

SUBSISTENCE MAPPING: AN EVALUATION
AND METHODOLOGICAL GUIDELINES

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CHAPTER 1

SUBSISTENCE-BASED LAND AND RESOURCE USE MAPPING: INTRODUCTION AND CONTEXT

INTRODUCTION

The relationships between hunting-gathering peoples and the terrestrial and aquatic environments in which they conduct resource harvest activities increasingly have become the focus of studies emerging from a diversity of disciplines and interests, including cultural ecology, human ecology, archaeology, cultural and economic geography, environmental studies, and public administration and planning. There are two primary explanations for this interest. First, as ecological models have found more widespread applicability in anthropological and related studies, scientists have looked to the adaptive strategies of contemporary hunter-gatherers in the hopes of gleaning insight into human evolution and human economic, social, and ideological change through time and space and having an opportunity to describe "traditional" or "indigenous" hunter-gatherer cultural patterns before such groups have been engulfed by "modern civilization." As aptly described in the 1966 Man the Hunter symposium (published in Lee and DeVore 1968), the geographic distribution of populations which have a subsistence focus based on hunting, fishing, and gathering has diminished over the past five hundred or so years

but most dramatically, however, during the last century. This phenomena has occurred despite the fact that hunting-gathering had been a successful and persistent adaptive strategy throughout most of human history.

Secondly, the facts that hunter-gatherer societies are contemporarily rare in a global perspective and generally distributed in marginal areas have not diminished the zeal by which extant agro-industrial societies have attempted to either occupy or manage lands and resources on which hunter-gatherers depend, particularly in more recent years. In general, the effects on hunter-gatherer societies of land policies imposed by colonial governments over the past century have included the reduction of territory available to these groups and modification of their traditional systems of tenure in favor of state-controlled systems with subsequent collapse or severe modification of hunting-gathering economies (Bodley 1975:83). In some areas of the world, such as northern North America, government policies regarding indigenous hunter-gatherer societies have incorporated a consideration of perceived moral or ethical obligations to aboriginal peoples, including the protection of necessary lands, waters, and resources or compensation for the loss of harvest areas and resultant access to resources. However, in order to operationalize such moral or ethical obligations into land-use policies, it has been necessary to understand the nature of hunter-gatherer land-use patterns and, in the case of compensatory measures, to establish a qualitative or quantitative value of land, resources, and related cultural loss. In other cases, recognition of hunter-gatherer land and resource rights

have been initiated or encouraged by legal and judicial action on the part of advocates of aboriginal claims.

In recent years the interests and issues described above, have resulted in a proliferation of studies dealing with the overall ecology of hunters and gatherers within holistic study frameworks focused on specific populations (for example, the Kalahari San work described and synthesized in Lee and DeVore 1976). Many of these studies have focused on the relationships between hunter-gatherers and their resource bases, including relative hunting versus gathering productivity, temporal requisites for achieving adequate harvest levels, access to resources and areas by competing groups, predator-prey relationships, flow of energy analyses, optimal foraging strategies, resource management schemes of indigenous societies (Williams and Hunn 1982), and others. However, despite the fact that resource availability and use by hunter-gatherers are dependent upon the land (or water) base in which the resources occur, the focus of interest on areas (land or water) rather than resources has accompanied the recognition of the ecological truth that you cannot separate resources from the land or water base from which they are derived and on which they are nurtured. Secondly, whereas colonial governments in many areas were primarily interested in resource extraction and control over commercially valuable resources, currently the value of land as property in addition to its association with resources has rapidly inflated. Thus, there has been some shift of interest towards describing and analyzing patterns of land (and water) use, tenure,

occupancy, control, and valuation in contrast to considerations with primarily a resource focus.

In the northern North American context, relatively recent studies of the subsistence-based economic systems of indigenous populations initially employed methodologies grounded in formal harvest surveys, since it was thought that merely an understanding of harvest productivity would provide a measure for evaluating, protecting, and compensating indigenous hunter-gatherer economic systems. Secondly, little was known about the structure and function of such subsistence-based economic systems. Naively governmental agencies thought that solely knowledge of harvest quantities would provide adequate criteria which could be measured against a western, formal economic model to assess the socioeconomic status of indigenous populations (Lotz 1976), thereby providing insight into the means by which such groups could be brought economically, socially, and culturally into the "modern world." In fact, in both Alaska and Canada, harvest surveys were frequently conducted by biologists with negligible training or experience in the social sciences.

The first major study in northern North America to recognize the relationships between indigenous hunter-gatherers and land and water areas they occupied and used resulted from a plan in the late 1950s to drastically alter a segment of northwestern coastal Alaska using atomic energy for purposes of constructing a harbor (Foote 1961). This study employed a methodology which included land-use mapping as well as harvest data and provided a model for subsequent land use and occupancy studies in Canada and, to a less sophisticated degree, in

Alaska (Usher 1984; Federal Field Committee for Development Planning in Alaska 1968).

Within the last decade, interest in and effort committed to land use and occupancy studies have continued to expand in both Canada and Alaska. Additionally, the demand for quality data generated from such studies has reached the level at which serious consideration of the theoretical relevance and methodological procedures of subsistence-based land-use mapping has to be addressed. This study was commissioned by the Division of Subsistence, Alaska Department of Fish and Game and U.S. Department of Agriculture, Forest Service to address these questions.

PURPOSE OF THE STUDY

Subsequent to its inception in 1978, Division of Subsistence, Alaska Department of Fish and Game, research personnel began mapping land and resource use areas in communities with subsistence-based socioeconomic systems (Wolfe and Ellanna 1985) using the land use and occupancy model which had been developed and applied to historic and contemporary subsistence patterns of the Inuit of the Northwest Territories in Canada (Freeman 1976). Over the past five years, Division of Subsistence staff has attempted to refine this mapping methodological model to accommodate the diversity of ecological and cultural data gathered by the division and to address particular research and applied questions. Nonetheless, to date methodological development has occurred primarily within the context of area-specific

and problem-specific research projects, and no single study has focused solely on the development of mapping guidelines. Additionally, governmental agencies mandated to manage competing land and resource uses on public lands have requested mapped subsistence data with indicators of intensity of use. To date Division of Subsistence research policy has not yet come to grips with whether it is possible or even desirable to map and release intensity data as study findings, since such endeavors involve extremely complex methodological, ethical, and substantive questions.

Secondly, the Division of Subsistence is preparing to embark on a major mapping effort in southeastern Alaska in conjunction with both state and federal (particularly U.S. Forest Service) interests in land-based subsistence use data. Because of the ecological and cultural distinctiveness of southeastern Alaska from areas of northern North America mapped to date by Alaskan and Canadian researchers and the heterogeneity of communities in the region, the Division of Subsistence and U.S. Forest Service jointly planned and funded this study. Objectives include an evaluation of extant subsistence mapping methodologies, the development of general guidelines derived from this methodological critique, the development of a methodology applicable to the southeastern Alaskan context, and a consideration of measures of intensity including criteria, depiction, qualification, and potential applicability.

More specifically, study objectives include:

- (1) The identification, review, and evaluation of methods for portraying geographic-based information on hunting, fishing,

trapping, intertidal collecting, and gathering derived primarily but not exclusively from participants in subsistence-based socioeconomic systems (emphasis is on northern studies but relevant methodologies from other areas of the world are considered);

- (2) the identification or development of methodological guidelines keyed to specific research questions -- these guidelines minimally depict land and water areas used for harvesting by species or species categories; changes in use areas through time; maps which are composites of individual or household resource use areas; traplines, trails, or other transportation corridors significant to resource use; camps, harvest sites, landmarks or other specific locations significant to resource harvest; means for analyzing geographic-based harvest data from subsistence-based socioeconomic systems; and an identification of problems intrinsic in portraying resource use data on maps;
- (3) the development and application of a mapping method applicable to resource harvest in southeastern Alaska; and
- (4) the examination of the application of valiative measures such as "intensity of use" to mapped subsistence-focused land and resource use data and the criteria upon which such measures are based.

Findings regarding these objectives are discussed in detail below.

METHODOLOGY

The identification and evaluation of extant methodologies for depicting geographic-based subsistence resource use information required an extensive literature search. Initially all major land use and occupancy studies from Canada and Alaska were reviewed and critiqued for strengths and weaknesses in light of stated objectives, conformity to scientific procedure including replicability, and applicability. Secondly, ecologically-focused precursors to land use and occupancy studies -- including harvest level research, baseline impact assessments, ethnographies, and problem focused investigations relating to human/environmental interactions -- were consulted to provide insights into the origins and development of contemporary land-use mapping methodologies. Hunter-gatherer literature from other areas of the world were reviewed for relevant and applicable approaches to recording and analyzing geographic-based subsistence data.

Subsequent to the review of specific studies described above, relevant sources in anthropological theory and method were consulted. These included early theories of environmental determinism, cultural and natural area theory (Kroeber 1939), multilinear evolution and culture change theory (Steward 1955), and more contemporary ecological analyses such as optimal foraging theory (Winterhalder and Smith 1981). Specific contributions of these theoretical perspectives to the study at hand will be described below. Additionally, some handbooks of anthropological research methods were reviewed to ascertain

how mapping has been used in data gathering, data analysis, or data depiction in the discipline as a whole.

As the primary focus of this study was to develop an understanding of the geographic components of hunting-gathering economies, it was therefore logical to examine appropriate literature from the discipline of geography. Particular attention was committed to the sub-fields of economic and behavioral geography and the methodology of cartography. Relevant statistical analytical techniques from geography were adapted to both general and southeastern Alaskan methodological models.

Since some of the more recent land-use mapping studies were not yet published, and in order to develop a more complete historical framework in which to view the development of northern mapping methodologies, interviews were conducted with both Canadian and Alaskan researchers. These informal interviews were most particularly instructive in the case of the Dene mapping project. The University of Alberta is currently the repository for these mapped data, and faculty, staff, and students participate in analysis of these data when questions primarily related to land-use planning decisions arise. In Alaska the most productive interview sessions involved the development of land-use mapping methods and associated analyses of North Slope Borough land and resource use data.

General subsistence-based mapping methodological guidelines were developed on the basis of the critiques of extant methodologies and review of other appropriate literature. It was originally thought that the methodological review process would result in the development

of a single, encompassing methodological model which could be applied to gathering and analyzing subsistence land and resource use data in general and to southeastern Alaska in specific. However, it became apparent from the review and evaluative process that no single model would be applicable to all ecological and cultural areas or to all research questions. In fact, it became readily apparent that the mapping model employed minimally had to fit the ecological, cultural, economic, political, and historic givens of the area of interest and needed to respond to the nature of the specific research questions being asked of the data. That is, mapping land and resource use data derived from subsistence-based socioeconomic systems was substantially more complex than originally believed, and no single model could provide all the answers.

While it was ascertained that no one model could provide answers for all questions regarding the spatial dimensions of subsistence-based land and resource use, a set of methodological guidelines were developed for applicability to specific ecological, cultural, and policy-related inquiries. Use of these guidelines would ensure comparability of data between studies and replicability of studies in time and space. Additionally, these guidelines included an assessment of the relative importance of mapping as a tool in developing an understanding of the structure and function of subsistence-based socioeconomic systems and as a tool for gathering and organizing data for application to land-use planning decision-making processes.

A model for application to southeastern Alaska was derived from these more general guidelines, taking into account the ecological,

economic, cultural, historic, and political nature of the region and its internal heterogeneity. This model evolved and was refined in the context of preliminary fieldwork in the community of Klawock on Prince of Wales Island, Alaska. Fieldwork included the gathering of map biographies from 19 key informants, who were selected on the basis of recurrent mention on lists of active harvesters elicited from Native and municipal organizations and other key respondents. After a preliminary selection of informants was made, it was determined that the informant sample minimally had to include three age groups (20s through 30s, 40s through 50s, and 60s and older), both long and short-term residents, with representation of individuals who had participated in either commercial fishing or commercial timber harvesting activities within their lifetimes. The temporal extent of each mapped biography was the entirety of the years in which the informant harvested resources while associated with the community of Klawock, as the outcome was a community-focused land and resource use pattern. Harvest information was gathered for salmon, deer, intertidal resources, waterfowl, and trapping resource categories in the initial design, although marine mammal harvest data were deemed important by informants so became a supplementary resource category. Geographic-based data gathered from the key informant sample provided the basis for designing geographic-based survey questions which were administered to a random sample of 36 households and 4 non-randomly selected key informant households. More specific detail about the southeastern model is presented in Chapter 5.

BASIC CONCEPTS

For the sake of clarity in the discussion to follow of mapping methods and associated evaluations, a concise review and definition of some basic concepts used through this presentation is in order. An understanding of these concepts as used in this context will be particularly useful to the reader unfamiliar with hunter-gatherer research in general and subsistence research in northern North America in specific.

While the term "hunter-gatherer" is commonly used in anthropological literature to describe economic systems and populations primarily reliant on locally available animal and vegetable resources for food and raw materials, the term itself falls short of a literal description of the spectrum of activities implied by its users. A more detailed description of economic activities engaged in by "hunters-gatherers" would vary ecologically and culturally but include, in this context, terrestrial and aquatic hunting, fresh- and salt-water fishing, intertidal collecting, trapping, terrestrial gathering of plant resources, and the socioeconomic and cultural institutions which support the production, distribution, consumption, and perpetuation through time of an economic system based on the use wild resources. In this context, therefore, the term "hunter-gatherer" will be used for the sake of brevity but will include the complex of features described above.

The concept "subsistence-based socioeconomic system" refers to an economic and attendant social and cultural system characterized by the following features (Wolfe and Ellanna 1983):

- (1) a mixed economy, including a subsistence sector focused on the harvest of wild, renewable resources for food and raw materials derived from hunting, fishing, and gathering but including a secondary, albeit important, cash sector derived from wage employment, simple commodity production, and transfer payments;
- (2) a community-wide seasonal round involving a patterned system of resource harvest keyed to specific seasons and associated availability of wild resources;
- (3) a kin-based system of production, referred to as a "domestic mode of production," in which the technology is small-scale and owned by family groups and production is primarily for use rather than for commercial distribution (sale);
- (4) extensive and patterned non-commercial networks of distribution and exchange;
- (5) relatively high production outputs;
- (6) relatively high levels of participation;
- (7) customary law which regulates land use and occupancy and, consequently, access to resources and which differs from western concepts of private property;
- (8) a wage sector which is characterized by seasonal, intermittent, insecure, and sporadic cash generation, usually derived from employment in government projects, capital

- construction endeavors, and the commercial extraction of resources (such as trapping and cannery employment); and
- (9) efficient methods and means and a long term advantageous cost/benefit ratio for the full spectrum of species.

The term "subsistence mapping" will be employed in the remainder of this study to refer to the investigation of the geographic dimensions (land and water) of the harvest-related activities of participants in subsistence-based socioeconomic systems. Although the term "subsistence" has numerous political and legal definitions and implications in the Alaskan context, its use in "subsistence mapping" will accommodate brevity and be descriptive of the phenomena of land and resource use by participants in subsistence-based socioeconomic systems and will not have any political or legal connotations.

"Harvesting behavior" involves several different components which are identified in the following discussion. A harvesting trip (for example, a hunt or fishing trip) as commonly practiced in rural Alaska is undertaken by a person or persons who depart their residence (community or camp) and travel lesser or greater distances usually to the unsettled surrounding countryside with the intent to harvest (kill or gather) animals or plants for some type of human use, returning some portion of the harvest to their residence. A harvesting trip is generally divided into three phases: location of resource (search, scan), chase (pursuit) in the case of game or fish, and capture or harvest. Each of these aspects of harvesting are discussed as they relate to the mapped representation of the spatial patterning of harvest activities.

How does the concept of "location of resource" or "search" relate to a harvest activity by a subsistence user? One of the analytical problems of search behavior is how to treat multispecies or opportunistic harvest trips. In most cases, harvesters undertake a harvesting trip with a primary species and a real objective in mind. In the course of that trip, however, he or she may encounter one or more additional species which may be harvested as a secondary or opportunistic consideration, particularly if the harvester is unsuccessful in obtaining the primary species objective. Additionally, the discovery of a highly valued resource may alter the focus and direction of the search. Whether a harvest is primary, secondary, or opportunistic is relevant to considerations of increasing competition for all resources located within a given area. Secondly, it is relevant to subsistence mapping to distinguish between whether or not the harvester is merely traveling through an area unsuitable or low in priority for purposes of search activities to get to a productive search area, or whether searching is on-going along a travel corridor. Lastly, the route traveled over land or water to get to a harvest area has differential relationships to actual search behavior. A route traveled is normally represented by a line on a map. Data collected from the Dene and analyzed by Michael Asch and his associates at the University of Alberta are of this nature. However, harvesters, particularly hunters, actually may be conducting hunting behavior some distance on either side of the route traveled. In some types of terrain, such as heavy underbrush, the actual area hunted may be virtually linear due to lack of visibility. At the other end of the continuum, however,

specific locations on a route, such as promontories, many allow for significant visibility and thus produce a wide area in which the harvester searches for animals. For example, tundra-dwelling Inuit commonly use piled sea ice ridges or elevated coastal crests to scan vast distances of relatively flat sea ice for evidence of leads, breathing holes, or other signs of marine mammal prey. In addition, there may be specific locations where hunters will sit and await game to pass by them. Thus, search behavior can be represented spatially as a spot, a line, or an area depending on to what degree and in what fashion travel corridors are searched by harvesters.

The second phase of harvesting, not applicable to the collection of plant resources, is pursuit. While the search has a general primary objective, pursuit is more specific. Pursuit behavior is more spatially limited and usually occurs within areas encompassed by search activities. However, pursuit may occur through terrain or habitat not desirable for searching, such as heavily forested areas between the beach and alpine meadows on southeastern Alaska islands. Spatially, the location of pursuit activities may be important to mapping resource use if such activities are located beyond search area boundaries or in cases of evaluative assessment (MacArthur and Pianka 1966).

The final phase of harvest behavior is capture or actual harvest. Generally, this activity can be reduced to a specific site where an animal is killed or plant foods picked. There are cases, however, in which an animal is wounded and then must be pursued for the final kill. In both circumstances, the location of harvest can be reduced

to a single spot or small area on a map for purposes of spatial analysis. While kill sites or small harvest areas are extremely important to quantitative analysis of mapped harvest data, "it must be clearly understood, especially with respect to land use issues, that to map hunter success (location of kills) is not necessarily to map Native land use, and certainly not to identify critical or important area in which Native harvesters have an interest" (Usher et. al 1985).

Lastly, another feature of harvest behavior is "harvest pattern." For purposes of this discussion, "harvest pattern" means the pattern of human use of the land and water for the harvesting of wild animal or plant resources. Harvest patterns involve: (1) a transportation technology, (2) a harvesting technology, (3) an ecological framework, (4) an economic framework, (5) a legal framework, and (6) a socio-cultural framework. The temporal dimension of the harvest activity -- that is, the season of its occurrence -- is important and embedded in several of the variables noted above. Therefore, given an exhaustive mapped set of hunting uses of a geographic area, the explanation for any particular pattern requires attention to each of the six variables noted above.

The concept of "territory" in hunter-gatherer societies diverges widely from territorial concepts in agro-industrial societies. In hunter-gatherer societies territories and associated resources generally are not conceived to be privately owned by individuals or groups in the sense of being marketable commodities. In the case of Australian Aborigines, "land ownership" is a core area of local politics and is a potentially-explosive topic (Sutton and Rigsby

1982). However, "land ownership" functionally means attachment to land that enables the "owning" group (rarely an individual) to confer rights over that land, most particularly access to resources and water holes on a given piece of land. "Ownership" of land is equivalent to the right to be asked for permission to use water or wild animal and vegetable resources. Along the northwest coast of North America, traditionally the rights of families and local village groups to control and harvest specific resources at specific sites was highly developed and often heritable (Hunn 1982). In areas of northwestern Alaska, territories used for fishing, hunting, and gathering were society-specific and defended vigorously against encroachment by individuals or groups who did not have kin-based linkages to the occupants of the territory in question, except for some cases of overlapping use areas during specific seasons when migratory species were being pursued (Burch 1981). In the case of the Pacific Northwest Plateau area, Indians harvested most resources in common and were free to travel over vast distances, but fishing platforms were considered to be property of a family which controlled access to fish caught at these locations (Hunn 1982). In the case of the Inuit of the Barren Grounds of northern Canada, a sole hunter may use between 3,000 and 4,000 square miles in his lifetime. Virtually all lands known firsthand by a hunter or through oral accounts from others are inhabited and used by members of a group to which he can trace kinship ties. Within the world view of such a hunter, there exists no territorial boundaries (no foreign lands or foreign groups), primarily because of the expansive land prerequisites for sufficient resource extraction in

areas of relatively low productivity and the focus on a highly mobile and somewhat unpredictable resource (caribou) (Hoffman 1976; Mauss 1979). The relevance of concepts of territory to an understanding of the geographic dimensions of harvest activities is the role which territoriality plays in maintaining an ecological balance between natural resources and harvesting populations. This balance is essential to maintaining some degree of stability in patterns of ecological adaptation in relationship to harvest areas (carrying capacity).

RELEVANCE OF SUBSISTENCE MAPPING

Some suggestions about the relevance of subsistence mapping were presented in the introduction to this chapter. This topic is explored more thoroughly here. Mapping is a method for collecting, analyzing, and depicting the geographic dimensions of subsistence-based socioeconomic systems. As previously mentioned, while earlier studies ignored mapping and its relevant contribution to the understanding of the structure and function of such systems, more recent studies, particularly those associated with land use planning, have exaggerated the contribution of mapping to knowledge of the nature of such systems. In fact, some study methodologies have assumed that land-use mapping unaccompanied by other socioeconomic and sociocultural data can provide the basis for developing land-use plans, compensatory or mitigating measures, resource allocation and management policies, legislation protecting land and associated uses, and other decisions affecting subsistence-based socioeconomic systems. Both extremes of

this continuum -- that is, ignoring mapping as a method to viewing it as the sole source of information for land and resource-use decisions -- can be viewed as examples of a general inadequate understanding of subsistence-based socioeconomic systems. Within these systems, the relationships between harvesters, resources, and the land or water bases necessary for the maintenance of resources are of central importance and can only be understood by the use of mapping as an integral tool in a more comprehensive study methodology. On the other hand, an understanding of mapped data requires a more holistic social, economic, and cultural perspective.

Bodley (1975:83) sets forth the characteristics of the relationship between tribal (i.e. egalitarian, kin-based, subsistence-based) societies and the land (and water) areas on which they conduct their economic activities. These characteristics include the following: (1) land and resources are the economic base of the society; (2) group boundaries are well defined and, in most cases, defended; (3) access across boundaries is permitted by social mechanisms to accommodate migratory species, ecological interdependence, and mutual dependency; (4) ownership of land and resources is in the hands of the kin group or community, with no conception of the individual ownership of land; (5) concepts of ownership within a group are irrelevant because patterns of use are based on usufruct rights; (6) access to and use of land is guaranteed to all members with some overlap between use area and flexibility to accommodate resource fluctuations; (7) resource availability through rules of access is well-adapted to population size and social mechanisms; (8) land has symbolic and emotional

meanings to group members; and (9) systems of resource management exist (e.g. rotation of areas and resources used, cyclical use patterns, selective hunting or gathering). Bodley argues that because land is the foundation of the socioeconomic system, disruptions to land and resource-use patterns inevitably affect all aspects of the sociocultural system. In fact, land policies have deliberately been used by colonial governments to bring about overall cultural change of indigenous peoples. Therefore, the use of mapping is fundamental as a means of understanding the relationships between people, the land (and water), and associated resources on which they rely.

