh is broadly synchronous with trends observed in continental settings of Siberia and especially central and northwest Alaska (Anderson 1988; Lamb and Edwards 1988; Lozhkin et al. 1993). The magnitude of vegetation change suggested by percentage changes in taxa at zone boundaries suggests that shifts in effective moisture and/or temperature were relatively abrupt and, furthermore, that they were associated with broader shifts in oceanic conditions that dominate the climate of the Aleutian arc.

Pollen stratigraphy at Kinzarof marsh records Holocene climate fluctuations that are also recognized over a much broader region than Beringia and thus may provide reliable evidence of the interaction of Pacific and Arctic airmasses that affect short and long term climate over northern North America. Geomorphic and biotic evidence of changes in Holocene climate that are linked to shifts in the position of these airmasses have long been recognized in eastern Beringia and western Canada (Bryson et al. 1965; Bryson and Wendland 1967). Changes in these large-scale atmospheric circulation systems are known to produce responses in the latitudinal position of treeline and in alluvial systems on a continental-scale (Bryson 1966; Bryson et al. 1965; Knox 1983; Sorenson et al. 1971). The abruptness of change between pollen zones and the temporal correlation with distant sites suggests that locales similar to Kinzarof marsh may record fluctuations of marine climate that are significant at regional to subcontinental scales. Clearly the potential for pollen-based climate records from the western Alaska Peninsula to represent broader trends in Beringia depends on corroborating data from additional sites in the region.

CONCLUSIONS

The complex patterns of vegetation succession suggested by pollen stratigraphy on the Alaska Peninsula and eastern Aleutian Islands reflect the variable influences of atmospheric, oceanic and geological processes on vegetation. While some Aleutian sites record a history of vegetation disturbance related to tephra deposition, the pollen record from Kinzarof marsh on the western Alaska Peninsula has been relatively unaffected by volcanic activity and represents a reasonable approximation of postglacial climate change. The region's maritime setting has damped the amplitude of changes in climate and vegetation assemblages throughout the Holocene. But because regional climate is largely controlled by the interaction of the North Pacific high-pressure and Aleutian low-pressure centers, changes in their long-term position and strength have had recognizable effects on vegetation and landscape development.

The peak in early Holocene warmth seen elsewhere in Alaska (Anderson and Brubaker 1993; Anderson et al. 1994; Bartlein et al. 1991) was moderated in coastal areas of southwest Alaska because of postglacial flooding of the Bering platform (Lozhkin et al. 1993). Sea surface temperature maxima in the North Pacific also lagged maximum summer insolation during the early Holocene (Sabin and Pisias 1996), keeping mean annual air temperatures low relative to continental areas.

In areas of the Aleutian arc where ash falls had a relatively minor impact on plant communities, postglacial temperature and precipitation varied sufficiently to force broad shifts in vegetation assemblages within the coastal tundra biome. Initial vegetation communities at such sites show an abundance of shrubs (*Empetrum*, *Salix*, or *Betula*), grasses and herbs that represent relatively long growing seasons and well-drained substrates (Heusser 1983, 1990). Conspicuous changes in pollen stratigraphy that occur at Kinzarof marsh between 6200 and 3200 yr B.P. reflect warm and moist conditions also seen at sites on Umnak Island, the Shumagin Islands and central Alaska Peninsula (Heusser 1985). Localized dunes were active at this time based on the lack of stable surfaces in regional eolian deposits. After 3200 yr B.P. vegetation changes at Kinzarof marsh indicate the onset of cooler wetter conditions that initiated Neoglacial advances and the stabilization of dunes. These conditions have persisted through the late Holocene, reflecting the region's maritime climate and marking the development of modern coastal tundra communities of the eastern Aleutian arc.

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Figure 6d. Cold Bay dunes showing stratigraphy of partially exhumed basal paleosol, person = ca. 2 m.

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LITHIC RESOURCE ABUNDANCE AND EXPEDIENT TECHNOLOGY ON AGATTU ISLAND

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Abstract: In 1989 a BIA ANCSA crew surveyed ten 14(h)(1) sites and documented 23 others on the island of Agattu near the western end of the Aleutian chain. Most of these sites had substantial exposures of artifacts and midden debris. Stone artifacts from these exposures and from small test excavations suggest prehistoric inhabitants employed a very expedient lithic technology greatly influenced by the nature of the island's considerable lithic resources.

Keywords: Aleutian Islands, Stone Tools, Inter-Island Contact

INTRODUCTION

In late May of 1989, a crew of four archeologists from the Bureau of Indian Affairs (BIA), ANCSA Office, traveled to Agattu Island in the western Aleutians to investigate 10 archeological sites selected by the Aleut Corporation under section 14(h)(1) of the Alaska Native Claims Settlement Act (ANCSA).¹ Logistical support and transportation to the island were arranged through a cooperative agreement with the U.S. Fish and Wildlife Service, which maintained crews in the western Aleutians in connection with its Aleutian Canada Goose reintroduction program. Their agency's research vessel, *Tiglax*, transported both the BIA and the Fish and Wildlife crews from Adak to Agattu with one stop on Buldir to set up a Fish and Wildlife camp there (Figure 1). During this stop, the BIA crew completed a survey of the single known site on that island (KIS-008). Upon reaching Agattu, the crew established a base camp on the island's north shore, then used inflatable boats for transportation to survey areas. Over the next five weeks the BIA archaeologists completed investigations of the ten 14(h)(1) sites (U.S. Bureau of Indian Affairs 1996), and 23 additional sites, including 21 Aleut village sites and two isolated rock cairns.

Most sites had substantial occupation mounds characterized by lush disturbance vegetation, numerous large cultural depressions, and exposures of artifacts and midden debris. The exposures often included very high densities of flaking debris and stone tools, which were produced from readily available lithic raw materials. These scattered artifacts yielded important clues about the characteristic chipped stone tool industry of the prehistoric in-

habitants of Agattu. This initial inquiry suggests Agattu's lithic technology conforms to models of expedient technology developing in the face of raw material abundance (e.g., Andrefsky 1994; Bamforth 1986; Parry and Kelly 1987), and it offers insight into broader questions of prehistoric lithic reduction strategies, especially in terms of curated versus expedient technologies. Although there have been few studies of lithic technology in the Aleutians, the Agattu stone tool industry appears to be an example of divergent technological development influenced chiefly by the island's lithology.

ENVIRONMENT

From the Alaska mainland, Agattu is the next-to-last island in the Aleutian chain and the southernmost in a cluster of five islands known as the Near Islands. Agattu is roughly triangular in shape and about 30 kilometers in maximum dimension. The interior is treeless with mountainous to rolling terrain and many small lakes. The coastline is characterized by steep slopes and precipitous cliffs interrupted at regular intervals by rocky points and small, kelp-congested bays. The cliffs are often nesting grounds for large colonies of birds of many species. In past years, sea lions congregated on many of the island's short, rocky beaches—especially on the southern shores. Seals and sea otters can be seen along most of Agattu's shoreline. Intertidal reefs associated with the bays provide habitat for several species of invertebrates. Prehistorically these invertebrates were an important food resource for inhabitants of the villages commonly located

¹See Pratt 1992 for information on the ANCSA 14(h)(1) program.

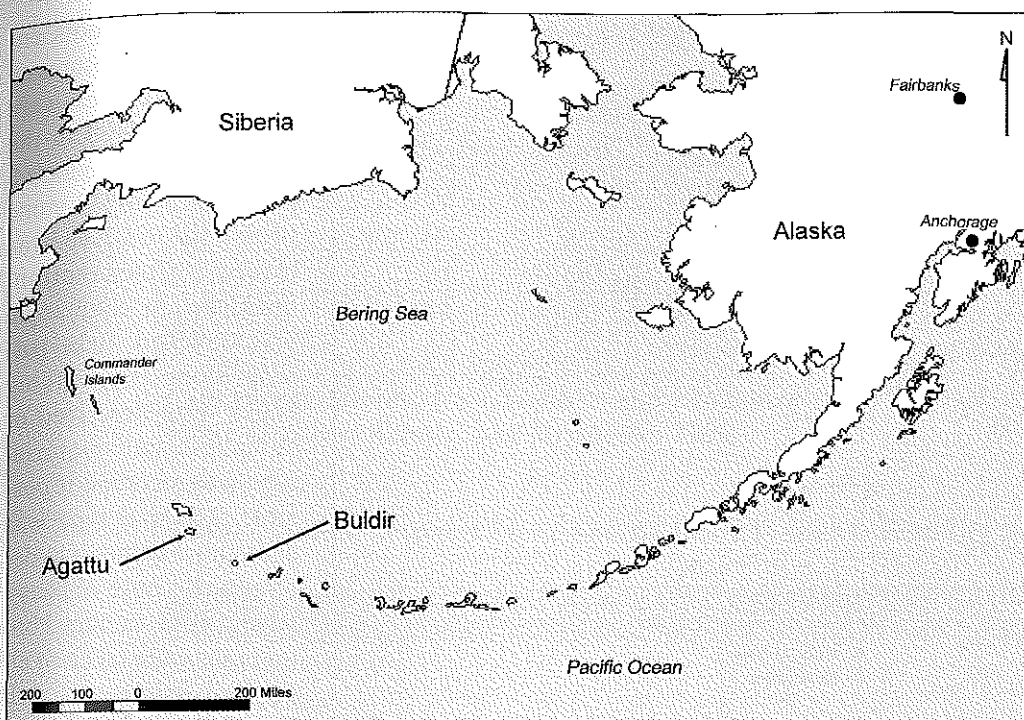


Figure 1. Bering Sea region, with Aleutian Islands to the south.

along the bays. Weather on Agattu is dismal by most standards. Though extreme temperatures are rare, high winds, fog, and drizzle are virtually everyday occurrences.

In general, the weather, terrain, vegetation, and wildlife of Agattu are typically Aleutian. Geologically, however, Agattu and the other Near Islands differ from the rest of the Aleutians in their lack of volcanic activity. They are composed of volcanic, sedimentary, and minor amounts of intrusive rocks, but there are no active volcanoes in the Near Islands. They have been shaped largely by preglacial marine and subaerial erosion. Basement rocks consist of basalts, waterlaid breccias and tuffs, sandstone, siltstone, mudstone, argillite, and chert (Gates et al. 1971: 709, 758). Especially important for Agattu's human history is the abundance of siliceous, relatively fine-grained, sedimentary rocks which are suitable materials for making chipped stone tools (Spaulding 1962).

PREVIOUS RESEARCH

Prior to 1989, archaeological investigations on Agattu had been limited to two short field seasons at two different locations. In 1937, Ales Hrdlicka (1945) excavated for three weeks on the island's eastern shore at Aga Cove (which he mistakenly called McDonald Cove; sites ATU-030 and 038), and Albert Spaulding (1962) excavated for five weeks in 1949 at Krugloi Point at Agattu's northeast tip (ATU-001 and 002 [Figure 2]). While Hrdlicka's primary objective at Aga Cove was to collect human skel-

etal material, he also collected artifacts, including "many hundreds of chipped points," a few of which are illustrated in his report on the Aleutian and Commander Islands (Hrdlicka 1945:442-449). Hrdlicka noted that bone tools were rare, and the chipped stone artifacts were of many varieties and often very coarsely flaked. Most stone tools were made of locally available bluish or brownish argillite. A less common "black basalt or andesite" was said to have been brought from elsewhere on the island to be used only for projectile points

and hafted knives. He called the stone industry "clearly unique" (1945:296), and suggested that artifact forms were greatly influenced by the raw material source. Hrdlicka concluded that this unique stone tool industry continued throughout the occupation of the site even though people of a new physical type occupied the site in its later years (1945:310).

Spaulding's excavations at Krugloi Point documented occupation of Agattu as early as 2500 years ago. In four excavation units, he recovered 819 artifacts, 384 of which were chipped stone. He noted similarities between some of his artifacts and those illustrated by Hrdlicka, but described many additional varieties of tools. His tools included various scrapers, graters, flake knives, drills, a chopper, a planing adze, various bifacial knives and fragments, and lance and projectile points. Noticeably absent from his inventory were cores, which he hypothesized did not occur because flat plates of stone rather than nodules were used. Typologies were hard to establish because of small numbers of some classes of tools and marked variation within others. Spaulding also failed to establish any definite patterns of distribution for the various classes of chipped stone tools through time. The material used most often at Krugloi Point was said to have been greenstone, with tan and gray cherts having secondary importance. As at Aga Cove, these were readily available materials. Spaulding echoed Hrdlicka's conclusion that the tools conformed, to a very notable degree, with original raw material form. Another similarity with Aga Cove was the scarcity of bone artifacts, which Spaulding was at a loss to explain.

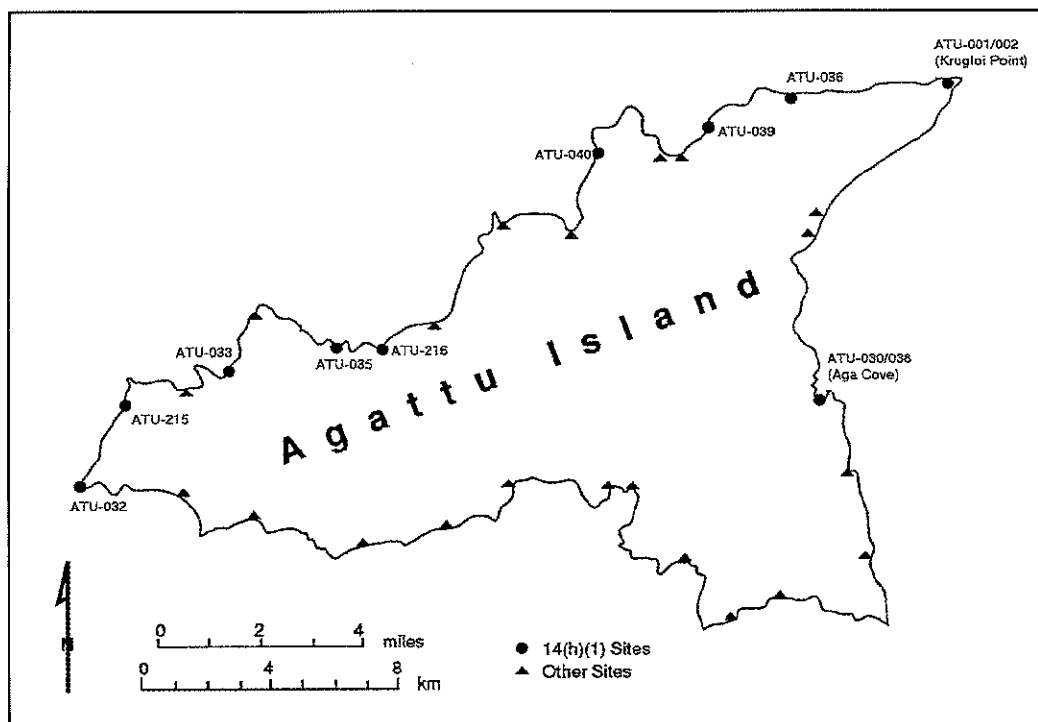


Figure 2. Aleut Village Sites on Agattu.

In 1996 Agattu was visited by a team of archaeologists from the Smithsonian Institution led by Stephen Loring. The Smithsonian team excavated at Karab Cove on the island's south shore. Like other researchers on Agattu, Loring (1998) was struck by the abundance of flaking debris at the habitation sites and noted the abundance of lithic raw material along the coast. The full report on the 1996 excavations is not yet complete.

RESULTS OF INVESTIGATION

The BIA surveys involved site mapping, quantification and description of surface features, and description of exposed artifacts and midden debris. Agattu's cultural features (primarily house depressions) are discussed in more detail elsewhere (Hoffman 1990; US BIA ANCSA 1996). The exposures, which are the main concern here, were seen at nearly all sites on the island. Exposures were most commonly noted in and around cultural depressions underneath the low canopy of the disturbance vegetation. Artifacts were also present in the small streams that were found at most sites. Occasionally material was seen eroding from stream cuts or waterfront terraces, but sites were generally very stable. Exposed material included bone, shell, human skeletal remains, bone and ivory tools and ornaments, chipped stone artifacts, ground stone tools, large cobble tools, and miscellaneous historic debris.

While all tools encountered in exposures on the 14(h)(1) sites were briefly described in the field, none were collected. For most chipped stone tools, the outline was traced, cross-section, thickness, or edge angle was sketched, flake patterns along any working edges were described or sketched, and material type was recorded if possible. Material type was sometimes difficult to determine because of heavy patination or staining. Photographs were taken of all stylized artifacts, as well as a sample of informal tools and cores.

The BIA crew did subsurface testing at two sites. A 50 X 50 centimeter (cm) unit was dug into a large depression at ATU-035, and a 1 X 1 meter unit was dug into a large depression at ATU-216. The units were dug in 10 cm arbitrary levels, and all material was screened through 1/4-inch mesh. Charcoal samples were collected for radiometric dating (Table 1). In both tests, excavation was halted at the 40 to 50 cm level when human skeletal remains were encountered. Both tests revealed jumbled deposits – probably the result of reoccupation of old house depressions. Two charcoal samples from the test at ATU-216 yielded dates of AD 1456 – 1650 and 1474 – 1676. At ATU-035, charcoal from a concentration in the upper part of the unit produced a date of AD 1156 – 1328, and scattered charcoal from the same level was dated to AD 1441 – 1644. A sample from the 40-50 cm level yielded a date of AD 404 – 639.

All artifacts from the test units were collected. Analysis of the stone tools recovered in excavations was consistent with the descriptions of tools done in the field. A total of 303 stone tools and cores were examined from excavations and surface exposures on 14(h)(1) sites (Table 2). Stone artifacts were found on every 14(h)(1) site and almost all of the non-14(h)(1) sites. Functional categories included stemmed projectile points or knives, flake tools, large crude unifacial and bifacial tools of many varieties, cores, wedges, and an adze.

Table 1. Radiocarbon dates from ATU-035 and ATU-216 house interiors.

Site No.	Feature	Unit	Datum Depth	Conventional Age RCYBP	Calibrated Age (2 sigma)	Lab No
ATU-035	18	1	9-16 cm	360+60	AD 1441-1644	Beta-33320
ATU-035	18	1	9-16 cm	760+70	AD 1156-1328	Beta-33321
ATU-035	18	1	40-50 cm	1550+60	AD 404-639	Beta-127625
ATU-216	49	1	40-43 cm	330+50	AD 1456-1650	Beta-33322
ATU-216	49	1	45 cm	280+50	AD 1474-1676	Beta-33323

Calibration datasets from Stuiver and Braziunas 1993; Stuiver et al. 1998; Stuiver, Reimer, and Braziunas 1998.

Table 2. Stone artifacts from Agattu 14(h)(1) sites (excluding flakes).

Artifact Type	ATU-001/002	ATU-030/038	ATU-032	ATU-033	ATU-035 Exp. Test		ATU-036	ATU-039	ATU-040	ATU-215	ATU-216 Exp. Test		Totals
Projectile Points/Knives		3		6	1		4				1		15
Unfinished Bifaces	2	3	1	4			6	1	1	2	4	2	26
Adze		1											1
Chipped Stone Wedges					1							1	2
Bifacially Retouched Plates/Fragments	1	9		4	1	1	3	1		1	4	5	30
Unifacially Retouched Plates/Fragments		8		9	1	1	2			4	1	3	29
Bi and Unifacially Retouched Plates/Fragments										3			3
Bifacially Retouched Flakes		1		1							13		15
Unifacially Retouched Flakes		4		2	2	4	3		3	3	2	2	25
Bi and Unifacially Retouched Flakes		1		1			1						3
Edge Damaged Flakes	2		1				2				3	8	16
Freehand Cores	27	7				1	15	10	12	3	4	4	83
Tested Raw Material		2										3	5
Ground and Flaked Stone				4			1			1			6
Ground Stone				1			3						4
Cobble Choppers						2		1					3
Saws/Groovers of Coarse Stone						4						2	6
Hammerstones							2		4			1	7
Anvil Stones	1	1		1					1	2			6
Grooved Cobble Sinkers	2						1				1		4
End Grooved Cobble Sinkers	1			1			5	1	3	1	2		14
Totals	36	40	2	34	5	14	48	14	24	20	35	31	303

Only fourteen tools could be classified as formal or patterned tools. Patterned tools are defined here as tools with an overall form dictated by intent on the part of the craftsman, as opposed to unpatterned tools in which form varies little from the form of the raw material blank. The patterned tools were the adze and 15 projectile point or knife fragments. Of these fragments, eight were proximal, three were medial, and four were distal. Nine of the 15 are clearly stemmed. Only one basal fragment is

unstemmed, and it is possibly a fragment of an unfinished tool. The stemmed points are generally similar, having broad blades and shoulders, and thin, lenticular cross-sections. Some stems contract slightly, and shoulders range from slight to barbed (Figures 3 and 4). Eight are of a gray/black laminated chert. The rest are made of argillite. Because of breakage, original length measurements were not possible on any of the points. Widths ranged from 2.2 to 3.9 cm with one exception – a 1.3 cm wide,

finely flaked point from ATU-216 (Figure 5). This point and one from ATU-033 both have single small notches on opposite blade edges. This notching was also seen on a small, stemmed point of gray/black chert from the island of Buldir (KIS-008). Spaulding (1962:27) reported similar notching on bifaces from Krugloi point and suggested it was an ownership mark. This interpretation is questionable, however, given the lack of variety and wide distribution of this trait. It might signify a group affiliation, or it could be purely functional.

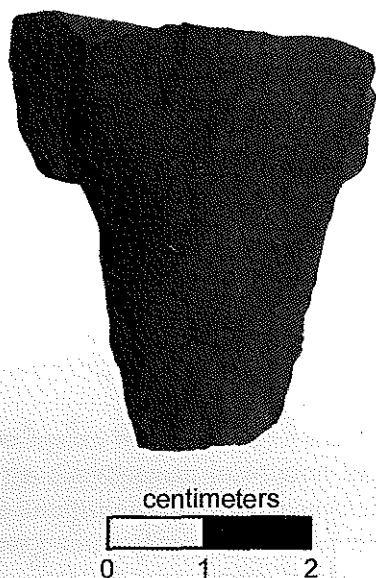


Figure 3. Stemmed biface with slight shoulders, site ATU-030/038.

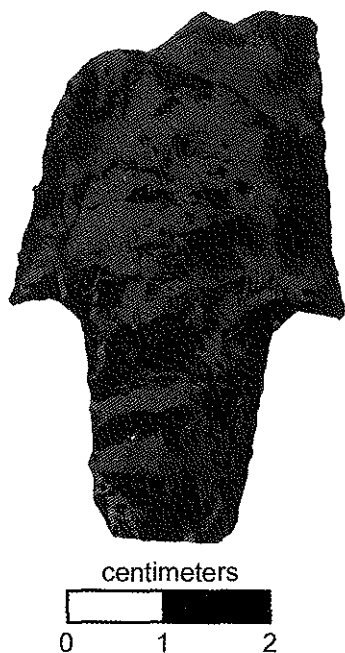


Figure 4. Stemmed biface with barbed shoulders, site ATU-036.