More specifically, subsistence mapping can be applied to research questions which fall into one or more of the following categories:

- (1) The geographic extent of a population's resource harvest activities (extensivity mapping);
- (2) changes in the geographic extent of use areas through time (changing land and water use patterns);
- (3) patterns of land tenure and territoriality through time and space;
- (4) the differential use of resources and related land and water areas (intensity mapping);
- (5) comparison of land and resource use patterns between communities or areas (cross-cultural comparisons);
- (6) the analysis of the human ecology of a given area;
- (7) the impact of land or resource use policies on altering pre-impact socioeconomic systems (impacts analysis);

- (8) the assessment of land requirements for communities with expanding populations (projective analysis);
- (9) the effects of community settlement (sedentarism) on subsistence-based land and resource use patterns;
- (10) the effects of changing modes of transportation (mobility) on subsistence-based land and resource use patterns;
- (11) changes in land and resource use related to an increased diversity or level of non-subsistence economic activities;
- (12) changes in resource availability due to population cycles, increased competition, the introduction (natural or artificial) of new species to an area, and other factors; and
- (13) cultural perceptions of, attitudes towards, and values associated with space and environment.

While the relevance of conducting subsistence mapping studies has been highlighted, it is also important to develop the mechanisms by which mapped data can be collected and analyzed in a manner which ensures comparability, replicability, and applicability. In order to develop a sound methodological model, it is essential that a brief review of the role of relevant mapping in the disciplines of geography and anthropology be conducted. This review is the topic of Chapter 2.

CHAPTER 2

MAPPING AS A METHODOLOGY IN THE SOCIAL SCIENCES: SOME PERTINENT EXAMPLES AND THEORETICAL PERSPECTIVES

RELATIONSHIPS BETWEEN ANTHROPOLOGY AND GEOGRAPHY IN THE STUDY OF HUMAN- ENVIRONMENTS

Anthropology and geography have been described as "sister sciences" (Clarkson 1970) in that they are both interested in human phenomena in relationship to the natural environment. While geographers and anthropologists look at many similar questions, easy interdisciplinary communication is lacking in large part because of differences in theory, terminology, and origins. This circumstance is in part explained by the development of geography out of the physical sciences, particularly geology, and the development of anthropology in large part out of the biological sciences in addition to history and social philosophy. Thus, while geography is seen as bridging the gap between the physical and social sciences, anthropology is often viewed as spanning a similar hypothetical space between the biological and social sciences (Clarkson 1970). Differences between anthropologists and geographers in their treatment of society, culture, and natural environment have persisted from the inception of the disciplines to the present day. Thus while it is purported that anthropologists are proficient in their comprehension of sociocultural systems, they are

more naive in their understanding of the dynamics of the natural environment. Conversely, geographers are wanting in their knowledge of the structure and function of sociocultural systems, while they have a more well-developed understanding of environment and have become highly proficient in the spatial analysis of natural and cultural features (Grossman 1977).

Although both geography and anthropology were interested in human-environment relationships, divergent interpretations of these relationships resulted in different theoretical perspectives. From the late 1800s to the 1920s, theory in geography was dominated by concepts of geographic or environmental determinism influenced by Darwinian evolution (Clarkson 1970). During this period the concepts of William Morris Davis dominated geographic study. He espoused the view that the concern of geographic research should be to investigate the relationships between inorganic cause and organic effect — that is, the effects of the physical environment (e.g. mountains, deserts) on humans. This view presented a one-way cause-effect relationship between the environment and human beings and was, in effect, an attempt to determine the place of humans in nature (Clarkson 1970).

During the next 30 years, the focus of geographic studies changed from environmental determinism (environmentally determined cause-effect relationships) to a concern for spatial analysis. Geography became the study of the placement of physical and cultural features within a landscape (an area represented by the forms on it). Geographers developed standardized methodologies for studying spatial relationships, including the collection, analysis, and depiction of

data through the use of maps. Thus, during this period, geography as a discipline was concerned with analyzing factors affecting the location of phenomena resulting from human activities. This differed from the previous focus of the discipline which ultimately tried to explain the systemic relationships between the environment and humans -- that is, the interaction between human activities and environmental setting. Seemingly, geography had abandoned its earlier, albeit naive, interest in human-environmental systems and replaced it with a more static interest in the differential location of human activities and their products.

Evidence of geographic determinism in anthropological thought predates its inception as a discipline of study. In fifth century Greek anthropological thought, geographical factors, particularly climate, were perceived to be capable of influencing behavioral dispositions, and for many centuries afterwards climatic influences were seen to be the primary geographic explanation of social phenomena. Although the ancient Greeks developed geography as a science, they only incidentally noted geographical factors other than climate relating culture to the natural environment (Honigmann 1976:29). Some early Christian theologians explained the diversity of cultures as relating to the varying uses that societies make of resources provided by nature, stressing the limitations imposed by different environmental settings (Honigmann 1976:43). In subsequent centuries, geographic determinism reappeared from time to time in western anthropological philosophy, such as in the 16th century writings of French jurist Jean Bodin, who combined concepts of geographic determinism

with cultural patterning to explain differences in mental illness between societies located in different climatic zones (Honigmann 1976:56). Ideas of geographical determinism were displaced in the 18th century due to the influence of Locke and other empiricists. "Strong doubts came to be voiced about the influence of the natural environment, including climate, on cultural development, temperament and human behavior" (Honigmann 1976:100). Montesquieu, the last defender of early deterministic thought, argued that fertile lands were easily subjugated by conquerors attracted to their rich resources and the poor defense of residents who were effeminate and weak because of their wealth and leisurely lives. Conversely, barren grounds induced industriousness, hardiness, and courage in their populations.

At the time of anthropology's inception as a discipline, anthropological theory had moved away from the narrow explanations of geographic determinism, but environmental-human interactions were implied through the application of evolutionary models to cultural phenomena. Elaborate schemes were developed to account for the sequences of the cultural evolution of religion, family forms, kinship terminology, and other aspects of culture and its superstructure (Honigmann 1976). "Near the start of Ancient Society, Lewis Henry Morgan holds improvement in mankind's technical ability to manipulate the physical environment to have been a mainspring of cultural development. . . .He emphasizes the importance of advances in means for procuring subsistence" (Honigmann 1976:288) in influencing cultural development. Features of geographic determinism were also implied in materialistic conceptions of history associated with Marx and Engels.

In these conceptions, all features of culture -- law, politics, ethics, religion, philosophy -- were ". . . basically influenced by the way a society is organized to produce the necessities of life" (Honigmann 1976:121). Culture was rooted in the relationships people establish with each other to produce goods, and these relationships of production were influenced in turn by technology.

Differing from earlier geographic determinism, early examples of cultural ecological theory conceptualized the relationship between culture and environment to be one of mutual interaction -- that is, a society's mode or ordering natural features, physically or cognitively, frequently leads to changes in the environmental milieu, thereby challenging the society to develop new modes of adaptation. The concept of "adaptation" has continued to imply an interactive and dynamic human-environment connection. The culture-area concept (Kroeber 1939) mapped entire cultures or groups of diagnostic traits on the habitats exploited by non-agricultural, non-industrial populations. Advocates of the culture-area concept recognized the problems of static boundaries on maps, however, and hoped to develop a means of portraying both sequential and spatial variation within culture areas (Ellen 1982:10), as they were aware of the dynamic nature of human adaptation. No major advances were made in the refinement of anthropological theory pertaining to human-environmental relationships until the approach of cultural ecology was presented in the work of Julian Steward (1955).

In Steward's work the concepts of evolution and ecology were wedded. Steward was interested in regularities of form and function

in the development of cultures, and he defined ". . . evolution operationally as the result obtained by an investigator who starts out looking for regularities in the conjunction of cause and effect in culture change" (Honigmann 1976:278). In his theory, Steward maintained that ecological factors are primarily responsible for producing such regularities, and that regularities or parallels arise when similar traits connected with subsistence and other biological imperatives come into use in different societies. Cultural evolution is therefore rooted in technical innovations for adapting humans to their physical environments (cultural ecology). Steward was the first to bridge the gap between culture and environment by analyzing exploitative patterns (Feit 1969). Subsistence adaptations and related cultural phenomena provide the core for cultural ecological theory. Cultural variations between several societies occupying a single geographical region are explained by applying the concept of "ecological niche" to human beings. Each niche contains resources which the group, given its technological capabilities, can exploit, use, and control at that particular time in history (Honigmann 1976:289). Critics of cultural ecological theory suggest that whereas it has been successfully applied to studying adaptations of hunter-gatherers or horticulturalists, it lacks the conceptual tools necessary to analyze the processes of cultural change and adaptation in complex societies. In addition, early cultural ecological theory lacked both the methodology and conceptual tools to apply spatial analysis to human-environmental data.

In the 1960s there was an increased interest in ecological or environmental studies. These studies became the focal point for the convergence of several disciplines including anthropology and geography. A common research goal was the development of a systemic understanding of the relationships between humans and their environments, including a concern for spatial analysis. To more adequately deal with the research questions focused on human-environmental relationships in an ecological perspective, modifications of conventional methodologies were required. For anthropology this meant the inclusion of tools of spatial analysis within the methodological repertoire of the discipline. Subsistence mapping is an example of this methodological application, although, as discussed in this study, this model requires considerable development and significant refinement. Geographers were required to develop methods for studying the dynamic relationships of variables within an ecological context — that is, they had to learn to analyze the spatial relationships of phenomena which change through time and space (Clarkson 1970). For example, recently geographers have been involved in impact studies in which they examine areas of natural hazards and correlate human activities with the nature of the hazardous conditions with which the human populations of the area are associated.

The opportunity for interchange between these two disciplines is greater now than it has been in the past. The interests of geographers and anthropologists in human-environmental relationships have been traced in this discussion. Whereas anthropologists have developed the conceptual tools for comprehending the systemic nature of

human adaptations to environment, they have done so with a basic disregard for the specifics of the human use of area -- the actual spatial requirements of human activities. Geographers, on the other hand, have been primarily focused on the location and spatial requirements of human activity. Contemporary research questions associated with land-use planning and policy and ecological orientations primarily in cultural anthropology and archaeology have required anthropologists to answer questions concerning the dynamics of human use in specific areas. The development of appropriate analytical models which may be applied to the spatial analysis of subsistence-based socioeconomic systems is an example of such research needs. Fortunately, contemporary geography offers theories and models more amenable to depicting and analyzing the dynamic nature of human-environmental relationships than did earlier ones. Thus, the adaptation of geographic models to anthropological questions is timely and a potentially fruitful area of interdisciplinary exchange. A review of the role of relevant mapping as a methodological tool in both geography and anthropology is explored in anticipation of applicability to subsistence-related research questions.

THE ROLE OF MAPPING IN GEOGRAPHY: SOME HUMAN-ENVIRONMENT EXAMPLES

Pertinent sub-fields of geography in relationship to land and resource use by participants in subsistence-based socioeconomic systems include economic and behavioral geography. Economic geography

is the study of the location, spatial arrangement, and linkages between economic activities within the context of place. It is concerned with production, consumption, and exchange locations on the earth's surface -- the spatial components of world economies (Larkin and Peters 1983:72). Methodologies and analytic procedures in economic geography are not critically different from those used in other areas of geography. The general corpus of techniques is now termed "spatial analysis." Review of theory and methods from economic geography is directed towards the applicability of spatial analytic methods to the general problem of mapping subsistence patterns and to the specific problem of applying spatial analysis to concepts of "intensity" of use.

Since the mid-1960s, dramatic changes have taken place in the way in which maps are used in geography. Developments of statistical and computer techniques have resulted in the expanded and more sophisticated use of methods of spatial analysis (Unwin 1981). An important distinction often made in spatial analysis is between explanatory and exploratory analyses. Bartells (1979:6) states that "it is explicitly recognized that the ultimate purpose of spatial statistical analysis is to obtain a quantitative, explanatory analysis of spatial phenomena." This is to be accomplished through tests of hypothesized causal relationships describing temporal and spatial processes. However, when clear theories as to the nature of spatial phenomena and interactions are lacking or only incomplete data are available, then exploratory statistical techniques are used in an attempt to discover patterns (non-random regularities) in the data.

Much of the literature on spatial analysis appears to be devoted to the development of a variety of statistical tests to determine whether or not any given pattern of distribution is or is not random. If patterns are not random, what then is the spatial analysts' response? Generally they turn to models of probability against which data can be tested to determine the degree of correlation with the hypothesis. The concern of this kind of analysis seems to be more with the degree to which spatial data can be represented mathematically than it is with the human processes which give rise to the distributions.

Some geographers appear too unhappy with this emphasis and suggest that the discipline must move beyond "purely deductively oriented and mechanistic" approaches because they inherently ignore the effects of human decision-making (Nijkamp 1979:3). As an example, Nijkamp (1979) cites a recent study of the dispersion of churches based upon medical diffusion models of epidemics and concludes that this was "a rather dubious approach." He suggests that "a historically oriented and at least a more behaviorally based approach is more satisfactory from a methodological point of view" (Nijkamp 1979:3).

Explanatory models in spatial analysis attempt to account for the distribution of phenomena through explicit theories of human behavior. Explanatory models are many and varied but most have economic assumptions at their base. Three of the best known and most widely utilized are the von Thunen model of agricultural location (Thunen 1966; Smith 1976a), Christaller's model of central-place theory (Christaller 1966; Losch 1954), and Hagerstrand's spatial diffusion models, sometimes

called gravity models (Hagerstrand 1953, 1965). Each of these models was developed to attempt to explain certain explicit patterns of spatial phenomena created by human behavior, but each is general enough to be potentially modified to other explanatory ends as well.

Thunen's model on theory may be relevant to the explanation of harvest patterns as they are related to a specific community. He postulated that the spatial distribution of crop production activities relative to a community was a function of the distance from the community, the price of the product in the community market, and the degree of labor intensity associated with production of the crop. Put more formally,

in the absence of variability in land fertility or transport ease in all directions from the center and in the absence of competing market centers, one should find a pattern of land use typified by concentric zones of production intensity: high labor-capital inputs put into high priced (or heavy) agricultural goods in the inner zones, where marginal productivity is highest, and low labor-capital inputs put into lower-priced (or lighter) agriculture in the other zones, while marginal productivity is lower (Smith 1976a:8).

The second model outlined above is the central place model. As originally proposed by Christaller (1966), this model was designed to predict the optimal location of various types of retail stores given different levels of consumer demand for different products. It assumes an isotropic (uniform) plain with equal transportation access and consumers with similar incomes and tastes. The resulting distribution of retail sites in different communities produces a nested hierarchy of different sized centers which fall into hexagonal

patterns of spatial distribution. The hexagon emerges as the form of the areas because it minimizes distances between centers while at the same time filling up the available space in the plain (Smith 1974).

Central place theory has been employed by a number of anthropologists to assist in accounting for patterns of regional behavior. Examples of these uses include Skinner (1964, 1965), Smith (1976a, 1976b, 1977, 1978), and Kelley (1976). For the most part these analyses are based on trade and marketing systems in horticultural or agrarian societies.

The Hagerstrand diffusion models are designed to predict the rate of spread of a given innovation from one point to another. The models are primarily driven by distance-friction functions, but Hagerstrand is also sensitive to a wide variety of qualitative factors such as information receptivity, information links, and the size of population centers. Two kinds of models have been proposed. Contagion models assume little volition on the part of human actors in the "receipt" of "innovations" such as diseases and seek to predict and explain the frequency in the spread of disease patterns. Hierarchical models assume certain centers of innovations as well as characteristics of progressively distant and less penetrable communities to the receipt of new innovations both as a function of space and cultural/qualitative characteristics.

In addition to the models mentioned above, there are several quantitative techniques in geography relating to the spatial analysis of groups and sub-groups. Because these techniques do not require as

much qualification as the models presented above (for example, assumptions of a uniform plain with equal transportation access), they may provide a greater degree of utility in subsistence-mapping methodologies. One example of a potentially useful quantitative technique is the "location quotient" (Wheeler and Muller 1981:368). The location quotient is appropriately applied in analyzing the relative distribution of a sub-group in comparison to the total group. An example of this would be determining the ratio of newcomers to total population using a specific harvest area. Another quantitative technique is termed the "index of dissimilarity" (Wheeler and Muller 1981:368). Whereas the locational quotient discussed above compares the use of an area by a sub-group with that of a total group, the index of dissimilarity allows for the comparison of two sub-groups to each other. For example, this analytical tool would allow the comparison of the hunting areas used by two sub-groups of a larger community. The "coefficient of areal correspondence" is used to measure the degree of correlation between two use areas. For example, this coefficient would measure the similarities of the hunting areas of two individuals.

The primary relevance of the employment of the models discussed above to subsistence-mapping is to provide mechanisms by which quantitative indicators of spatial relations can be systematically generated. These indicators would contribute meaningfully to the replicability and comparability of subsistence-mapping studies.

One case study application of spatial analysis to northern North American data is found in The Evolution and Economy of the Delta Community (Wolforth 1971). In one chapter the author uses several techniques from spatial analysis to simplify the complexity inherent in the raw data and present an understandable picture of changes in trapping practices over time. The data consist of records of fur trappers' harvests in selected years from the 1930s to the 1960s. Data were available on approximately 30 trappers. Trapping harvest figures are assigned to geographic areas based on the system of trapping territories in use on the Mackenzie Delta during this period.

One of the techniques used is the creation of "isarithmic surfaces" of muskrat harvests from the trapping data. Figure 1 displays these surfaces for three periods of relatively recent Mackenzie Delta history. In order to determine the general structure of the isarithmic surface, Wolforth then fitted "trend surfaces" to them (Figure 2). Chorley and Haggett (1965) developed this method for portraying continuous areal data in order to give a clearer picture of regional trends. Wolforth found the method to be unsuitable for a number of years in the data base as the linear and quadratic equations developed from the mappings did not explain a large proportion of the variability inherent in the data. Figure 2 depicts the years for which the data proved amenable to this kind of analysis.

Further regression analysis of the trends produced residuals which indicated a trough between the communities of Aklavik and Inuvik, which suggested that the construction of Inuvik led to lower muskrat yields than would be expected from the trend surface of

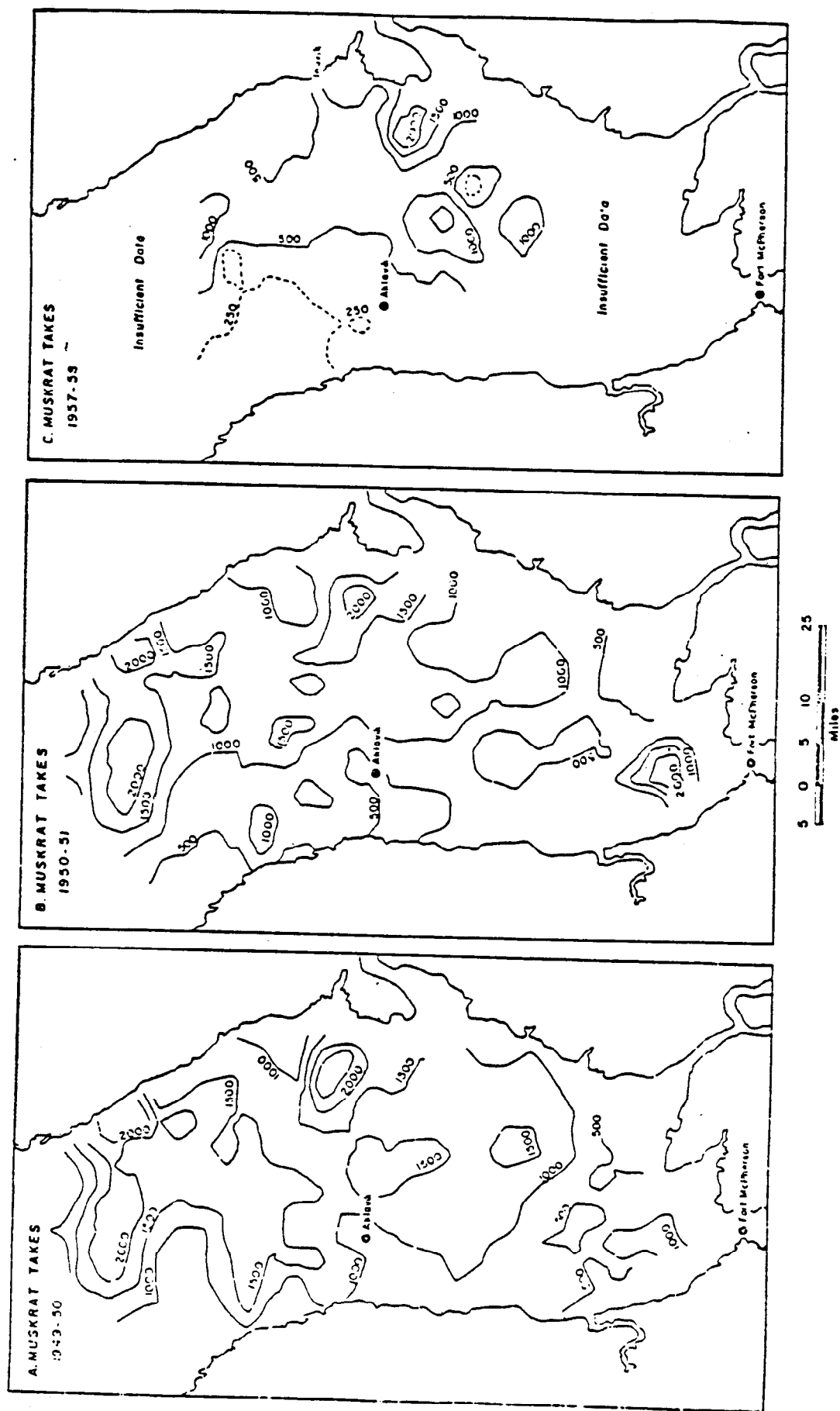


Figure 1. Isarithmic surfaces of muskrat taken from registered trapping areas in the Mackenzie Delta, 1949-1950, 1950-1951, and 1957-1958 (taken from Walforth 1971).