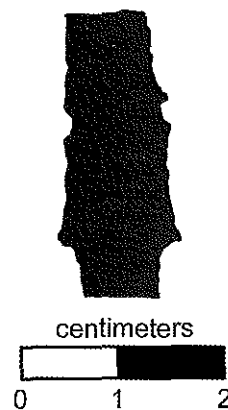


Figure 5. Narrow point with small notches on blade; site ATU-216.

Twenty-six bifaces appeared to be unfinished. These were thick bifaces with roughly oval outlines and irregular edges. Most had breaks consistent with production failure. These were found at all but one of the 14(h)(1) sites. Fifteen were made of argillite, three of gray/black laminated chert, six of indeterminate or unrecorded material type, and one of a gray/brown, exotic chert.

The most common chipped stone tools were large, crude, unpatterned tools made by unifacial or bifacial edging of cobbles or tabular fragments of stone. Sixty-two of these were recorded on eight of the ten sites. They were equally divided between unifacial and bifacial with some tools showing both kinds of flaking. These tools were made by relatively few flake removals, and flaking was concentrated on the edge only, so overall form varied considerably. They ranged in size from roughly 3 X 5 cm to 10 X 20 cm and from 1 to 3 cm thick. Forty-three of the 62 were made of argillite. This argillite was available in enormous quantities in the form of beach cobbles at every site surveyed. Three of these tools were of gray/black laminated chert, seven were of miscellaneous coarse metasediments, and nine were of indeterminate or unrecorded material type.

Flake tools were recorded almost as frequently as the large unpatterned tools. They may actually be more common, but because of their small size and less obvious modification they were more likely to be overlooked in surface exposures, which often included large numbers of waste flakes. Flake tools include flakes with marginal unifacial and/or bifacial retouch, usually by pressure flaking. They also include flakes showing damage from use, but we were very conservative in accepting this type of flake tool in the field because of the difficulty of distinguishing use damage from other types of damage.

Of the 57 flake tools recorded, 36 were of argillite, seven were of gray/black laminated chert, and 14 were of indeterminate or unrecorded material type.

Another indication that flake tools might be more common than suggested by the flake tool counts is the fact that 88 cores were recorded. These cores produced flakes that were too small to be fashioned into any of the other types of tools identified. The cores were almost exclusively free-hand, hard-hammer percussion cores. Most had few flake removals. Five were recorded as "tested raw material." Only three were recorded as exhausted cores. The source for raw material, again, was beach cobbles. Of the 60 cores for which material type was recorded, all were argillite.

Flaking debris was the most common form of artifact found in surface exposures. It was noted in 111 of the 358 cultural depressions recorded on 14(h)(1) sites, and the flake scatter was so dense at one non-14(h)(1) site that a Fish and Wildlife Service employee hypothesized that the house depressions had been chiseled into stone. While not all sites had such dense scatters, many were comparable, especially where vegetation allowed ground visibility.

Flaking debris was not recorded in detail in the field. Generally its presence was noted, as well as the material type(s) represented. As might be expected, most flakes were of argillite. Gray/black chert was present on most sites in small amounts. Flakes of possibly exotic material were present in five instances on four sites. The materials were red chert, maroon chert, gray/white banded chert, and translucent brown chalcedony.

Flaking debris recovered from the two test excavations on the north shore totaled 1941 pieces (Table 3). In the lab these flakes were sorted by material type, platform characteristics, and cortex. Seventy-seven percent were made of blue/green argillite. This was the same argillite used to make most of the artifacts already discussed and the same argillite so common in flake scatters elsewhere on the island. It is apparently the same material as Spaulding's "greenstone" which was so com-

Table 3. Flaking debris comparisons.

	Gray/Black Laminated Chert	Other Materials
Total Flakes	81	1860
% Lipped	46%	20%
% Cortical	12%	16%

Table 4. Core/tool comparisons.

	Gray/Black Laminated Chert	Other Materials
Total Cores	0	88
Total Tools	25	140
% Patterned	32%	6%
% Unpatterned	68%	94%

mon at Krugloi Point. In addition to the blue/green argillite flakes, flakes of miscellaneous argillites made up 12 percent of the flaking debris. This category is less precise and might include other silicified sediments which resemble argillite. Four percent of the flaking debris was a distinctive gray/black laminated chert, two percent were miscellaneous fine sediments, and five percent were miscellaneous coarse materials.

The gray/black laminated chert is finer grained and has better flaking properties than the argillites. It is apparently the same material identified by Hrdlicka at Aga Cove as "black basalt or andesite." He reported that this material was used for projectile points and hafted knives. Gray/black chert was observed in many instances during the BIA survey at Aga Cove. It was present in small but noticeable quantities on sites all around the island, though it was observed to occur naturally only on the eastern and southern shores.

In comparing flaking debris of this material with other flakes, the chert appears to have been used for more finely flaked tools. A much greater proportion of the chert flakes have lipped platforms, indicating they are the result of biface thinning, and a smaller proportion have cortex, which could indicate they are from a more advanced stage of reduction. This idea is supported by the high proportion of patterned tools made of this material (Tables 3 and 4).

DISCUSSION

Lithic raw material is abundant on Agattu. Argillite can be found on cobble beaches around the entire coast.

Gray/black chert also occurs naturally on the island, but in lesser quantities and more limited distribution. The chert is relatively fine-grained and seems to have been a preferred material for curated tools. Argillites and coarser sediments, on the other hand, seem to have been used mostly for expedient tools. The finer grades of argillite are comparable in quality to the chert, and some argillite was finely flaked, but generally it was used for simple flake tools or crudely flaked knives, scrapers, or choppers. Its abundance essentially made it disposable. There was no need for material to be used efficiently, and there was no need for most tools to be curated. Because the material came in large plates and cobbles, which could be firmly held in the hand, hafting was seldom necessary for domestic tools. Tools were probably quickly discarded and often reused, as is evidenced by different types of retouch on the same piece and by fresh flake scars on weathered flaked surfaces (Figure 6). The fact that lithic resources were uniform around the whole island reinforced this throw-away technology.



Figure 6. Argillite tool with differential weathering on flake scars, ATU-030/038.

Comparisons between the bone and stone industries on Agattu are misleading. Hrdlicka and Spaulding both commented on the scarcity of bone tools, and Spaulding was admittedly confused by it (Hrdlicka 1945:288; Spaulding 1962:43). In the 1989 surveys, bone tools were once again found to be relatively rare. Despite excellent conditions for bone preservation in the Agattu middens,

bone tools made up less than 10 percent of the total tool inventory. By comparison, bone tools accounted for 46% of the tool inventory at six sites excavated on Amchitka Island in the western Aleutians (Desautels et al. 1970:75). In the central Aleutians, Denniston (1966:84) reported that 30% of the tools from the 1962 Trench A at Chaluka were of bone. The difference in the frequency of bone and stone tools on Agattu is, at least in part, a function of the expendable nature of the stone. Bone may have been no less important on Agattu than elsewhere in the Aleutians, but its importance is overshadowed by the sheer number of stone artifacts.

Relatively little is known about the stone industries elsewhere in the Near Islands, but Agattu might have been a source of lithic material for inhabitants of other islands. Jochelson recovered artifacts on Attu made of "green hornstone-schist" which he believed had been traded from Agattu (Jochelson 1925:57). He also reported stone implements made of andesite which, according to Native informants, came from Agattu (1925:114). A small collection made by another BIA crew on Nizki in 1989 included both green argillite and gray/black chert, and a private collection from Shemya confiscated by the U.S. Fish and Wildlife Service included many artifacts of finer green siliceous stone. It is not known if this material occurs naturally on these islands, but it very closely resembles the material from Agattu. A 1990 study on Shemya identified propylitized andesite or "greenstone" as the most common lithic material (Corbett et al. 1997a:475; 1997b:108). The stemmed point mentioned earlier from the island of Buldir was certainly not of a local material. Most chipped stone tools at the Buldir site were made of a locally available phyllite of extremely poor quality, but one point recorded during the 1989 BIA survey was made from a "gray/black banded chert." This material was obviously exotic and quite possibly from Agattu. This is interesting because Buldir is believed to have been a stepping stone in the earliest migrations of people to Agattu, and this artifact may represent a small "backwash" from west to east.

SUMMARY

The lithic industry on Agattu is intimately adapted to an unusual, island-specific resource. The inhabitants of the island relied on vast quantities of readily available, flakable stone to make large numbers of simple flake tools and large crude unifacial and bifacial tools which were essentially disposable (see Figure 7). This expedient technology was in use at least as early as 2500 years ago and probably continued up until Russian contact. Finer



Figure 7. Crudely flaked argillite tool, site ATU-035.

tools were made, but in relatively small numbers and often using a specific type of higher quality chert. There is evidence that materials from Agattu were used elsewhere in the Near Islands and as far east as Buldir. Perhaps they were trade items, or at the very least, evidence of contact. The nature of this contact is the subject of ongoing research (Corbett et al. 1997a, 1997b).

Agattu chipped stone artifacts illustrate the potential for island-specific stone tool technologies and possible misconceptions in comparing stone artifact assemblages from different islands or island groups. Ironically, this underscores the importance of bone tools, as Workman (1966) and McCartney (1974) have suggested, as temporal and ethnic markers because they are influenced much less by raw material variability than stone, which can vary significantly between the isolated islands of the Aleutian chain.

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THE DEVELOPMENT OF LARGE CORPORATE HOUSEHOLDS ALONG THE NORTH PACIFIC RIM

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Abstract: The North Pacific supported three different ethnic groups of complex hunter-gatherers: the Aleut of the eastern Aleutian Islands, the Koniag or Alutiiq (Pacific Eskimo) of the Kodiak Archipelago, and the Tlingit, Haida, and Tsimshian of the northern Northwest Coast. The archaeology and ethnohistory of these regions provide our best data for investigating aspects of the transition from small, egalitarian households to ranked, corporate households. We argue that this transition occurs in all areas when three conditions are met. First, corporate groups beyond the nuclear or extended family must form. Second, there must be social or reproductive means to create differential corporate group size. And third, there must be a reason why smaller corporate groups cannot or will not fission from larger villages.

Key words: Households, Hunter-gatherers, Social Inequality, North Pacific

INTRODUCTION

One of the most important transitions in the history of humanity is a systemic shift from achieved status differences to hereditary status differences or rank. In the archaeological literature theories as to the origins of ranked societies have included population pressure (Binford 1969, 1983), scalar stress (Ames 1985; Johnson 1982), competitive feasting (Hayden 1990, 1995, 1997), control of resources (Coupland 1985a, 1985b, 1988a, 1988b), control of labor (Arnold 1993, 1996a), warfare (Carneiro 1970), control of trade (Bishop 1983, 1987), economic intensification (Croes and Hackenberger 1988; Matson 1983, 1985), storage (Testart 1982), and many others (e.g., Arnold 1996b; Price and Feinman 1995).

Within these explanations are two primary themes: groups and/or societies creating a new adaptation (nobility for example) because of some external pressure (Ames 1985; Binford 1969, 1983; Croes and Hackenberger 1988; Johnson 1982), or individuals taking advantage of either internal or external pressures for their own (or their kinsmen's) self interest (Arnold 1992; Hayden 1992, 1997; Maschner 1990, 1991, 1992; Maschner and Patton 1996). We take the latter approach. Theoretically, following Hayden (1992, 1995, 1997), Flannery (1986), Clark and Blake (1994) and Maschner (1990, 1992; Maschner and Patton 1996), we argue that individuals striving for status and prestige results in hereditary social inequality when certain conditions are met. This model relegates all other explanations to the level of symptoms of inequality.

The question becomes: what were the social and environmental conditions that allowed striving headmen to put themselves in a position of power and get away with it (following Binford 1983:220)? There are three organizational characteristics critical to the rise of hereditary social inequality. The first is founded in village size and household size (Hayden and Cannon 1982; Hayden and Gargett 1990). We see this as important to understanding social and political ranking because, as has been shown in a number of studies, there is a strong correlation between corporate group size, village population size, resource abundance, and hereditary inequality (Coupland 1988b; Donald and Mitchell 1975; Hayden et al. 1985; Maschner 1990, 1991, 1992). Thus, there must be an ecosystem capable of supporting a reasonably large population, there must be a reason for nucleation, and there must be a reason for the formation of multi-family corporate groups. Second, it is clear that almost unilaterally, the headman of the largest corporate group (or any other multi-family organizing unit) in an independent community is most likely the headman of the village (Chagnon 1975, 1979a, 1979b, 1988; Maschner 1992, 1996a; Maschner and Patton 1996). This is so because the leader of the largest social, political, or economic faction has the greatest number of political supporters to substantiate his or her aspirations. And third, circumscription (either environmental [e.g., Carneiro 1970] or social [e.g., Chagnon 1975]) has an important role in the rise of hereditary inequality in early villages because ranking does not de-

velop until small corporate groups no longer have the desire or option to leave. Thus, when villages form with multiple kingroups or other corporate entities, when there is opportunity for differential corporate group size to develop, and when small, less powerful groups have little opportunity to leave, hereditary inequality will develop.

We apply this approach to the northern Northwest Coast, the Kodiak archipelago, and the lower Alaska Peninsula areas inhabited at contact by Tlingit/Haida/Tsimshian, Pacific Eskimo (Alutiiq), and Aleut (Unangan), respectively. These are excellent locations for this form of study because village surface features are readily apparent, there is an excellent ethnographic record, and because in all three areas we see ranking developing along similar trajectories.

To put the conclusions first, we find specific similarities in the development of villages in all three regions. Villages are argued to first form in all areas as a product of resource abundance. Later, intensification in village formation and the formation of a ranked social organization appears to correlate with increasing levels of either violent conflict or inter-ethnic interaction as seen through the construction of defensive fortifications and long distance trade. Diachronically, increasing house floor size and house floor size variability (together), are shown to be good indicators of the development of hereditary inequality and occurs between AD 200 and AD 1200.

THEORY

Maschner (1990, 1992) has argued that in all societies there are some individuals who strive for status and this status striving results in differential access to mates, prestige, and wealth (see also Alexander 1979; Barkow, Cosmides and Tooby 1992; Goldschmidt 1991; and many others). While strivers, aggrandizers, achievers, and despots have all been invoked in recent years (Flannery 1986; Clark and Blake 1994; Hayden 1992; Maschner 1990, 1992; Maschner and Patton 1996), little attention has been given to the actual process by which individuals put themselves in a position of high status and maintain it, even beyond death.

We argue that there is only one way in which this is possible – by having the largest corporate group (or some other supra-family integrating entity such as lineage, clan, or whatever). In nearly every society surveyed where differential lineage size has been documented (Maschner 1996a, 1996b; Maschner and Patton 1996), it was found that the headman of the largest corporate group was most often the headman of the village, thus, it was the highest

ranked household in the community. But not all societies with high status headmen have hereditary inequality, which brings up a precondition. There must be a reason for a number of corporate groups to live in the same location (village) and it must be more expensive to leave the community than to be a member of a low status corporate group. Thus, when there is differential corporate group size, and smaller lineages cannot fission to new locations or less hierarchical communities, ranking develops because the headmen of the largest lineages can put themselves in a position of leadership and get away with it.

One of the biggest criticisms we have with theories of labor control, trade control, resource control, or any other kind of materialist manifestation of inequality is that no one is willing to take a stand on the actual process by which individuals gain that control. Hayden's competitive feasting argument is perhaps the closest, yet he does not indicate why some individuals are able to compete and others not (1992, 1997). Hayden argues that the largest and most powerful corporate groups developed because they control some critical resource such as salmon (1997:25) that is in turn used to put others in debt through feasting. But there is no explanation of why individuals allow themselves to be put in debt or what this might actually mean for the distribution of power. Since Hayden is discussing the control of labor in the harvesting of the controlled resource (as does Arnold 1996a), we are left with a situation where a headman is controlling the labor of people who are most likely kinspeople who work for the headman only because they expect some return on their investment. Control of a resource is only interesting if you are strong enough to prevent other kingroups from taking it away. One does not maintain control in these societies by controlling external labor, but rather, by convincing your kinspeople that it will be a great investment to support one's own political aspirations. While the headman does indeed, at least in the social world, control resources, he or she does so at the whim of their followers. Feasting is just one of many expressions of rank that are not used against one's own group, but rather, against competing groups. Feasting is simply a means of demonstrating economic, political, and military prowess to avoid direct confrontation over day to day affairs (cf. Rosman and Rubel 1971). Since it is only the largest corporate groups that are usually able to give competitive feasts, feasting is perhaps just another symptom of differential corporate group size and status striving between headmen. Thus, to be a successful leader, one must convince one's kinspeople to support your aspirations, and one must have a large enough kin-group to defend those aspirations from other kin-groups.

Maschner has argued previously that the reason there are so many symptoms (theories) of the rise of hereditary status differences is because humans have found a myriad of ways to compete with other humans (1992:90-98). But what exactly does this competition result in? It results in individuals being able to attach a greater number of kinsmen to their corporate group, increasing the headman's political and social abilities in the context of all of the other corporate groups. The headman with the greatest number of followers has the most political power and, thus, the most say in the affairs of the community. It must be emphasized that this is a completely social form of power. Social power must precede economic power otherwise there is no means by which economic control can be gained in a village-based society.¹ Since these corporate groups are usually lineage based, and since the transition from one headman to a new headman is usually within the descent group, any corporate group that is able to maintain its position as the largest, has created hereditary inequality by default (Maschner and Patton 1996).

The one means by which hereditary social power can be identified in the archaeological record is by differential house floor areas, especially when the argument can be made that the entire corporate group lives in the same household. Our model follows Hayden and Cannon (1982) in using multi-family houses as evidence for both the presence and relative size of corporate groups. We recognize, however, the limitation of conflating a dwelling (the physical structure) with a household (a social unit). Not all members of a corporate group necessarily share a single dwelling nor does co-residency automatically imply household membership for all occupants (Ashmore and Wilk 1988; Hirth 1993a; Lawrence and Low 1990:461; Wilk and Rathje 1982). This variability, in part, reflects the realities of day to day existence faced by individuals and the "cycle" of family development (Goody 1958). Ames (1996a) has shown that the sizes of Northwest Coast households did fluctuate through time, but the largest households appear to have stayed the largest throughout several hundred years of occupation, an argument made by Hayden as well (1997). These issues are not severe limitations for our investigation since much of the archaeological data from regional scale household and village studies reflects long-term patterns rather than particularistic behavior.

The significance of house-size variability has generated considerable research interest throughout North

America (Ames 1996a, 1996b; Ames et al. 1992; Archer 2001; Coupland 1985b, 1988b, 1996; Hayden and Spafford 1993; Hirth 1993b; Lightfoot and Feinman 1982; Nass and Yerkes 1995, Trubitt 2000). It is generally assumed, based on broad overviews of the ethnographic record, that the larger houses were occupied by the village elite and their larger corporate group (Hayden 1997; Hayden et al. 1985). Testing of this assumption is primarily based on expectations of economic differences such as a higher frequency of exotic items, greater storage capacity, and/or control of subsistence resources associated with elite residences (Ames 1996a; Hayden 1997; Hoffman 2001; Trubitt 2000). These assumptions are supported by ethnographic and cross-cultural studies that have found a general correlation between dwelling size, household rank, political power, and wealth (Abrams 1989; Netting 1982). Individual case studies demonstrate, however, that these correlations are not universal patterns (Wilk 1983); although Ames has shown that the largest households on the lower Columbia River did indeed have the greatest amounts of storage, exotic items, and other differences (1996a), as has Hayden for the Fraser Plateau (1997).

Ethnohistoric data from the three north Pacific regions used in this study support the critical assumption that dwelling size reflects the occupants' status. In summarizing the reports from Russian traders, the historian Coxe wrote in 1787 that among the Eastern Aleuts: "The office [of village leader] ... is generally conferred on him who is most remarkable for his personal qualities; or who possesses a great influence by the number of his friends. Hence it frequently happens, that the person who has the largest family is chosen" (quoted in Hrdlicka 1945:25).

On the Northwest Coast it is clear from the ethnographic record that there is a correlation between house size and household rank or status (Ames and Maschner 1999; Coupland 1988b; Donald and Mitchell 1975; MacDonald 1983; McNeary 1976). In ethnographically documented villages, where one or more houses stood out from the others in size it was most often the highest ranked residence. Coupland (1988b:270) found that a historic ratio of 1:3 to 1:5 (ranked to non-ranked houses) in a Niska village (McNeary 1976:128) was similar to prehistoric villages on the Skeena River with a ratio of one large to every 4.4 smaller houses. In the Queen Charlottes, Acheson (1991) also noticed the disparity between large and small houses as an indicator of wealth and size, and this is born out by MacDonald's work as well (1983). Archer has perhaps done the most in this realm, clearly

¹ This is a point missed by Tim Earle (1997) and all others who study hierarchical societies from the view of complex chiefdoms where power is economic and where the people they are studying have been complex for so long that they cannot talk of origins. Social power comes from kin-selection; it is a form of power that only comes from having a lot of supporting kinspeople and it is fundamentally important in village-based societies.

demonstrating both the increase in house size, and the increase in house-size variability across the egalitarian-ranked transition.

Thus, it is demonstrable that household size, especially differential household size, is a powerful measurement of differential status in societies organized into multi-family corporate groups. Therefore, we believe that once multifamily corporate groups form there will be opportunity to increase group size at the expense of, or in competition with, other corporate groups (e.g., Maschner and Bentley [in press]). What were the conditions then that allowed the headmen of the largest lineages to participate in aggrandizing behavior and begin taking advantage of smaller corporate groups?

To answer this question we must first identify when corporate groups first form and then identify the historical context of the rise of variability in house size. At that point we must attempt to describe and explain the social, political and environmental events that resulted in conditions where it was more advantageous to be lower rank than it was to remain independent.

THE STUDY

The three areas used in this study, the lower Alaska Peninsula/eastern Aleutian Islands, the Kodiak Island group, and the northern Northwest Coast, are extraordinary for a number of reasons. First, they consist of perhaps three of the richest environments on earth. From the 10s of thousands of sea mammals and abundant fisheries of the Aleutian chain, the salmon runs of Kodiak Island that ran as many as 10 million fish a year in a single river, and the incredible herring, halibut, and salmon resources of the northern Northwest Coast, there was probably never a time when human societies with an aboriginal technology could have put any significant harvesting pressure on these marine ecosystems (Hayden 1981:529-530). The result is that all three areas were inhabited by fully sedentary and ranked hunter-gatherer societies at historic contact.

The Aleutian data are based, except where noted, on our research over the last eight years on the lower Alaska Peninsula (Hoffman 1999, 2001; Jordan and Maschner 2000; Maschner 1998b, 1998c, 1999a, 1999b, 2000a; Maschner and Hoffman 1994; Maschner et al. 1994, 1997; Maschner and Reedy-Maschner 1998), and on site evaluations conducted by the BIA ANSCA Office in Anchorage (USBIA 1991). The Kodiak data are based on the research of Richard Jordan and Richard

Knecht (1988; Knecht 1995), Hausler-Knecht at Rice Ridge (1993), the work of Amy Steffian (1992a, 1992b) on the Kachemak, and the primarily Sikalidik Island study conducted by Ben Fitzhugh (1995, 1996). The northern Northwest Coast data are from eight years of research conducted by Maschner (1990, 1991, 1992, 1996b, 1997, 1998a; Maschner and Stein 1995; Maschner and Patton 1996) and the seminal studies of Gary Coupland (1985a, 1985b, 1988a, 1988b, 1996), Kenneth Ames (1994, 1996a, 1996b, n.d.), and Steve Acheson (1991).

The Eastern Aleutian Region

Village-based maritime foragers occupied the eastern Aleutian region as early as 7000 BC² (Aigner 1976, 1978; Laughlin 1975, 1980; Dumond and Bland 1995). Although no sites in our study region predate 3000 BC, several early sites have been identified on Unalaska and Umnak Islands to the west. The earliest documented sites are assigned to the Anangula tradition and include a coastal village with oil lamps, blade technology, and semi-subterranean houses with roof entries (Aigner 1976; McCartney and Veltre 1996). A poorly understood gap with few sites separates the Anangula tradition from the Aleutian tradition which spans the period from approximately 4000 BC to Russian Contact (McCartney 1984; McCartney and Workman 1998). The Aleutian tradition is characterized by village midden sites, many of which were occupied for hundreds to thousands of years suggesting considerable stability in settlement patterns throughout the middle to late Holocene. Excavations at Anangula and early Aleutian tradition villages have all found houses that are single-family sized, and generally four to six meters in length. Each household appears to have been economically self-sufficient based on artifact analysis (Aigner 1978, 1983, 1985; Aigner and Del Bene 1982). No status differences have been documented, although the sample size is small.

The earliest Aleutian Tradition villages in the lower Alaska Peninsula study region are small, generally under 2000m² and have between 8 and 50 houses. House size between 3500 and 1000 BC, presented graphically in Figure 1 and as data in Table 1, is similar to the earlier Anangula village houses, ranging from 3x3m (circular) to 5 x 9m (ovoid). Villages have storage facilities in the form of numerous small depressions less than 2m in diameter scattered around and between the houses.

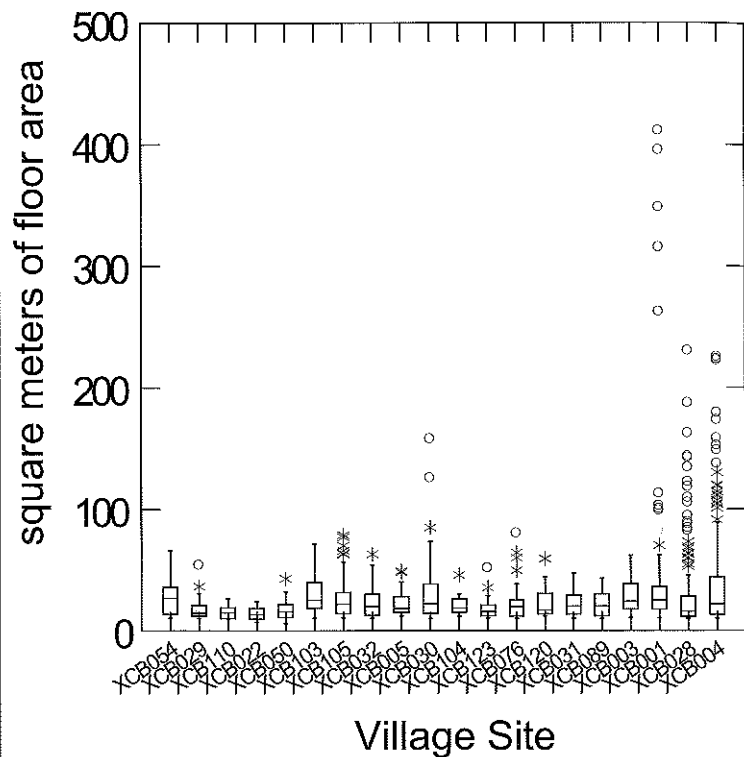
Between 1000 BC and AD 600 houses and villages on the lower Alaska Peninsula become larger. While many houses stay in the 4 x 6 m range, a few reach 6 x 12m with many in the 7 x 7m (circular) range. We interpret

² Calibrated years.

these larger features as the dwellings of an "emerging" village elite.³ These large structures indicate an increase in village complexity sometime around 3000 years ago. There is also an increase in the number of external storage facilities at these sites and the presence of many depressions that might be evidence of summer tents (McCartney 1974). Village area reaches 140,000m². The largest village has over 800 surface depressions (Maschner et al. 1997; Maschner 2000a).

During a brief interval dating between AD 700 and AD 1100, houses become smaller again, as villages and houses revert in size to the distributions seen prior to 1000 BC. But after AD 1100, villages in the region undergo a radical transformation, both in the organization of the community and in the size of the household (Figure 1). Perhaps the most visible archaeological evidence of this transformation is the appearance of large multi-family houses. These communal houses have been found on the Lower Alaska Peninsula, the Shumagin Islands, Unimak Island, and Unalaska Island (Cooper and Bartolini 1991; Hoffman 1990, 1995, 1997, 1999, 2001; Johnson 1995; Maschner et al. 1997; Veltre and McCartney 1988). Important inter-regional variability in the size of these features exists (Hoffman 1999). The Unalaska houses typically range between 20 and 40 m in length, while the largest house depressions recorded on the lower Alaska Peninsula are under 25 m in length (Hoffman 1990, 1999; Maschner 1999a, 1999b). One interesting characteristic of these communal houses are the numerous small side rooms that are attached to the main room. Historic descriptions of contact period Aleut houses indicate these side rooms were used as sleeping quarters, storage space, or as burial chambers (Merck 1980:169; Veniaminov 1984:261-264). As potential storage areas, these side rooms represent a substantial increase in storage capacity located inside the houses. The main room and side rooms combined result in an effective increase in usable floor area to three or four times the size prior to the transition (Figure 1).

Figure 1. Box plot of house floor area data for 20 villages from the lower Alaska Peninsula listed oldest to youngest. The chart shows the beginnings of household size variation by XCB-105 (900-200 BC), becoming more pronounced by XCB-030 (AD 500), and then changing dramatically by XCB-001 (AD 1150). A box plot is a summary plot that is based on the median, quartiles, and extreme values within a single variable. 50% of the values are within the box, which is the interquartile range. The highest and lowest values are marked by the whiskers. The outliers, those that fall outside of the .95 confidence interval, are marked as stars. The median is marked by a line across the box. Data are from the lower Alaska Peninsula Project and USBIA (1991).



Village size becomes much larger overall after AD 1150 with five villages between 30,000 and 60,000 m². One village has 200 surface depressions, three have between 400 and 600, and one has over 800 surface depressions. The numbers of nucleus-satellite houses in the larger villages ranges from 7 to 30, which also may indicate the number of corporate groups.⁴ If even two-thirds of these houses are occupied simultaneously, these villages range in population from 250 to over 1500 individuals.⁵

The Kodiak Archipelago

The earliest well-documented occupation of the

³ There is no evidence for ceremonial structures in the Aleutian region.

⁴ There is every reason to believe that the majority or all of these large houses were occupied at the same time. First, they are often organized as a village, with equal spacing between depressions. Second, they are never overlapping, or, apparently, cutting through older depressions. Third, in 1997 we randomly sampled six of twenty of these large houses at a single site. All had identical stratigraphy, floor formation and accumulation, and soil development. There was no evidence of reuse or spatial variability in village occupation.

⁵ Based on 4m² per person (Coupland 1988b). The authors are also aware of three sites with a single nucleus-satellite house, one with two houses, and one with four houses. But these are rare when compared with the larger villages.

Kodiak region is the maritime-focused Ocean Bay tradition (4000-1500 BC). Like the early Aleutian villages, these villages are rare, small, and located on the most productive landscapes (Erlandson et al. 1992:46; Hausler-Knecht 1993). Ocean Bay assemblages include small stone lamps, bilaterally barbed harpoons, fish hooks, microblades and blade cores (early in the tradition), and after 5000 years ago, ground slate lances (Clark 1996; Haggarty et al. 1991, Fitzhugh 1996). Thin, red ochre covered floors are interpreted as tent structures, suggesting at least seasonal mobility characterized Ocean Bay residential patterns (Fitzhugh 1996). Rice Ridge, one of the best preserved Ocean Bay sites excavated to date, however, provides evidence of more substantial structures. Hausler-Knecht (1993) describes these houses as oval-shaped, semi-subterranean, and about 5x3 meters in size. The data from Rice Ridge suggests that at least semi-sedentary Ocean Bay communities existed in some regions (resource rich), whereas residential mobility characterized other areas (Fitzhugh 1996).

The Kachemak tradition (1500 BC – AD 1000) marks the first appearance of substantial midden sites with house depressions in the Kodiak region. Kachemak villages were generally small, 100-1000 m², but a few larger sites are documented (Knecht 1995; Jordan and Knecht 1988; Steffian 1992b). There are some material differences between Ocean Bay and Kachemak, but with toggling harpoons and labrets the only significant additions (Clark 1996: Table 1). Economically, there was an increase in diet breadth (most notably the substantial harvest of shellfish), while abundant notched-stone net sinkers indicate an increasing emphasis on mass capture technologies, particularly for the harvest of salmon.

Storage facilities become prevalent in the archaeological record and include storage pits unlined or lined with clay, wood, or stone slabs. Kachemak houses differ from the Ocean Bay houses in that they are square-shaped and include side entrances. Kachemak houses range between about 10 to 50 m², but exhibit little intra-site variability as seen in Figure 2 and Table 2. Through time, storage facilities are increasingly located inside the houses and include construction of corner alcoves that foreshadow the multi-room houses of the Koniag period to follow.

A major escalation in village formation occurs with the arrival of the Koniag tradition after AD 1100 (perhaps even as late as AD 1400 in some areas). A distinct settlement hierarchy emerges with small (500-1000 m²), medium (4000-8000 m²) and large villages (12,000 m²). This hierarchy has been interpreted as reflecting func-

tional differences, such as winter aggregation sites versus seasonal encampments (Fitzhugh 1996), or due to infilling of the landscape with larger groups occupying the richest locations (Haggarty et al. 1991; Erlandson et al. 1992). In either case, the large villages, which include "mega-villages" with 100 or more houses (Jordan and Knecht 1988; Knecht 1995), indicate the presence of social units of substantial size. Houses also become larger, most notably with the addition of side rooms during the later "Developed" Koniag period after AD 1400 (Figure 2).

These complex, multi-room houses result in considerable intra-site variability in house size, with houses ranging between about 20 and 150 m². Use of the multi-room houses continued until after Russian contact. Historic documents indicate the large Koniag houses were occupied by extended families and held an average of 18-20 individuals (including slaves). The main room was used for entertaining and manufacturing activities. Side rooms functioned as kitchens, sweat baths, and bedrooms.

The Northern Northwest Coast

On the northern Northwest Coast we find large shell-midden sites in southeast Alaska, the northern British Columbia coast, and on the Queen Charlotte Islands forming in the Early Pacific Period about 3000 BC (Ames and Maschner 1999; Maschner 1997, 1998c). These sites are located at the most productive harvesting locations and faunal analyses indicate that some of these sites were occupied throughout most of the year (Ames n.d.; Ames and Maschner 1999; Davis 1990; Maschner 1992; Okada et al. 1989, 1992). No remains of houses have been found in any of these early shell midden sites. Site size ranges from a few square meters to several thousand. There are numerous temporary camps in coves and in rockshelters indicating that at least some of the population was rather mobile (Maschner 1997).

The first evidence of permanent houses and house depressions occurs after approximately 1500 BC in the Middle Pacific Period of northern Northwest Coast prehistory: much later than in the Aleutians and Kodiak Island. At the Boardwalk site in Prince Rupert Harbour, and at the Paul Mason Site on the Skeena River, houses are square to rectangular and average 50-60 square meters (Ames 1996a; Coupland 1985a, 1988a). This period of village formation seems to last from approximately 1000 to 200 BC, after which many areas appear to be abandoned. These Middle Pacific villages are large and well organized with one or two rows of houses on terraces above the current shoreline. A burial complex shows clear evidence of status differences at the Boardwalk site

Table 1. Summary data for the lower Alaska Peninsula village sites used in this study. Note that only depressions greater than 10m² were used in the analysis. The mean values for the lower Alaska Peninsula depressions are misleading because summer (small) and winter (large) houses were often in the same village after AD 1150. If only the depressions left by the large, corporate households are used the mean ranges between 75 and 135 m² and standard deviation between 30 and 45. Regardless of approach, the result is the same. Of special notice here is the coefficient of variation (C.V.), which is the standard deviation divided by the mean. The C.V. is a measure of the variability in house floor area. There is a substantial increase in the C.V. with the rise of large, corporate households after AD 1100. Data are from the lower Alaska Peninsula Project and USBIA (1991). All units are in square meters.

Site	XCB-054	XCB-029	XCB-110	XCB-022	XCB-050	XCB-103	XCB-105
Period	2200 BC	1500 BC	1500 BC	1250 BC	1100 BC	600-400 BC	800-100 BC
N of cases	14	26	12	12	27	32	115
Minimum	10.40	10.20	10.00	7.07	6.00	10.50	10.60
Maximum	66.00	53.90	26.40	24.00	42.84	71.30	78.75
Range	55.60	43.70	16.40	16.93	36.84	60.80	68.15
Sum	417.00	469.70	184.20	169.63	454.50	940.10	2960.28
Median	26.90	14.60	14.90	13.35	15.70	25.25	21.98
Mean	29.79	18.07	15.35	14.14	16.83	29.38	25.74
Standard Dev	18.22	9.65	5.29	5.94	9.40	14.92	14.86
C.V.	0.61	0.53	0.34	0.42	0.56	0.51	0.58

Site	XCB-032	XCB-005	XCB-030	XCB-104	XCB-123	XCB-076	XCB-120
Period	200 BC - AD 100	50 BC - AD 400	AD 300 - 600	AD 300 - 600	AD 700 - 1000	AD 700 - 1000	AD 700 - 1000
N of cases	70	18	109	7	31	49	13
Minimum	10.50	12.00	10.10	11.80	10.33	10.00	11.93
Maximum	63.00	49.00	157.50	45.70	51.24	80.00	59.35
Range	52.50	37.00	147.40	33.90	40.91	70.00	47.42
Sum	1659.32	417.00	3194.80	158.50	560.32	1118.10	341.48
Median	19.81	18.00	22.00	18.60	15.53	19.63	16.76
Mean	23.70	23.17	29.31	22.64	18.07	22.82	26.27
Standard Dev	12.66	11.83	23.29	11.82	8.78	14.77	17.33
C.V.	0.53	0.51	0.79	0.52	0.49	0.65	0.66

Site	XCB-031	XCB-089	XCB-003	XCB-001	XCB-028	XCB-004
Period	AD 700 - 1000	AD 700 - 1000	AD 700 - 1000	AD 1100 - 1800	AD 1100 - 1800	AD 1100 - 1800
N of cases	95	9	33	143	192	148
Minimum	10.11	10.00	10.70	10.30	10.00	10.10
Maximum	47.21	42.84	61.70	411.00	230.00	225.00
Range	37.10	32.84	51.00	400.70	220.00	214.90
Sum	2117.07	202.97	959.10	5693.80	5514.70	6085.70
Median	20.00	20.00	23.90	25.00	15.75	21.60
Mean	22.28	22.55	29.06	39.82	28.72	41.12
Standard Dev	9.91	11.28	14.99	61.87	33.68	45.86
C.V.	0.44	0.50	0.52	1.55	1.17	1.12

(Ames n.d.). But elsewhere in the region there are permanently occupied shell midden sites, oftentimes a number of them occupied simultaneously in each bay system, but the dwellings associated with them have not been discovered.

About AD 200 (but maybe a bit earlier in Prince Rupert Harbour), large, Northwest Coast style villages begin to form and are seen as a number of square to rectangular house depressions in a row along the beach

(Acheson 1991; Ames and Maschner 1999; Archer 1992, 2001; Maschner 1992, 1997). These Late Pacific houses range from 60 to 300 square meters and continue to be used into historic times, as shown in Figure 3 and quantified in Table 3. Villages become larger as well, increasing from 1000-2000m² to over 6000 m². All evidence points to full sedentism at this time, although there is little evidence to argue against sedentism any time in the 3500 years before historic contact. The Late Pacific Period also witnesses a proliferation in the construction of de-

defensive fortifications on the northern Northwest Coast (Ames and Maschner 1999; Maschner 1990, 1992, 1998a, 1998c; Moss 1989; Moss and Erlandson 1992).

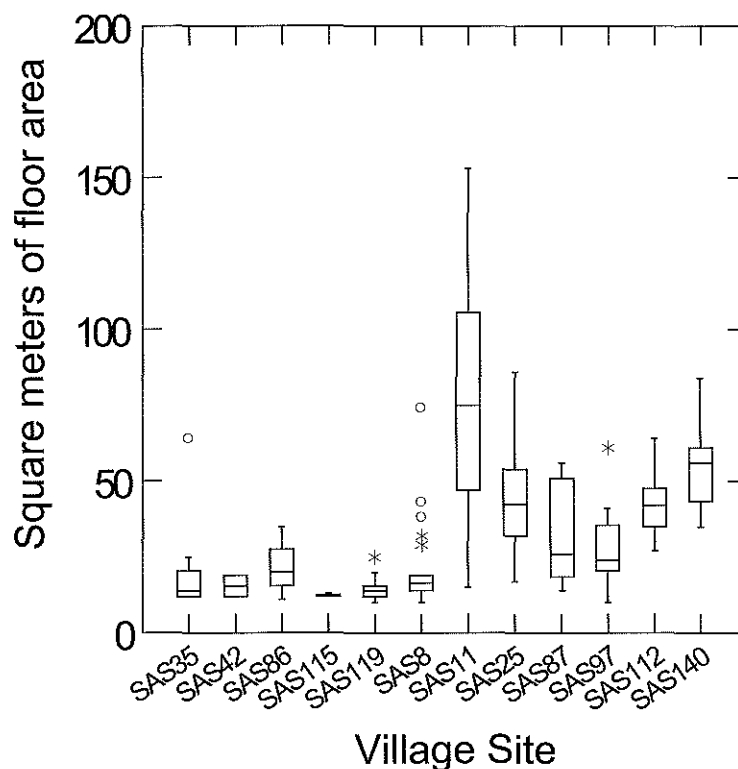
DISCUSSION

In a broad survey of village-based political organizations, Maschner recognized that the most fundamental aspect of status and political power in both egalitarian and ranked villages is corporate group size (Maschner 1996a). Differential corporate group size can be seen across the North Pacific in house floor size variability. In all cases where we know the numbers, status, and floor area of the houses in a village, the largest house was inhabited by the most individuals, and the headman of this house, and the lineage itself, was the highest ranked in the community. Plainly speaking, the largest lineage has the most influence because they have the most people and the most people require the largest house. This is a critical point because, as has been demonstrated for the Yanomamö by Chagnon (1975, 1979a, 1979b, 1988), and through a number of cases elsewhere, social power can exist without any concomitant economic power. Thus, our only independent means of measuring status differences archaeologically, before any economic signatures, is through house floor area.

This increase in household size, and this variability in size as an indicator of lineage rank, is seen across the north Pacific. The statistics of house floor size for all three regions through time are presented in Tables 1-3. All three areas show a major shift in household size between the Middle and Late Pacific Periods (AD 200 and 500) on the northern Northwest Coast, between the Kachemak and Koniag Periods at AD 1100-1400 in the Kodiak Archipelago, and after AD 1100 in the eastern Aleutian Islands and lower Alaska Peninsula. In all three areas we see a doubling or greater in house floor area and a tripling of the standard deviation. This is a transition from houses that were composed of 4-12 individuals to houses that were occupied by as many as 60 individuals, variability that has considerable implications for the village power structure.

Correlates to these increases in household size include the movement of some storage facilities from outside the structure to inside and a substantial increase in the size of the community. Maschner (1992, 1996b; Maschner and Patton 1996) argued that in central south-east Alaska this transition can be seen as a switch from

Figure 2. Box plot of house floor area data for 12 villages from the Kodiak Archipelago listed as Kachemak Tradition (left six) and Koniag Tradition (right six). All from J. B. Fitzhugh's dissertation (1996). Note the substantial increase in house floor area and floor area variation at the Kachemak to Koniag transition (SAS8 to SAS11 on this chart). See Figure 1 for a description of box plots.



single lineage (single corporate group) villages to multi-lineage (multi-corporate group) villages. We would expect that in the transition to villages with multiple kin groups, more emphasis will be placed on protecting storage facilities.

We argued above that social ranking will develop in any area where it is possible, and this possibility is founded first in resource abundance and second in social or environmental circumscription. As archaeologists, it is our job to find the conditions under which striving headmen were able to put themselves and their lineage in a position of power and get away with it. This can only occur where there are abundant resources and where smaller lineages cannot fission. So why would small corporate groups or families on the North Pacific join to form large corporate groups and then join together to form large villages?

Maschner has argued that the bow and arrow probably put an interesting twist on inter-village politics and seems to spur the construction of defensive fortifications after its arrival on the northern Northwest Coast after AD 200-500 (Blitz 1988; Maschner 1992, 1998a).

Table 2. Summary data for the Kodiak area village sites used in this study. Note that only depressions greater than 10m² square meters were used in the analysis. Of special notice here is the coefficient of variation (C.V.), which is the standard deviation divided by the mean. The C.V. is a measure of the variability in house floor area. Unlike the lower Alaska Peninsula, the C.V. for all time periods are similar even though there is a substantial increase in mean floor area from the Kachemak to Koniag Phases. This probably results from the small number of Kachemak houses, but may also be a product of the kashim or men's house being present in the Kachemak Phase. The site numbers and the data are as presented by J.B. Fitzhugh in his fieldwork and reported in his dissertation (1996). All units are in square meters.

SITE	SAS35	SAS42	SAS86	SAS115	SAS119	SAS8
Period	Kachemak	Kachemak	Kachemak	Kachemak	Kachemak	Kachemak
N of cases	7	2	3	3	12	26
Minimum	12.00	12.00	11.00	12.00	10.00	10.00
Maximum	64.00	19.00	35.00	13.00	25.00	74.00
Range	52.00	7.00	24.00	1.00	15.00	64.00
Sum	155.00	31.00	66.00	37.00	177.00	551.00
Median	14.00	15.50	20.00	12.00	14.00	16.50
Mean	22.14	15.50	22.00	12.33	14.75	21.19
Standard Dev	19.03	4.95	12.12	0.58	4.14	14.15
C.V.	0.86	0.32	0.55	0.05	0.28	0.67

SITE	SAS11	SAS25	SAS87	SAS97	SAS112	SAS140
Period	Koniag	Koniag	Koniag	Koniag	Koniag	Koniag
N of cases	16	22	7	8	7	11
Minimum	15.00	17.00	14.00	10.00	27.00	35.00
Maximum	153.00	86.00	56.00	61.00	64.00	84.00
Range	138.00	69.00	42.00	51.00	37.00	49.00
Sum	1208.00	1010.00	235.00	231.00	298.00	589.00
Median	75.00	42.50	26.00	24.00	42.00	56.00
Mean	75.50	45.91	33.57	28.88	42.57	53.55
Standard Dev	36.91	19.23	18.34	15.76	12.58	14.62
C.V.	0.49	0.42	0.55	0.55	0.30	0.27

Maschner has also seen a transition in the locations selected for village construction from areas with good resources to areas that are more defensible (1992, 1996a, 1997, 1998b).