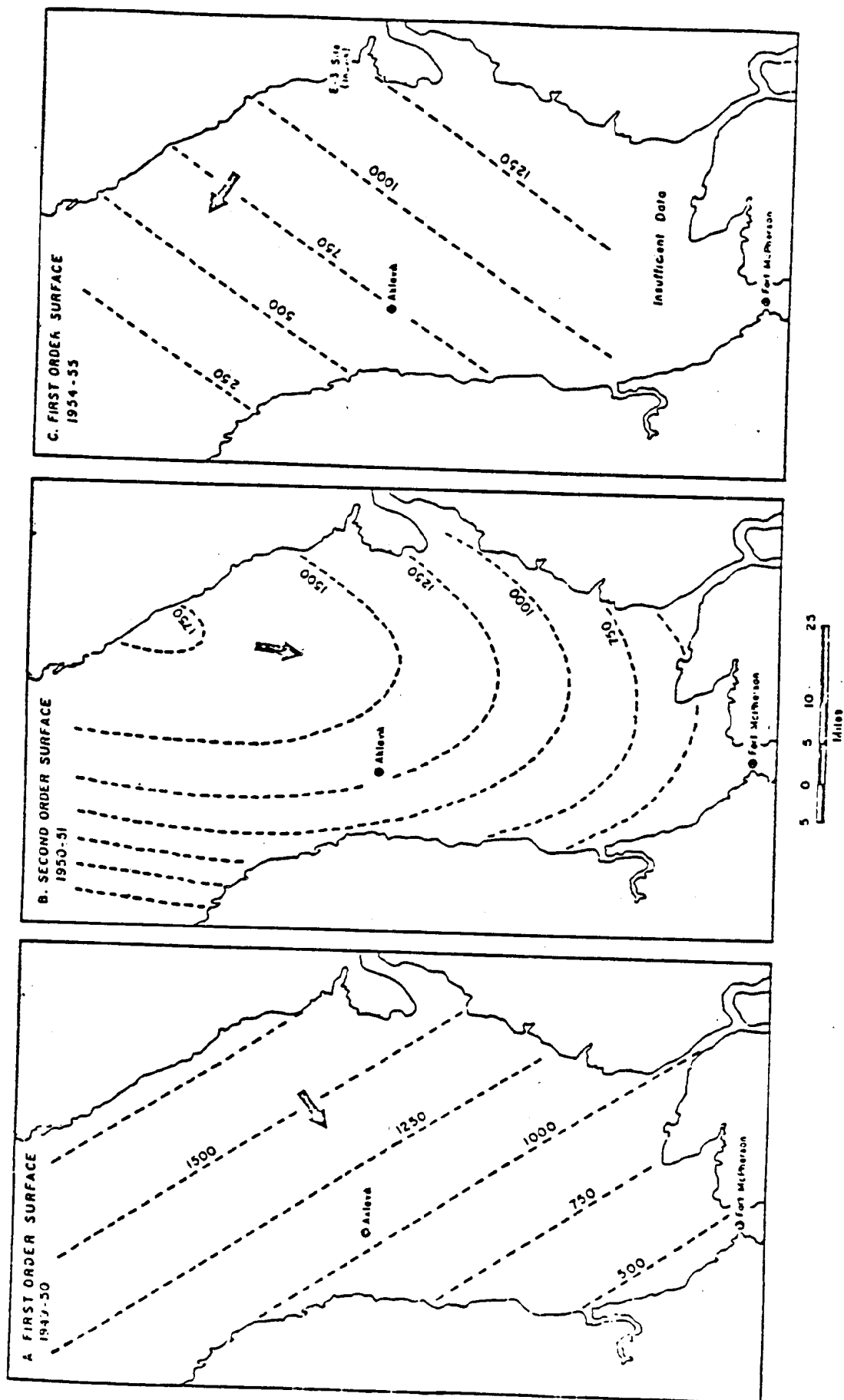


Figure 2. Trend surfaces of muskrat taken from registered trapping areas in the Mackenzie Delta, 1949-1950, 1950-1951, and 1957-1958 (taken from Walforth 1971).

registered areas in the immediate vicinity (Wolforth 1971:97) (demonstrated in Figure 3). Wolforth, however, does not discuss whether this decline in harvests between the two communities is the result of ecological disruption due to human activity in the area or the result of trapping areas falling into disuse.

While models from economic geography provide a framework for analyzing harvest data in a spatial perspective, any decision about whether or not to use these techniques and which ones to use should be based on a clear understanding of what information they provide. Decisions also should be based on insight into how the information will be used in the decision-making process.

Behavioral geography is the common name for that sub-field of geography that adopts a behavioralist approach to the study of human-environment relationships. Explanations of spatial patterns of behavior are sought primarily in cognitive processes which provide a foundation for that behavior (Gold 1980). The approach of behavioral geography has four primary features. First, behavioral geography maintains that two environments exist, the actual and the perceived. The actual environment can be studied by direct means such as observation and mapping. The perceived environment is in the minds of a study population and can only be explored by eliciting information from informants via methods such as interviews, surveys, and other means of stimulating recall. Humans make decisions on the basis of the perceived world. Environmental perception, a key concept of behavioral geography, is the ability of people with different cultural backgrounds to observe and interpret their environment in different

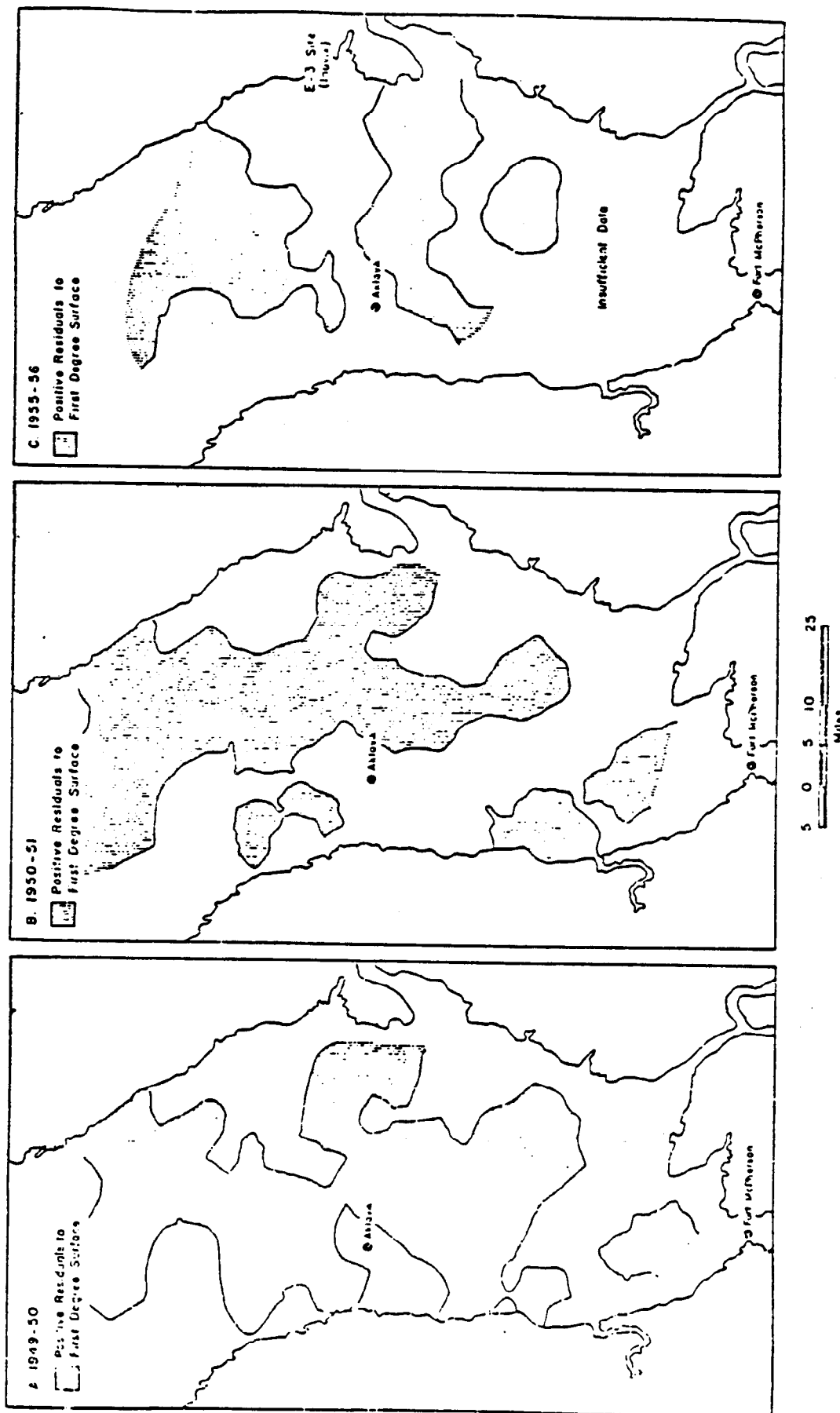


Figure 3. Residuals to linear trend surfaces of muskrat taken from registered trapping areas in the Mackenzie Delta, 1949-1950, 1950-1951, and 1955-1956 (taken from Walforth 1971).

ways (Larkin and Peters 1983:93). Secondly, behavioral geography maintains that individuals are not only influenced by their social and physical environments but also modify these environments. Thirdly, the individual rather than the group is the focus of study. Lastly, behavioral geography is multidisciplinary in its perspective, borrowing perspectives and concepts from psychology, sociology, anthropology, and others.

Since subsistence-mapping relies heavily on informant recall as a means of gathering data, these data are largely perceived. In the process of mapping subsistence information, perceived informant data are drafted on maps which are intended to represent the "real world" based on a western scientific model. Behavioral geography may provide insights into the processes of mapping and interpreting perceptions of human activities in an environmental context. Interestingly, an analysis of maps drawn by non-literate hunters-gatherers representing particular areas with which they are familiar provide insights into culturally influenced environmental perception.

In addition to the general application of behavioral geographic models to an understanding of relationships between perceived and actual environments, specific concepts of interest to the methods of subsistence mapping include perceptions of social distance, areal size, spatial distance, emotional involvement in an area (valuative criteria), and cultural and social barriers to movement or land use. The application of some of these concepts to subsistence-mapping guidelines is presented in Chapter 5.

THE USE OF MAPPING METHODS IN ANTHROPOLOGICAL RESEARCH

In the development of anthropology as a discipline, the use of mapping as a formal tool for collecting, analyzing, and depicting cultural data has not been pronounced, despite the training of some early influential anthropologists such as Boas in the discipline of geography. A review of recent handbooks in anthropological method highlights the nature of the role of mapping in the discipline as a whole and the sub-field of cultural anthropology specifically. Spradley (1980), in his work on participant observation in cultural anthropology, refers to maps as a method of recording observations, not a means of gathering or analyzing data. He observes that maps are important for depicting the location and arrangement of cultural phenomena, such as routes people travel frequently, the most common human activities and where they occur, and relevant physical features (Spradley 1980:157). He also makes reference to the use of sketch maps in field notes as a means for ordering and thereby understanding data, but, despite this suggestion, provides no guidance on the use of maps for this purpose.

Edgerton and Langness (1974), in a guide to method and style in studying culture, perceive mapping to be part of an overall census data gathering tool which locates members of a study community in space (for example, where people live, which way their doors face, where their fields lie, location of water sources, etc.). Such maps may help explain internal social relations, whereas mapping of

neighboring groups and resources point out important factors external to the community (Edgerton and Langness 1974:28). However, no direction in how to use mapping effectively and systematically in accomplishing these ends is put forth. It is assumed that using mapping for these purposes is self-explanatory or intuitive, requiring little more than a mere suggestion of kinds of questions that can be answered by plotting the spatial location of these phenomena.

Pelto (1970) concedes the importance of knowledge of physical location in understanding human organization and guides the reader into using mapping as a tool for getting at social data:

. . .The fieldworker should map out the spatial relationships of significant social groups man-made physical features and other elements of the sociophysical landscape. (It is a source of constant surprise that many ethnographic reports do not contain maps of the physical setting within which social behavior takes place.) Such maps should locate major action settings, . . .major social divisions of the community, agricultural areas, directions and distances of neighboring communities, and major natural features such as rivers, mountains, and swamps (Pelto 1970:231).

Although Pelto makes these very meaningful observations on how spatial location can be used to derive relevant features of social organization, no technical guidance is offered in how to go about systematically exploring spatial relationships through mapping. In fact, it is of interest to note that most of the mapping questions raised above focus on the anthropologists' perceptions of physical features of the environment of potential cultural relevance and the areas in which human activity occurs (e.g. major action settings) as opposed to mapping human behavior as perceived by the informant such as is the case in subsistence mapping. However, Pelto is clearly cognizant of

the relevance of human-environmental relationships and their spatial significance, although he fails to provide specific direction in this area of research.

In a historical perspective, anthropology as a discipline, with some exceptions, has only recently emphasized the use of quantitative analysis, systemic data gathering techniques (which ensure replicability), and refined technical skills in conducting research. Anthropologists were long unconcerned with elements of research design (Foster, Scudder, Colson, and Kemper 1979:2), and the ability to achieve rapport with members of a study community and gather data primarily through participant-observation was as much an art as it was performance of scientific method. This is not to suggest that anthropologists failed to gather quality data and considerable insights into human behavior and cultural systems. Nonetheless, their methodological techniques were subject to critique, their studies perceived to be not replicable, and the discipline variously described as an art rather than a science, a social philosophy or a non-objective fascination with "the primitive" by scholars from the "hard" sciences. In part, it is useful to see the rather slow development of systematic and formal mapping procedures as a method of both data gathering and analysis in anthropology in this larger perspective. Whereas the use of maps in field notes has undoubtedly taken place for as long as anthropological fieldwork has been undertaken, the systematic mapping of informant data requires considerable technical skills, lengthy formal interview sessions with informants, adequate and detailed base maps on which to place human-related data, an interest in the spatial

dynamics of human-environmental relationships, and a specific research design which defines the kinds of information to be gathered in a mapped format. The use of maps also requires spatial analytical techniques not generally a part of the formal academic training of anthropologists. It is not surprising, then, that as cultural anthropology has become more comfortable with scientific method and quantification to complement its highly developed and productive in-depth, holistic, and culturally relative methodologies, there is an increasing interest in using mapping techniques in cultural studies.

It should be noted that archaeology, by its very nature, has had a longer interest in and familiarity with spatial analysis, since archaeologists have only products of culture, their spatial relationships, and environmental factors as data from which they hopefully can extrapolate human behavior and cultural systems. Not only does archaeological data lend itself well to numerical techniques, but archaeologists also receive more training in the disciplines of statistics, ecology, geology, and geography than do other anthropologists with the possible exception of paleoanthropologists. Since archaeologists do not have the advantage of making direct queries of or observations about the behavior of their study populations, they have had to pay more attention to the details of the environmental milieu in which their study populations have resided (e.g. climate, flora, fauna, and natural processes). There is a considerable body of archaeological theory related to culture and environment. Environmental change is a key variable in explaining archaeological phenomena. However, since archaeological theories and models are not

designed to study the behavior of living populations directly, they have not been widely adapted to the sub-field of cultural anthropology.

Finally, the limited use of mapping in cultural anthropology, particularly in the early decades of the discipline, in part may have been related to Euroamerican concepts of land tenure and a lack of understanding of hunting-gathering economies. The mapping of hunting-gathering subsistence patterns recognizes the fact that hunters-gatherers have rights to land and resources (Brody 1982), and many colonial governments did not accept the concept of aboriginal rights. Up to the present day, there remain segments of many agro-industrial societies which have retained the view that aboriginal land and resource rights do not exist. A related perception that persists to the present day is that the vast "wildernesses" used for resource harvest by hunters-gatherers are basically vacant, unused, and undeveloped and therefore available to be assigned to meaningful or productive public purpose. Other views purported that although indigenous peoples did have rights to land (territories), the territory of a group was coterminous with its use area. In fact, population density as an economic indicator was calculated on the basis of these territories. Therefore, it was assumed that if territories were mapped, a practice more common in anthropological research than was subsistence mapping, there would be no need to map resource use areas since they were one and the same. Finally, it was assumed that hunting and gathering were catch-as-catch can activities, not representative of an economic system, and throughout the 1940s, 1950s, and into the early

1960s, many anthropologists shared in this commonly-held view (Brody 1982). Since hunting-gathering was not perceived to be an economic system, there was no need to recognize economic rights to land or patterns of use of land.

While maps and mapping techniques have been employed unsystematically in the study of culture, dependent upon the interests and skills of particular researchers, there have been characteristic uses of mapping techniques by cultural anthropologists, basically in the absence of formal and specific methodological direction. Some of these uses will be explored below.

One use of maps which was common during the early decades of anthropological fieldwork but also occurs today in areas where professional base maps have not been developed (Chagnon 1974) -- or in cases in which a researcher uses informant drawn maps to study processes of cognition -- is to have informants generate maps of the environment to provide geographic data for the study. An early example of this use of mapping is Boas' (1964) geographic expedition to Baffin Island, Canada in 1883-1884. Boas' cartographic work on this expedition was his first and only venture in this field (Boas 1964:x). "Boas drew heavily on information supplied by Eskimo informants for those parts of Baffin Island and other Arctic areas which he himself had not visited. One of the most valuable features of these maps are the red, blue and black lines indicating the routes of travel followed by the Eskimos in different seasons of the year" (Boas 1964:xi). Boas recognized the dynamic and patterned nature of human location in relationship to the seasonality of resource distribution. He

described the location of "tribes" in detailed narrative but did not map tribal "territories," nor did he map or discuss in depth the geographical components of hunting, fishing, or other resource use. He commented on the quality and extensivity of the Eskimos' geographic knowledge of their environment and their ability to draw distances on the basis of travel time, relative position, and direction.

Because U.S. Air Force navigation charts and National Geographic Society maps of the area occupied and used by the Yanomamö were incorrect and incomplete, Chagnon (1974) had to rely heavily on informants and first-hand exploration to develop baseline maps on which the study team located stream mouths and lengths (as they were essential transportation corridors) and abandoned and current garden plots (which provided information about demographic history, settlement patterns, and community fission and fusion). The study team relied on multiple respondents for geographic data in order to correct, validate, and verify locations of groups, gardens, and settlements (cross validation). Information about garden locations in past and present and the men associated with garden plots provided key information to understanding demographic and political processes.

Mapping of group ("tribal") locations (territorial distribution) has been common in ethnography and was preceded only by linguistic mapping in anthropology. In fact, the only reference to mapping as a technique in one major recent handbook of method in cultural anthropology (Naroll and Cohen 1970) is a method of computerized mapping of society locations and associated cultural trait and cluster distribution on a continent-by-continent basis (Societal Research Archives

System). This use of mapping is reminiscent of the culture and natural area concepts of Kroeber, Wissler, and Schwartz in the first half of the 1900s (1917 to the 1950s). Kroeber (1939), for example, maintained that subsistence patterns (environmental exploitation) were key to the distribution of "tribal groups" in North America. Groups of North American Indians were culturally classified on the basis of cultural complexes and natural or geographic boundaries, particularly vegetation types. Kroeber (1939) and others recognized the static nature of these types of maps and Wissler's maps had no boundaries between tribes. Kroeber was cognizant of the boundary problem and stated that in reality there were gradients or transitions between groups with overlapping cultural traits (1939:5). However, cultural boundaries were necessary to provide comparisons with vegetation boundaries, and vegetation boundaries provided the basis for natural areas because they were seen to underlie faunal distribution. Culture and natural area theorists argued that inadequacies in mapping methodologies (i.e. cartography) prevented confirmation of this theoretical model (Ellen 1982), though subsequent critiques stressed the weakness of the theory (which failed to treat cultures as dynamic systems) as being as problematic or more so than the technical deficiencies associated with mapping.

In recent years, problem oriented studies focused on hypothesis testing and model building have largely supplanted general ethnographic studies in anthropology. Several of these have been long-term with multidisciplinary research team composition (for example, Lee and DeVore 1976; Chagnon 1974). The ecological adaptation or socioterri-

torial organization of hunting-gathering or horticulturalist populations has been the primary theme of some long-term efforts (the Lee and DeVore team's work with the San of the Kalahari Desert has been more ecologically-focused, while the work of Chagnon and associates with the Yanomamö of Venezuela is more socioterritorially-focused). Other shorter-term, single researcher studies have addressed ecological and territorial questions to hunter-gatherer data (Nietschmann 1973; Tanner 1979; Feit 1969; Nelson 1973; Helm 1968; Spencer 1959; Gould 1982; and many others). Examples of mapping as a methodological technique in studies with an ecological or socioterritorial focus have more relevance for subsistence mapping methodologies.

The Kalahari San work coordinated by Lee and DeVore (1976) was intended to develop as complete a picture as possible of hunting-gathering as a way of life. A multidisciplinary team was engaged to produce a greater range of data, although subsistence, technology, land use, group structure, ecological setting, and economic production were seen to be the core features of San society. Therefore, major research variables included subsistence ecology, spatial organization, and the distribution of the plant and animal resource base. In large part, the study of energy relations using time as a measure of work grounded the study of San social life in the natural sciences. Gathering was determined to be the primary (in terms of productivity and reliability) economic activity and access to water the most significant variable in influencing human seasonal and annual distribution (Lee 1979; Lee and DeVore 1976).

Although the subsistence ecology of the San, as perceived by the research team, focused on access to water and associated vegetable resources and on the social mechanisms which allowed flexibility in group membership by season and during different years to accommodate changing water and resource availability, the team employed mapping techniques to depict some features of San subsistence ecology. One type of map depicts the location of groups, place names, permanent and seasonal waterholes, and associated mongongo nut groves, and camps within a specific area and with no temporal reference. There are no boundaries between groups, and "to some extent areas overlap, they are not defended, and in some instances more than one group will move within a single area" (Yellen 1976). The !Kung San word for locality, land, or territory which surrounds each waterhole and provides the resources on which the people of the waterhole depend is n!ore. Each n!ore is associated with a group of owners, but the size and shape of a n!ore cannot be measured (and it is assumed mapped) because they vary from year to year depending on who is using the resources and on what neighboring groups are doing (Lee 1979). N!ores are inherited between generations and everyone within a camp has free access to resources within the area. Visitors can also access resources through kinship ties with residents of a camp if permission is granted by n!ore owners. Some maps depict only resource areas (primarily mongongo nut groves or waterholes) with no temporal or human reference. It is assumed that these are depicting the "ethnographic present" (e.g. the study period) and based on researcher observations,

but this can not be confirmed in discussions of methodology. Other maps depict routes of travel between camps.

Lee (1979) attempts a mapped reconstruction of the distribution of land-holding groups in one area for the period 1920-1930, showing convergence during dry seasons and dispersal during wet seasons (arrows depict the merging and dispersal patterns). It is not clear, however, if this reconstruction is based on informant data, early field data, or both. To the degree that settlement patterns are coterminus with use areas, these maps are in part "subsistence maps" but in only the most general sense. Lee's (1979) interest in this reconstruction in large part is associated with economic changes involving San settlement and economic participation in Bantu agricultural communities in recent years and the associated decline of some named land holding San groups.

Although Lee and DeVore (1976) recognized the concept of "subsistence space," they apparently did not develop map biographies to record changes in areas used during an individual's lifetime -- a technique which may have provided substantial documentation of seasonal and annual patterning. According to Lee and DeVore "subsistence space is bounded, but these boundaries are vague and not defended" (1979:79), thereby making mapping of subsistence areas difficult. Lee (1976) argues, however, that there are two main issues regarding boundaries and space that need to be clarified in hunter-gatherer research. First, a distinction needs to be made between social and spatial boundaries. Group boundaries and land boundaries should be treated discretely in analysis, since open groups may have non-

overlapping territories but still accommodate movement of personnel across boundaries, and it is theoretically possible for closed groups to have overlapping territorial boundaries (1976:74-75). Secondly, researchers concerned with human use of land and resources need to distinguish between group behavior (actual use) and conceptions or folk views (perceived) of use. Unfortunately this long-term study sheds little insight on methodologies for making these very critical distinctions.

There has been some use of descriptive maps in socioterritorial studies. The use of maps in Yanomamö research (Chagnon 1974) has already been described above. These maps provided environmental features, travel routes and areas of economic activity (garden plots), but their main intent was to document settlement patterns through time and associated socioterritorial dynamics. Helm (1968) maps Dogrib "regional bands" for a 70-year period based on published ethnographic and field data. Although these maps depict areas of use, there is no information on specifically how they were derived. Helm (1968) is primarily interested in sociopolitical or socioterritorial units at several different levels of integration (i.e. the regional band, local band, and task group segregated by time and space). Helm describes the criteria for membership identification and recruitment as including territorial range, specific resources and resource locales used within the range, and kinship (1968:118). However, since the study is neither ecological nor economic in orientation, Helm seems to have made the assumption that territories and use areas are basically coterminous, an assumption which needs to be tested in the case of the

Dogrib by more detailed land and resource use mapping (Tanner 1979). The relationships between land and the dynamics of group membership have also been the focus of some Aboriginal studies in Australia, emerging primarily out of the settlement of land rights in the Northern Territory (Williams and Hunn 1982). One such study makes reference to conducting mapping in documenting patterns of Aboriginal land ownership, but no discussion of method or mapped product is included in the study (Sutton and Rigsby 1982).