On Kodiak and the lower Alaska Peninsula the transition to large corporate households occurs at the point where the expansion of Thule culture (people or traits) is abutting Kodiak and the lower Peninsula. This occurs at the same time as an increase in the use of the bow and arrow (here we mean the recurve bow) on many islands (Johnson 1988; Workman 1969) where there is nothing to hunt with the bow and arrow except humans (Maschner and Reedy-Maschner 1998), an increase in the manufacture of armor plate and shields (Dall 1878; Knecht 1995), and an increase in the use of defensible bluff tops and islands (Fitzhugh 1996; Hoffman 1999; Knecht 1995; Maschner and Reedy-Maschner 1998; Moss and Erlandson 1989). Maschner has stated that this introduction of the 'Asian war complex' had ramifications well beyond this region (2000b). But this is not a

clear relationship and will require further investigations to test as a formal hypothesis.

But perhaps it was something completely different. There is clear evidence from throughout the region that there is a region-wide increase in salmon populations, particularly red salmon, at this time (Finney et al. 2002); and in fact, most major villages in the region are directly associated with red salmon spawning streams (Langdon 1979; Maschner 1999). An alternative political explanation might include an expansion of trade networks and involve the role of elite members of the community in either production, redistribution, the control of trade, or all three (*sensu* Hoffman 2001). Either the distribution of resources or a desire for access to prestige goods might have created a sort of 'downtown' effect that drew families to focal villages that resulted in the large towns witnessed ethnographically throughout the region.

Whatever the cause, and all of these are quite testable with further investigations, the conditions for the rise

of ranked foragers were present because social and/or environmental circumscription kept people in the community. There must have been conditions where, whatever the aggrandizing behavior of the emerging elite, there was still reason for smaller, less well-off families to stay in the community. This is the exact condition where we would expect striving, charismatic leaders of the largest lineages to put themselves in a position of power for the sole reason that they are able to get away with it. These are also the conditions where internal social pressures would necessitate means for maintaining cohesion between unrelated households. Therefore, feasting should arise at this time as both a means for maintaining alliances but also as a form of non-violent competition.

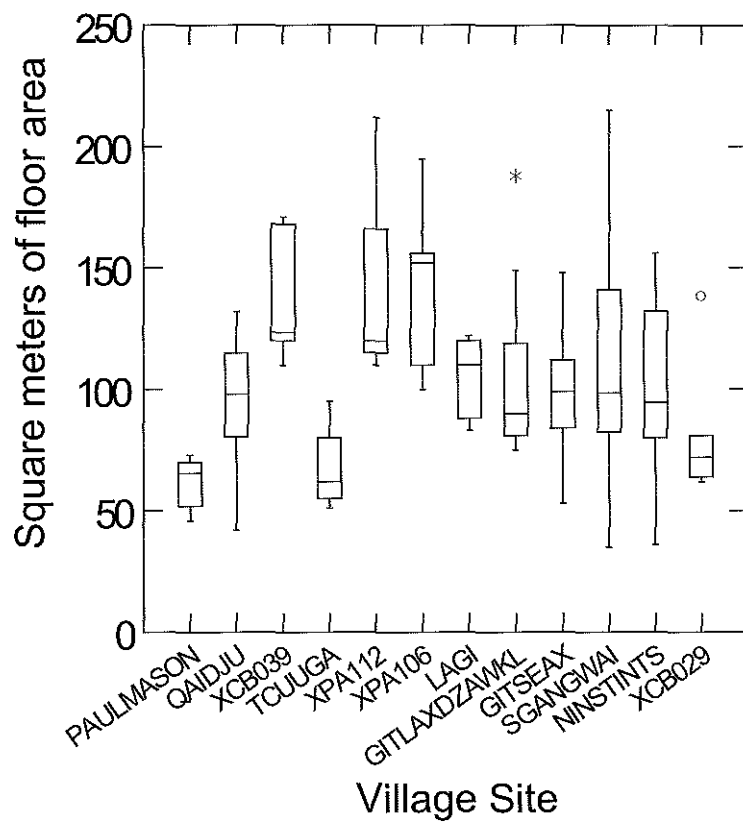
CONCLUSION

In historic times the north Pacific rim was occupied by three different groups of complex hunter-gatherers who shared a number of organizational and behavioral similarities. These societies developed in one of the world's richest landscapes. The excellent ethnohistoric record, the quality of the archaeological preservation, and the current state of archaeological knowledge in the area makes this a perfect region for investigating the development of ranked household organization.

We have argued that ranked households can develop in a social context before any evidence of economic differences might be discernable. This is so because one cannot maintain economic power without having the social power in place to protect it. The means to identify social power is through the size and size variability of corporate groups because the only basis for status and power will be in the number of followers available to support social and political aspirations of the headmen. Leaders who are able to increase the size of their corporate group disproportionately in relation to other groups will have a political advantage. When conditions develop where small corporate groups either cannot leave or simply choose not to, the leaders of the largest corporate groups will be able to put themselves in a position of influence and create the kinds of hereditary structures we see ethnographically.

Thus, when three conditions are met, ranked village organization will arise. First, there must be an environment capable of supporting large, permanent villages.

Figure 3. Box plot of house floor area data for 12 villages on the northern Northwest Coast. The only Middle Pacific Period village in the region with a large number of house depressions is Paul Mason (Coupland 1988a). Two other Middle Pacific houses (not included) at the Boardwalk site (Ames n.d.) are the same size as the Paul Mason houses. All of the village sites in the Late Pacific Period are on average larger but, more importantly, have much greater variation in size than Paul Mason, as Coupland (1988a), Ames (1994), and Maschner (1992) have noted previously. Two villages, Tcuuga and XCB-029, have mean floor areas close to those at Paul Mason, but each has at least one house that is much larger than any at Paul Mason. See Figure 1 for a description of box plots. Data are from Acheson (1991), Coupland (1988a), and Maschner (1992).



Second, there must be a reason for households to organize at levels larger than the family. Third, there must be a reason that small corporate groups cannot fission away from the larger village. When these conditions are present, the scene is set for the headmen of the largest corporate groups to put themselves in a position of authority for the sole reason that they are able to do so. The opportunistic status striving tendencies of headmen can only be manifested when these preconditions are met. The creation of structured and corporate status differences may or may not eventually lead to economic inequalities. But the political, social, and ultimately reproductive advantages of being a leader or member of the most powerful corporate group cannot be underestimated.

Table 3. Summary data for the northern Northwest Coast area village sites used in this study. Note that only depressions greater than 10m² were used in the analysis. Of special notice here is the coefficient of variation (C.V.), which is the standard deviation divided by the mean. The C.V. is a measure of the variability in house floor area. Note that the single Middle Pacific village site has the lowest C.V., a point made by Coupland (1988b:273-274), but two Late Pacific sites also have a low C.V. even though the mean floor areas for houses are substantially larger in the all Late Pacific samples. The low C.V. in most of these villages, even though the mean floor areas are large and although there are some very large houses, might be due to the population growth constraints that result from a matrilineal form of organization, which creates a population peak of 50 to 60 individuals. Data are from Acheson (1991), Coupland (1988a), and Maschner (1992). All units are in square meters.

SITE	PAUL MASON	QAIDJU	XCB-039	TCUUGA	XPA-112	XPA-106
Period	Middle Pacific	Late Pacific	Late Pacific	Late Pacific	Late Pacific	Late Pacific
N of cases	10	16	6	4	3	5
Minimum	46.00	42.00	110.00	51.00	110.00	100.00
Maximum	73.00	132.00	171.00	95.00	212.00	195.00
Range	27.00	90.00	61.00	44.00	102.00	95.00
Sum	618.00	1512.00	816.00	270.00	442.00	713.00
Median	65.50	98.00	123.50	62.00	120.00	152.00
Mean	61.80	94.50	136.00	67.50	147.33	142.60
Standard Dev	9.81	27.42	26.48	19.21	56.23	38.38
C.V.	0.16	0.29	0.19	0.28	0.38	0.27

SITE	LAGIGITLAXDZAWKL	GITSEAX	SGANGWAI	NINSTINTS	XCB-029
Period	Late Pacific	Historic	Historic	Historic	Historic
N of cases	5	10	17	16	18
Minimum	83.00	75.00	53.00	35.00	36.00
Maximum	122.00	188.00	148.00	215.00	156.00
Range	39.00	113.00	95.00	180.00	120.00
Sum	523.00	1067.00	1715.00	1848.00	1794.00
Median	110.00	90.00	99.00	98.50	94.50
Mean	104.60	106.70	100.88	115.50	99.67
Standard Dev	18.11	36.74	26.36	47.83	33.75
C.V.	0.17	0.34	0.26	0.41	0.34

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IMPLICATIONS OF "PUNCTUATED PRODUCTIVITY" FOR COASTAL SETTLEMENT PATTERNS: A GIS STUDY OF THE KATMAI COAST, GULF OF ALASKA

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Abstract: GIS spatial analysis of 15 categories of subsistence resources (sea mammals, fish, birds, shellfish) and 90 archaeological site locations along the Pacific shoreline of Katmai National Park and Preserve indicates that sites of all time periods are concentrated within enclosed bay systems where resource diversity tends to be highest. This pattern of intensive settlement in resource-rich "hot spots" may apply to the entire Gulf of Alaska region. Ethnohistoric information on Alutiiq subsistence practices and site survey data from the study area suggest that large and ecologically diverse bays (e.g. Kukak and Amalik) may have offered sufficient resource options to buffer cyclical shifts in the productivity of salmon and other species, and to thus provide stable, self-sufficient territories for autonomous local groups. Several gaps in the Katmai occupation record are nonetheless identified (5600 – 4600 cal. yrs. B.P.; 2900 – 2000 cal. yrs. B. P.) that may represent periods when even the most diverse and stable settlement areas were abandoned. The study suggests that reconstructions of maritime adaptations and social development in the Gulf of Alaska must take account of the physical and ecological heterogeneity of the coastal environment, as well as its instability over time.

Keywords: subsistence, settlement pattern, GIS, resource diversity, maritime adaptations, Gulf of Alaska, Alutiiq.

The Pacific shoreline of Katmai National Park and Preserve (Figure 1) was occupied by indigenous populations for at least 7000 years and offers an important setting for the archaeological study of Alaskan coastal adaptations. Cultural resource surveys have been conducted along virtually all sections of the topographically varied coastline between Katmai Bay and Cape Douglas, where 90 pre-contact and historic period settlements are now known. The present GIS-based study of site locations, resource distributions, and coastal geomorphology incorporates archaeological data and interpretations from University of Oregon research (G. Clark 1977; Dumond 1964, 1971, 1987; see also W. Davis 1954; Oswalt 1955), post-*Exxon Valdez* oil spill surveys and cultural ecological analysis (Dekin et al. 1993; Environment and Natural Resources Institute 1993; Erlandson et al. 1992; Haggarty et al. 1991; Mobley et al. 1990), and recent interdisciplinary studies sponsored by the National Park Service and Smithsonian Institution (Crowell and Mann 1996; Crowell and Mann n.d.; Hilton 1998, 2002; National Science Foundation 2002; Schaff 2002). It builds on Allen McCartney's observation (1988:46) that the Pacific coast of the Alaska Peninsula is a region of "punctuated productivity" where ecological hotspots correspond with areas of intensive human use.

The cultural history of the Katmai coast, where a small Alutiiq¹ population resided until the early 20th century, is unified with that of the Alutiiq region as a whole (Figure 2), with particularly close parallels to Kodiak Island and lower Cook Inlet (D. Clark 1984a; G. Clark 1977; Crowell 2000; Steffian 2001; Workman 1980). Initial settlement of the coast was almost certainly an aspect of the Paleoarctic expansion from Siberia (West 1996). Although presently known only from the Ugashik Narrows site and other inland locations on the Alaska Peninsula (Dumond 1981; Henn 1978), Paleoarctic sites dating to between 8500 and 10,000 calendar years have been documented in the eastern Aleutian Islands (Dumond and Knecht 2001; McCartney and Veltre 1996) and southeastern Alaska (Ackerman et al. 1979; S. Davis 1996; Dixon et al. 1997). Middle Holocene sites on the Katmai coast, assigned to the Takli Alder (4700 – 2700 B.C.) and Takli Birch (2700 – 1000 B.C.) phases², contain barbed harpoons and remains of sea otter, harbor seal, sea lion, porpoise, and a wide variety of fish and sea birds, all indicative of fully-developed maritime harvesting capabilities (Bender 1999; G. Clark 1977; Dumond 1977). Apparent population growth, the appearance of medium to large coastal villages with semi-subterranean houses and thick shell middens, and a continuing shift from chipped

¹ The Alutiiq population (plural, Alutiit) has been referred to as "Pacific Eskimo" in earlier literature (e.g. Birket-Smith 1953; D. Clark 1984b). Crowell et al. (2001) discuss the currency of Alutiiq as a cultural designation. The spelling "Alutiiq" has been retained because of widespread usage and publication. However, in the revised orthography now used by the Alaska Native Language Center (University of Alaska Fairbanks) it would be "Alu'utiq" (Leec 2001).

² Date ranges are expressed in calendar years as revised from G. Clark (1977) to accommodate new sites and an expanded series of calibrated radiocarbon dates (Crowell and Mann 1996).

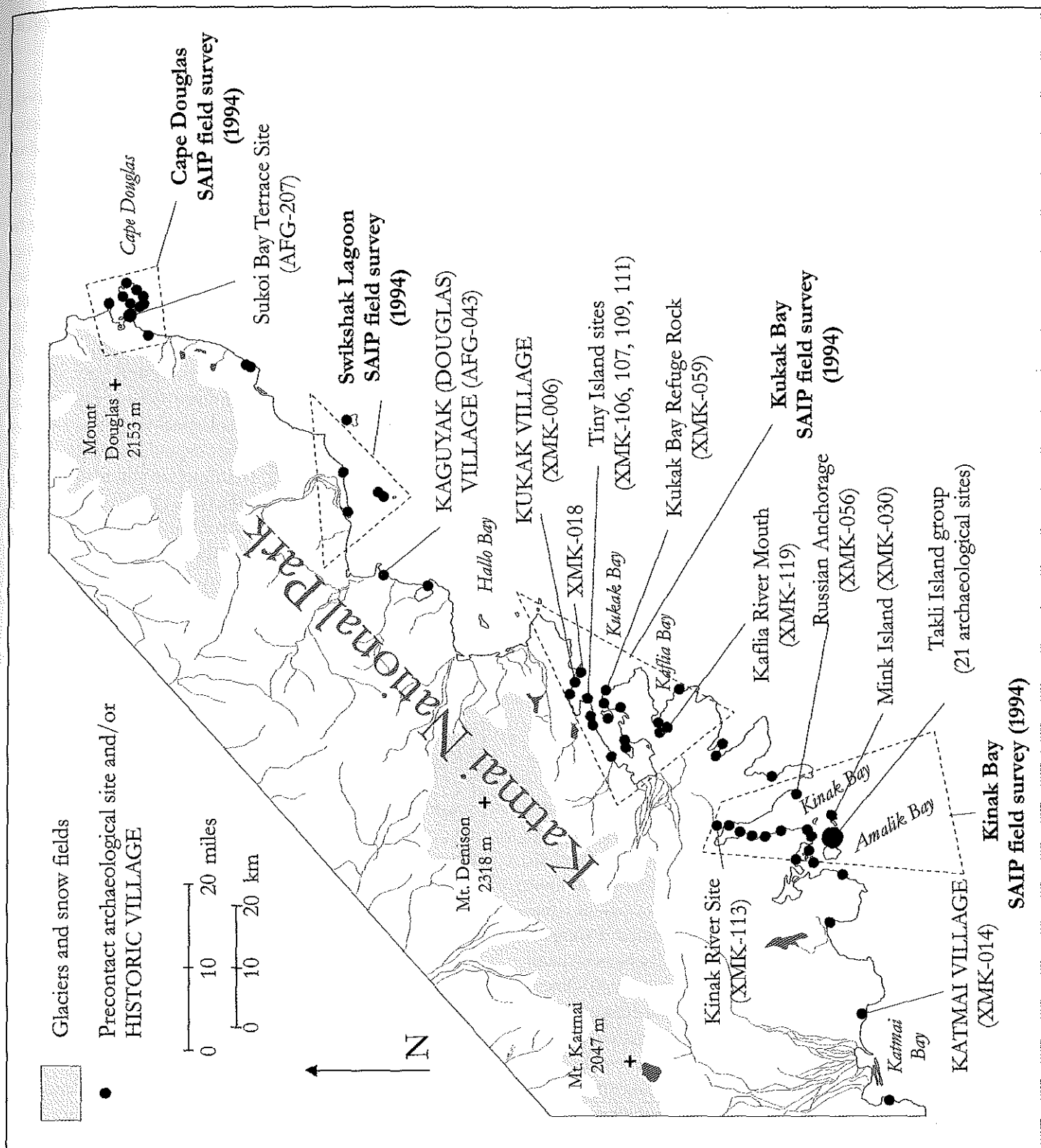


Figure 1: The Gulf of Alaska shoreline of Katmai National Park, showing 1994 survey locations, pre-contact archaeological sites, and historic villages.

to ground stone tools are among the important trends that characterize subsequent periods of occupation, known as the Cottonwood phase (A.D. 1 – 500), Beach phase (A.D. 500 – 1000), and Mound phase (A.D. 1000 – 1700). Artifact assemblages from these phases suggest strong

east-west interactions with other Gulf of Alaska populations from the Aleutians to Prince William Sound, as well as intermittent connections northward to Bristol Bay and the Bering Sea (D. Clark 1984a; G. Clark 1977; Dumond 1974, 1981).

Russian fur traders who arrived in the late 18th century noted several Alutiiq villages in what is now Katmai National Park, including Katmai (Alutiiq name, *Qayihwik*) and Kukak (*Qukaq*) on the Pacific coast and Severnovskoe (*Ikak*) at Naknek Lake in the interior (Arndt n.d.; Hussey 1971; Lührmann 2000). There were scattered seasonal camps as well. All Alutiiq settlements within the study area, including newer communities at Douglas and Kafil Bay, were deserted after the massive eruption of the Katmai/Novarupta volcano in 1912.

Native descendants of this historic population now live in villages to the west and north of the park, including Chignik, Chignik Lake, Chignik Lagoon, Perryville, Ivanof Bay, Port Heiden, Ugashik, Pilot Point, Naknek, South Naknek, and King Salmon. The Pacific coast Alutiiq villages maintain a subsistence-oriented economy that is focused on salmon, seals, caribou, moose, and a wide range of other animal foods and wild plants (Fall et al. 1995; Fall and Hutchinson-Scarborough 1996; Morseth 1998). Oral traditions relating to life on the Katmai coast prior to 1912 are strong (Partnow 2002). This continuous relationship between people and the land is an important aspect of contemporary Alutiiq cultural identity and underlines the broader significance of archaeological studies in the Katmai area (Crowell et al. 2001).

The present paper examines the spatial distribution of indigenous habitation sites along the Pacific (Shelikof Strait) shoreline of Katmai National Park in relation to both the coastal landscape and the availability of marine subsistence resources. The focus in the latter instance is on access to key fish and game species of the coastal zone, including sea mammals, salmon, bottom fish, seabirds, and waterfowl³. Along the Katmai coast, most food species are concentrated in discrete patches that are seasonally specific and unevenly distributed. Examples include sea lion haul-outs and rookeries, harbor seal haul-outs and breeding areas, sea bird colonies, salmon spawning streams, shellfish beds, and spring concentrations of waterfowl. From the standpoint of the human harvester, the coastal and near-shore zones thus represent a space-time mosaic of relatively predictable hunting and fishing opportunities. The Katmai Alutiit and their ancestors chose settlement locations and adopted patterns of seasonal movement that maximized these opportunities, as

documented by archaeological and historical data and as discussed in this paper⁴.

A limiting but necessary assumption of the analysis is that spatial distributions of fish and game species have remained at least approximately the same over the last 7000 years. It is certainly true that the populations of some species have been reduced by historic impacts including commercial fishing and whaling. It is also to be expected that populations of all coastal fauna have fluctuated as the result of cyclical changes in climate, sea temperature, and other natural variables (Beamish and Bouillon 1993; Francis et al. 1994, 1998). We nonetheless assume that animals have utilized broadly similar feeding, breeding, and migration areas through time, despite these changes in population. Future paleoenvironmental research and studies of archaeological fauna may at least partially invalidate this assumption and lead to modification of the present model. To minimize untenable projections from present data into the past, the analysis focuses on the *generalized spatial diversity* of resources rather than on measures of absolute abundance.

One key perspective of the study is that large bays with complex coastlines are topographically and ecologically diverse and for this reason offer an exceptional variety of harvest options to human foragers (cf. Haggarty et al. 1991:225-247). The spatial concentration of resource locales within such bays probably attracted settlement for several reasons, including shorter foray distances and less need to shift residence from main villages to seasonal fishing and hunting camps. Diversity of subsistence options would also have mitigated changes in the abundance of individual food species. In addition, bays that are protected from ocean storms by reefs and islands provided a relatively sheltered environment for travel in skin-covered kayaks and larger transport craft (*angyat*). Low energy beaches are safer for landing boats, and their physical characteristics – including substrate, sediment, width, and slope – indirectly reflect the reduced risks of boat travel in the vicinity. For these reasons, the geomorphological characteristics of Katmai beaches were incorporated into the GIS analysis.

The results of the study are relevant to the ecology of human settlement and adaptation around the Gulf of

³ Terrestrial resources were not included in the present analysis. Brown bears and moose have generalized distributions along the Katmai coast, while caribou are sometimes locally available in the vicinities of Hallo Bay and Katmai Bay. Caribou are more abundant along the coast west of the study area and in the interior, beyond the Aleutian Range. Usable distributional data are lacking for porcupine, fox, beaver, and other smaller land animals. Limited archaeological samples suggest that terrestrial species played a relatively minor role in the diets of former coastal inhabitants of Katmai National Park (Bender 1999; Dumond 1977), although they are important today for Alutiiq villages such as Chignik.

⁴ Mike Hilton (personal communication 2002) suggests that "catcher beaches" where driftwood is available in quantity were also important resource locales.

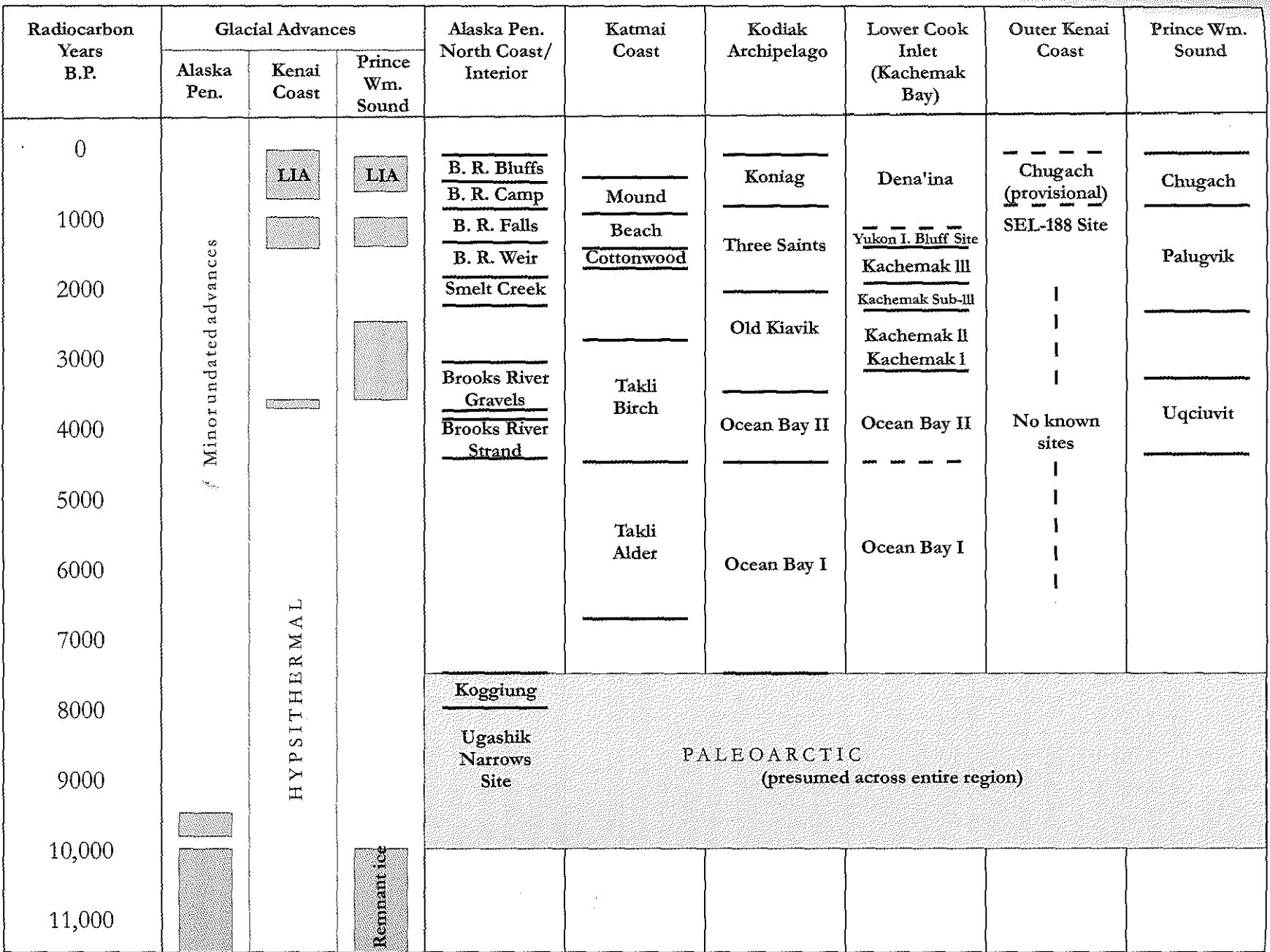


Figure 2: Cultural phases of the central Gulf of Alaska coast.

Figure 3: Ethnohistorically reconstructed Alutiiq seasonal round for Kodiak Island, circa 1790 – 1805 A.D.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
FUR SEAL					3,4							
HARBOR SEAL								3,4				
SEA LION								3,4				
PORPOISE								3				
SEA OTTER								2,3,4				
WHALES								1,2,3,4				
SALMON										3,4		
HALIBUT							4,5					
COD						1 ("early spring" & "winter")						
BIRD EGGS					4							
BIRDS												
PLANT FOODS												
SHELLFISH												

1. Davydov (1977:175, 224, 232)
2. Holmberg (1985:48, 50)
3. Merck (1980:106-106)
4. Sauer (1802:178)
5. Billings (in Merck 1980:206)

Alaska, one of the world's most productive oceanic regions (*Exxon Valdez Oil Spill Trustee Council* 2002; Hood and Zimmerman 1986). Southern Alaska – along with the coasts of southern California, Florida, and Peru – was among the earliest places in the Americas where human foragers came to rely primarily on maritime food sources (Erlandson 2001; Workman and McCartney 1998; Yesner 1998). Trends of the middle and late Holocene – including increased sedentism, population growth, social inequality, and warfare – prefigure ethnographic characteristics of historic Unangan, Alutiiq, Dena'ina, Tlingit, Haida, and Tsimshian societies (Crowell et al. 1991; Lantis 1970; Townsend 1980). Environmental variation and instability – demonstrated on a local scale for the Katmai coast – are likely to underlie these cultural and demographic patterns.

SETTLEMENT PATTERN STUDIES IN THE ALUTIIQ REGION

Ethnohistoric Patterns

Ethnohistoric data for the Alutiiq area (e.g., Black 1977; Davydov 1977; Gideon 1989; Holmberg 1985; von Langsdorff 1993; Merck 1980; Sauer 1802) indicate that pre-contact settlement patterns were characteristic of a "logistical foraging mode" of hunting, fishing, and gather-

ing (Erlandson et al. 1992). Logistical foraging systems, which incorporate movements of task groups between base settlements and temporary exploitation camps, are associated with pronounced seasonality and spatial dispersion of food resources.

A reconstruction of early historic period Alutiiq seasonal subsistence activities is presented in Figure 3, with source annotations. The figure represents Kodiak Island for the period of about 1790–1805 and is a proxy for the Katmai coast, where direct ethnohistoric information is scarce. The pattern may be distorted to a certain degree by Russian colonial control and its imposed focus on maritime fur production. During the environmentally unproductive months of October through March, coastal residents undertook relatively few subsistence activities and concentrated in large, long-established villages where they consumed a diet of dried salmon, seal oil, berries, and other stored foods. Shellfish were collected in all seasons but were especially important as a source of food in the spring when other supplies ran low. From April through September the population was more dispersed, as households divided their efforts among a wide variety of subsistence harvest opportunities as well as sea otter hunting voyages (Black 1977:85; Davydov 1977; Lisianskii 1814:195; Merck 1980:206; Sauer 1802:178). During this

time, salmon, whales and dozens of other migrant species become available and many birds and sea mammals were concentrated at their breeding grounds. Individuals and family groups traveled to hunting, fishing, and collecting places and often resided there for periods of days or weeks. Accumulated stores of dried fish, whale meat, and other foods were transported back to the main villages by boat. Fleet watercraft and the close packing of ecological zones permitted many subsistence efforts to be staged entirely from the winter villages, where at least some of the population resided year-round (Clark 1987; Haggarty et al. 1991:93-98).

Ioasaf summarized this pattern from his observations on Kodiak Island in 1794-1799:

Almost every family has its own dwelling, and many have more than one dwelling in various places. They settle on the bays and inlets, on the sea shore, and near streams, but change their locations and dwellings with the seasons. In the spring they usually stay in places where the run of fish from the sea toward the streams occurs earliest, and in winter near the shallows where they can find subsistence for themselves. (Black 1977:85).

Ethnographically-recorded factors in the selection of settlement sites included proximity to the sea, protected beaches for boat landings, open views of adjacent bays for monitoring sea mammals and the approach of enemies, and access to fresh water and food (Birket-Smith 1953; D. Clark 1984b, 1987; de Laguna 1956). It is important for archaeological interpretation to note that seasonal subsistence phases were often but not *necessarily* associated with either different locations or different types of dwellings. Impermanent shelters such as skin tents, overturned boats, and small plank sheds were used for travel and subsistence camps (Arteaga 1779:107; Merck 1980:122-123; Portlock 1789:253; Zaikov 1979:4), while winter or year-round base villages on Kodiak Island and the Alaska Peninsula consisted of semi-subterranean dwellings that could shelter as many as 15 – 20 occupants (Davydov 1977:154; Gideon 1989:39-40; von Langsdorff 1968:235; Lisianskii 1968:212-213; Merck 1980:204; Shelikhov 1981:55-56; D'Wolf 1968:66-67). However, similar houses were also built at many summer salmon fishing locations (Clark 1987; Jordan and Knecht 1988). In Prince William Sound, plank dwellings for summer and winter use were very similar in construction (although floors of the latter were more deeply excavated) and both types were sometimes built in the same locations (Birket-Smith 1953:53-55; de Laguna 1956; Walker 1982:140-141; Zaikov 1979:4).

Archaeological Models

Archaeological settlement pattern models for southern Alaska have placed varying degrees of interpretive emphasis on the physical and biological characteristics of coastal environments. "Landscape focus" models interpret site locations primarily in relation to such variables as shoreline topography, wave and weather exposure, beach substrate, and fresh water access (e.g., Dekin et al. 1992; Maschner 1999a; Maschner and Stein 1995; McCartney 1977). Biological resources are typically assumed to be sufficiently homogeneous in distribution to be equally accessible from all possible settlement locations. "Resource focus" models, on the other hand, may incorporate a variety of physical variables (such as wave energy and shoreline shape) but in particular address the spatial heterogeneity or "patchiness" of subsistence resources and the attraction that resource concentrations would have had for indigenous settlers (e.g., Corbett 1991; Crowell and Mann 1998; Dumond 1987; Environment and Natural Resources Institute 1993:71-77; Erlandson et al. 1992; Fitzhugh 1996; Haggarty et al. 1991). Erlandson et al. (1992) consider paleodemography as an additional factor, positing that early settlement and human population growth in the most productive and reliable environments would have been followed by fissioning and territorial expansion into less desirable locations.

Investigations of long-term shoreline history are essential to settlement pattern modeling on the North Pacific rim because tectonically and isostatically-induced changes in relative sea level – often rather localized in their effects – are important factors in the formation and destruction of the coastal archaeological record (Crowell and Mann 1996, 1998; Fitzhugh 1996; Johnson and Winslow 1991; Maschner 1999b). Changes in relative sea level can also have widespread effects on coastal ecology by altering the tidal regime in biologically productive lagoons and marshes (Gilpin 1995).

One result of recent coastal surveys has been recognition that human populations were in fact disproportionately concentrated in some areas of the Gulf of Alaska, and that these concentrations are almost certainly related to variations in ecological productivity and diversity. Mobley et al. (1990) found that there are two to four times more archaeological sites per km of coastline in the Kodiak archipelago than in other parts of the Alutiiq region including the Alaska Peninsula, Kenai Peninsula, and Prince William Sound. This measure is affected by differential site preservation due to sea level and glacial histories but correlates roughly with comparative estimates of Alutiiq subgroups at the time of Western contact (Crowell and Lührmann 2001:30-36)⁵. Local concentra-

tions of sites are evident in the Morzhovoi Bay/ Cold Bay area of the lower Alaska Peninsula (Maschner 1999a, 1999b), Amalik Bay and Kukak Bay on the Katmai coast (Erlandson et al. 1992; this paper), the Karluk River/ Uyak Bay area of western Kodiak Island (Jordan and Knecht 1988), Sitkalidik Island and the entire east side of Kodiak Island (Clark 1987; Fitzhugh 1996), Kachemak Bay in lower Cook Inlet (de Laguna 1975; Workman et al. 1980), and the outer islands of Prince William Sound (de Laguna 1956).

Haggarty and co-authors (1991) suggested that pre-contact human populations were highest in areas where the widest variety of resources was available. They quantified proximity of archaeological sites in the central Gulf of Alaska to several types of food sources: salmon streams, sea lion rookeries and haul-outs, harbor seal concentrations, and seabird colonies. The sample included 285 sites in the Kodiak archipelago, 23 on the Pacific coast of the Alaska Peninsula, and 17 on the Kenai Peninsula⁶. The authors found that, on average, sites in the Kodiak archipelago were within 10 km of 18 different resource locales, about a third more than mean values for the Alaska Peninsula and Kenai Peninsula. Kodiak's higher site density may therefore be attributable to a richer, more diverse resource base.

A large majority (81%) of archaeological sites in this sample was located in "protected" and "semi-protected" waters of bays and fjords, while only 19% were along exposed outer coasts and 1% along rivers. Outer bays were found to support a disproportionate number of the largest sites, many with surface imprints of semi-subterranean houses and evidence of occupation over time spans of hundreds or thousands of years (Haggarty et al. 1991:226-228). Such settlements fit the ethnographic profile of winter village sites. One evident advantage of outer bay placement for winter villages was minimization of travel distances to resources across a wide gradient of ecological conditions, from surf-pounded offshore rocks where sea lions and sea birds can be taken to quiet inner bays where larger streams with salmon runs are typically located. Reefs, islands, and submerged glacial moraines add to the topographical and ecological complexity of many outer bay areas, increasing the harvest potential for shellfish. In contrast, the heads of bays are often poor areas for shellfish because of silting, winter freezing, and low salinity.

These findings are corroborated by D. Clark's (1987) ethnohistorical and archaeological analysis of 32 winter settlements on Kodiak Island. Clark found that 20 (63%) of the winter villages reported by Lisianskii in 1805 were located in the middle or outer thirds of major bays or straits; eight (25%) were in outer coast locations, and only four (12%) were located in the inner reaches of bays.

Expectations for the Katmai study area derive from these previous studies and observations. Overall site densities should be highest in areas of maximum resource diversity and these should occur in the outer portions of protected bay systems. These same resource-rich zones should support the largest settlement sites – probable winter villages – characterized by semi-subterranean house depressions and thick, stratified middens. Other settlement sites will be smaller in extent, may lack house pits, and will have relatively thin middens. The latter are likely to be warm season exploitation camps and may be present in locations where fewer or perhaps only a single resource is accessible. Virtually all sites should be at locations where low or medium energy beaches allow reasonable access by skin boat. On-shore topography, including availability of level terrain for house construction, may further constrain site locations.

KATMAI COAST STUDY AREA

The study area includes the entire 250 km coastline of Katmai National Park, from Katmai Bay to north of Cape Douglas (see Figure 1). Mt. Katmai, Mount Douglas, and other glaciated volcanic peaks form the crest of the rugged Aleutian Range, which rises north of the narrow fringe of coastal land and partitions it from the lake and river country of the Alaska Peninsula interior. Passes extend through the mountains from Katmai Bay, Hallo Bay, and north of Cape Chiniak (at Douglas) into the upper Naknek drainage, and were important routes for trade and travel (Arndt n.d.; Clemens and Norris 1999; Dumond 1977).

The coast includes two distinct geomorphic sectors (Mann 2001). The shallowly scalloped shoreline from Hallo Bay northeast to Cape Douglas is a depositional environment indicative of long-term tectonic uplift. Long, surf-pounded beaches of sand and gravel are composed of sediments transported by streams from the glaciated interior. A contrasting zone of long-term subsidence extends along the southern coast, configured of drowned glacial valleys. The heads of larger fjords like Kukak Bay are filled with alluvium while their outer portions are

⁵ For regional comparison, Kroeber (1939) estimated that overall Alutiiq population density was similar to that of the Tlingit (2.8 and 2.5 persons per coastal mile, respectively) and relatively low in comparison to the eastern Unangan (4.6), Tsimshian (7.0) and Haida (8.2).

⁶ The study included a tiny and unrepresentative sample of only three sites from Prince William Sound and results for that area are ignored here.

characterized by bedrock cliffs that drop steeply into deep water. Small islands and shoals create intricate, sheltered coastlines in the mouths of both Kukak and Amalik bays.

A discontinuous pre-Pleistocene marine terrace extends along many parts of the southern coast at 10–15 meters above current sea level. This terrace provided an attractive platform for pre-contact settlement and is occupied by numerous archaeological sites dating from the Alder phase to historic times. These perched sites have been fortuitously protected from erosion during minor Holocene fluctuations in relative sea level, which appear to have included a high stand (1–2 m above present level) that ended around 4000 years ago as well as one or several periods since 3000 B.P. when sea level was slightly lower than it is today. However, lower elevation sites may have been destroyed or submerged by these fluctuations. A number of sites in Amalik Bay are currently eroding as the result of a .5 m increase in sea level that occurred during the last 300 years (Crowell and Mann 1996:26; Hilton 1998).

Unlike areas further east in the Gulf of Alaska, the Katmai coast was relatively unaffected by Holocene glaciation. This has been a positive factor in preservation of the archaeological record. Repeated volcanic eruptions, including the Katmai/Novarupta event in A.D. 1912, have draped the coast in tephra deposits.

Vegetation along the Katmai coast is dominated by grass and shrub tundra, with isolated patches of recently arrived Sitka spruce and stream mouth stands of willows and cottonwoods. The weather is generally windy and highly changeable, with frequent storms from October through April. This weather pattern, combined with strong currents and a large tidal range, poses great risks to boat travel on Shelikof Strait.

The Katmai coast is located within an exceptionally rich area of summer phytoplankton production that extends from the Kenai Peninsula to Umnak Pass (Sambrotto and Lorenzen 1986). Marine food resources are correspondingly abundant and dominate strongly in archaeological midden samples (Bender 1999; G. Clark 1977; Davis 1954; Oswalt 1955). In total, the area is home to six species of marine mammals, 29 species of land mammals, 137 bird species, 24 freshwater fishes and five anadromous fishes.

ARCHAEOLOGICAL RESEARCH

Most of the Katmai coast has been archaeologically surveyed on at least a reconnaissance level, beginning with field work by the National Park Service, University of Oregon, and the University of Alaska in the 1950s (Davis 1954; Oswalt 1955) and by the University of Oregon in the following decade (G. Clark 1977; Dumond 1964, 1971). These projects included extensive excavations at Kukak Village (XMK-006) and the Takli Site in Amalik Bay (XMK-018).

Systematic coastal surveys conducted after the 1989 *Exxon Valdez* oil spill added a substantial number of new locations and radiocarbon dates (Table 1). These surveys were augmented through coordinated archaeological and geological research by the Arctic Studies Center (Smithsonian Institution) and National Park Service (NPS) in 1994 under the NPS Systemwide Archaeological Inventory Program (SAIP), resulting in documentation of 22 new sites.

The focus of the SAIP work was on four sections of the coast where existing data were inadequate. These were 1) Cape Douglas 2) Swikshak Lagoon 3) Kukak and Kafia Bays combined, and 4) Kinak Bay and Amalik Bay combined (Crowell and Mann 1996; Crowell and Mann n.d.)⁷. The SAIP study areas, indicated in Figure 1, also represent contrasting environmental zones: the resource-poor Cape Douglas headland, the estuarine environment of Swikshak Lagoon, and the resource-rich, protected waters of several major bay systems. More recent NPS-sponsored studies include supplemental site assessments in Kukak Bay and Amalik Bay and excavations at the Mink Island site (XMK-030) in the Takli island group (Hilton 1998, 2002; Schaff 2002).

Some sections of the coast – for example, Katmai Bay – have not been intensively examined and may be under-represented in the inventory of known sites. One benefit of the GIS model presented here is its utility for identifying areas of high site potential where future investigations may be focused.

GIS ANALYSIS: DATA AND METHODS

A GIS model of the coast of Katmai National Park was developed in ArcView 3.1 (Environmental Systems Research Institute 1998) to quantify aspects of the biological and physical settings of indigenous archaeological sites. The purpose was to test expectations about coastal

⁷ Our work in Amalik Bay was geological only, complementing archaeological surveys and excavations by other investigators (G. Clark 1977; Dekin et al. 1993; Haggarty et al. 1991; Mobley et al. 1990).

Table 1: Archaeological Sites and Radiocarbon Dates on the Pacific Coast of Katmai National Park and Preserve
Calibrated radiocarbon dates from Crowell and Mann 1996; Mills 1994; and calculated from other sources using the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program Rev. 4.3

Site Number	Site Name	Culture	Site Type	Period	Radiocarbon dates	Citations
AFG-001	Cape Chiniak	Indigenous	Midden & structures	Pre-contact		Dumond 1964:37-41; Dumond 1965:14; Mobley et al. 1990; Haggarty et al. 1991; Hilton 1998:80-81
AFG-037	Ashivak	Indigenous	Midden	Historic		Petroff 1884:28; Porter 1893:72
AFG-043	Kaguyak Village Site	Both	Midden & structures	Pre-contact & historic		Davis 1954:45ff; Dumond 1965:9-13; Orth 1971:484; Mobley et al. 1990; Haggarty et al. 1991; Hilton 1998:81-82
AFG-044	Swikshak Lagoon	Indigenous	Midden	Unknown		Dumond 1965:8-9; Mobley et al. 1990; Hilton 1998:83-84
AFG-107	Cape Douglas Sod Feature	Unknown	Structures	Unknown		Mobley et al. 1990; Haggarty et al. 1991
AFG-108	Sukoi Bay Cabins	Unknown	Structures	Historic		Haggarty et al. 1991; Crowell and Mann n.d.
AFG-109	Swikshak Cannery	Euro-American	Cannery	Historic		Haggarty et al. 1991; Hilton 1998:84-86
AFG-110	Swikshak House Pits	Indigenous	Structures	Pre-contact		Mobley et al. 1990; Hilton 1998:86-87
AFG-117	Shakun Lithic Site	Indigenous	Midden	Pre-contact		Mobley et al. 1990; Hilton 1998:88
AFG-118	Shakun House Pits	Indigenous	Structures	Pre-contact		Mobley et al. 1990; Hilton 1998:89-90
AFG-134	Cape Douglas Cairn	Indigenous	Rock cairn or cache	Pre-contact		Mobley et al. 1990
AFG-165	Sukoi Cairn	Unknown	Rock cairn or cache	Historic		Mobley et al. 1990; Crowell and Mann n.d.
AFG-171	Pre-Katmai Historic Scatter	Indigenous	Midden & structures	Historic		Haggarty et al. 1991; Crowell and Mann n.d.
AFG-176	Triple Lakes Creek #1	Indigenous	Midden	Pre-contact		Haggarty et al. 1991
AFG-177	Triple Lakes Creek #2	Indigenous	Midden	Pre-contact		Haggarty et al. 1991
AFG-181	Kiupalik Island North End Depressions	Indigenous	Structures	Unknown		Hilton 1998:90-92
AFG-192	Kiukaplik Island Historic Remains	Euro-American	World War II site	Historic		Hilton 1998:92-93
AFG-194		Indigenous	Structures	Pre-contact		Dekin et al. 1993
AFG-199	Sukoi Cabin II	Unknown	Structures	Historic		Crowell and Mann n.d.
AFG-200	Cape Douglas Lithic Scatter I	Indigenous	Lithic Scatter	Pre-contact		Crowell and Mann n.d.
AFG-201	Cape Douglas Lithic Scatter II	Indigenous	Lithic Scatter	Pre-contact		Crowell and Mann n.d.
AFG-202	South Cape Douglas Camp	Indigenous	Structures	Historic		Crowell and Mann n.d.
AFG-203	Cape Douglas Lithic Scatter III	Indigenous	Lithic Scatter	Pre-contact		Crowell and Mann n.d.