Finally, a more sophisticated use of mapping in an ecologically-focused study is found in Nietschmann (1973). Nietschmann's study of the Miskito Indians of eastern Nicaragua explores the relative productivity of subsistence activities. Research questions of interest include the types of resources harvested by econiche ("biotope"), the proportion of harvests and harvest activities taking place in each econiche, costs associated with each harvest activity, and seasonal variation of harvests. To answer these questions, Nietschmann uses maps to depict the spatial variation of harvest activities by season, to analyze such activities in terms of distance and travel costs, to depict extensivity of use area, to measure comparative intensity of econiches used (areas used as a percentage of total area exploited), and to depict primary habitat. Mapping methodologies employed by Nietschmann include the use of aerial photographs (1:40,000), topographic maps (1:50,000), 35 mm. transparencies shot from light aircraft, ground reconnaissance with Miskito guides, daily field observations (kill sites and quantities harvested), agricultural yields and labor data, and informant records. All data are gathered during a one

year period. Nietschmann's main interest is an economic analysis of Miskito society -- that is, to see how subsistence and cash sectors of the economy mesh -- so mapping endeavors are more focused on productivity (intensity) than on land use patterns per se. However, Nietschmann recognizes that the spatial dimensions of harvest activities are central to the understanding of subsistence-based economic systems -- "thus the location of food resources in relation to the settlement site and to each other helps determine the degree to which they are utilized" (1973:118).

Only one northern example of the use of mapping has been presented in this discussion, as the development of northern mapping methodologies will be presented as an introduction to Chapter 3. The intent of this section was to present some examples of mapping methodologies employed by anthropologists in a historic and world-wide perspective, since the remainder of the text is primarily a review and development of northern-focused subsistence mapping methodologies. Undoubtedly, there may be more complete methodological discussions in unpublished or government sources ("gray literature") of land and resource use mapping in other areas of the world, but it is expected that the development of subsistence mapping techniques and analysis may be further along in northern North America in association with the settlement of land claims of indigenous peoples.

THEORETICAL PERSPECTIVES OF STUDY

Some key theoretical perspectives provide the framework in which extant subsistence mapping methodologies can be presented and critiqued and in which general methodological guidelines and a southeastern Alaska model can be developed. These perspectives are concisely described below:

- (1) The spatial dimensions of land and resource use by participants in subsistence-based socioeconomic systems are patterned. "Ethnographically there is no case known of a society in which the members move randomly in a totally overlapping space. Toward the opposite extreme, however, there is apparent evidence in a number of societies for tightly organized groups maintaining exclusive territories" (Lee 1976). It is expected, then, that in the course of subsistence mapping, these patterns will emerge.
- (2) Patterning of spatial dimensions of land and resource use (subsistence patterns) correspond closely with patterns of the natural environment (such as seasonality, faunal migration, cyclically disparate resource availability, geographic barriers, and others) (Steward 1955; Mauss 1979). There are several correlaries to this relationship between subsistence patterns and environment. First, mobility is an essential element of ecological adaptation and is in a constant evolution to maintain balance with the environment, changing rapidly or slowly as circumstances dictate (Kelly 1983). In

recent years, the trend towards centralization and sedentarism on the part of hunter-gatherer populations has affected mobility patterns which, in turn, influences patterns of land and resource use (subsistence patterns) (Asch 1977). Secondly, core features (e.g. settlement pattern, technology, organization of production, etc.) of the cultural system most strongly reflect the human-environmental adaptive system (Steward 1955). Thirdly, there is not a direct correspondence between the range of the hunter-gatherer and the range of a given species. It may be the case that a species is sought in only a small section of its total range or a small segment of its total spatial/ecological niche. Thus, mere mapping of land and resource use areas should not be the sole indicator of the sensitivity of an area or species to change or impact. Fourth, cyclical habitat changes may span numerous years (even centuries in some cases) (Feit 1969). Therefore, a single year or even several years of data may not reveal the entire range of land and resource use by any given group. There is no such phenomenon as a "normal year" for hunter-gatherers (Lee and DeVore 1968 and 1976), so decisions for alternate land and resource use must be based on multi-year data. Finally, hunter-gatherers are not merely passive victims of environmental processes in most cases. Their relationships with the natural environment are interactive and they possess numerous sociocultural mechanisms for

responding to environmental change, not the least of which is environmental modification (Williams and Hunn 1982).

- (3) Territoriality is a mechanism for maintaining a functional relationship between hunter-gatherers and use areas:

A fundamental feature of native customary law was that every group had a distinct and recognized geographic territory within which its members hunted and fished. The boundaries might change over time, and they might overlap with other groups, but both the boundaries, and the customs and rules that governed land use within them, were understood by all. No hunting group was without such a territory, in which those who inhabited it hunted automatically by virtue of their membership in the group, and to which outsiders might by permission gain access for certain purposes, so long as they followed the rules. What this means is that under customary law, fish and wildlife were not common property resources in the modern sense (Usher 1982).

Mechanisms for maintaining territory and rules governing internal and external access vary cross-culturally but basically function to maintain the carrying capacity of particular areas (Cashdan 1983). However, territories should not be viewed as one and the same as use areas. The flexibility of hunter-gatherer residential groupings, exchange networks, and the fact that members of one "land-owning" group may utilize resources controlled by one or more other groups, makes it extremely difficult to define carrying capacity or actual use areas by solely referring to a group's territory (Williams and Hunn 1982; Tanner 1979).

- (4) Decisions regarding land and resource use are based upon emic perceptions of the world. This factor has considerable significance for studying the spatial dimensions of land and

resource patterns through time and space. If data regarding subsistence patterns are gathered from informants, a common and recommended data gathering technique, the researcher is collecting informant perceptions of land and resource use behavior related to his perceptions of the environment. By way of contrast, data based on observations of participation in subsistence-based economic activities are based on the researcher's perception of behavior of members of the study population (often, and somewhat biasedly referred to as the "real" or "actual" world). Land and resource management policies promoted by the governments of agro-industrial nations are most commonly grounded in "scientific evidence" -- that is, the perceptions of trained, researchers. Secondly, what informants report to be their subsistence behavior and what actually occurs on a day-to-day basis may not correspond exactly because of the divergence in all cultures between "ideal" and "real" behavior. The substance of subsistence mapping, then, may be idealized informant perceptions of their resource harvest patterns, more objective observations of this behavior by a third party, or perceptions of resource harvest behavior as interpreted through the cultural screen of a "scientific observer," who may see the relationships between humans and environment in a very different perspective. As previously mentioned, boundaries between land and resource use areas and entire patterns of use based on these various perceptions may vary

meaningfully, and comparisons between "perceived" and "real" patterns may be very instructive to understanding land and resource use patterns.

The context for presenting and evaluating extant subsistence mapping methodologies and developing general and southeastern-focused methodological guidelines has been established in Chapter 1 and 2. Chapter 3 proceeds with a description of major northern subsistence mapping examples and each, in turn, is critically evaluated in Chapter 4.

CHAPTER 3

SUBSISTENCE MAPPING METHODOLOGIES IN NORTHERN NORTH AMERICA: A DESCRIPTION

INTRODUCTION

This chapter provides a description of the development of subsistence mapping in northern North America, early Alaskan models of applied mapping, Canadian land use and occupancy studies, and more recent Alaskan land and resource use mapping projects. This review of methodologies is not intended to be exhaustive but, rather, only to include primary mapping study models. Each of the methodological types described in this chapter will be evaluated in Chapter 4, so there is no attempt at analysis in this chapter.

The components which are discussed for each subsistence mapping methodology include the following (assuming data are available):

- (1) period of research;
- (2) group and area studied;
- (3) purpose of study (research questions);
- (4) methodology, including model (if any), means of data collection, sampling, techniques, supporting information, means of analysis, and depiction; and
- (5) application.

AN OVERVIEW OF SUBSISTENCE MAPPING IN NORTHERN NORTH AMERICA

Unquestionably mapping, as a tool to aid in the geographic identification of features of the landscape, location of bodies of water, and spatial distributions of indigenous populations and their communities, was used by early explorers in northern North America. Examples of Inuit preparations of maps for their own use and the use of explorers (including relief maps produced in sand or snow) have already been mentioned (Spink and Moodie 1976). Additionally, early ethnographic observers used maps in field notes as a means primarily of recording information obtained from informants or observed. As already mentioned, Boas' (1964) work among the central Inuit of northern Canada is an excellent example of this. However, the use of maps to gather, analyze, and depict land and resource use information in a standardized and systematic manner is not readily evident in early northern literature.

Perhaps the earliest published study to use maps to examine land use patterns was a work by F. G. Speck entitled "Mistassini Hunting Territories in the Labrador Peninsula" published in the American Anthropologist in 1923. Although this publication was not available, Tanner (1979) discusses it to provide a substantive comparison with his work in the 1970s on the relationships between ideology and land tenure and use among the Mistassini. Based on comparisons with Speck's work, Tanner (1979) was able to conclude that there had been little change in land control by extended families via the mechanism

of trapping territories over the 50-year interval between the two studies.

In the 1950s there were three separate publications that dealt with land use, concepts of space, and human-ecological relationships in northern North America. Based on the earliest fieldwork, Carpenter, Varley, and Flaherty (1959) explored the "mental maps" of the Inuit of Southampton Island in Canada focused on their own work and the work of George Sutton in the 1920s. When Sutton visited Southampton Island in 1929, there were no accurate maps of the island, so he obtained them from two Aivilik Inuit men (Carpenter, Varley, and Flaherty 1959:8). Sutton noted that in comparison with "modern maps," the Inuit enlarged areas which were favorite hunting grounds, but the accuracy of the map, particularly details of the shoreline, were notable. Carpenter, Varley, and Flaherty (1959) make the following observation about Aivilik mapping:

I asked several Aivilik to make sketches of this world. After much giggling on the part of the women and joking by the men, they produced a number of interesting maps, two of which are shown. The first . . . is limited to a series of dots, each representing a trading post and including all settlements known from experiences and hearsay. Southampton Island is in the center; other trading posts lie in the broadening circles of familiarity, like small islands in a vast sea. . . . Both . . . directions and estimates of distance are good, although distances are increasingly underestimated as one travels away from Southampton Island. (9)

The maps described above were made by a woman, and the researchers were made cognizant of how, in mapping, females orient themselves in terms of settlements or other fixed locations, whereas males orient themselves primarily towards the details of coastlines (familiar hunting territories). Carpenter, Varley, and Flaherty

(1959) also noted that the Aivilik had no names for inland areas not accessed in hunting endeavors, that areas familiar to them were drawn proportionately larger than those with which they had lesser contact, and that they did not view space as static and therefore measurable by a single standard.

Spencer (1959) conducted fieldwork among the coastal and inland Inupiat of north Alaska in 1952 to 1953. Although his work was ecological and historical in nature, and he was particularly interested in the economic divergence and interdependencies between the coastal Tareogmiut and inland Nunamiut, he basically disregarded mapping as a tool of analysis. Whereas Spencer mapped territories of north Alaskan Eskimo, and described in great narrative detail the relationship between people and environment, he made the assumption that territories paralleled use areas, leading to his concept of a coastal/inland dichotomy in north Alaska that has more recently met with substantive challenge. Spencer's effort is mentioned in this context because of his detailed narrative and questions regarding land and resource use systems, which have subsequently led to lines of inquiry by other researchers who are applying mapping methods; and because if he had applied subsistence mapping methods (particularly map biographies) to his study, he may have conceptualized differently the static nature of a coastal/inland dichotomy in north Alaska.

Sonnenfeld's (1956) study was the first notable application of mapping methodologies to issues of public policy -- specifically, conflicting land and resource use. The intent of the study was an early attempt to establish the basis of a land claims settlement for

purposes of protecting the subsistence economy of the Inupiat of the Barrow area under the provisions of the Indian Reorganization Act of 1934. Sonnenfeld recounts the history of attempts to establish a reservation in the Barrow area (including an area from Barter Island to west of Point Barrow [Peard Bay] and south to the Brooks Range), noting that the initial survey of use area conducted in 1943 was equivalent to 750 square miles and failed to include the vast majority of Inupiat hunting, fishing, and trapping grounds except for a segment of coastline (1956:578). Through this project, funded by the Arctic Institute of North America, community leaders were asked to map hunting, fishing, and trapping areas in community council meeting contexts. It was proposed that these maps would protect subsistence by creating a game reserve in which hunting, fishing, and trapping might somehow be restricted for the use of only the Inupiat. Local control over land and resources was advocated as the only protection for the subsistence-based economic systems. The maps, ranging in scale from 1:40,000 to 1:5,000,000, depict a sequence of reservation proposals and governmental counter proposals. It is not possible to evaluate this methodology because of a lack of detail, but it is significant in being a very early effort to apply a land-use study to ensuring the viability of a subsistence-based economic system and in recognizing the wide-expanse of land necessary for doing so. Lastly, this study contended that by the act of harvesting resources from a given area, the harvesters had a claim to the land base which they used.

In the Canadian context, the late 1940s was a period marked by an increasing recognition of both the impending scarcity of certain species and economic problems affecting Canada's Native peoples. The first studies to address these problems relied on existing governmental statistics regarding wild resource harvest levels and the overall economic status of Canadian Natives. Prior to the 1950s, little attention was paid to Native harvest volumes, so little information was available. Subsequently it was determined that existing governmental data bases were too inadequate to answer questions regarding harvest levels and other economic indicators of Native society. Consequently a generation of studies followed which developed new methods of collecting these data, including chiefly participant observation, flexible or open-ended interviews, and formal questionnaires -- essentially typical methodologies of ethnology and sociology (Usher 1984).

In the late 1950s to 1960s area economic surveys were conducted by the Industrial Division of the Department of Northern Affairs and National Resources in the entirety of the Northwest Territory, northern Yukon Territory, and arctic Quebec (Usher 1984:9). The objectives of these studies were to determine what uses were being made of resources in various areas and to suggest ways to make more productive use of wild resources -- effectively, economic planning. The surveys were done primarily but not solely by biologists with little or no training in the social sciences and in cross-cultural sensitivity (Lotz 1976). Reports included maps and tables of game harvested, harvesting areas for seals, trapping areas, income and employment, and

extent of contact between Inuit and non-Inuit. Mapped data were gathered through various means by different researchers and depicted a very dynamic period in Native history when there were drastic changes in settlement pattern from camp life to more sedentary community residence. Additionally, maps presented data for a very limited period of time (generally one of two years) and ". . . could make no claim to represent maximal land use for the community for any more extensive a period of time" (Lotz 1976:24). Newly formed communities were focused on the location of schools, health facilities, and new housing, not on the basis of land use areas, and the reports represented only these very recent land use and occupancy data. One of the studies made an intensity distinction between resource zones (areas still being intensively hunted and trapped) and major resource areas (territories hunted or trapped in the past or present on an occasional or extensive basis) (Lotz 1976). This study estimated square miles of some harvest areas but provided no explanation of how data were derived. As Lotz (1976) states, however, the harvest and mapped data from most of these studies were of limited utility because of the brief period for which they were gathered and the economic development orientation of the studies. Neither Lotz (1976) nor Usher (1984) detail the exact methods used in gathering or depicting geographic-based data in the area economic surveys.

One economic study from the mid-1960s, which included an attenuated mapping effort, was that of Tanner (1966) based on data gathered during a three month period on hunting, trapping, and fishing in the Yukon Territory. Although the central focus of this study was cash

income derived from trapping, and in that sense it was one of the series of economic assessment studies on-going in Canada during the 1960s and 1970s, Tanner (1966) demonstrated an interest in the geographic association of harvest activities with a land base. Based on informal data gathered from a variable sample of key informants and government trapline registration and harvest records, Tanner identified registered trapping areas as functional overall hunting and fishing areas. Some of these traplines were registered to individuals and others (such as Old Crow, Ross River, and Fort McPherson) were still registered to groups. In group areas, individual trapper families or partnerships were recognized to have exclusive rights to individual traplines (Tanner 1966:12). Although Tanner (1966) discusses differential harvests and incomes of Indians, Metis (part-Indians), and non-Indians, he does not conduct a spatial analysis of distinctions in land and resource use among the three groups except to indicate that a larger percentage of "whites" than Indians or Metis had inactive registered lines in 1964 (Tanner 1966:20). In regards to overall land and resource use patterns, Tanner (1966) notes that in 1964, older people trapped within five miles of a settlement, that the costs related to trapping under settlement conditions had encouraged roadside, vehicle-based trapping, that registered trapping areas averaged 273 square miles, that trapline registration procedures discouraged traditional partnerships, and that overall cash economic and harvest quantity data indicated a "culture of poverty" represented in the study area.

While work was commencing on the area economic surveys and other independent research in Canada, the first major study in northern North America to specifically address itself to the questions of developmental impact on the land and resource use of indigenous people was undertaken in northwestern Alaska. This study, termed Project Chariot, was to become the model for numerous land use and occupancy studies in both Canada and, subsequently, Alaska (Usher 1984). Project Chariot was a proposed plan to use nuclear devices to excavate a deep water harbor in the vicinity of Cape Thompson, approximately 32 miles from Point Hope (Foote 1961). Research, conducted between 1958 and 1961, was multidisciplinary in nature. The human geographical component employed field methods including informal interviews and participant observation in an attempt to reconstruct Inupiat (Point Hope, Point Lay, Kivalina, and Noatak) harvest activity during the years 1957 through 1959, with an emphasis on winter activities from 1958 to 1959. Data generally included the construction of maps which located principal Inupiat place names (1:250,000 scale), the use of maps to question hunters about 1958 to 1959 activities (1:500,000 scale), and the use of maps to get data on hunting and other resource harvest activities in prior years until a point in time at which ". . . actual events could no longer accurately be attributed to a specific month or year" (Foote 1961:iv).

Foote (1961) reconstructed land and resource use for four Inupiat societies which use the area for the decade 1850 to 1860 by season (summer, fall, winter, and spring) (see Figure 4). Species are labeled and each of the four groups designated by specific line

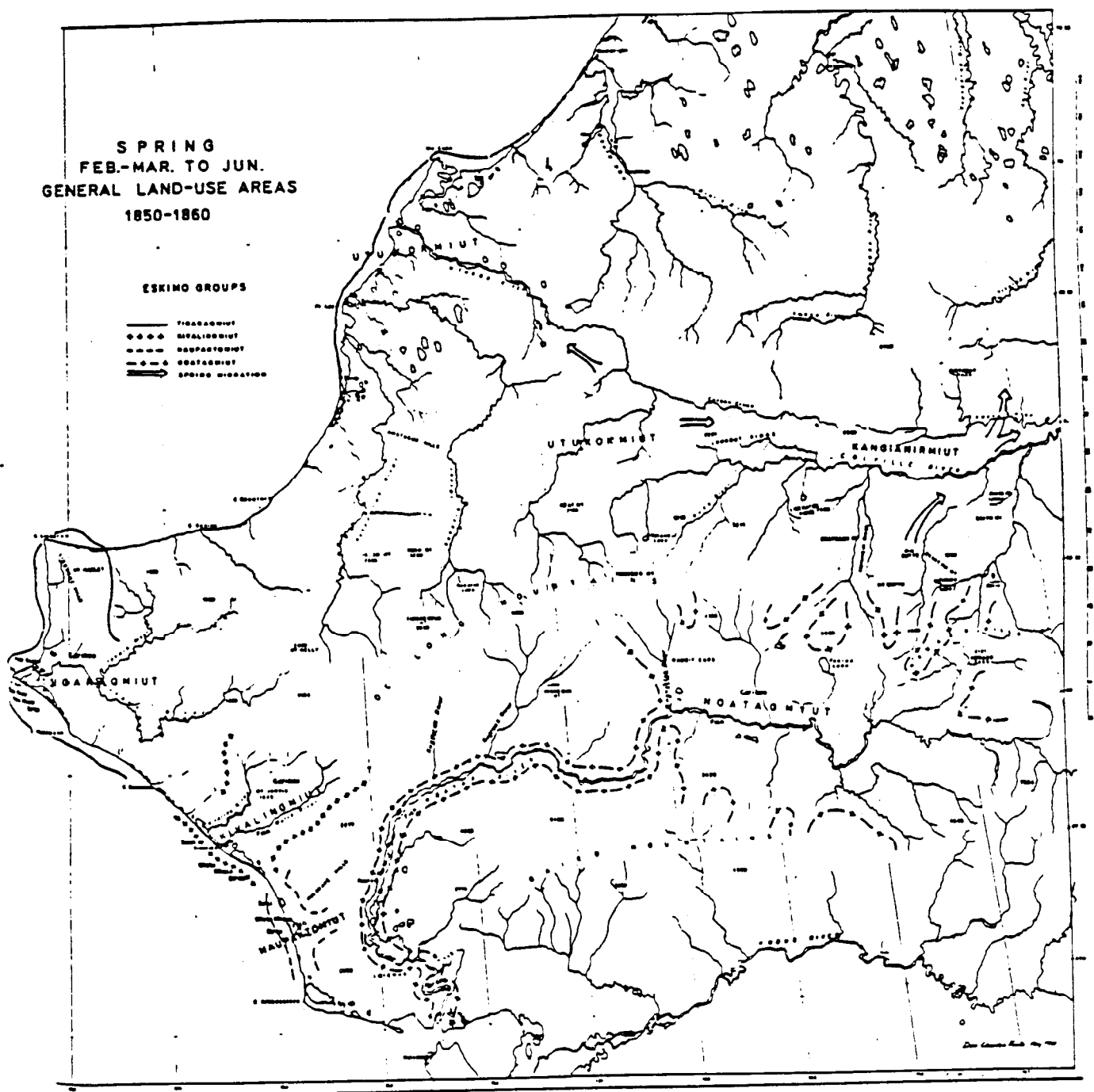


Fig. 4. Spring (February-March to June) general land-use areas, 1850-1860
(taken from Foote 1961:31).

patterns keyed to a legend. Some areas are enclosed others appear to be travel corridors, and other lines simply end suggesting incomplete data. Narrative description of subsistence activities accompanies each map. Foote (1961) does not indicate the methodology he uses for the 19th century reconstruction, but it is assumed to be historical accounts. His purpose is to portray a traditional land and resource use baseline. For comparative purposes, Foote maps the same seasonal data for four villages during the time period 1950 to 1960 (Figure 5). Data are more complete for the latter period and derive from both informant recall and observation (1957 to 1959). Mapped information is descriptive and includes no insights regarding sample size. Supporting data include historical narrative, particularly of events which influenced the subsistence-based economy, harvest data to which Foote assigns variable levels of reliability related directly to size of species harvested (ranging from 90 percent for large species to 20 percent for salt water fish and small mammals including birds), number of resource harvest trips, and cash income and expenditure data. Foote (1961) concludes by stressing that based on these data, the products of the hunt provide most of the food, fuel, and work clothing for residents of the area; that those with some cash income are larger subsistence producers than those without; that there is historic continuity in area use patterns through time; and that access to the area and its resources permits a large degree of self sufficiency for residents of the area. This study was to become an early model because of its integration of historic and contemporary land use with

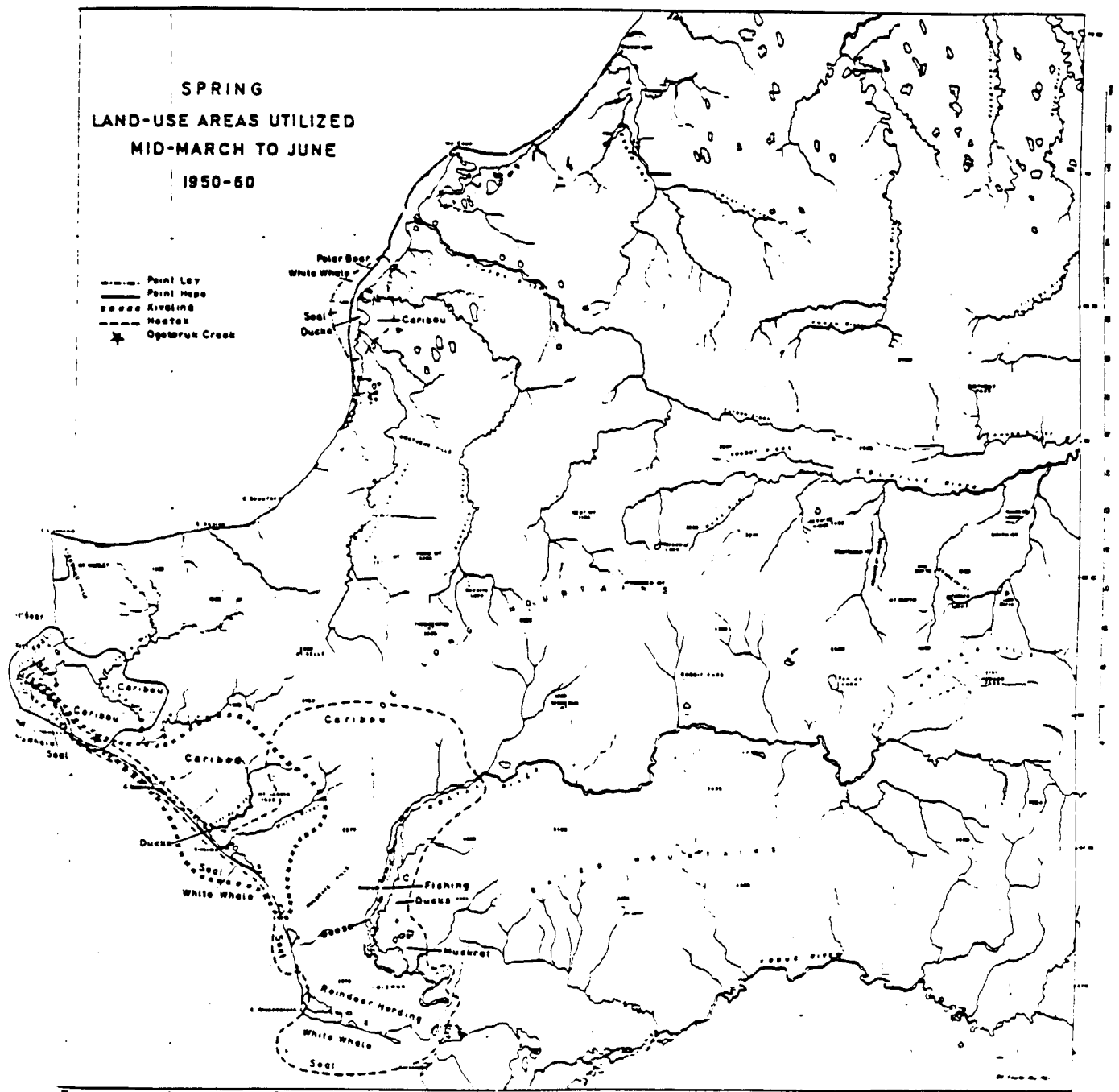


Fig. 5. Spring land-use areas utilized mid-March to June, 1950-1960
(taken from Foote 1961:67).

harvest quantities and cash economic data -- certainly the most holistic subsistence study in northern North America to that time.

In Alaska, the Federal Field Committee for Development Planning in Alaska published Alaska Natives and the Land in 1968 at the request of the U.S. Congress in their attempts to settle Alaska Native claims to clear the path for the development of the Trans-Alaska Pipeline. This report was intended to ". . . record all relevant, available data and information on the Native peoples, the land and resources of Alaska, the uses which these people have made of them in the past, their present uses and ownership, and the future -- often conflicting -- needs of the Native people, the State of Alaska, and the federal government" (Federal Field Committee for Development Planning in Alaska 1968:iii). In part, the intent paralleled that of Canada's area economic surveys by providing information which would aid in "improving the circumstances" of Alaska Natives by "bringing them into the modern world" (FFCDPA 1968:3). The larger aim, however, was to settle Alaska Native claims in order to free land for economic development by the state and federal governments through the auspices of private industry.

Authors of Alaska Natives and the Land (1968) suggested that indigenous peoples make use of all the biological resources of the land and interior and contiguous waters of the state, in general balance with the environment which they inhabit, limited only by factors of technology (536). It was recognized that Natives "occupy" the land in the sense of using it in pursuit of subsistence but not in the senses implied by agrarian land values or Anglo-American

jurisprudence. The Federal Field Committee acknowledged Native concepts of family or group territoriality with definable boundaries based on usufruct rights to land and resources and found these territories to be the basis of the indigenous economic system in 1968. However, the use of maps to demonstrate these points was limited and relied solely on the work of others -- namely Foote (1961) and Oswalt (1967). Foote's maps (1961) have already been described above and were presented as exemplary of land and resource use patterns along Alaska's arctic coast. The Oswalt (1967) map depicted "major subsistence patterns" geographically, including arctic whaling, Pacific whaling and fishing, caribou hunters, arctic hunters and fishermen, Bering Sea hunters and fishermen, and salmon fishermen (FFCDPA 1968:95; Oswalt 1967:5). This typology was defined by macro-subsistence harvest foci based primarily on pre- or early contact data and provided little information on intra-area variability, the complexity of subsistence systems, or changes which had taken place over the past century or so. Oswalt's purposes had been primarily historical and academic -- the Federal Field Committee's intent was applied, policy-focused, and contemporary. Therefore, subsistence maps in Alaska Natives and the Land (1968) were not uniform in state coverage nor were they particularly relevant to the task at hand.

The Alaska Native Claims Settlement Act (ANCSA) of 1971 bore little relationship to the land requisites described in the Federal Field Committee report (1968) for the continuance of subsistence-based socioeconomic systems in Alaska. This factor significantly influenced

the development of subsistence mapping methodologies and their use in the Canadian context:

By 1972, we had become aware of problems resulting from the lack of a substantive land use record as a basis for the Alaska Native Claims Settlement Act. We felt that in Canada we had the opportunity to acquire in advance of a settlement real place data on lands and waters used and occupied and to bring this information into the design of a national land claims settlement and post-settlement local government configuration appropriate for northern Canada. More over, we felt that the actual land use and occupancy record would favor the Inuit people showing . . . that indeed, their ". . . footprints are everywhere." In the meantime similar work was being conducted by the Dene people in the Mackenzie Valley. The Dene chose, however, not to make their records public nor ~~the~~ work under the auspices of the Canadian federal government. (Francis 1980:2)

CANADIAN LAND-USE AND OCCUPANCY STUDIES

After the passage of ANCSA (1971) in Alaska, mapping projects were employed in Canada to address two separate but interrelated policies or philosophies concerning the claims of indigenous peoples to lands and resources. One intent of mapping studies, as discussed by the Francis quotation above, was to document the extent of land use and provide the basis for claims to ownership or usufruct property rights to the land by its traditional inhabitants (for example, the Inuit Land Use and Occupancy Project or the Dene Mapping Project). Secondly, subsistence mapping, in conjunction with harvest studies, were viewed as a means of providing an appropriate measure of compensation to Canadian Native peoples for loss of or disruptions to the use of traditional lands and resources (for example, Weinstein 1976; Brody 1982). Examples of both applications of mapping methodologies are presented below.

Weinstein (1976) essentially is exemplary of a study with potential compensatory outcome. The study was initiated at the request of the James Bay Cree at the end of 1973 after they were successful in winning a temporary injunction against the development of the James Bay hydroelectric project. The intent of the study was to document the extent of dependency on wild resources by Native (Cree and Inuit) people of Fort George, Quebec and to document the location of resources being used and the potential impact of the proposed James Bay hydroelectric project on these resources and associated uses. Temporally, this study proceeded or was concurrent with the development of the Inuit Land Use and Occupancy Project so did not call upon its methodology. Specific objectives included the establishment of harvest levels of different species, an estimate of the food these species provided to the community, and a determination of specific land-use patterns. Harvest level data were desirable particularly for negotiating baseline allocations of fish and game resources.

The methodology of Weinstein (1976) involved several major procedural innovations. Some of Weinstein's methods had previously been developed for an earlier subsistence economic study among the Cree of Fort George (Usher 1984). In the James Bay project, Weinstein interviewed Cree and Inuit status and non-status males 19 years or older during an 18-month period from freeze-up in mid-November 1972 to the commencement of the spring goose hunt in mid-April 1974 regarding harvest activities (1976:87). Of 338 potential informants, 307 provided harvest data for this relatively brief period. Each interviewee was asked to designate the locations of his known harvests and

those of his dependents on 1:250,000 scale topographic maps. Harvest locations were coded into three geographic categories (see Figure 6 for an example): (1) the actual locations were coded onto a 100 square kilometer grid system using a multi-digit code which indicated location and radius of the harvest area; (2) the registered trapline from which the harvest was derived (an alpha-numeric code); and (3) the hydroelectric project impact area from which the harvest came (Weinstein 1976:88). Computer aggregates of these data were used to depict areal harvest intensity by species based on harvest levels per grid. Harvest distributions, depicted by contour lines connecting points of comparable harvest intervals, were generated for composite resource categories (for example, all waterfowl as demonstrated in Figure 7). In all, 472,336.7 pounds of harvested resources were coded. Additionally, maps of registered trapline areas were compared with areas projected to be impacted by the hydroelectric project. Resource maps included the distribution of harvests from fur mammals (including separate maps for beaver, otter, and lynx); the distribution of harvests from waterfowl (including separate maps for Canada goose, intensive fall and spring Canada goose hunting areas, and snow goose; the distribution of harvests from small game (including discrete maps for snowshoe hare, ptarmigan, and porcupine); the distribution of harvests from fish (including discrete maps for lake whitefish and cisco); and the distribution of the total Fort George bush food harvests for the period 1973 to 1974 -- 18 resource maps in all.

Supporting data for geographic-based information included demography, ethnicity, community social and non-subsistence economic

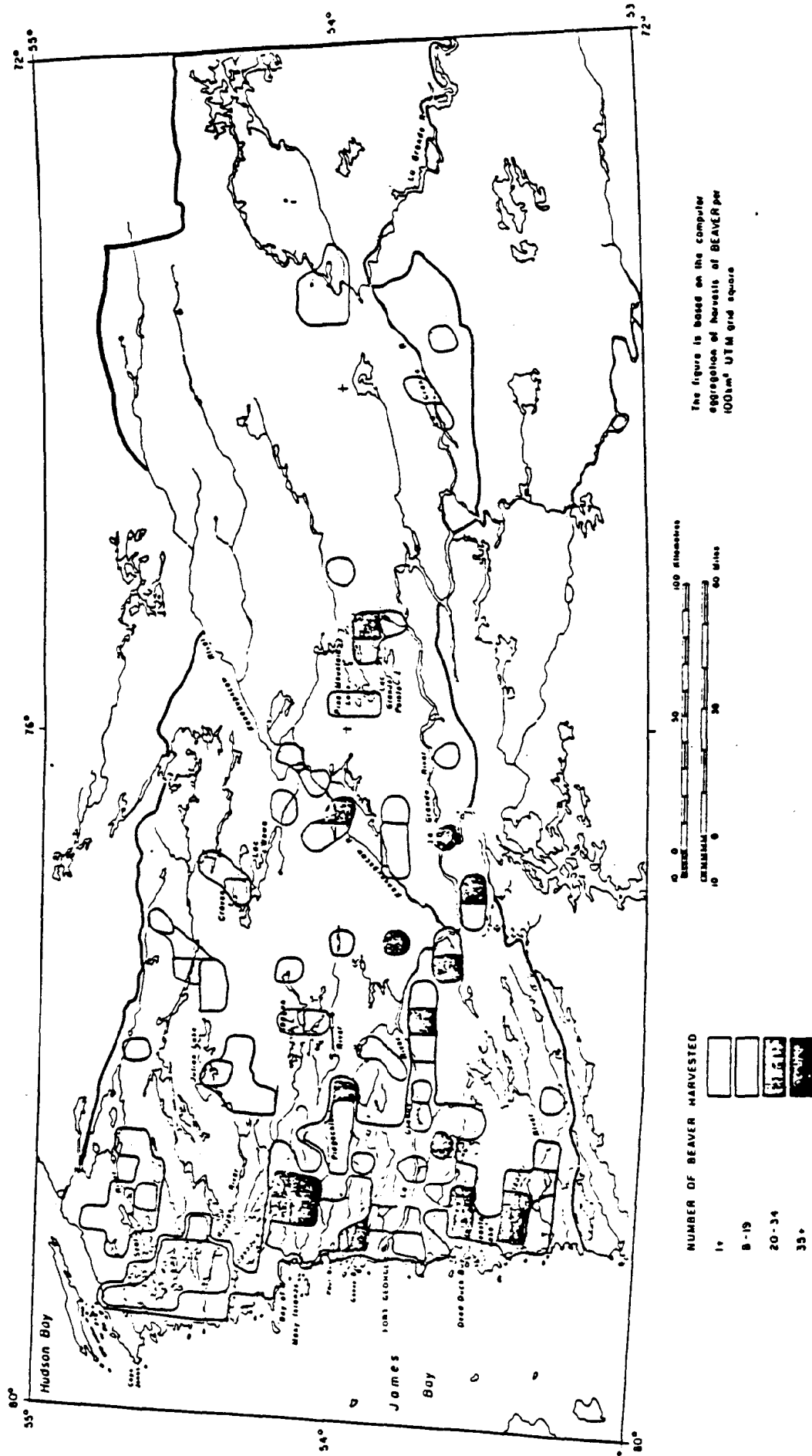


Fig. 6. The distribution of beaver harvests in 1973-1974 by Fort George Natives (taken from Weinstein 1976:129b).

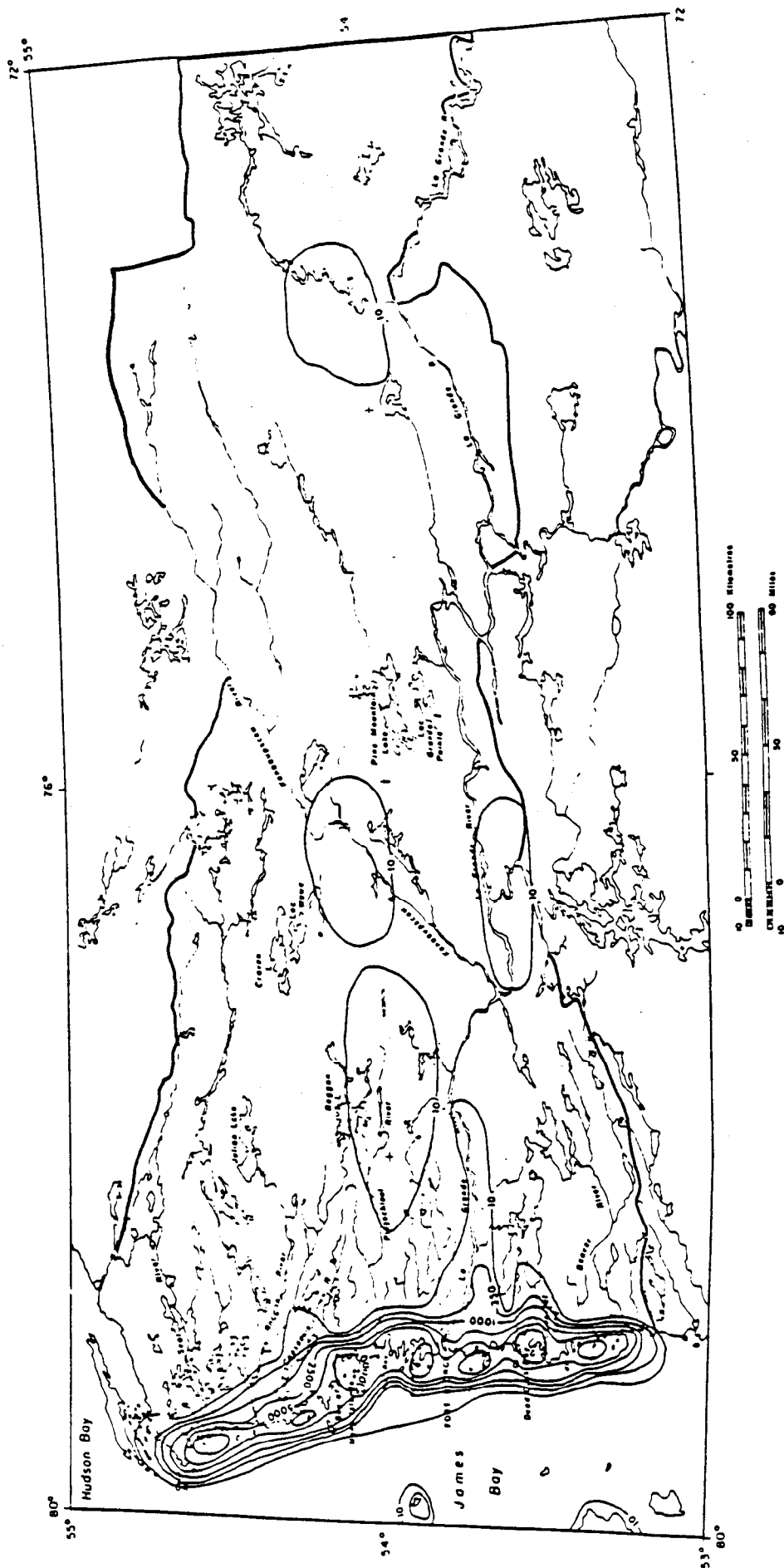


Fig. 7. Distribution of the Fort George bush food harvest from waterfowl, 1973-1974
(taken from Weinstein 1976:138b).

institutions, discussions of floral zones and species and faunal distributions relevant to subsistence activities, a history of the trapping registration system, an analysis of the trapline system, subsistence narratives, and harvest levels and conversions to pounds usable weight for 35 species. Importantly, Weinstein described the traplines as actually being ". . . the hunting and trapping areas of extended families or of a number of related family groups. To the people who have traditionally hunted on particular traplines, these areas are their primary world. Their roots and their ideas of who they are are tied to their lands" (Weinstein 1976:178). The recency of community settlement and sedentarism (i.e. 10 to 15 years) was stressed as was its impacts on land and resource use patterns.

Lastly, data applications from this project established harvest levels on which the community was economically and socially dependent in the period 1972 to 1974 and the land base associated with this harvest. The study demonstrated seasonal and annual area and species-specific flexibility associated with shorter and longer term ecological shifts, faunal population levels, and accessibility. Importantly, the data documented the spatial and related economic consequences of sedentarism. Finally, Weinstein was able to evaluate the relative importance of species by area, with an ultimate application to questions regarding the potential impact of the proposed hydroelectric project, including inland-coastal interdependencies and converted harvest quantities tied to specific geographic units or 100 square kilometer (approximately 38 square mile) grids.

The first major Canadian mapping study to deal with the issue of land claims was requested by the Inuit Tapirisat of Canada, with preliminary planning discussions held in 1972 to 1973. This proposed study had three components: (1) the non-renewable resource project (not reviewed in the context); (2) the renewable resources project; and (3) the Inuit land use and occupancy project (Boreal Institute for Northern Studies 1975:ii). The renewable resources project was essentially an effort to provide the Inuit with an assessment of the location of important faunal and floral resources. The intent of the study was to allow the Inuit to better evaluate the potential of particular lands in a claims selection process. Data were derived primarily from literary accounts or field observations of explorers, naturalists, and others. Therefore, data, while not explicitly representative of human use patterns, by the nature of its collection methodologies, implicitly is biased towards human use and perceptions. Since this study is not representative of subsistence mapping per se, however, it is not considered in any more detail for purposes of this effort.

The Inuit Land Use and Occupancy Project (Freeman 1976) is the most relevant for purposes of this study. In February 1973 the Inuit Tapirisat of Canada proposed to the Minister of Indian and Northern Affairs that research should be undertaken to produce a comprehensive and verifiable record of Inuit land use and occupancy in the Northwest Territories, which would delimit the past and present uses and occupation of land and marine environments by Inuit populations (Freeman 1976,v.2:15). In view of the continuing role which land and

associated resources plays in defining the cultural and ecological circumstances of Inuit life, the research was also intended to provide an explicit statement, by the Inuit themselves, of their perceptions of human-land relationships. The research area was grouped into "regions" for logistical and administrative purposes, although such "regions" had no major cultural or political reality. Except for the presentation of brief settlement histories, all textual materials were derived from Inuit informants through field data gathering techniques. Details of methodology are central to the purposes of this study, since the Freeman (1976) document provided the most detailed account, both temporally and spatially, of land use and occupancy by indigenous peoples of northern North America to date. As will be discussed in more detail below, this study was noteworthy in its exemplary use of the "map biography" as a tool for collecting resource and land use data for individuals through time.

At the outset it was intended that the Freeman (1976) study would represent, to as great a degree as feasible, the Inuit perceptions of human-environmental relationships rather than those of the outside observer, as was assessed to have been the end result in the case of the area economic surveys (Lotz 1976). The focus of the study was to determine the geographic or territorial extent of land and related resource use. "We seek to say in what way a certain piece of land was used by the local people. We do not attempt to determine whether that piece of land yielded a certain number of animals in a certain number of years, nor do we attempt a qualitative assessment of perceived 'usefulness' of that piece of land" (Freeman 1976,v.2:47). Valuation

was avoided in this study, in part because of the lack of an acceptable, standardized measure by which land and associated resources could be evaluated. Additionally, it was recognized that resources harvested in one area may be nurtured in another, so that a high evaluation of an area productive in terms of harvest may be biased in missing an appropriate evaluation for the area on which that resource depends during stages of growth and development. Finally, it has been suggested that the act of differentially evaluating specific areas of land would imply that the Inuit could be compensated for loss or disruption of land and associated resources -- an untenable position at this point of time (Michael Asch, personal communication 1985).

Although the study was conducted in the mid-1970s, the intent of the map biography method was to record land and resource use patterns during the entire lifetime of each hunter included in the interview sample. Therefore, the temporal extent of the data spanned a period from the earliest hunting memories of the oldest informants to the ethnographic present (the time at which the interviews were conducted) -- specifically from pre-1912 to 1974 depending upon the study community.

Because a great deal of variation in land use behaviour is either local or idiosyncratic, the most valid way to organize variations through time is by selecting blocks of time of sufficient temporal extent so as to illustrate (a) changes having longer-term significance rather than short-term fluctuation -- and/or (b) of widespread synchronic occurrence, thus enabling the Arctic region as a whole to be so categorized in a valid and uniform fashion. (Freeman 1976, v.2:49)

For the most part, time periods were divided into the years prior to the local arrival of traders, the fur trade period, and the period of

growth of permanent settlements and related increased sedentarism. In some cases, a fourth period on the contemporary end of the spectrum was included. Social time, as opposed to chronological time, was the measure of significance.