Table 1: Archaeological Sites and Radiocarbon Dates on the Pacific Coast of Katmai National Park and Preserve, con't

AFG-204	Cape Douglas Cairn II	Indigenous	Rock cairn or cache	Unknown		Crowell and Mann n.d.
AFG-205	South Cape Douglas Midden	Indigenous	Midden	Pre-contact		Crowell and Mann n.d.
AFG-206	Cape Douglas Cairn II	Indigenous	Rock cairn or cache	Pre-contact		Crowell and Mann n.d.
AFG-207	Sukoi Bay Terrace Site	Indigenous	Midden & structures	Pre-contact	B.C. 190 (B.C. 10) A.D. 140 B.C. 2040 (1900) 1740	Crowell and Mann n.d.; Crowell and Mann 1996
AFG-208	Sukoi Bay Cairn II	Indigenous	Rock cairn or cache	Pre-contact		Crowell and Mann n.d.
AFG-209	Cape Douglas Cairn III	Indigenous	Rock cairn or cache	Pre-contact		Crowell and Mann n.d.
ILI-058	Shaw Island Site	Indigenous	Structures	Pre-contact		Mobley et al. 1990
KAR-127	Twin Creeks Midden	Indigenous	Midden	Pre-contact		Mobley et al. 1990
XMK-006	Kukak Village	Indigenous	Midden & structures	Pre-contact & historic	A.D. 1030 (1261) 1394 A.D. 1020 (1261) 1400 A.D. 711 (977) 1170 A.D. 268 (609) 860 A.D. 400 (605) 759	G. Clark 1977:12ff; Dumond 1964:31-35; 1965:14; 1971:Davis 1954; Hilton 1998:53-54
XMK-006A	Kukak Isolated Housepit	Indigenous	Midden & structures	Pre-contact	B.C. 5030 (4724) 4249	G. Clark 1977; Hilton 1998:54-55
XMK-007	Kafila	Indigenous	Midden & structures	Pre-contact & historic		Oswalt 1955; Dumond 1963:36; 1964:36-37; 1965:17-19; Mobley et al. 1990; Haggarty et al. 1991
XMK-014	Katmai	Both	Midden & structures	Pre-contact & historic		Orth 1971:502; Davis 1954; Dumond 1971; Petroff 1881:33
XMK-015	Old Kukak	Indigenous	Midden & structures	Pre-contact & historic		Dumond 1964:31; Orth 1971:549; Mobley et al. 1990; Hilton 1998:55-56; Crowell and Mann n.d.
XMK-017		Indigenous	Midden	Pre-contact		Dumond 1965:19-21
XMK-018	Takli Site	Indigenous	Midden	Pre-contact	B.C. 1289 (984, 954, 943) 799 B.C. 1419 (1099) 839 B.C. 3090 (2856, 2688, 2622) 2204 B.C. 4779 (4495) 4249	G. Clark 1977:7ff; Dumond 1965:23-24, 33-43; Dekin et al. 1993:788ff; Hilton 1998:11-12
XMK-019		Indigenous	Midden	Pre-contact		Dumond 1965:24-25, 1971; Mobley et al. 1990; Dekin et al. 1993:794; Hilton 1998:14
XMK-020	Hook Point Site	Indigenous	Midden & structures	Pre-contact	A.D. 100 (381) 600 B.C. 2130 (1865, 1845, 1771) 1519	G. Clark 1977:10ff; Dumond 1971; Dekin et al. 1993:801-802; Hilton 1998:15
XMK-021		Indigenous	Midden	Pre-contact		Dumond 1971; Haggarty et al. 1991; Dekin et al. 1993:803; Hilton 1998:16-17

Table 1: Archaeological Sites and Radiocarbon Dates on the Pacific Coast of Katmai National Park and Preserve, con't

XMK-022		Indigenous	Midden & structures	Pre-contact	B.C. 3356 (2882) 2458 B.C. 4356 (3983) 3652 B.C. 3486 (2902) 2470 B.C. 3501 (3078, 3071, 3025) 2679	Dumond 1971; Mobley et al. 1990; Haggarty et al. 1991; Dekin et al. 1993:706ff; Hilton 1998:17-18
XMK-023		Indigenous	Midden	Pre-contact		Dumond 1971; Hilton 1998:19
XMK-024		Indigenous	Midden	Pre-contact		Dumond, D.E. 1971; Dekin et al. 1993:805ff; Hilton 1998:19-20
XMK-025		Indigenous	Midden	Pre-contact		Dumond, D.E. 1971; Haggarty et al. 1991; Hilton 1998:20-21
XMK-026		Indigenous	Midden	Pre-contact		Dumond 1971; Mobley et al. 1990; Dekin et al. 1993:811ff; Hilton 1998:22
XMK-027		Indigenous	Midden	Pre-contact	B.C. 2841 (2276, 2253, 2229, 2221, 2206) 1774 B.C. 3941 (3492, 3469, 3373) 2877	Dumond 1971; Mobley et al. 1990; Dekin et al. 1993:814ff; Hilton 1998:23
XMK-028	Little Takli Island	Indigenous	Midden	Pre-contact		Dumond 1971; Mobley et al. 1990; Hilton 1998:24-25
XMK-029		Indigenous	Midden & structures	Pre-contact		Dumond 1971; Mobley et al. 1990; Dekin et al. 1993:819ff; Hilton 1998:25-27
XMK-030	Mink Island Site	Indigenous	Midden & structures	Pre-contact	B.C. 4898 (4705, 4691) 4460 *reports 84 unpublished dates from B.C. 5650 to A.D. 1460 (calibrated)	Dumond 1971; Mobley et al. 1990; Dekin et al. 1993:821ff; Hilton 1998:27-29; National Science Foundation 2002*; Schaff 2002
XMK-031		Indigenous	Midden	Pre-contact		Dumond 1971; Dekin et al. 1993:824ff; Hilton 1998:29-30
XMK-046	Devil's Cove House Pits	Indigenous	Midden & structures	Pre-contact		Dumond 1965:15-17, 1971; Oswalt 1955:53; Hilton 1998:57; Crowell and Mann n.d.
XMK-047	Kukak Bay I	Indigenous	Midden & structures	Pre-contact	A.D. 1235 (1310, 1365, 1375) 1440	Dumond 1971; Hilton 1998:58-59; Crowell and Mann n.d.
XMK-049		Indigenous	Midden & structures	Pre-contact		Dumond 1971
XMK-055	Kachemak Village Site	Indigenous	Midden & structures	Pre-contact		
XMK-056	Russian Anchorage	Indigenous	Midden & structures	Pre-contact	A.D. 1240 (1290) 1410 B.C. 20 (A.D. 120) A.D. 320 B.C. 3920 (3710) 3640 B.C. 4020 (3920, 3880, 3810) 3660	Mobley et al. 1990; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-057		Indigenous	Midden	Pre-contact		
XMK-058	Cape Gull Cove Site	Indigenous	Midden & structures	Pre-contact	A.D. 1284 (1421) 1637 A.D. 1284 (1406) 1482 A.D. 1301 (1414) 1466 A.D. 1245 (1329, 1343, 1395) 1482 A.D. 1028 (1278) 1413 A.D. 1028 (1282) 1431	Mobley et al. 1990; Haggarty et al. 1991

Table 1: Archaeological Sites and Radiocarbon Dates on the Pacific Coast of Katmai National Park and Preserve, con't

XMK-059	Kukak Bay Refuge Rock Site	Indigenous	Midden & structures	Pre-contact	A.D. 1435 (1505, 1595, 1620) 1660 B.C. 2106 (1880, 1837, 1831) 1686	Mobley et al. 1990; Hilton 1998:59-61; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-060	Kukak Bay Cannery	Euro- American	Cannery	Historic		Mobley et al. 1990; Hilton 1998:61-62
XMK-061	Kafila Bay Cabin	Unknown	Structures	Historic		Mobley et al. 1990
XMK-062	Point Jane Hut	Unknown	Structures	Historic		Mobley et al. 1990; Hilton 1998:63
XMK-067	Rounded House Pits	Indigenous	Midden & structures	Pre-contact		Mobley et al. 1990; Hilton 1998:33-34
XMK-068	Nate's Told You So Site	Indigenous	Structures	Pre-contact		Mobley et al. 1990
XMK-070	Thirty Meter Cutbank Site	Indigenous	Midden	Pre-contact		Haggarty et al. 1991; Dekin et al. 1993:831-832; Hilton 1998:34-35
XMK-071	Twenty Meter Cutbank Erosion Scatter	Indigenous	Midden	Pre-contact		Haggarty et al. 1991; Dekin et al. 1993:833-34; Hilton 1998:35-36
XMK-072	Intertidal Debitage Site	Indigenous	Midden	Pre-contact	B.C. 2457 (1945) 1531 B.C. 2880 (2397, 2384, 2344) 1830	Haggarty et al. 1991; Dekin et al. 1993:757-769; Hilton 1998:36-37
XMK-073	Takli Island Fox Farm	Unknown	Fox farm	Historic		Dekin et al. 1993:835-37; Hilton 1998:38-39
XMK-074	Takli Southwest	Indigenous	Midden	Pre-contact		Haggarty et al. 1991; Dekin et al. 1993:838-83; Hilton 1998:39-41
XMK-075	Geoduck Site	Indigenous	Midden	Pre-contact	B.C. 795 (201) A.D. 317 B.C. 345 (B.C. 38, 30, 21, 11, 1) A.D. 131	Haggarty et al. 1990; Dekin et al. 1993:770-787; Hilton 1998:41-42
XMK-076	Amalik Bay Inlet Flakes	Indigenous	Midden	Pre-contact		Haggarty et al. 1990; Hilton 1998:42- 43
XMK-077	Fuel Cache Point	Indigenous	Isolated artifact find	Pre-contact		Haggarty et al. 1990
XMK-079		Indigenous	Midden	Pre-contact		Dekin et al. 1993:770-787; Hilton 1998:44-45
XMK-080		Indigenous	Midden	Pre-contact		Dekin et al. 1993:788-89; Hilton 1998:45-46
XMK-081		Indigenous	Midden	Pre-contact		Dekin et al. 1993:843; Hilton 1998:47- 48
XMK-089		Indigenous	Midden & structures	Pre-contact		Hilton 1998:48-50
XMK-090		Indigenous	Midden	Pre-contact		Hilton 1998:50-51
XMK-091	Kukak Bay II	Indigenous	Midden	Pre-contact		Hilton 1998:64-65
XMK-106	Tiny Island Village	Indigenous	Midden & structures	Pre-contact	A.D. 390 (550) 660 B.C. 4580 (4470) 4350	Hilton 1998:65-67; Crowell and Mann n.d.
XMK-107	Tiny Island II	Indigenous	Structures	Pre-contact		Hilton 1998:67-68; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-108	Kukak Bay III	Indigenous	Structures	Pre-contact		Hilton 1998:68; Crowell and Mann n.d.
XMK-109	Tiny Island Passage I	Indigenous	Midden & structures	Pre-contact		Hilton 1998:69-70; Crowell and Mann n.d.

Table 1: Archaeological Sites and Radiocarbon Dates on the Pacific Coast of Katmai National Park and Preserve, con't

XMK-110	Inner Kukak Bay Village	Indigenous	Midden & structures	Pre-contact		Hilton 1998:70-71; Crowell and Mann n.d.
XMK-111	Tiny Island Passage II	Indigenous	Midden & structures	Pre-contact	B.C. 1690 (1520) 1405	Hilton 1998:71-72; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-112	Kinak Bay Islet	Indigenous	Midden	Pre-contact	A.D. 1475 (1665) 1950	Crowell and Mann n.d.; Crowell and Mann 1996
XMK-113	Kinak River Wet Site	Indigenous	Midden & structures	Pre-contact	A.D. 1530 (1670, 1950) 1950 A.D. 990 (1040) 1220	Crowell and Mann n.d.; Crowell and Mann 1996
XMK-114	Kinak Bay I	Indigenous	Midden	Pre-contact		Crowell and Mann n.d.
XMK-115	Aguchik Island Cove	Indigenous	Midden & structures	Pre-contact	B.C. 2137 (1886) 1688	Hilton 1998:72-73; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-116	Aguchik Island Tombolo	Indigenous	Midden	Pre-contact	B.C. 1390 (1211, 1198, 1192, 1138, 1133) 1001	Hilton 1998:73-74; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-117	Aguligik Island I	Indigenous	Midden & structures	Pre-contact		Hilton 1998:75; Crowell and Mann n.d.
XMK-118	Kukak Point Village	Indigenous	Midden & structures	Pre-contact	A.D. 1020 (1170) 1260	Hilton 1998:75-76; Crowell and Mann n.d.; Crowell and Mann 1996
XMK-119	Kafila River Mouth-South Midden	Indigenous	Midden	Pre-contact	B.C. 1880 (1630) 1425	Crowell and Mann n.d.; Crowell and Mann 1996
XMK-120	Kafila River Mouth-North Midden	Indigenous	Midden	Pre-contact	A.D. 1400 (1440) 1640	Crowell and Mann n.d.; Crowell and Mann 1996
XMK-121	Aguligik Island II	Indigenous	Midden	Pre-contact		Hilton 1998:77-78; Crowell and Mann n.d.
XMK-122	Kukak Bay IV	Indigenous	Midden	Pre-contact		Hilton 1998:78-79; Crowell and Mann n.d.

foraging and settlement strategies, as discussed above. Several layers of information were incorporated: base maps, archaeological data, resource distributions, and shoreline classification. The model was then used analytically to examine environmental variation and patterns in site location.

Base Maps

Base maps for Katmai National Park and Preserve (coastline, park boundary, streams) were derived from an ArcView extension, the GIS Theme Manager, developed by the Alaska Support Office of the National Park Service (NPS-AKSO 1997).

Archaeological Data

Primary archaeological data consisted of all indigenous coastal sites within the park boundary, a total of 90 locations that represent the Alder phase through the early 20th century (Table 1). Digital description and location data were acquired from the Alaska Heritage Resources Survey (AHRs) database, with checks and corrections

based on field notes and topographic maps. The Alaska Heritage Resources Survey classifies 72 as probable pre-contact middens, of which 34 have evident surface house pits. In addition, there are eight sites with house pits that are classified as historic or of unknown age; three lithic scatters, six rock cairns or caches, and one isolated artifact find. Four historic sites were excluded from most statistics: two canneries, a fox farm, and a World War II facility.

This sample was treated as an aggregate, without attempting any breakdown by age other than pre-contact vs. historic. This choice allowed inclusion of many sites—more than half of the sample—that do not have even approximate age determinations. Many sites also have multiple components. Therefore, the selected sample reflects site location choice over a period of almost 7000 years but allows very limited interpretation of temporal trends. Radiocarbon dates and apparent gaps in the occupation record are discussed separately below.

Biological Data

We used digital species distribution data packaged with the NPS-AKSO GIS Theme Manager (see www.nps.gov/akso/gis) and which are in turn derived from two main sources: the *Kodiak Island and Shelikof Strait Environmental Sensitivity Index* (National Oceanic and Atmospheric Administration 1998) and the *Cook Inlet and Kenai Peninsula, Environmental Sensitivity Index* (National Oceanic and Atmospheric Administration 1995). These sources combine information from zoological surveys by the U. S. Fish and Wildlife Service (USFWS), the Alaska Department of Natural Resources (ADNR), and the Alaska Department of Fish and Game (ADF&G).

Several non-digital sources were converted for use in the project. The preliminary edition of the *West Coast of North America Strategic Assessment Atlas* (National Oceanic and Atmospheric Administration 1988) provided coverage of Pacific cod, Pacific halibut, and harbor porpoise. For harbor seals, we used the *Sensitive Areas Identification Project* produced by the Kodiak Island Borough Coastal Management Program (Kodiak Island Borough 1997). Further technical details are available from the authors.

Coastal Geomorphology

Schoch (1996) described shoreline geomorphology for the entire Katmai coast. This dataset, based on the Howes Physical Shore-Zone Mapping System (Howes et al. 1994), differentiates 4160 segments of shoreline into 34 classes according to four categories: substrate, sediment, width, and slope. A simplified binary classification into beaches that are favorable or unfavorable for skin boat landings was derived for purposes of the analysis. Favorable beaches (13 of the 34 Howes classes) were defined as those composed mostly of sand and/or finer sediments, with slopes of less than 5 degrees. Low beach angle is a reasonable index of low wave energy throughout the year, indicating that such beaches are sheltered from heavy surf (Carl Schoch, personal communication, 1999).

Method

The first step was to overlay the base map with distributional data for all 15 subsistence resources (see Figures 4-7 [Appendix]). These include harbor seal haul-out and high use zones, sea lion haul-outs, sea otter concentrations, and harbor porpoise areas (Figure 4); outlets of salmon spawning streams (Figures 5 and 6); spring herring spawning areas, concentrations of adult halibut during April - October, and year-round concentrations of adult Pacific cod (Figure 6); summer seabird colonies,

spring and fall waterfowl concentrations, and razor clam beds (Figure 7).

Computer-generated catchment zones (buffers) were drawn around resource locales to represent reasonable or average distances that indigenous residents would have traveled to harvest them. Ethnohistoric information suggests that exploitation of salmon and shellfish was generally carried out in the immediate vicinity of settlements, including fishing camps, so we assigned one km buffers to the sources of these foods. Resources that were normally exploited by kayak, including sea mammals, bottom fish, and seabirds, were assigned 10 km buffers. Note that this method generates circular catchments around point sources (e.g., seabird colonies and mouths of salmon streams), whereas resource locales that cover definable areas (e.g., harbor seal concentrations) were enclosed by irregular catchments of the same shape as the actual distribution.

Overlays (unions) of these catchment zones were then combined. The resulting map (Figure 8 [Appendix]) shows the number of resource locales, ranging from one to 24, which is available by foot or skin boat from any point along the coast. The map demonstrates considerable variation in resource density, from broad areas where only three or four food sources are available to sections of the south coast where 20 or more sources are within range.

We took an alternative view of the same data by constructing 1 km and 10 km catchment circles (as appropriate by prey species) around archaeological site locations. By taking this site-centered view of what resources were within range, we were able to compare harvest potentials for different categories of sites by location and type (Tables 2, 3, and 4).

The next two procedures were applications of the coastal classification data. Figure 9 [Appendix] shows segments of shoreline that are favorable for skin boat landings (blue), unfavorable (red), or unknown/unspecified (green), on the basis of our index combining shoreline substrate and inferred wave energy. This figure graphically illustrates that points and headlands are exposed to the full force of the sea, and tend to have few usable beaches. Unfavorable sections of shoreline are also indicated within Kukak Bay and other protected areas. For the most part, these are places where sheer cliffs enter the water directly.

Access to "favorable" beaches was determined by generating 250 m buffers around all archaeological sites

Table 2: Average number of resource harvest locations per site catchment, by general resource category

Location	No. sites	Marine mammals	Fish	Seabirds & clams	Total
Cape Douglas	17	3.9	1.7	2.6	8.2
Amalik Bay/Kinak Bay	33	9.7	5.1	5.8	20.6
Kukak Bay/Kafliia Bay	26	4.8	5.7	7.2	17.7
Swikshak	9	5.3	2.1	2.6	10.0
All other sites	9	5.2	3.6	3.0	11.8

Table 3A: Average number of resource harvest locations per site catchment by marine mammal species

Location	No. sites	Harbor seal	Sea lion	Sea otter	Harbor porpoise	Total Marine mammals
Cape Douglas	17	1.9	0.0	1.0	1.0	3.9
Amalik Bay/Kinak Bay	33	4.2	2.7	1.8	1.0	9.7
Kukak Bay/Kafliia Bay	26	2.2	1.3	0.3	1.0	4.8
Swikshak	9	2.6	.7	1.0	1.0	5.3
All other sites	9	2.1	1.2	.9	1.0	5.2

Table 3B: Average number of resource harvest locations per site catchment by fish species

Location	No. sites	Pink salmon	Chum salmon	Coho salmon	Sockeye salmon	King salmon	Herring	Halibut	Cod	Total fish
Cape Douglas	17	0.7	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.7
Amalik Bay/Kinak Bay	33	0.1	0.1	0.0	0.0	0.0	2.9	1.0	1.1	5.1
Kukak Bay/Kafliia Bay	26	0.3	0.2	0.0	0.2	0.0	2.9	1.0	1.2	5.8
Swikshak	9	0.3	0.3	0.2	0.2	0.0	0.0	1.0	0.0	2.1
All other sites	9	0.3	0.1	0.0	0.0	0.0	1.2	1.0	.9	3.6

Table 3C: Average number of resource harvest locations per site catchment by clams and bird species

Location	No. sites	Razor clams	Seabirds	Waterfowl	Total
Cape Douglas	17	0.5	1.1	1.0	2.6
Amalik Bay/Kinak Bay	33	0.0	4.8	1.0	5.8
Kukak Bay/Kafliia Bay	26	0.1	6.1	1.0	7.2
Swikshak	9	0.6	2.0	0.0	2.6
All other sites	9	0.1	2.6	0.3	3.0

Table 4: Number of Harvest Resource Locations per Site Catchment
By Site Type

Site Type and Period	Total Sites	1-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-24
Pre-contact midden sites without structures	38	0	2	1	3	2	1	1	3	25
Pre-contact middens with structures	34	0	0	4	3	2	1	2	11	11
Historic or unknown age with structures	8	0	0	4	2	0	1	0	0	1
Lithic scatter	3	0	0	2	1	0	0	0	0	0
Rock cairn or cache	6	0	1	3	2	0	0	0	0	0
Isolated artifact find	1	0	0	0	0	0	0	0	1	0

Table 5: Access to Favorable Boat Landing Beach
By Site Type

Site Type and Period	Total Sites	Favorable Shore	Unfavorable Shore	Inland Site	Not Classified
Pre-contact midden sites without structures	38	31	6	0	1
Pre-contact middens with structures	34	22	8	2	2
Historic or unknown age with structures	8	3	5	0	0
Lithic scatter	3	3	0	0	0
Rock cairn or cache	6	2	4	0	0
Isolated artifact find	1	1	0	0	0

(Table 5). This distance represents an arbitrary but practical walking distance between shore and living area. If a “favorable” beach segment of any length occurred within this circle then access was considered to be available.

The final step was to integrate both aspects of the analysis for the purpose of identifying portions of the coast that have both good landing beaches and high resource access (greater than ten food sources within range). Segments of coastline that meet both criteria are indicated in red on Figure 10 [Appendix]. This figure also shows the locations of all archaeological sites in the sample, allowing the actual and predicted distribution of sites to be compared.

RESULTS

Exceptional resource density is indicated along the highly indented southern coastline (Figure 8). The highest values (up to 24 resources in range) are in Amalik Bay, Kinak Bay, Kuliak Bay, and Kaflia Bay. Slightly lower values pertain to most of Kukak Bay. Considerably lower values are evident in the wider bays and along the straighter coastlines north to Cape Douglas and southwest to Katmai Bay. Site-centered subsistence scores (Table 2) indicate that site catchments in the Amalik Bay/Kinak Bay and Kukak Bay/Kaflia Bay SAIP survey areas included an average of 20.6 and 17.7 different food sources respectively, while corresponding figures for Cape Douglas, Swikshak, and elsewhere on the coast are half these values or less. The Amalik Bay/Kinak Bay area is exceptionally high in sea mammal resources.