The map biography was the primary mechanism for data gathering in this study, although field notes for additional information such as local history, oral histories, place names, animal behavior, and personal histories were compiled and used in narrative portions of the study and for the development of supplemental maps depicting camp sites, place names, core hunting areas, and other cultural data. To compile the map biographies, each Inuit male who had independently hunted, trapped, or fished, whatever age, experience, or place of origin, was interviewed and geographic-based information recorded on maps. Informant recall, then, provided the vast majority of data. Researchers attempted to validate the accuracy of informant recall by cross-checking data between informants of the same area and similar age groups and by bringing composite maps back to each community for verification and approval. Where applicable, data were also compared with archaeological, ethnographic and historic data bases (Hoffman 1976). The vast majority (120 of 140) of data gatherers were local residents. Informants drew use areas by species or species categories generally on 1:500,000 scale maps or mylar overlays using different colored pens to differentiate between species. Hunters were familiar with the 1:500,000 map scale and with maps as a means of depicting geographic knowledge in general. In most cases, each informant produced a map depicting only his individual data, but in a few cases

a single map was used to represent the use areas of more than one person. Species categories mapped included seals, fish, whales, walrus, polar bear, waterfowl, caribou, moose, musk oxen, grizzly bear, wolf, wolverine, red fox, lynx, marten, beaver, muskrat, arctic hare, ground squirrel, and sheep. Additionally, traplines, camps, and fox trapping areas were also mapped.

There were 33 communities in which data were gathered. Individuals not resident in permanent communities were not mapped, so land and resource use patterns depicted were community-specific. As previously mentioned, only males with independent resource harvest experience were originally targeted as informants. While study objectives included the interview of every hunter in each of the 33 communities, the actual sample ranged from 71 to 96 percent of the total hunters of each study community (an overall average of 85 percent of all hunters in the study area) (Freeman 1976,v.2:48; v.3:xv). Although the original study intent was to include only Inuit male hunters, the actual sample included non-Inuit males considered to be members of the study community and virtually every male household head, some of their older sons, and a few widows who had supported their families by hunting and trapping. The total number of informants was approximately 1600 individuals.

Analysis involved the use of an electronic data storage system that could accommodate the land use data of each individual hunter from any of the 33 communities, for each species or species category, during any of the three or four time periods, on any identifiable unit of land of 25 square kilometers (9.6 square miles) in dimension

(Freeman 1976,v.2:21). Although extensivity of land use, not an analysis of variation, was the intent of this work, the data gathered were analyzed and presented in other studies for total area used by community for each species and for each period (Philbrick 1976:65). The level of analysis for this purpose, then, was solely nominal -- that is, the presence or absence of use.

Data depiction took two forms -- composite map biographies for each community and for each of three or four time periods and supporting narrative. Figure 8 demonstrates the procedure by which mapped data were compiled. All species or species category data were represented on 1:2,000,000 scale maps -- a single map per community, per time period, and per trapping or hunting activities, or a maximum of 8 maps for each community (see Figures 9 and 10 for an example of trapping and hunting areas for the community of Tuktoyaktuk during Period III, 1955-1974, respectively). All mapped data were depicted by points (e.g. camps or settlements), lines (e.g. traplines), or areas (e.g. hunting area). A single legend was presented at the beginning of the volume containing the maps. Each species or species category was depicted in this legend by a series of 22 color and pattern combinations.

Supporting studies included narratives describing subsistence patterns by region, prehistoric and historic accounts, ethnographic description, background data, linguistic maps, oral histories, emic perceptions of the land and resources, and methodological critiques. Noticeably absent are cash sector socioeconomic data and harvest levels, which were the keystone for the economic development, impact,

Figure 2
Portion of a sample "map biography": One hunter, all species,
multiple time periods

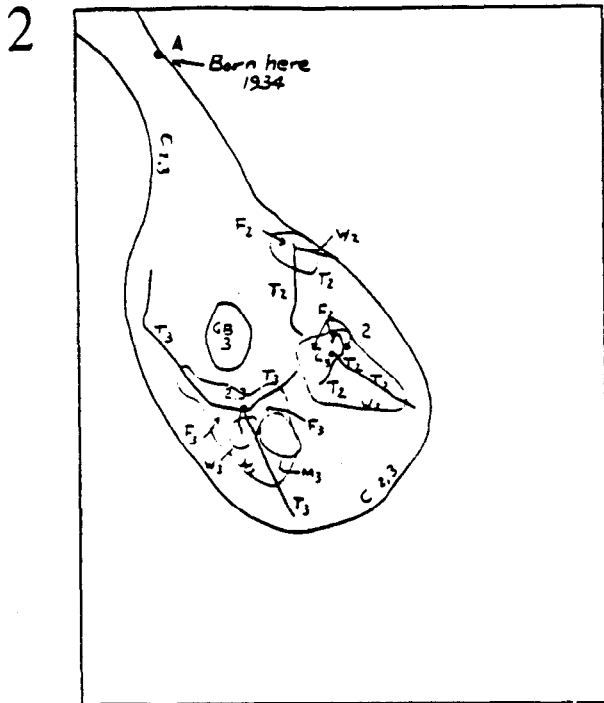


Figure 3
Compiled "map biographies": All hunters in area, caribou only,
Period II only

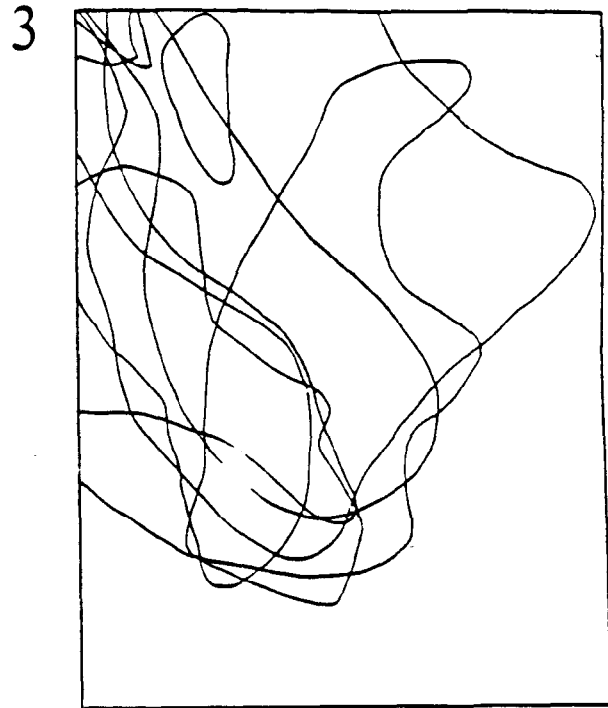


Figure 4
Portion of hunting area: Caribou only, Period II only

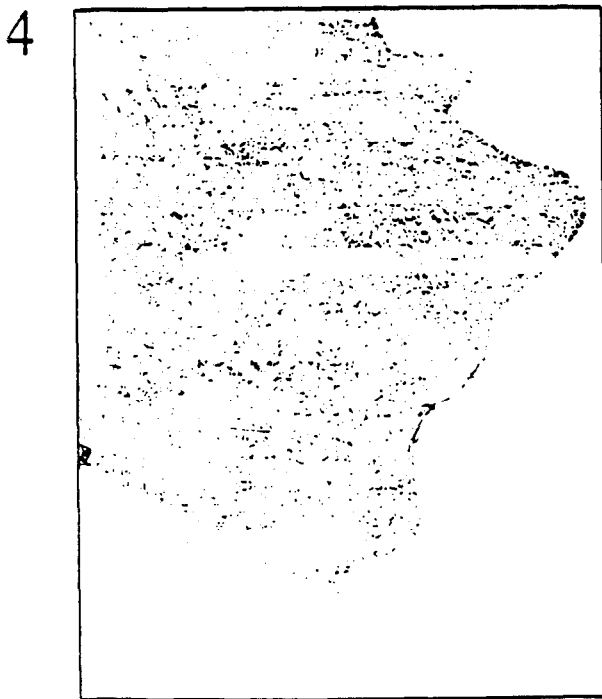


Figure 5
Portion of final hunting area map: All species, Period II only

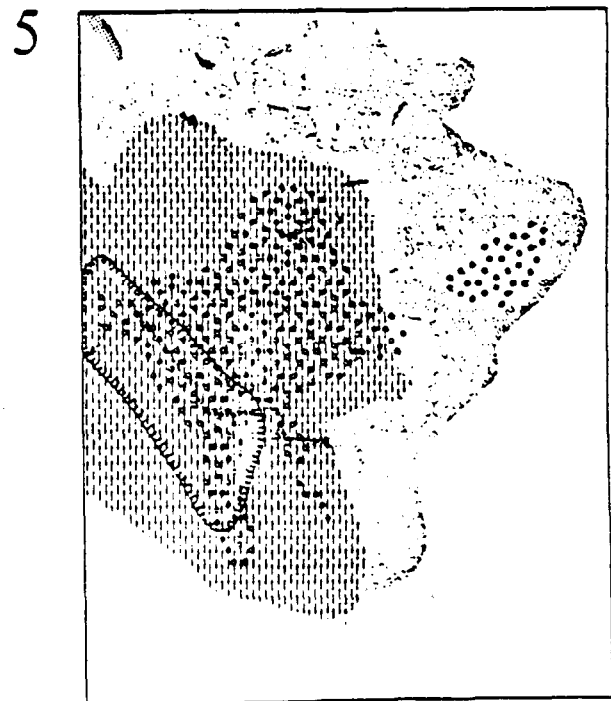


Fig. 8. Mapped data compilation procedure in The Inuit Land Use and Occupancy Project (taken from Freeman 1976, v.3:xvii).

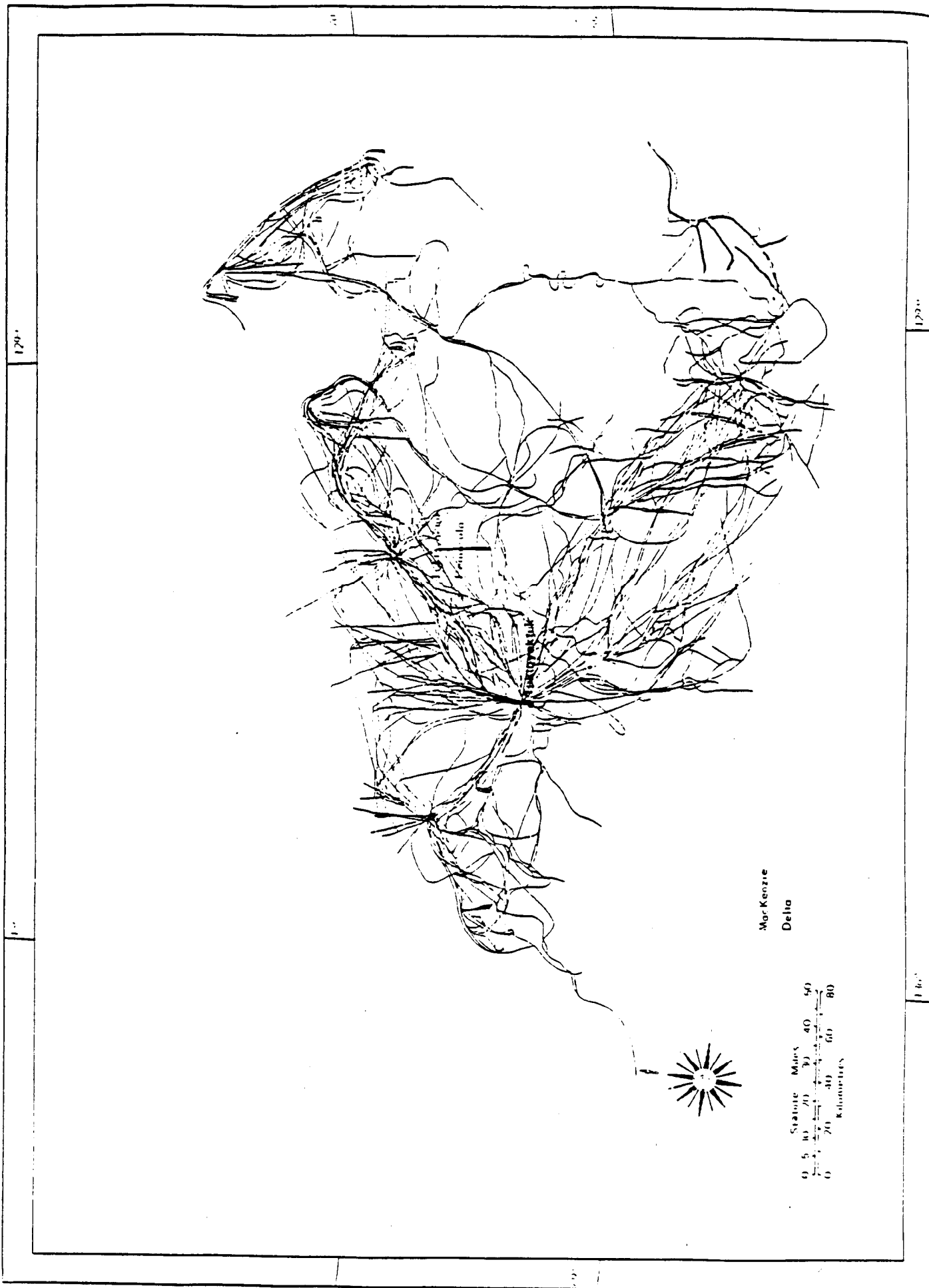


Fig. 9. Tuktoyaktuk trapping, 1955 to 1974 (taken from Freeman 1976, v.3:11).

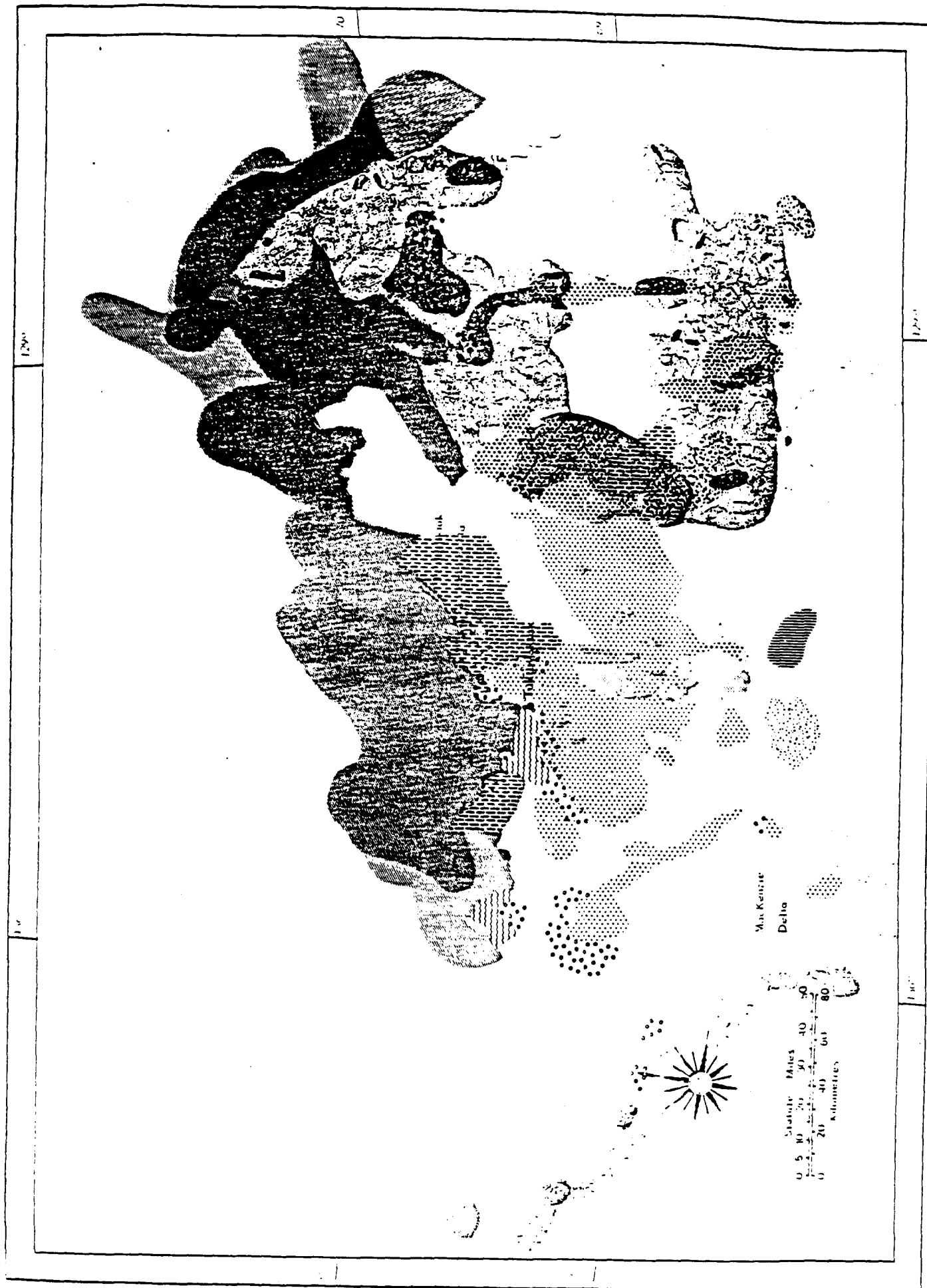


Fig. 10. Tuktoyaktuk hunting, 1955 to 1974 (taken from Freeman 1976, v.3:12).

or compensatory oriented studies prevalent in Canadian subsistence research. The descriptive nature of this study and application to land claims issues has already been discussed.

In 1975 the Labrador Inuit Association entered into an agreement with the Department of Indian Affairs and Northern Development to undertake research in preparation for a statement of land claims modeled, in large part, after the Inuit Land Use and Occupancy Project (Freeman 1976) of the Northwest Territories. The intent of this project (Brice-Bennett 1977) was to document the nature and extent of Inuit land use and occupancy in Labrador. This study was organized into three parts, each of which had somewhat different ~~but~~ related objectives. The first part provided a narrative of the prehistory and history of Labrador to substantiate the historic depth of contemporary patterns of occupancy and land use with a focus on the distant past. This segment was not reviewed for purposes of this study. The second part, of primary concern to this effort, identified the community-based wildlife resources and seasonal subsistence activities of the residents of five communities of northern coastal Labrador, including the delimitation of areas of land and sea harvested in the experience of informants now residing in the study area. The final section of the study explored the depth and richness of residents' cultural traditions and dependency on land and sea -- that is, narrative links between the past and present and attitudes towards the intellectual, social, and physical environments of contemporary residents (Brice-Bennett 1977:vii). The third part also was not reviewed for consideration in this study. The selection on land use in the Nain and

Hopedale regions is reviewed in this context as exemplary of the methodologies employed in this project overall.

Nain and Hopedale are the two largest Inuktitut-speaking communities of five communities (two of which were abandoned by the mid-1970s) in northern Labrador. Because residents of the abandoned communities of Nutak and Hebron relocated, in part, in Nain and Hopedale, land use patterns represented in this study include data representing all four settlements. The areal limits of the entire range over which hunters have harvested terrestrial and marine animals were defined by the gathering of individual map biographies for two or three periods of time (pre-settlement, post-settlement, and post-1971 to 1976 in some cases) from over 100 individuals and, subsequently, compiling individual biographies into community-based maps. Whereas data were gathered from non-Inuit settlers, no land or resource use information was included from the Naskapi-Montagnais Indians residing in the area in the mid-1970s.

Prior to conducting map biography interviews, researchers held community meetings to explain the objectives and methodology of the study. Participants in the meetings established the maximum range of all hunting and fishing activities from each community on large-scale maps, thereby aiding in the development of appropriate base maps to be used in each study settlement. As in the Freeman (1976) study, local individuals were engaged as data gatherers and interviews were conducted largely in Inuktitut (with the use of translators when researchers were non-local). Additionally, general background data, including related cultural and ecological information such as place names,

wildlife distribution, and historic territorial affiliations, were gathered.

Differing from the Freeman (1976) study, map biographies were targeted at key informants -- that is, individuals with a ". . . prolonged experience in an area or a particular interest in a certain species . . ." -- rather than with a total sample of the resident hunter population of the study communities (Brice-Bennett 1977:97). In the actual sample, 75 map biographies were gathered in Nain (an 88 percent sample of resident hunters) and 40 in Hopedale (a 66 percent sample), for a total of 115 map biographies from these two communities (Brice-Bennett 1977:98). It was the opinion of the researchers that additional biographies would have proven to be repetitive. Interviews occurred over a 5-month period in 1976 and lasted from 1 to 10 hours per informant. In addition to the mapped data, information about animal population dynamics, attitudes towards land and animals, and rules governing patterns of land and resource use and occupation were elicited from each informant. Individual map biographies were compiled into composite community maps to show the maximum areal extent of hunting activities within the two or three selected time periods described above and for each species or species category.

Map scale and the level of detail on the base map proved to be methodological areas of importance to this study. Map data were gathered on a 1:250,000 scale topographic map. Researchers assessed that due to the complexities of the coastline adjacent to the study areas (networks of lakes, streams, bays, coves, and islands), a larger scale would have made the location of harvest areas difficult and

inaccurate. Secondly, base maps with color contrasts, contours, and the complex of aquatic features associated with the study area were too costly to reproduce (apparently mylar overlays were not employed), so a more simple base map -- without contours, colors, and secondary bodies of water but including place names, coastal features, and major drainages -- was used in gathering map biography data using color variation for different species.

With the exception of seasonal camp sites and some traplines, geographic-based subsistence data were presented as areal phenomena with camp sites cabins serving as reference points in the delineation of use areas. Species or species categories mapped included fox, otter, mink, caribou, black bear, porcupine, partridge, rabbit, hare, migratory birds, five species of seals, white whale (belukha), walrus, bottlenose dolphin ("jumper"), polar bear, freshwater fish, and marine fish (i.e. cod, char, and salmon). Data were gathered but not mapped for numerous other species (including vegetation).

Another variation in the Labrador study from the Freeman (1976) model is the presentation of ecology maps which depict the distribution of marine mammals by community and the distribution of nesting areas for migratory birds. The ecology maps do not have a temporal reference. Additionally, place name maps provide a link between the past and the present and enable hunters to construct oral maps by which they can visualize areas, approximate distances, and define travel routes.

The Labrador study differs significantly from the Freeman (1976) study in the analysis of the mapped and supporting data. Brice-

Bennett (1977) presents an elaborate narrative account of the study area's economic and settlement history focusing on events which are determined to have impacted the traditional subsistence-based socioeconomic system and associated land and resource use patterns. There is no evidence that any type of statistical analysis of the mapped data was applied, but the narrative links specific economic and social changes in Labrador Inuit history to alterations in use patterns as presented in the mapped data. For the most part, the third time period (post 1971 to 1976) was not mapped but treated in a narrative form because analysis revealed considerable continuity with the data from the post-settlement period. In some cases, however, the researchers note that the time periods chosen were not meaningful (Brice-Bennett 1977:112).

The Labrador study concludes that mapped data indicate continuity in the range of use areas through time, particularly for major species such as caribou, although core areas (e.g. areas of intensity most likely measured by the number of hunters using an area) have undergone shifts in location between the pre- and post-settlement periods (Brice-Bennett 1977:203). The processes of centralization and sedentarism related to stoves, schools, missions, and wage employment, and the associated abandonment of two established settlements and portions of family-based use areas associated with these communities, have resulted in a shift from a previously more self-sufficient subsistence-based system to a mixed economy with the disintegration or modification of some features of the traditional land and resource use and occupancy patterns.

There are three publications associated with the Indian land use and occupancy study of the Peace River area of northeastern British Columbia, Canada (Union of British Columbia Indian Chiefs 1980, Weinstein 1979, and Brody 1982). This was the second of the major Canadian subsistence mapping studies to be directly associated with industrial impact, namely a planned natural gas pipeline paralleling the Alaska Highway directly through areas of Indian land use and occupancy in northeast British Columbia. Although this work served the purpose of documenting land and resource use patterns in the Peace River country, like its James Bay Hydroelectric Project predecessor, it was specifically a response to an externally generated industrial impact of some magnitude (Brody 1982). According to Brody (1982), however, previous government-sponsored work in British Columbia basically had disregarded the land and resource use patterns of Indian reserve populations located between the Rocky Mountains and the Albertan and Yukon borders. In 1977 the Union of British Columbia Indian Chiefs called for a public inquiry into the social and economic consequences of British Columbia frontier development in general. Specifically, the pipeline-related project was planned in 1978 and mapping commenced in September of the same year. The study was conceived to have three components: (1) transcripts of public hearings related to the potential pipeline; (2) an interim report -- namely the land use and occupancy study (including Weinstein's Appendix); and (3) a published work geared towards a broader audience and public distribution -- namely Brody (1982). The raw data and much of the original land use and occupancy document remained either

confidential or received very limited distribution. It was intended that the project be founded upon a core of land use maps with supporting social, economic, and cultural data.

The area which was the focus of the study had traditionally been occupied by Beaver (Athabaskans), although Cree had come from the east to occupy portions of northeast British Columbia during the fur trade period (Brody 1982). In 1978 there were representatives of seven distinct bands occupying seven functional reserves. The land use and occupancy patterns documented in the study included those of residents of the Doig, Blueberry River, East Moberly Lake, West Moberly Lake, Halfway River, Fort Nelson, and Prophet River reserves, most of which contained both Beaver and Cree (and some Slave) populations.

The study's mapping methodology was modeled basically after that of Freeman (1976), with modifications associated with varied resource bases and different cultural and historical circumstances. The map biography remained the primary research instrument and local band members accompanied by ethnographers were involved in data gathering. In general mapped data were gathered between September 1978 and March 1979, and composite maps were returned to communities for verification and correction by key informants. The study team attempted to obtain a 100 percent level of participation, and the majority of men and many women in 7 of 9 reserves drew maps of land use in addition to providing supporting data (Brody 1982:148). Base maps were 1:250,000 scale depicting main rivers and their tributaries. Individuals marked everywhere they had hunted, fished, trapped, picked berries, and

camped in their lifetimes -- outer boundaries were denoted with lines and campsites marked with an "X."

Individual informant maps from a single reserve were aggregated for all activities, but, differing from Freeman (1976), external boundaries of individual use areas were not obliterated in the composite. Hunted species were portrayed collectively on a single map, whereas distinct maps were aggregated for trapping, fishing, and berry picking areas. Since the Union of British Columbia Indian Chiefs (1980) document and the Weinstein (1979) Appendix were conceived to be interim products, the Weinstein maps depict only trapping areas (see Figure 11) despite their captions, whereas hunting, fishing, berry picking and camping sites are depicted in Brody (1982) (see Figures 12, 13, 14, and 15 respectively) as well as traplines registered to Indians in 1979 (Figure 16). In turn, reserve-focused maps were aggregated to illustrate regional patterns.

In contrast to Freeman (1976), maps in this study were not drawn to indicate patterns of land use for different temporal periods. According to Brody (1982:174), researchers in this study were unable to accommodate mapping for different time periods, as hunters ". . . saw no meaning in such distinctions . . . and Indians repeatedly insisted that land used five years ago are the same as the lands they used thirty years ago." However, a sub-sample of East Moberly Lake hunters drew maps of land use prior and post-1961 which significantly depicted shifts in subsistence patterns resulting from settlement and development related pressures on land.

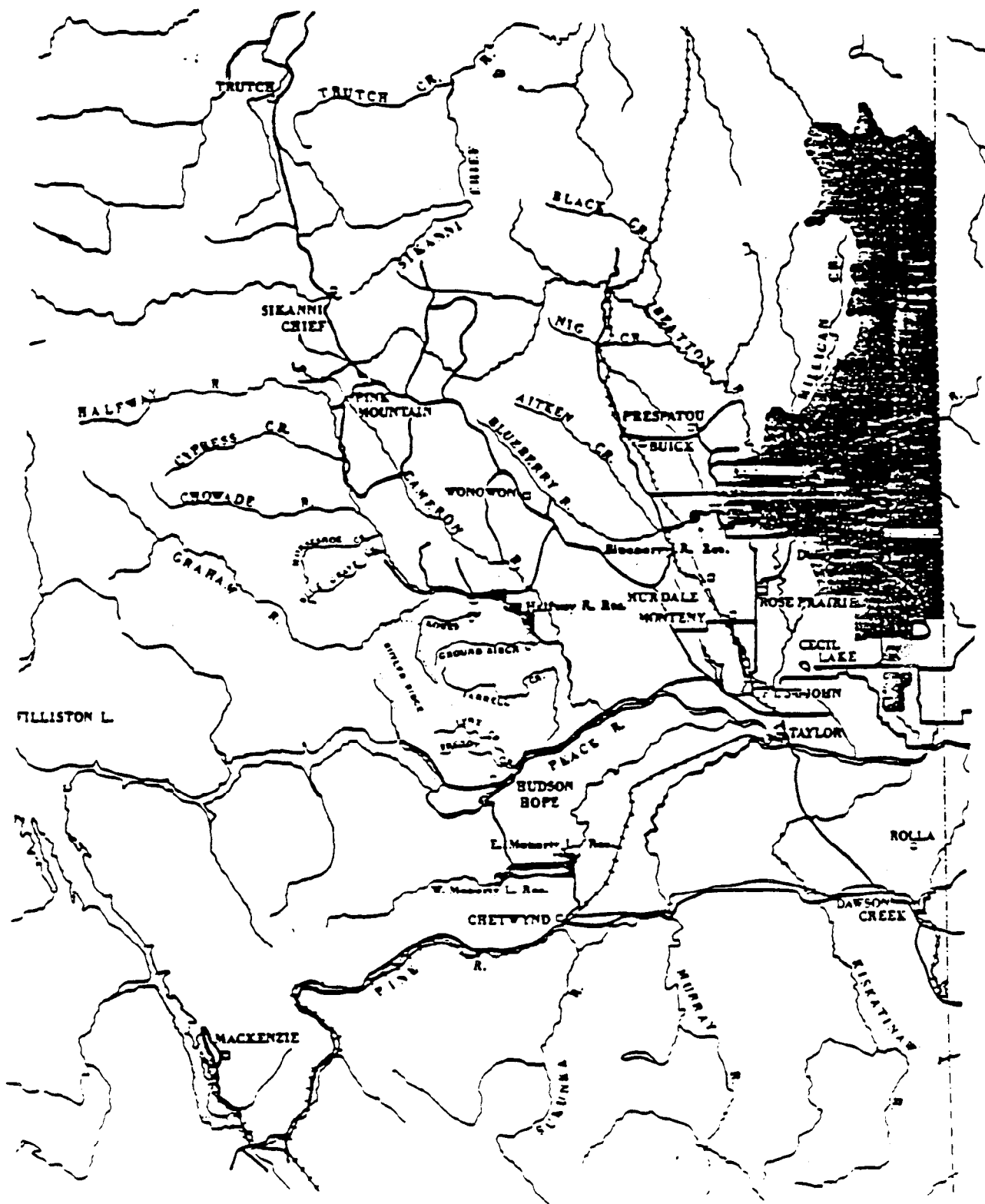


Fig. 11. Doig River Reserve traplines and hunting grounds (hunting grounds have not been added from the map biographies) (taken from Weinstein 1979:126b).

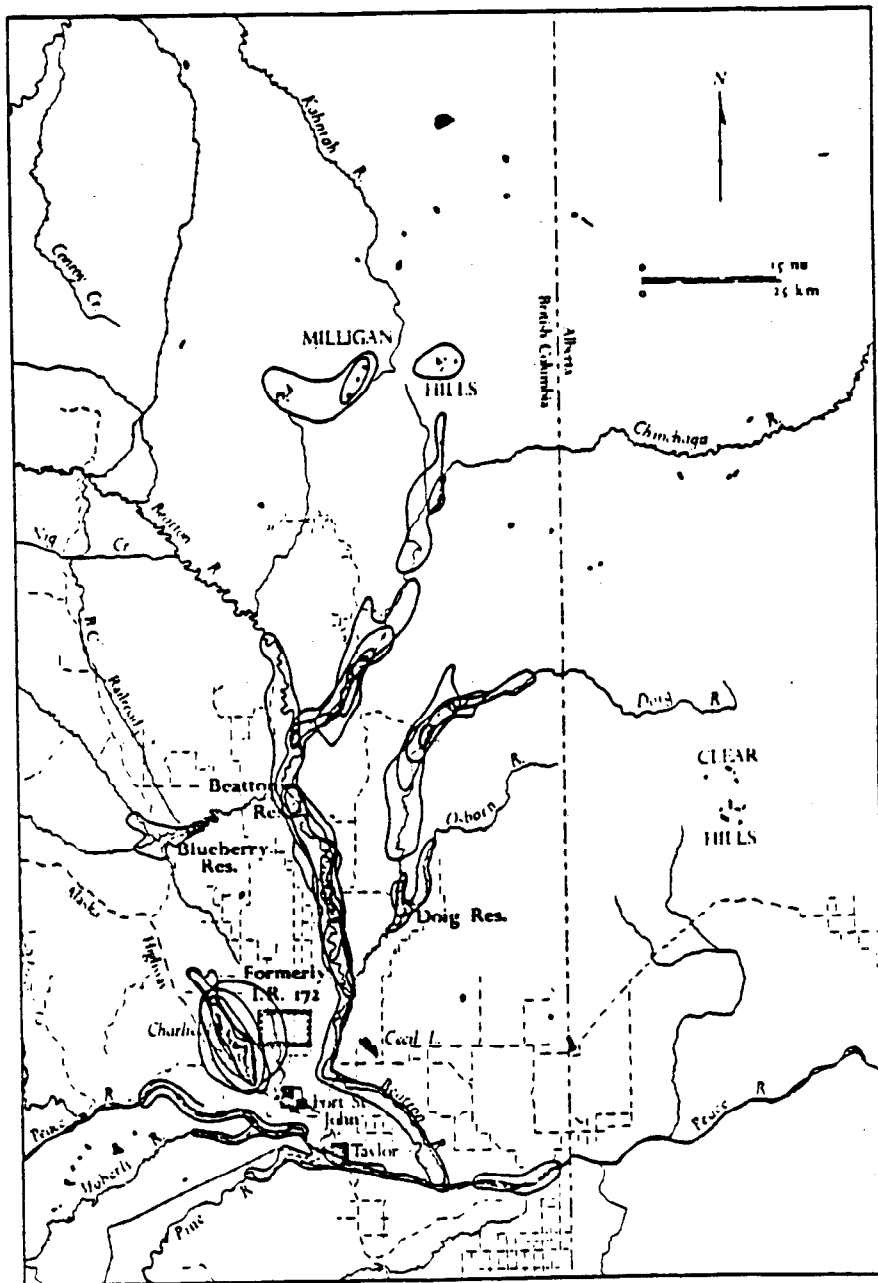


Fig. 13. Doig River Reserve fishing areas
(taken from Brody 1982:157).

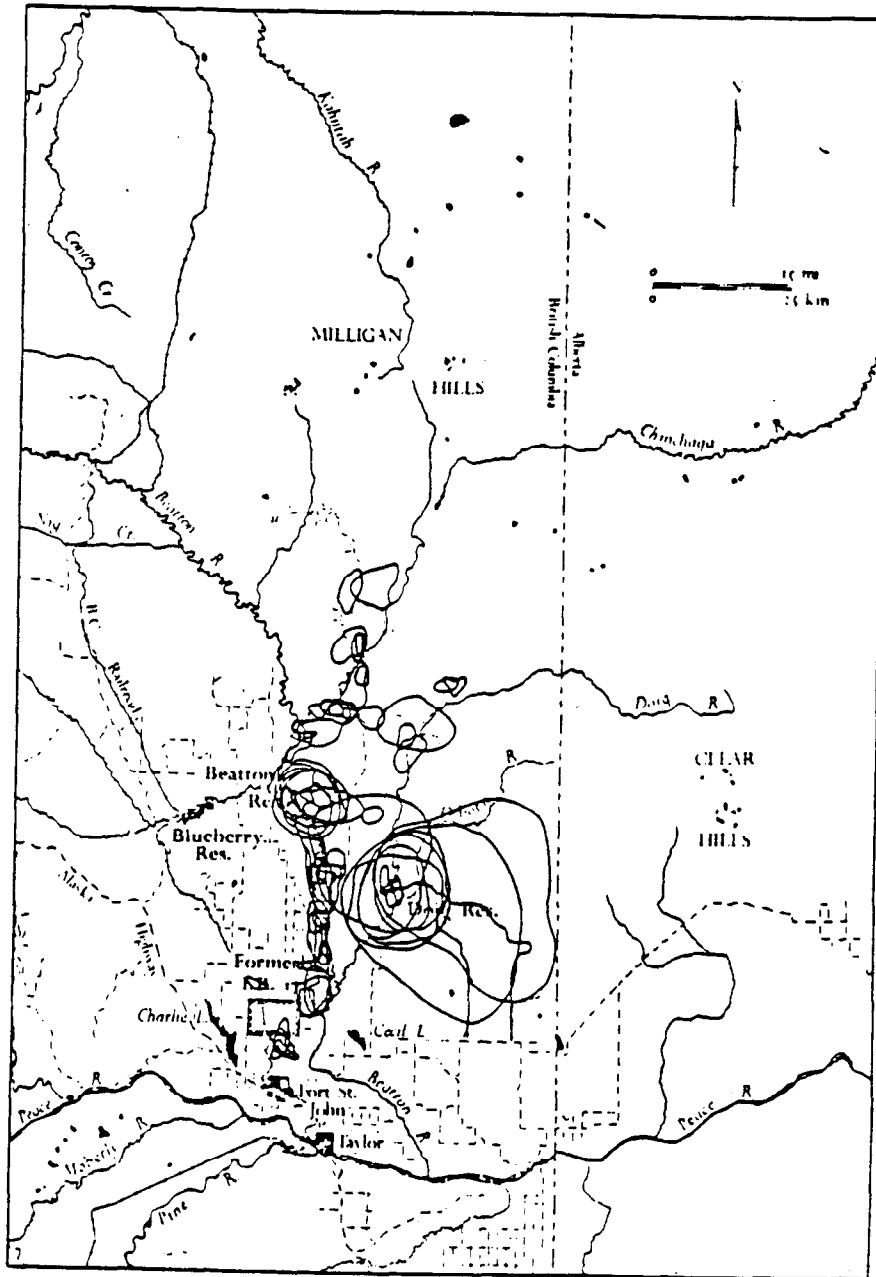


Fig. 14. Doig River Reserve berry picking areas (taken from Brody 1982:155).

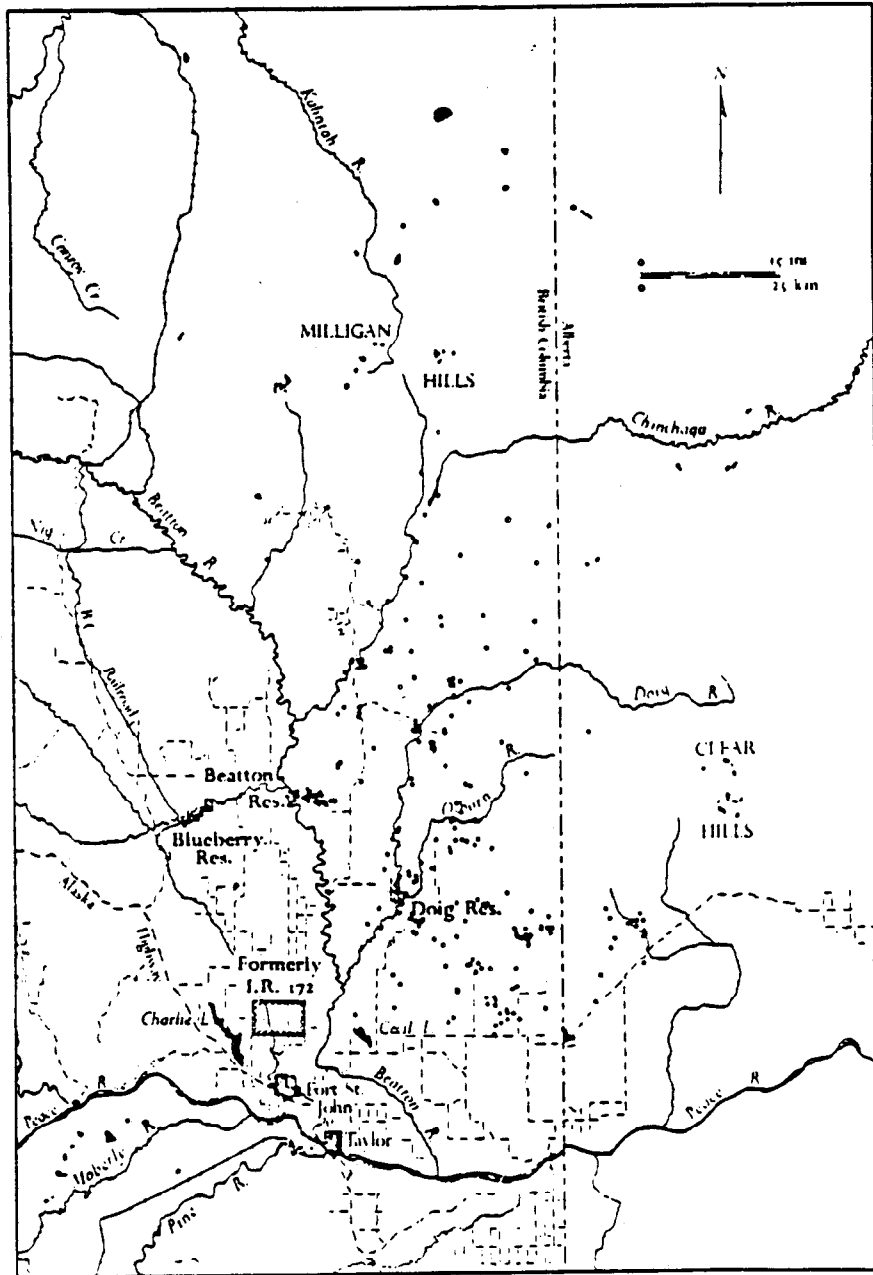


Fig. 15. Doig River Reserve camping sites
(taken from Brody 1982:159).

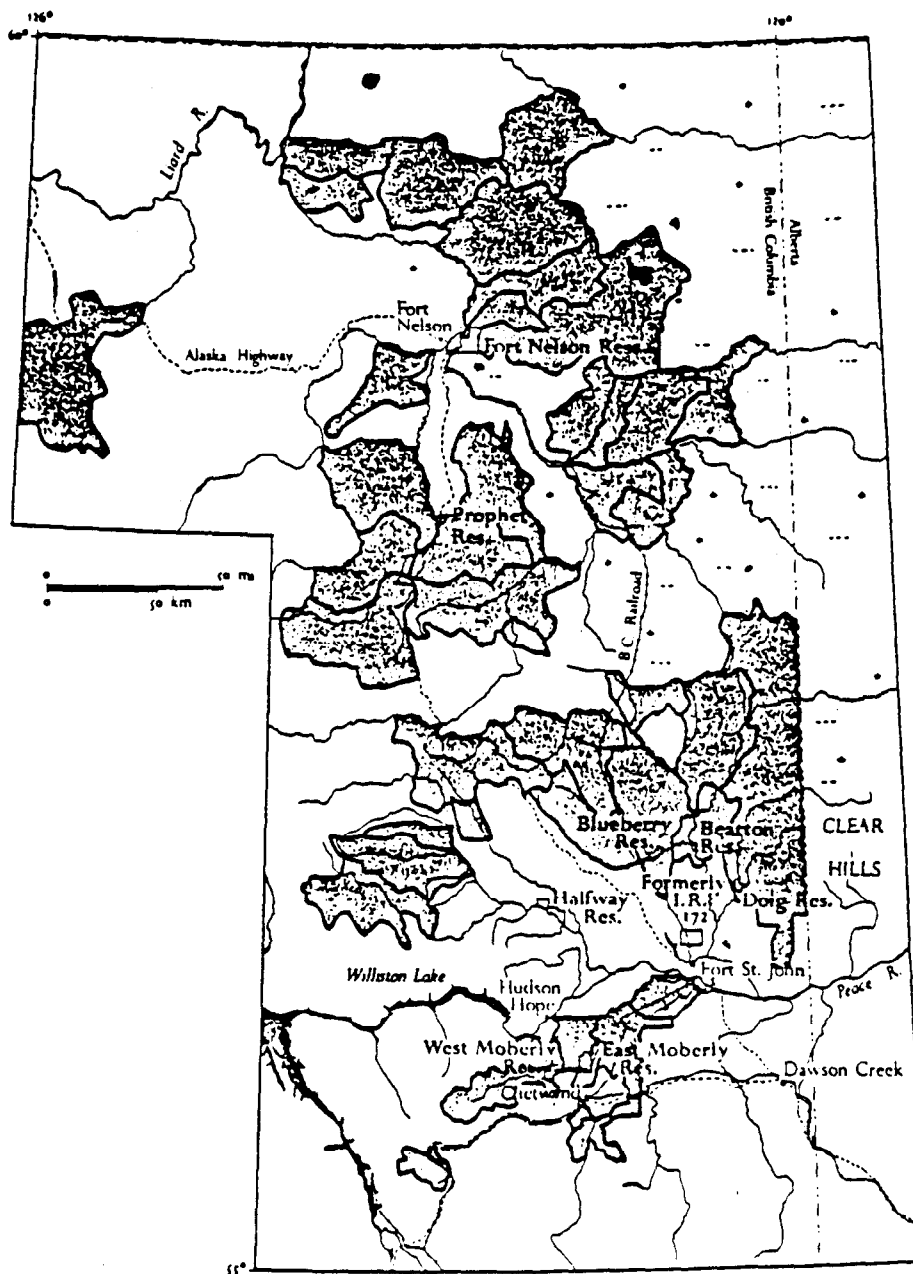


Fig. 16. Traplines registered to Indians, 1979
(taken from Brody 1982:101).

As Brody (1982) describes the underlying question for the north-eastern British Columbia study, the main intent was to determine whether or not the Indian economy had survived into the present and, if so, to document its existence in part through mapping. However, Brody (1982) underscores the significance of providing supporting data to be used in association with mapped data to address this question, including the economic and social history of the study area (for example, fur trade, trapline registration, homestead settlements, forest and oil and gas developments); "sectoral economic analysis" (such as wage employment, quantity and value of resources harvested, and transfer payments); subsistence narrative (for example, changing settlement patterns in response to ecological and other factors, seasonal rounds, changing patterns of land and resource use reflecting ecological annual or seasonal variability); conflicting land uses and competition for resources; and industrial development scenarios.

This study applied levels of analysis of geographic data not encountered in the other Canadian mapping efforts reviewed in this context. Whereas the Freeman (1976) study commented on the accuracy of informant recall in gathering subsistence data (Arima 1976), the British Columbia study provides a more detailed and operationalized assessment of the reliability of informant recall (referred to as the "test of truth"). Although actual methods were not well documented, the study team compared similarities between individual use areas, the consistency of overall use patterns, continuity through time, and reserve-focused core and peripheral hunting, fishing, and trapping areas to establish reliability of informant data. Additionally, they

used economic development scenarios and histories including maps to assess potential land use conflicts. Furthermore, it was determined that traplines and hunting areas were largely one and the same and there existed a continuity of land use patterns between old and young resource users. Finally, it was concluded that competition from sports hunters occurred as a part of frontier development with associated impacts (mostly negative from the point-of-view of the Indian) on access to subsistence resources.