Resource density - the number of separate resource locales within range of a site - tends to be accompanied by resource diversity. Average subsistence scores by species (Tables 3a, 3b, and 3c) include relatively few values of zero or less than one for Kukak/Kaflia Bay and Amalik/ Kinak Bay areas, whereas many zero values (meaning no access at all) are evident for Cape Douglas, Swikshak, and elsewhere. For example, Cape Douglas offers no access to sea lions or to any fish species except pink salmon and halibut, whereas residents of Kukak and Kaflia Bays had access to all subsistence species except for king salmon and coho salmon.

Results of the Katmai analysis show that high resource access correlates strongly with the locations of indigenous settlements. Villages and camps are clustered along the ecologically rich south coast where 59 sites, well over half the total for the entire park shoreline, are

located in just four fjords: Kukak Bay, Kaflia Bay, Kinak Bay, and Amalik Bay (Figure 10).

For the whole park coast, 82% (59/72) of pre-contact settlements have catchments encompassing more than 10 resource locales (Table 4). While this result accords with the expectations of our settlement model, the data do not support the corollary proposal that sites with house depressions - a minimum but not sufficient condition for identifying winter settlements - should be associated with areas of highest resource density. In fact, the average total number of harvest locations is 18.4 for sites without house pits and only 16.4 for sites with house pits. However, this result may be skewed by a distinctive impediment to archaeological surveys on the Katmai coast - the great extent to which house depressions and other surface features have been filled in with tephra from the 1912 eruption and earlier volcanic events, making them difficult to identify. Aeolian sands are also a factor at some locations (Schaff, personal communication 2002).

Several anomalies in spatial patterning are notable. A cluster of 17 sites appears at Cape Douglas, an intensively surveyed area that is not favored by a good subsistence base. However, many of the Cape Douglas sites (9/17) are rock cairns and surface lithic scatters and most others (5/17) are post-contact cabins and house pits. This unusual combination of site types probably reflects the greater importance of the cape as a stopping-over locale for coastal kayak travelers rather than as a place to live. The cairns, most near the shore, are food caches or landing markers. Although no historic records pertaining to Alutiiq residence at Cape Douglas have been located, it is likely to have been a summer camping place for sea otter fleets dispatched by the Russian-American Company (Kodiak District). These fleets hunted each year along the Alaska Peninsula coast from Sutkhum to Kamishak Bay. Sea otter hunting continued in this area under American rule (Arndt n.d.; Clemons and Norris 1999:12-37).

Two major villages - Katmai and the post-contact fur trade settlement of Douglas (also known as Kaguyak) - appear to be located in areas of relatively poor resource diversity. However, both villages are situated near important passes through the mountains, and caribou are locally available at Katmai. Under Russian and American rule, both villages served as trading centers that dealt in furs from the interior as well as sea otters from the annual commercial hunt.

Of the sites in the total sample 69% (62/90) had access within 250 m to a “favorable” beach for landing

and launching boats while 26% (23 sites) did not (Table 5). Most of the sites without good landing beaches are located at Cape Douglas, Swikshak, and other parts of the more exposed northern coast, although a few are scattered through the fjords of the southern coast. Five sites were either too far inland for access to any beach or were located along "unclassified" segments of shoreline.

DISCUSSION

The non-random distribution of human settlement along the Katmai coast arose in part from tectonic forces that shaped the coastline and produced its varied configuration from north to south. The indented and island-studded southern coast provided diverse habitats for marine species that in turn supported long-term and relatively intensive human occupation.

Local Settlement Patterns

The Katmai coast data suggest the possibility that the most ecologically productive bay systems may have offered self-sufficient territories for autonomous local groups. In this case, fjords along the south coast should each include contemporaneous sites representing all phases and activities of the annual subsistence cycle. Excavation data, faunal samples, and radiocarbon dates are presently inadequate for detailed settlement pattern analysis on the local level, although preliminary results may be mentioned.

In Kukak Bay, a series of large house pit sites of different ages is located in the mouth of the fjord. During its time, each may have been a central village where the whole population of the bay resided during winter. Smaller sites of all time periods, interpreted as probable warm weather subsistence camps, are scattered around the bay at salmon streams, islands, and other locations.

The earliest of the hypothetical central villages is Tiny Island Village (XMK-106), which has Alder and Birch phase components and a calibrated basal date of 4470 B. C. The site was resettled during the Cottonwood phase (about A. D. 200 – 500) after a long occupation hiatus that is part of a general pattern on the coast (see discussion below). Tiny Island Village was deserted again in about A.D. 500, a date which corresponds to the beginning of occupation at the very large Kukak Village site (XMK-006). Thick midden deposits and 89 surface house depressions at Kukak Village span the Beach and

Mound phases, ending about A. D. 1500 (G. Clark 1977). Dumond (1977) suggests from annual growth rings on clam shells and other faunal data that Kukak Village was probably used throughout the year, which is consistent with the Alutiiq ethnographic pattern of "winter village" occupation⁸.

By A. D. 1500 the local population appears to have shifted again, this time across the bay to XMK-059, a large village site that is partially perched atop a high sea stack. Defensible villages of this type are widespread across the Gulf of Alaska during the 2nd millennium A. D. (Maschner and Reedy-Maschner 1998; Moss and Erlandson 1992).

Another apparent occupation hiatus in Kukak Bay spans the last several hundred years before Western contact. By the early 19th century people were once again living at Kukak Village, as reported by George von Langsdorff and John D'Wolf in the summer of 1806 (von Langsdorff 1993; d'Wolf 1968).

Farther west along the Katmai coast, the majority of sites in Amalik Bay are small Alder and Birch phase components dating from 5650 – 1000 B. C., clustered in the Takli Island/Mink Island group. The deeply stratified Russian Anchorage site (XMK-056) at the mouth of adjoining Kinak Bay was first inhabited between about 3800 B.C. and A.D. 100 and may have been the winter home of families that spent the summer fishing for cod and halibut and hunting sea mammals, seabirds, and waterfowl on the Amalik Bay islands. Dumond's faunal analysis suggested a summer occupation at XMK-018, the Takli Site (Dumond 1977). There are later Beach and Mound phase occupations at Russian Anchorage and XMK-030 on Mink Island. A newly reported site on Mink Island (XMK-092) with 19 house depressions and storage pits may represent a central village during the late prehistoric period, although satisfactory radiocarbon dates are not yet available (J. Schaff, personal communication 2002).

Resource Stability

Another implication of demonstrated ecological diversity along the southern Katmai coast is that total subsistence output should have remained relatively stable, allowing a greater potential for uninterrupted human occupation. In other words, alternatives were locally available to human foragers when any one prey species or set of species declined in abundance.

⁸ The contemporaneous but much smaller Kukak Point Village site (XMK-118) should also be mentioned. XMK-118, located only 1 km from the main Kukak Village, has a thick midden and deep house depressions including a very large, central structure (20 x 27 m) that may have served as a winter ceremonial house (*qazgiq*). The basal midden date of this village site is A.D. 1020 (1170) 1260.

Significant fluctuations of major prey species must in fact have been a general problem for Gulf of Alaska foragers. Sockeye salmon, for example, increase dramatically during periods of warmer sea surface temperatures (SST) in the Gulf of Alaska, as shown by historic catch records and nitrogen isotope signatures in spawning lakes (Finney et al. 2000). Over the past 500 years there have been six phases of high temperatures and salmon abundance alternating with periods of colder SSTs and salmon minima (Finney 1998). Change in the opposite sense is indicated for sea lions and seals, which declined substantially during warmer sea temperatures from the mid-1970s through 1990s but may now be recovering (Francis et al. 1998). This decadal-scale cycling of marine regimes overlies long-term paleoclimatic trends including colder Neoglacial temperatures after 3800 B.P. and the Little Ice Age of A.D. 1400 – 1900. (Mann et al. 1998).

The wide range of food choices within bay systems of the southern coast would have buffered most impacts of ecosystem change and encouraged the long-term residential stability of local groups. Nonetheless, there are several temporal gaps in the archaeological record of the area that suggest reduction or out-migration of the Katmai coast population as a whole (Figure 11 [Appendix]). In calibrated radiocarbon years, there are no known components between 5600 - 4600 B.P. or 2900 - 2000 B.P., and only a few in the Little Ice Age interval of 100 – 500 B. P. Further study is needed to account for such gaps, which could conceivably be laid to the tectonic destruction of cultural deposits, abandonment of the coast as the result of large volcanic eruptions such as the 1912 Katmai/Novarupta event, or climate-driven ecosystem changes, as Knecht suggests for Kodiak Island at the start of the Little Ice Age (1995). In the latter instance we believe that ecologically diverse bay systems such as Kukak and Amalik would have been the last areas to be abandoned, and the first to be resettled. Verification awaits a better understanding of site structure and chronology for the coast as a whole.

CONCLUSION

Resource and landscape factors were combined to create a heuristic GIS model of coastal settlement patterns on the Katmai coast. The model is predictive as well as descriptive and suggests, for example, that under-explored areas of high site potential lie in parts of Kukak Bay, between Kinak Bay and Kafli Bay, in Hallo Bay, and north of Cape Douglas (Figure 10). More and larger excavation samples will be needed, however, to test and refine the view of Katmai coastal settlement that

we have proposed. Actual resource use at different sites, as determined from faunal remains, may in the future be compared to the harvest options suggested by our catchment analysis. Linear regression and other mathematical modeling techniques could be employed to make the model more statistically robust (e.g. Maschner and Stein 1995), although the principal conclusion – that resources and sites are non-randomly distributed and spatially correlated – is clear from inspection and basic data tabulations.

More generally, the present study suggests that reconstructions of maritime adaptations and social development in the Gulf of Alaska must take account of the physical and ecological heterogeneity of the environment, as well as its instability over time. In Katmai and elsewhere, population appears to have been concentrated in limited local areas of high resource potential that are separated by significant expanses of exposed and relatively unproductive shoreline. Effective population densities were therefore much higher than regional averages might suggest, underlining the potential for territorial circumscription, forced sedentism, intensification of resource harvests, aggressive competition between local groups, and complex political relations even at a relatively early stage of the region's demographic growth (Ames 1981, 1994; Coupland 1996; Fitzhugh 1996; Erlandson et al. 1992; Maschner 1991; Maschner and Reedy-Maschner 1998).

On the other hand, even the most favored local areas might occasionally fail biologically or become uninhabitable due to eruptions, tectonic subsidence, or glacial advances. The devastation and abandonment of villages on the Katmai coast during the 1912 Katmai/Novarupta eruption is only one example (Hussey 1971; Morseth 1998; Partnow 2002). Others include Alutiiq abandonment of the Kenai Fjords coast around 1170 A.D. as the result of sudden tectonic submergence (Crowell and Mann 1998), abandonment of Kachemak Bay around A. D. 500, possibly due to subsistence failure (de Laguna 1975; Workman and Workman 1988), and the late 18th century Tlingit migration from Icy Straits north to Yakutat when Little Ice Age glacial advances filled Glacier Bay and submerged local shorelines (de Laguna 1972; Mann and Streveler 1996). We suggest that subsequent Tlingit and Eyak pressure on eastern Prince William Sound may have forced Chugach Alutiiq migration to the outer coast of the Kenai Peninsula, as recounted in oral histories from the Cook Inlet villages of Nanwalek and Port Graham (Stanek 1999). Alutiiq populations around eastern Bristol Bay were similarly displaced by aggressive Yup'ik (Aglurmiut) expansion in the late 18th century (Harritt

1997). In the dynamic environment of southern coastal Alaska it would appear that natural disasters and human migration – sometimes requiring the seizure of new territory by force – must have periodically punctuated longer periods of stability, population growth, and cultural complexification within fixed territories.

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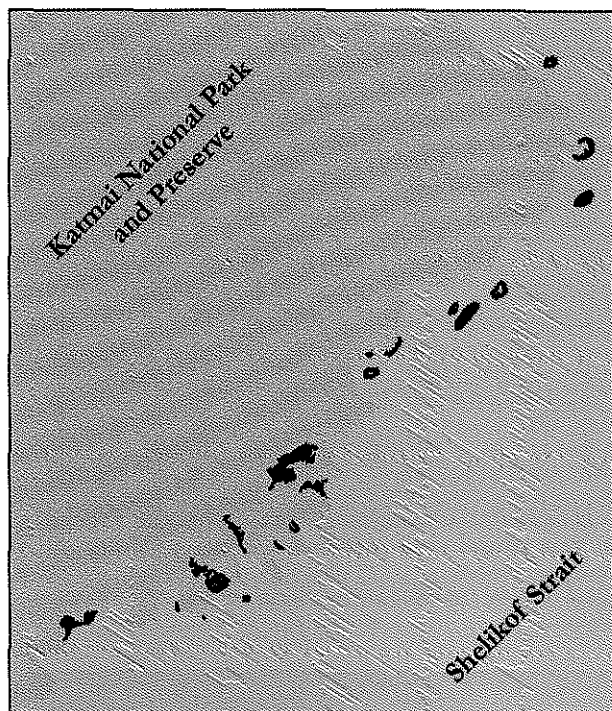
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APPENDIX

Figure 4: Harbor seal, sea lion, sea otter, and harbor porpoise distributions.

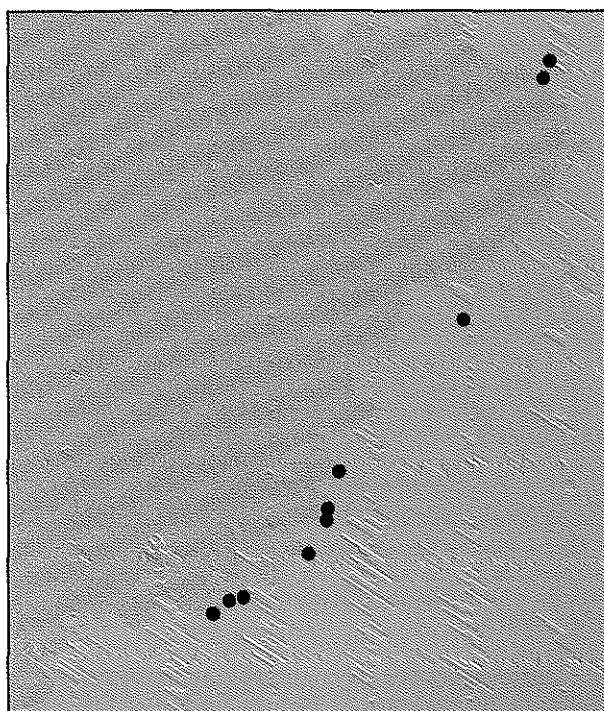


A. Harbor seal concentration areas

Phoca vitulina richardsi

Sensitive Areas Identification Project

Kodiak Island Borough 1997

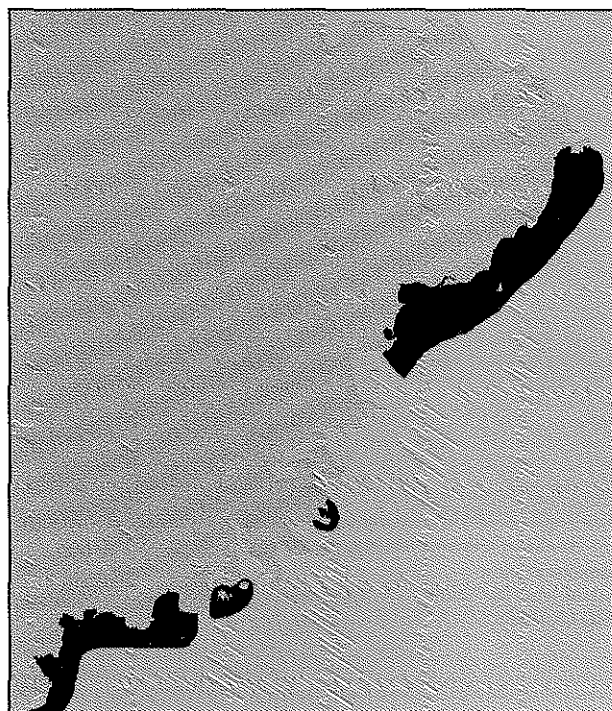


B. Sea lion haulouts

Eumetopias jubatus

Kodiak Island and Shelikof Strait Environmental Sensitivity Index

NOAA 1998

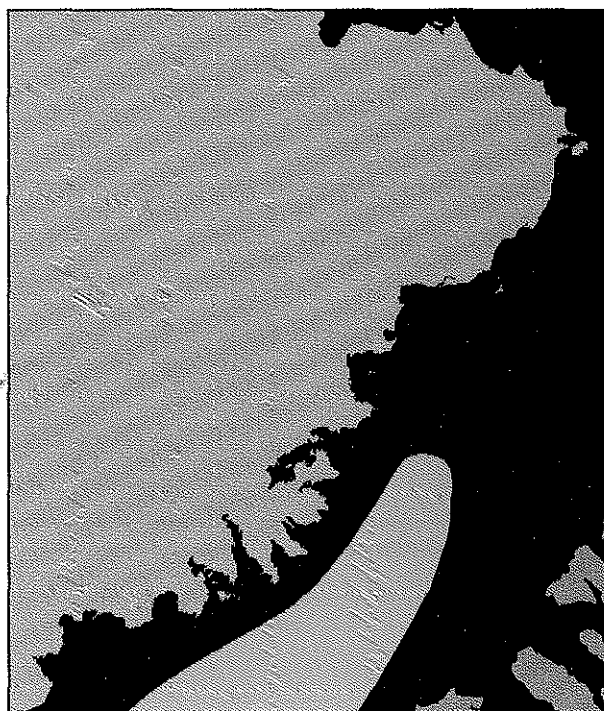


C. Sea otter concentration areas

Enhydra lutris

Kodiak Island and Shelikof Strait Environmental Sensitivity Index

NOAA 1998



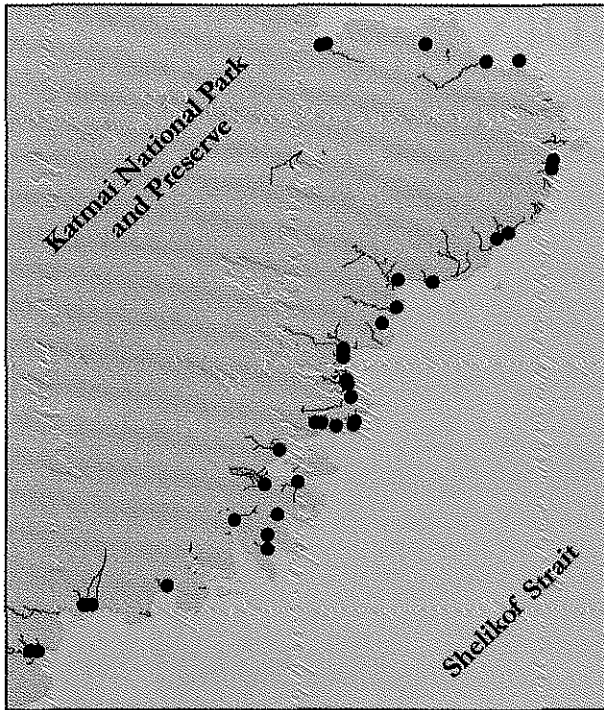
D. Harbor porpoise adult area (year round)

Phocoena phocoena

West Coast of North America Strategic Assessment Atlas

NOAA 1988

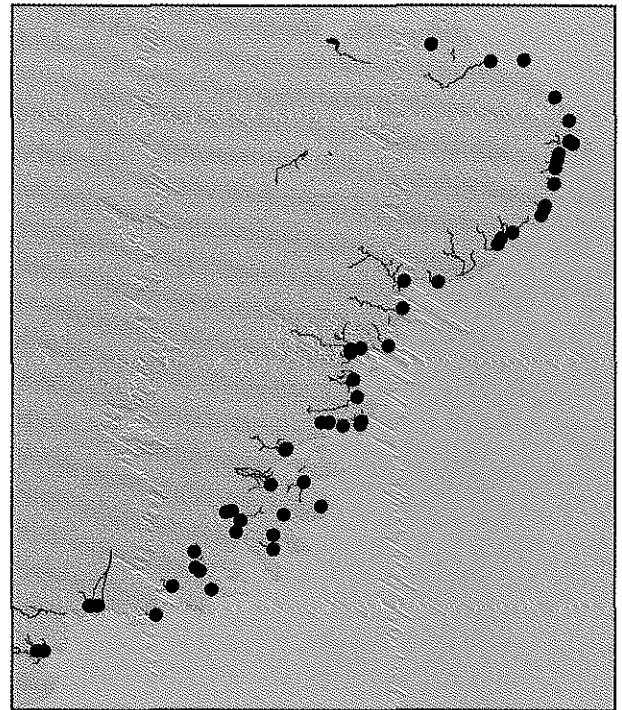
Figure 5: Salmon resources (chum, pink, coho, and sockeye).



A. Chum salmon stream outlets

Oncorhynchus keta

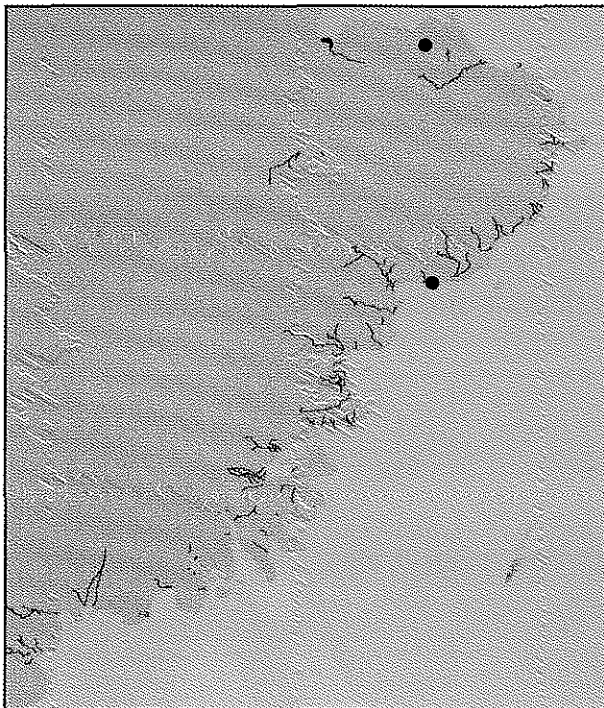
Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1988)



B. Pink salmon stream outlets

Oncorhynchus gorbuscha

Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1988)



C. Coho salmon stream outlets

Oncorhynchus kisutch

Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1988)

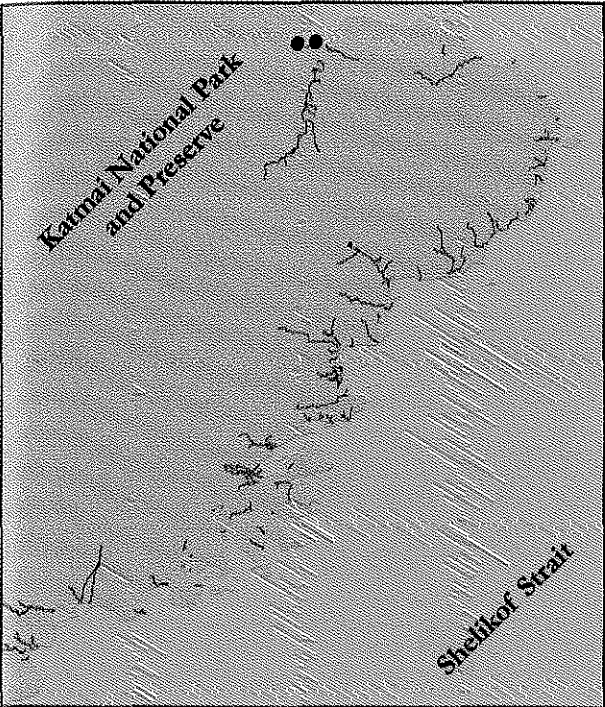


D. Sockeye salmon stream outlets

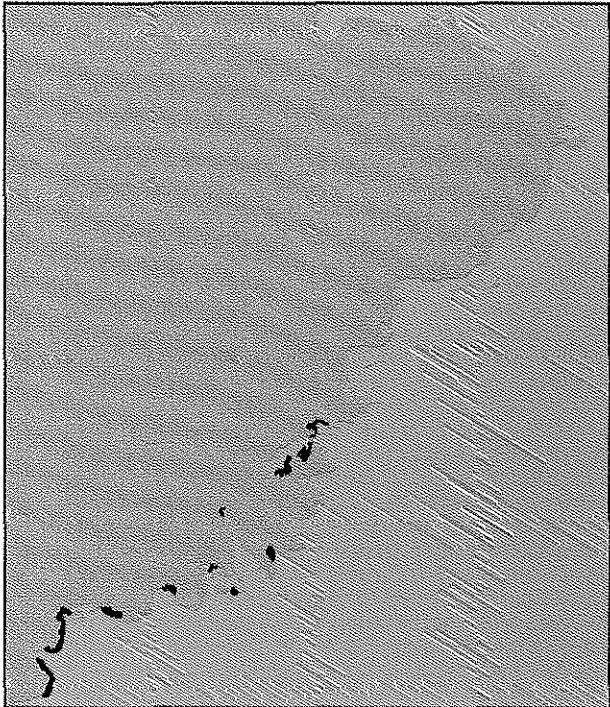
Oncorhynchus nerka

Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1988)

Figure 6: Fish resources (king salmon, herring, cod, and halibut).



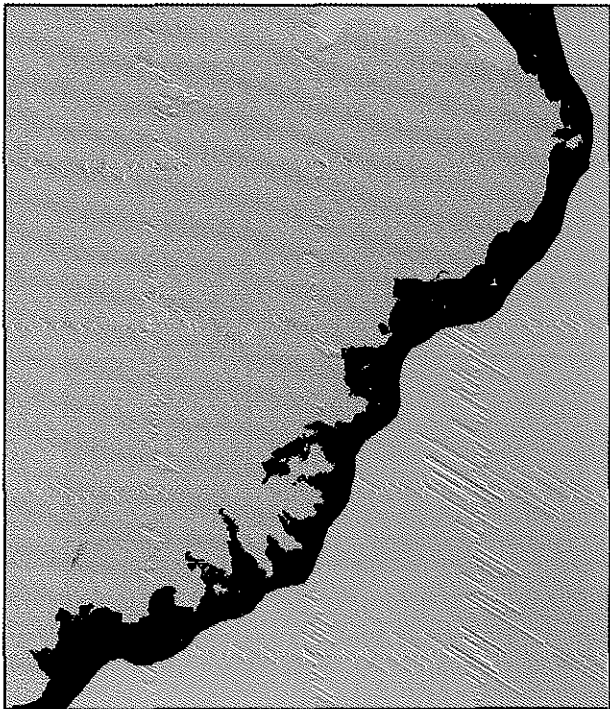
A. King salmon stream outlets
Oncorhynchus tshawytscha
Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1988)



B. Pacific herring spawning areas
Clupea harengus pallasii
Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1988)

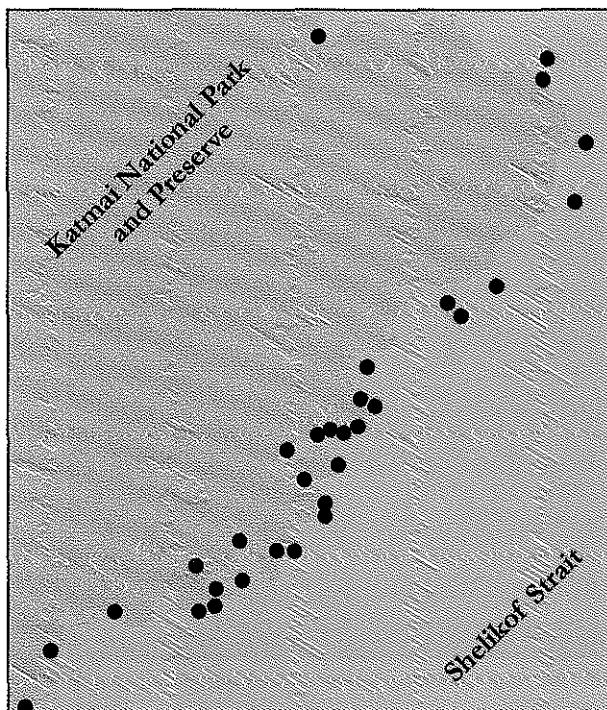


C. Pacific cod major adult concentrations
Gadus macrocephalus
West Coast of North America Strategic Assessment Atlas
(NOAA 1988)



D. Pacific halibut adult area (November - March)
Hippoglossus stenolepis
West Coast of North America Strategic Assessment Atlas
(NOAA 1988)

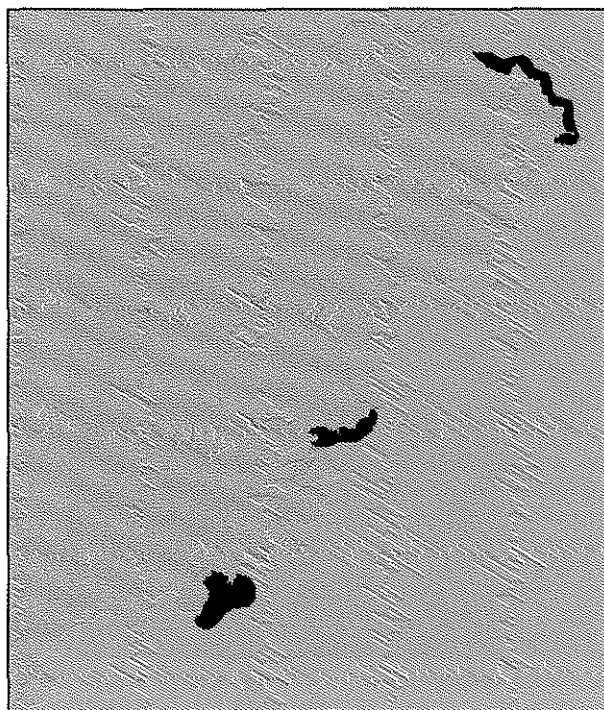
Figure 7: Seabird, waterfowl, and razor clam distributions.



A. Seabird colonies

Seabird species

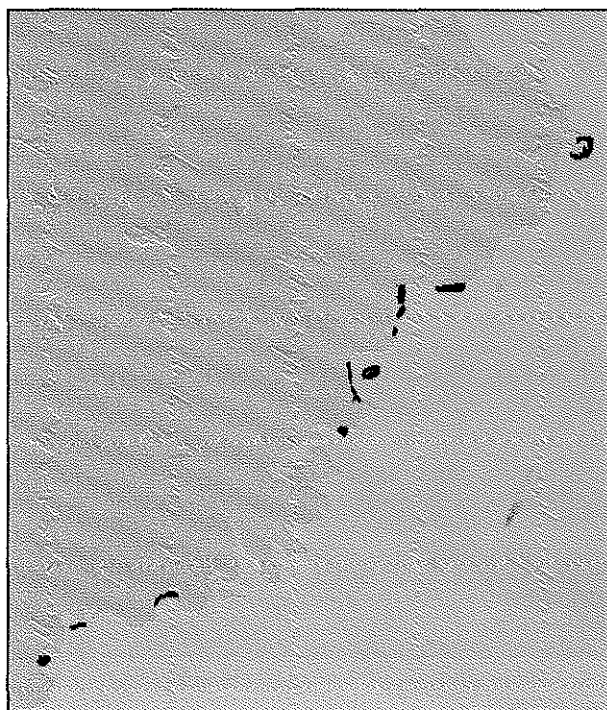
Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1998)



B. Waterfowl concentration areas

Family Anatidae

Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1998)



C. Razor clam beds

Siliquapatula

Kodiak Island and Shelikof Strait Environmental Sensitivity Index
(NOAA 1998)

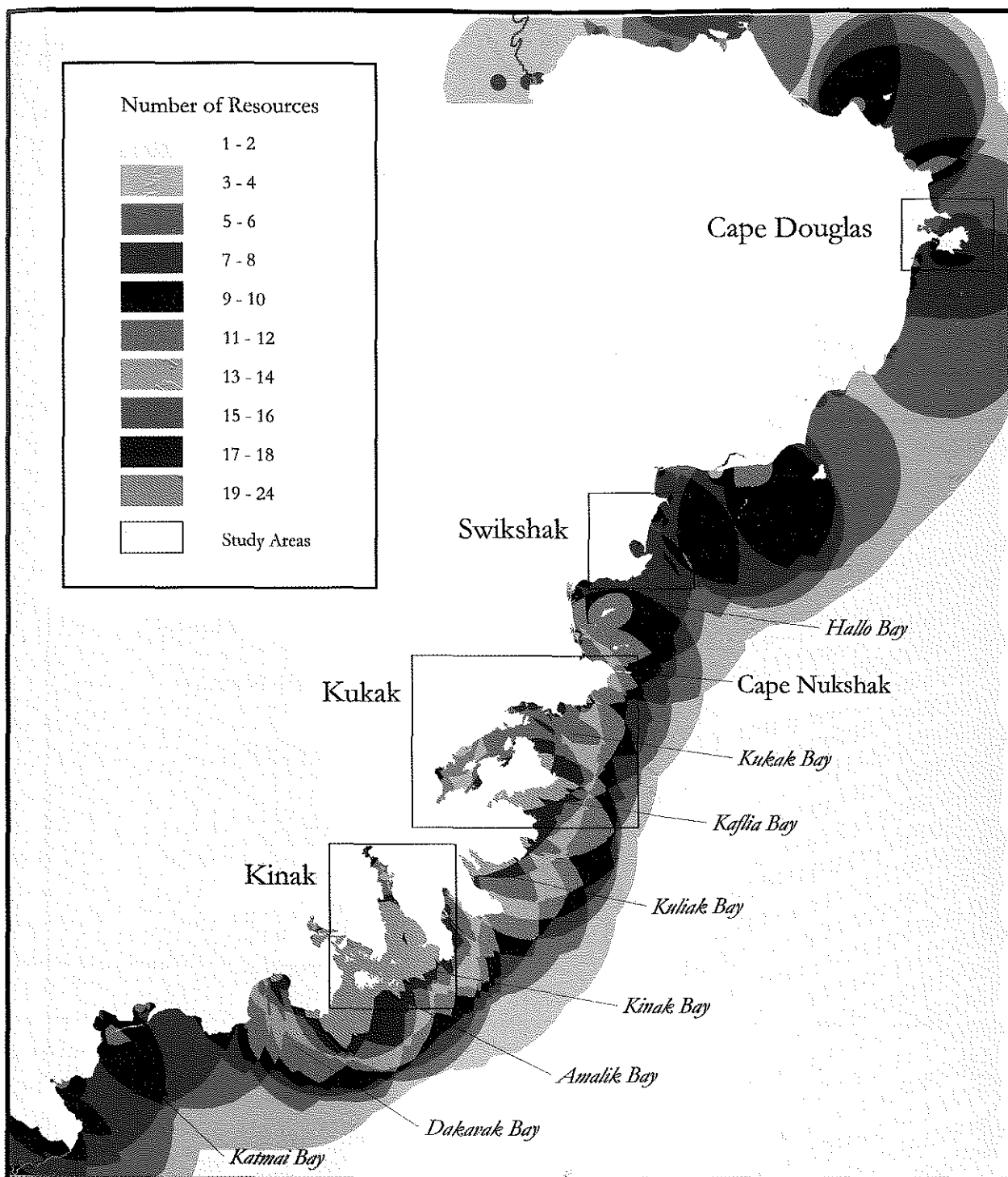


Figure 8: Variations in combined resource availability along the Katmai coast. Ten km kayak-harvest zones surround sea mammal, bottom fish, and seabird resource locales; one km foot-harvest zones center on clam beaches and the mouths of salmon streams. Color-coded overlaps indicate total numbers of accessible resource locales.

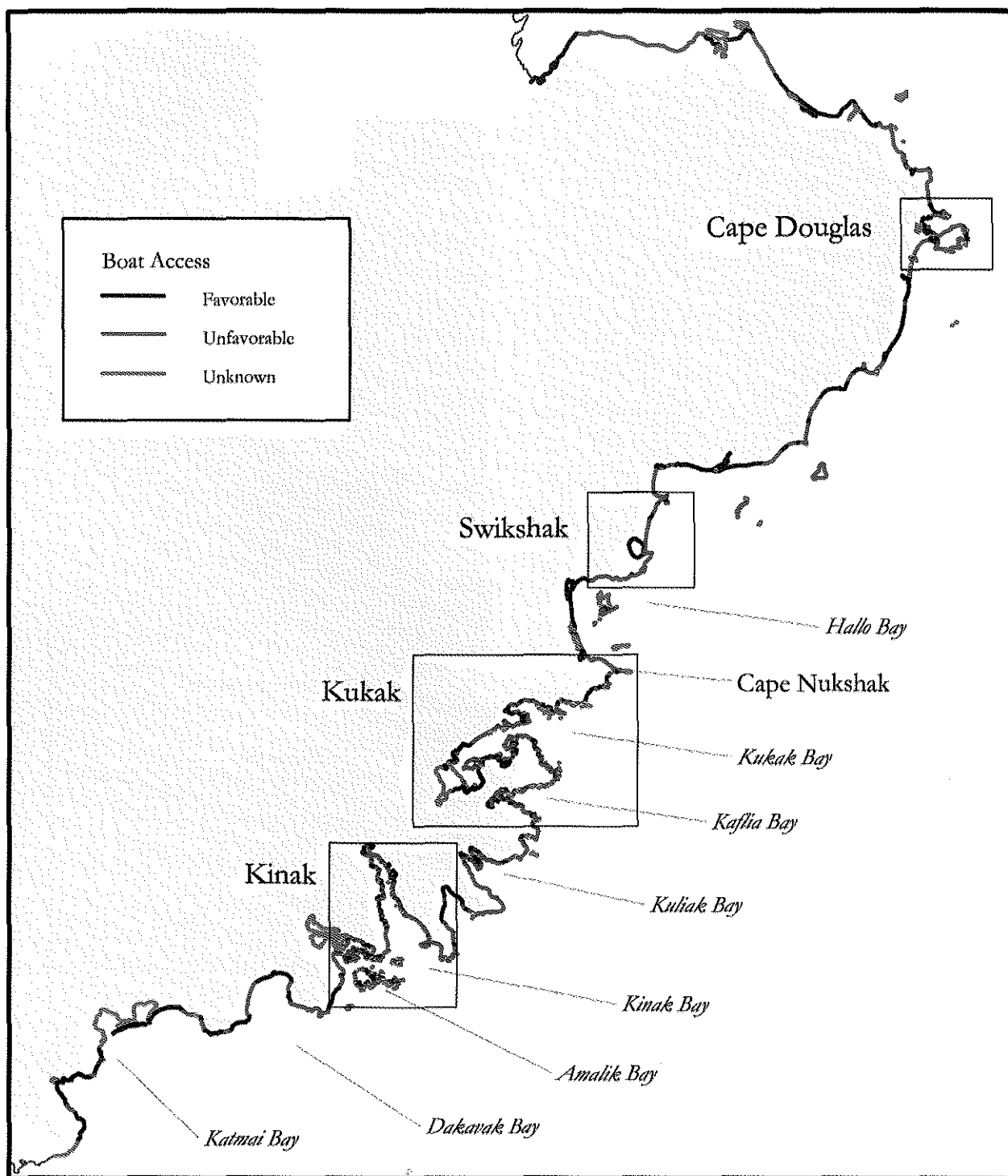


Figure 9: Suitability of shoreline for landing skin boats, based on substrate and inferred wave energy. "Favorable" beaches (green) are composed of fine sediments and have slopes of less than 5 degrees.

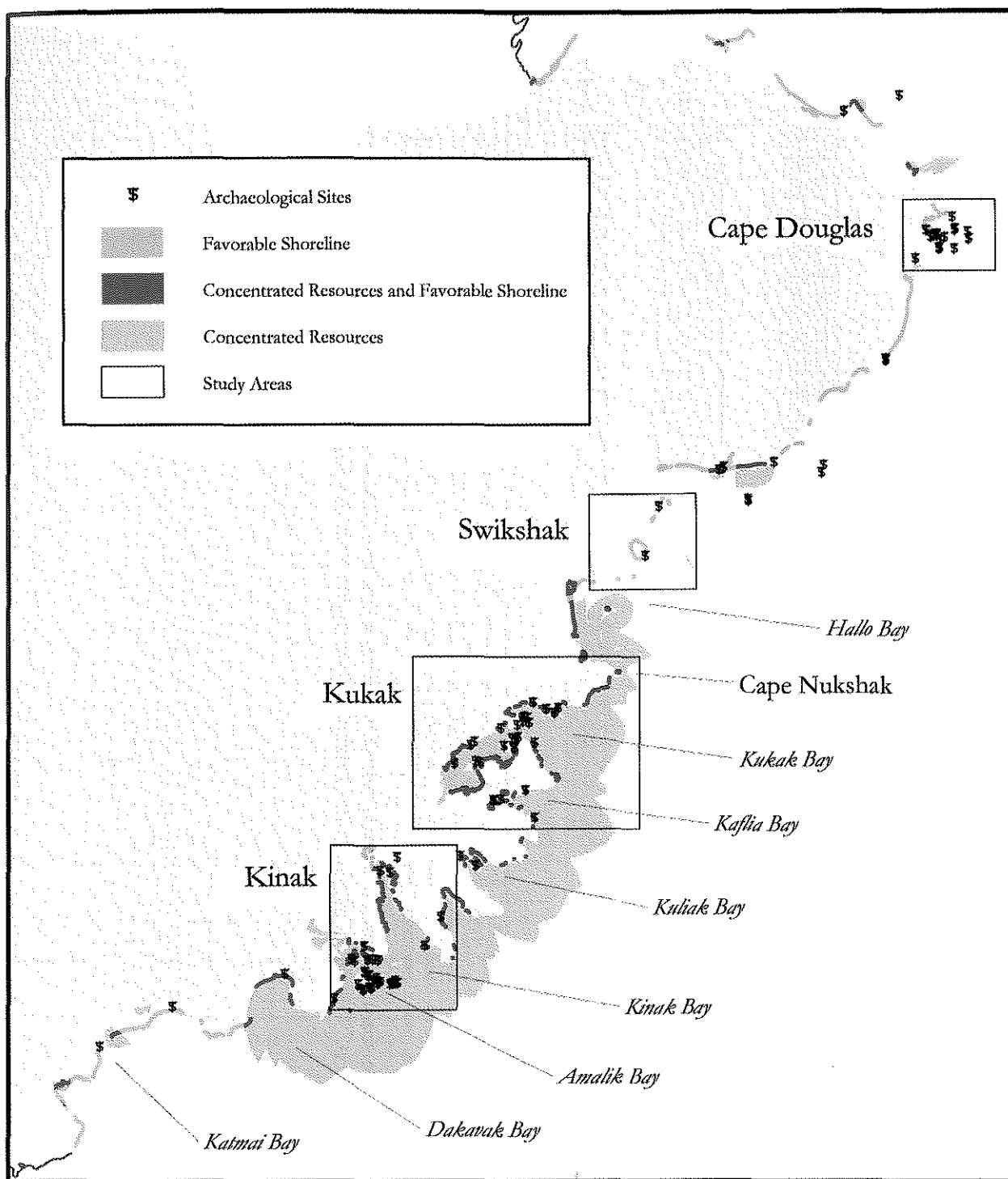


Figure 10: Spatial distribution of all archaeological sites in relation to sections of shoreline with favorable skin boat access (yellow) and favorable skin boat access combined with concentrated resource availability (red). Areas of resource concentration (green) are defined by access to 11 or more resource locales.

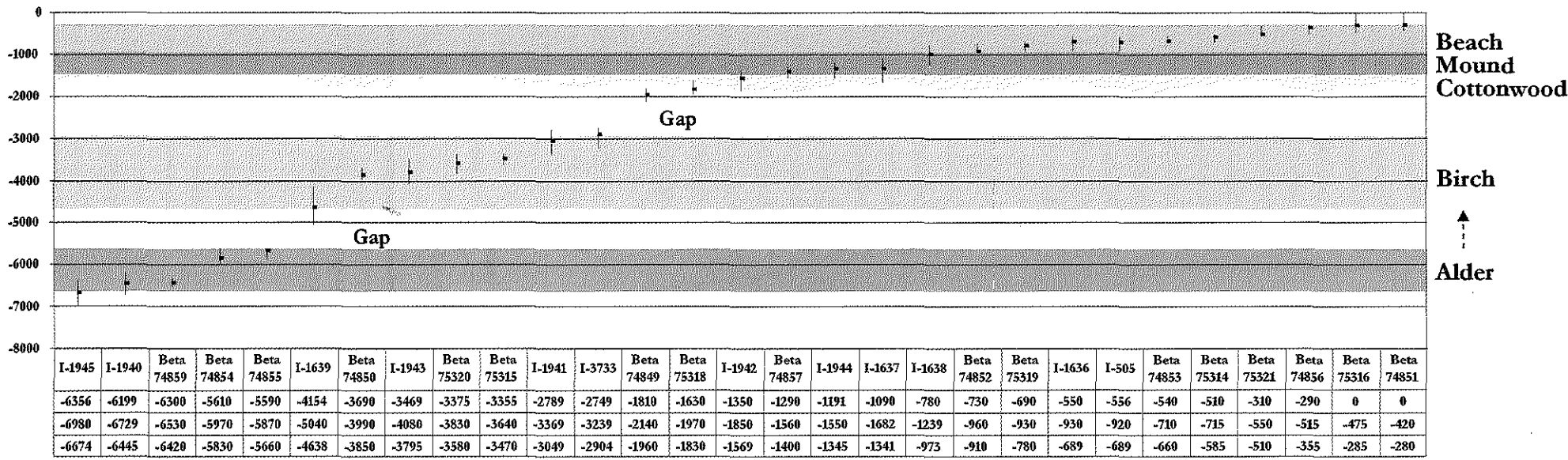


Figure 11: Calibrated radiocarbon dates from the coast of Katmai National Park, showing gaps between 5600 – 4600 cal B. P. and 2900 – 2000 cal B. P. Ranges represent two standard deviations. The figure excludes the extensive date series from the Mink Island Site (XMK-030), not yet published.