The final major Canadian subsistence mapping endeavor to be described in this context is the Dene mapping project, a largely unpublished data base intended for use primarily in land claims actions. Although the project was conceived by the Indian Brotherhood of the Northwest Territories in 1972, actual data gathering commenced in 1974 and was basically completed in 1976 with funding through the auspices of the Department of Indian and Northern Affairs (Nahanni 1977:22). It was the intent of the Dene that these mapped data would be used in forms and for purposes which the Dene people saw as being appropriate, so the body of data were not published as had been the comparable Inuit data base (Freeman 1976). Except for a few exemplary maps (see Nahanni 1977), the data base has been computerized and analyzed, as need dictates, by faculty, graduate students, and staff of the Department of Anthropology, University of Alberta in Edmonton, Canada, under the direction of Dr. Michael Asch. The Dene have not accepted funding sources which mandate the publication of or public assessability to this data base in the absence of consent.

Specifically, the intent of the Dene project was to develop a data base upon which land claims could be settled and the Dene could secure continued benefit from use of the land; to act as a medium for reestablishing a bond between young Dene and their past; to provide the data necessary for land use decisions and settlements; to provide a record of land use and occupancy of the Dene in the Northwest Territories through time; to provide non-Dene with an understanding of the importance of land to the integrity of cultural identity; to assess and present the costs to the Dene of non-Dene development affecting land and resource use patterns; and to present the Dene point of view regarding lands and resources of sociocultural and socioeconomic importance to them (Nahanni 1977). The Dene perceived that a land claims settlement based on mapped subsistence data would solve many problems related to community-based centralization and related involvement in the cash economy, if such a settlement provided control over land, resources, and associated social, economic, and political processes (Asch 1977).

The Dene project most closely parallels the Inuit Land Use and Occupancy Project (Freeman 1976) in that research objectives focused on documenting the maximum extent of land use as opposed to determining the intensity of land and resource use. As in the Inuit model, the primary descriptive and analytical tool was the map biography.

Methodological variations from the Inuit study included a smaller sample size (30 percent of active hunters) selected on the basis of extensive land use patterns and time depth in the area, since older informants could describe pre-settlement mobility primarily associated

with trapping. The sample was drawn from 24 communities in 5 regions (Mackenzie delta, north Mackenzie, south Mackenzie, north Slave, and south Slave) covering 450,000 square miles, including Dene and Inuit informants, and numbered approximately 1,075 hunters. These data were collected by local people under the guidance of project staff and directly recorded on approximately 1:250,000 scale base maps (T. Abrams and S. Smith, personal communications 1985). Questions asked of informants included: when did you first begin to trap alone? Where did you trap? If you moved to other areas, why? What did you hunt and trap? Where did you fish? Where did you set up camps? What kind of camps? Do you go to this camp every year? How much does land mean to you? What are your views on land? (Nahanni 1977:26). The data were collected to reflect seasonality. Informants depicted use patterns generally with lines rather than enclosed areas, such as was the case in the Inuit project. Examples are not available for inclusion in this study, but maps generally resemble the lineal depictions of traplines in the Inuit Land Use and Occupancy Project (Freeman 1976).

Mapped data were digitized, and trails and trail segments were coded for information concerning species harvested and years and seasons used. The coding process spanned a two person-year period (T. Abrams, personal communication 1985). The cost of computerized analyses of these lineal data resulted in the creation of an alternative data bank based on use within quadrants of a grid overlying the use areas. Levels of analysis included extent of land use, species harvested, and changes through time for both regions and communities.

Specifically, data were compiled into maps depicting subsistence hunting during all seasons from camps; seasonal hunting of caribou; part-time hunting for all seasons from a community base; spring hunting and trapping; winter trapping; all season fishing; and fishing from spring and/or summer fish camps (Nahanni 1977). To date the primary application of these data has been to settle boundary disputes between villages and regions in preparation for land claims settlement (T. Abrams, personal communication 1985).

Supporting studies included basic demographic information, seasonal rounds, harvest breadth, place name data (also mapped), and a narrative of the Dene economic system with attention given to inter-village relationships, patterns of mobility, and patterns of marriage. In some cases, oral histories regarding land and resource uses were taped, whereas other researchers gathered ancillary relevant data recorded in field notes. In yet other cases, no auxiliary data were procured or recorded. It is of interest to note that whereas both the Inuit and Dene projects initially were designed to exclude the collection of quantifiable harvest data or other measures of intensity, Usher (1984) suggests that both the Dene and Inuit have noted that they ". . . need harvest statistics both to exercise the resource management rights they assert, and seek recognition of, and to document their continuing use of and interest in fur, fish, and game resources" (38). Harvest data are now seen to be necessary to support land claims negotiations, future economic planning, and assessments of the impacts of industrial development, including both contemporary and historical information. The Dene believe that these harvest studies

need to be designed and conducted by Dene people using consultation with outside expertise when necessary -- that is, they view the research process to be as important to the Dene's involvement in resource management as the end product itself (Usher 1984:38).

As a final note on Canadian land-use and occupancy studies, the data provided by these research efforts, although largely descriptive in nature, have stimulated and become the subject of, in some cases, more theoretically oriented analyses such as Müller-Wille (1978). Whereas Müller-Wille, a geographer, did not employ mapping as a research method, he utilized geographic-based data from his own work in 1974 and 1975 and from the Inuit Land Use and Occupancy Project (Freeman 1976) to assess the impact of centralization and involvement in the cash economic system on land use and the harvest of natural resources in Repulse Bay, Northwest Territories, Canada. Müller-Wille used mapped subsistence data to ascertain the ideal density of hunter per square kilometer of land in Repulse Bay necessary to support a functional subsistence-based socioeconomic system. He concluded that centralization has led to differential levels of exploitation of subsistence use areas -- that is, areas closest to a community are more heavily used than those at a greater distance from the settlement (Müller-Wille 1978:101). In order for hunters to economically exploit the land base necessary to support community residents, they are required to have access to contemporary transportation technology (e.g. snowmachines, sleds, freight canoes, and outboard motors). This technology requires a significant cash investment. While involvement in the cash system provides the mechanism for acquiring this necessary

transportation technology and thus for exploiting a larger area and increasing harvest yields, it reduces the number of individuals who can derive their primary livelihood from the subsistence sector of the mixed economy. Resources are depleted in areas proximal to the community, thereby creating a condition in which a segment of the community (those without access to the technology essential to mobility) are reliant on other hunters who remain able to produce viably or reliant on transfer payments and other minimal cash support -- or some combination of all of the above. Conversely, hunters with the cash necessary to purchase technology essential to the needs of expanded mobility or resource harvest in shorter time periods (more rapid mobility) are caught in the bind of having to balance their time efficiently between subsistence activities and wage employment. Müller-Wille (1978) concludes, indirectly, that the subsistence-based socioeconomic system essentially collapses into a pattern of land and resource use resembling that of sports hunting and increased reliance on a cash-based economic system. Basically, then, land-use patterns associated with viable subsistence-based socioeconomic systems are difficult, if not impossible, to achieve in the long term from central, sedentary community bases.

ALASKAN LAND AND RESOURCE USE STUDIES

Although it had been an Alaskan study (Foote 1961) which originally inspired the development of Canadian land use and occupancy

studies that employed mapping as a method for gathering, analyzing, and depicting subsistence data (Usher 1984), the use of mapping methodologies for these purposes generally received little attention in the Alaskan context until the late 1970s and early 1980s. Land claims had been settled, more or less, and the need for geographic-based subsistence data originated from somewhat different, although related, questions. An underlying theme connecting these questions was a concern with how proposed non-subsistence land and resources uses would affect subsistence uses and connected sociocultural systems. Specifically, Alaskan subsistence mapping research can be categorized into regional land planning and assessment studies, industrial impact studies, resource allocation-related baseline documentation, and ethnographic or theoretically-focused studies. Two qualifications need to precede this discussion. First, there is no attempt in this context to review each and every mapping effort but only to describe relevant examples from each category delineated above. Secondly, several studies have targeted multiple purposes, so their assignment to one or another category is somewhat arbitrary although based upon their stated primary intents. In almost all cases, subsistence mapping efforts, in fact, have had multiple applications which are included in the discussions below.

One of the earliest post-land claims regional land and resource assessment studies to use mapping as a research tool and to depict subsistence data in a geographic-based format was Patterson (1974). The original intent of this study was to obtain inventories of subsistence resources harvested in every village of each of the 12 ANCSA-

formed regions for the early 1970s and to map the extent of land areas used in harvest. In fact, data were gathered for only 5 of the 12 regions (Arctic Slope, NANA, Doyon, Bering Straits, and Ahtna regions). Since the maps developed in the context of this study are not included in the currently available version of the report, a description of the methodologies used and the portrayal of data are reconstructed from the narrative.

Data gathering techniques varied from region to region, although all employed local interviewers and instruments (surveys) developed by village councils or local Native corporations. However, methodological details (such as sample size, selection of informants, etc.) are sketchy in the Patterson (1974) narrative. Data were assimilated by a Resource Planning Team representing the five regions. "Maps were used to show the extent and use of land areas, and from these overlays were drawn on a scale of 1:250,000 to portray the areas by seasons of the year, or delineated by activity such as hunting, trapping, fishing, and berry picking" (Patterson 1974:1). According to Patterson, the Arctic Slope data were gathered for all communities based on "average annual gathering" (1974:4) for the period 1969 to 1973. It is suggested that the Arctic Slope data may have been gathered from key informants (termed "village representatives" in the narrative). In the NANA region, "maps were used by representatives to delineate subsistence areas, from which overlays were constructed to portray land/water areas utilized in the spring, summer, fall, winter seasons" -- a 30 million acre area, according to the narrative (Patterson 1974:9). The NANA data were gathered in 1972 for a period termed "the

past several years." The Bering Straits Corporation sponsored their survey in 1973, again for a period of time termed "the past several years" by season and included data for 12 of 18 communities in the region. The Doyon region gathered harvest data for four subregions represented by the communities of Fort Yukon, Galena, McGrath, and Tok and surrounding areas, but no graphic information was made available from the Fort Yukon or Tok areas (43 Doyon communities were surveyed for harvest and mapped information). In the Doyon case, data were derived from Native residents, village councils, and relevant committees (Patterson 1974:25), and data were cross-checked with 1967 Bureau of Indian Affairs data. Lastly, the Ahtna survey was conducted in the fall of 1972 with additional data added in 1973. As in the Doyon case, information was derived from "representative regional communities" (Patterson 1974:43).

Supporting data included harvest levels in number converted to pounds dressed weight using Alaska Department of Fish and Game conversion factors. In fact, pounds harvested per capita appear to be the main thrust of the study, but there is no indication that intensity based on per capita harvest criteria was presented geographically. No supplementary supporting data are identified, although it is assumed that resource breadth and possibly seasonal round information were collected based on the questions asked of informants to derive harvest quantities and mapped seasonality of harvests.

It is Pedersen (1979) who provides the initial published link between the Inuit Land Use and Occupancy Project model (Freeman 1976) of the Canadian Northwest Territories and Alaskan subsistence research

through his application of the map biography concept to eight Inupiat villages (Kaktovik, Nuiqsut, Atkasuk, Barrow, Wainwright, Point Lay, Point Hope, and Anaktuvuk Pass) of the North Slope Borough. The intent of the project was to determine the land and sea (ice) uses and associated cultural values of the National Petroleum Reserve of Alaska (known as NPR-A) to aid the planning process of the NPR-A Planning Team. This project was jointly supported by the Cooperative Park Studies Unit of the University of Alaska and National Park Service and the North Slope Borough and conducted under a federal mandate associated with NPR-A land use policies. This study is only one example of the continued interest and participation in and funding of North Slope Inupiat land and resource use and occupancy mapping by the North Slope Borough, which has attempted to develop and maintain a comprehensive temporal and spatial land use computerized data base.

Specifically, the objectives of the multidisciplinary team were to document the extent of land use and the specific resources utilized through time, although there was no interest in gathering harvest levels in this context. Methodologically, the means to accomplish these ends involved interviews of 80 residents of the study communities, with the percentage of total households interviewed ranging from a low of 5 percent in Barrow to 47 percent at Point Lay or 12 percent for the region overall (Pedersen 1979:2). The selection of informants was limited to residents of permanent communities and community-based resource harvest -- that is, except for two cases, periods of "nomadism" were not documented. Most data were derived from males, although some use area insights were derived from females who accompany hunters

for purposes of somewhat separately conducting berry picking or ice fishing activities simultaneously with male hunting. Informants were asked to map the lifetime extent of their use areas for 16 resources or resource categories (each color coded) on a single overlay at a scale of 1:250,000 (Pedersen 1974:1). Each overlay was identified for village, informant, date of interview, and interviewer and included a legend. Data from individual maps were aggregated into 1:250,000 scale village summaries, 1:1,500,000 scale land use on NPR-A summaries, and 1:1,000,000 scale regional summaries by resource category or subgroups of categories and for all resources by village and for the region as a single unit. Regional maps included the number of respondents for each resource category. All community maps were informally reviewed by residents and all resource summaries were corrected for overlap by village, by region, and by resource category.

Supporting studies included, by community, total population, number of households, average household size, number of families interviewed, percentage of households per village interviewed, list of species harvested (with common, scientific, and Inupiaq names), and cultural values for the land (published in a separate volume). Although there is no mapping of intensity in this document, Pedersen refers to initially having "intensive use data" for Wainwright and Point Hope, but provides no details about the criteria used to measure intensity (1979:2). This study also has been used for determining potential land use conflicts associated with oil and gas development by other North Slope researchers and as a model for the application of

Inuit Land Use and Occupancy Project (Freeman 1976) methodologies to the Alaskan context.

In 1978 the Alaska Legislature passed a statute aimed at insuring the continuance of subsistence hunting and fishing and associated ways of life in Alaska. As part of this legislative action, it created a new section (now a division) of the Alaska Department of Fish and Game with a mandate to compile existing data and conduct studies which would gather information on all aspects of the role of hunting fishing in the lives of state residents. Although the division has no authority to make regulations or manage resources per se, its research role has been broadly defined and data generated by its research staff, based throughout rural Alaska, have been applied to the management of resources including allocation decisions, impact assessments, and state and federal habitat assessments and regional planning efforts. From its inception the Division of Subsistence recognized a need to develop and employ subsistence mapping techniques in its research, since land and resource issues to which the division's data were applied required geographic-based information. This study, as previously mentioned, is an attempt to consolidate existing methodologies and provide formal guidelines for the continuance of the division's mapping efforts. Nevertheless, to date the Division of Subsistence has employed a variety of subsistence mapping methodologies, examples of which are described in this chapter and evaluated in the next, to answer questions associated with the categories of research about which this review is organized.

In the context of describing methods associated with regional land and resource assessment and planning efforts, the contribution of the division to the Bristol Bay Management Plan was primarily a mapping effort which did not employ the concept of the map biography as the key element in data collection (published initially as part of the Bristol Bay Management Plan but also separately in Wright, Morris, and Schroeder 1985). In this case, subsistence mapping was part of an overall regional planning effort and was not intended to stand on its own. Research was conducted in virtually all communities of the Bristol Bay Region, which extends from Togiak on the northwestern shore of Bristol Bay to a point on the Alaska Peninsula approximately 50 miles southwest of Port Heiden, and included communities of the Calista region which geographically are located on the northwest perimeter of Bristol Bay (approximately 30 communities). Research was conducted by four division staff primarily during 1980 and 1981.

In early Bristol Bay planning meetings held in villages throughout the region, residents suggested the use of key informants in gathering data (S. Behnke, personal communication 1985). Mapped subsistence data gathered in previous (1973) Bristol Bay research not conducted by the division provided a starting point for this effort. It was decided that data would be gathered for a period commencing with the use of snowmachines to the present -- 20 years in most cases -- as it was known that the use of snowmachines in the area had altered the immediate preexisting land use patterns. It was an assumption of the method that snowmachines had extended existing land use patterns to encompass areas used prior to year-round

centralization in sedentary communities such as during the fur trade period) and beyond, in some cases, to access caribou. Data gathering specifically was aimed at documenting the extent of land used for resource harvest and involved the use of both key informants and group meetings. The number of key informants varied from 1 to 25 or 30 in larger communities such as Togiak. In some cases, key informant data were supplemented by information provided in community group meeting contexts. Mapped data were subsequently reviewed in community meetings for purposes of modification. Individual participation in group meetings varied widely between communities in the study area. Both key informant and group mapping was opportunistic in nature. Resources or resource categories were based on previously gathered data and represented what researchers determined to be "major species or species groups" without being too detailed (S. Behnke, personal communication 1985). One phenomenon encountered in this study which has not been previously discussed was the mapping of harvest patterns associated with the use of aircraft in hunting or trapping. This problem was addressed by mapping only use areas which fell within the Bristol Bay Management Plan perimeters and describing other land and resource uses in narrative.

Data from this project were digitized for computer processing (geoprocessed). Both community and regional maps for all resources or resource categories were generated. This mapping model -- that is deriving data from key informants and groups in order to depict community and regional land and resource use patterns within limited time periods -- has been applied by other agencies and by Division of

Subsistence staff with modifications to other cases of regional or sub-regional land and resource use planning (for example, the joint Kodiak Area Native Association/Division of Subsistence Kodiak Island subsistence study and the current mapping efforts in the NANA Region in association with the habitat guides for northwestern Alaska).

Another example of the application of subsistence mapping to regional planning in general (i.e. the Tanana Basin Area Plan) but additionally to a specific, more restricted problem associated with the state's land disposal program was Martin (1983), another Division of Subsistence project. More explicitly, this study, conducted with approximately a one-month period of fieldwork at Dot Lake in 1982, was in response to the projected sale of the Sam Creek Subdivision in 1983 approximately four miles northwest of Dot Lake. Its purpose was to document contemporary demography; resource harvest patterns contemporarily and historically (including maps); methods and means of harvest, preparation, and distribution of resources; the cultural significance of wild resources; and contemporary wage employment. Mapping, then, was one of several data gathering techniques and subsistence maps were among the end products in this study context (Martin 1983:1).

Methodologically, Martin (1983) modeled this study after Freeman (1976) through her use of the map biography. She compiled map biographies on 1:63,360 scale maps for primarily males, with input from females regarding fishing and gathering, for 11 of the 15 (73.3 percent) households in Dot Lake, and for a time period from the founding of the community in the 1940s to 1982. In the case of moose,

Martin (1983) produced two maps for different time periods -- 1946 to 1965 and 1966 to 1982 -- seemingly to demonstrate the impacts of more restrictive moose hunting regulations on resource and land use patterns, although this rationale was not specifically stated in the study's methodology. As in Freeman (1976), individual map biographies were compiled into a community composite and reviewed in a public meeting at Dot Lake.

This study was analytically significant in depicting community subsistence use areas on 1:125,000 scale maps overlying a delineation of the Sam Creek Subdivision. This comparative technique was also described in Weinstein (1976) and will be noted in descriptions of other studies within and without the Division of Subsistence.

Pedersen, Coffing, and Thompson (1985) present a more elaborate development and refinement of the Inuit Land Use and Occupancy Project model (Freeman 1976) than did Pedersen (1979) for application to the North Slope Borough community of Kaktovik. The primary purpose of this relatively long-term study (in excess of three years) is to document Kaktovik residents' historic and contemporary land and resource use against a backdrop of rapidly changing land status and land use patterns on the Arctic Slope related to state and federal oil and gas development, the Arctic National Wildlife Refuge, the Gates of the Arctic National Park, and economic development schemes of the Arctic Slope Regional Corporation (ASRC). Specifically, the purpose of the study was a ". . . delineation of the contemporary spatial requirements of hunting, fishing, trapping, and gathering sector of Kaktovik's economy" (Pedersen, Coffing, Thompson 1985), including a

documentation of each major resource category on 1:250,000 scale maps, distribution and exchange information, a basic village socioeconomic profile, documentation of Inupiaq place names, a seasonal round, an overview of present land status within the community's use area, and the creation of a mapped data base amenable to cartographic automation by the North Slope Borough Geographic Information System, the Department of Natural Resource's Alaska Land and Resource System, and Division of Habitat's Alaska Wildlife Habitat Information Network (AWHIN).

~~Methodologically~~, this study employed the map biography focused on the community from its inception in 1923 to 1983. The study team completed 21 map biographies (2 of which were from a husband and wife in the same household) gathered from primarily heads of households including data from any other household member who wanted to participate in the mapping session. Of 46 total households in Kaktovik, 7 were short-term, 3 were determined to have non-active hunter household heads, and of the remaining 36 households, 20 were assessed to have the best hunters who were available and who were willing to participate in the study. Additionally, four single year maps (1981 to 1982) were completed for four active hunters. The data gathered were for 16 resources or resource categories (referred to as "land use categories" in the study). Formal interviews were conducted in English or Inupiaq using a local bilingual research assistant, and informants were paid an hourly wage for formal sessions (which ranged from two to five hours each). In addition to mapping harvest areas, the study also spatially documented camps and the approximate location of kill sites

of caribou. All land use patterns mapped were based on access by surface transportation modes as was the case in the Bristol Bay study. Composite maps were returned to Kaktovik for review by the community prior to analysis.

In terms of analysis, the Pedersen, Coffing, and Thompson (1985) study involved more complex procedures than have previously been described for Division of Subsistence projects. (Since this study is in draft form at the time of this writing, no mapped examples can be included in this discussion, however.) The research team verified some aspects of the accuracy of informant recall by conducting aerial surveys of the travel corridors reported by informants as indicated by the impressions of tracked vehicles left on the tundra in the spring and by participant observation. Additionally, cap sites and kill sites were verified by aerial and ground surveys. There were four steps of aggregation for community maps: (1) all land use information for each resource category was aggregated on separate overlays; (2) the maximum boundary for each resource category was delineated; (3) maps were drafted; and (4) all resource categories were aggregated on one overlay, depicting the maximum areal extent of Kaktovik's subsistence land use from 1923 to 1983. Community-based land use maps from a previous study (conducted in the mid-1970s) were combined with this study's data to extend the boundaries where they didn't conform in maximal extent. Data from the four 1981 to 1982 maps were compared to the map biography composites to analyze changes through time. Rates of participation (calculated as a percentage) were provided for each resource category in tabular form. Additional measures of intensity

were introduced by calculating the number of square miles used for each resource and determining the percentage of the total area used for the harvest of each resource (eliminating overlap). Furthermore, on a household basis, the study examined the range of square miles and resource categories used for the smallest and largest total map biography areas gathered. Finally, this research team perceives subsistence mapping to be a on-going process with increasingly complex levels of analysis (S. Pedersen, personal communication 1985). Towards this end, all geographic-based data from the Kaktovik project have been digitized to facilitate subsequent modification and analysis based on future research and updates.

The second major category of subsistence mapping application in the Alaskan context is industrial impact studies. The vast majority of these studies have been conducted under the auspices of the Socio-economic Studies Program (SESP) of the Alaska Outer Continental Shelf (OCS) Office (now referred to as Minerals Management Service). One of the earliest of these reports to apply a land and resource use mapping methodology was Wolfe (1981), actually completed under subcontract with the Division of Subsistence, Alaska Department of Fish and Game. The Wolfe (1981) study is a baseline description of the economy and culture of residents of the Yukon River delta as they existed in 1980 to 1981 based on fieldwork conducted during the summer of 1981. This research specifically was in response to OCS lease sale 57 off the Yukon delta. Particular research objectives included the identification and mapping of general settlement and resource utilization

patterns (Wolfe 1981:18) of the communities of Alakanuk, Emmonak, Kotlik, Mountain Village, Sheldon Point, and Stebbins.

Methodologically this study differs from those described above in that it not only mapped the areal extent of resource use (in the case of salmon and marine mammals) but also the sites located on waterways or bodies of water from which, or at which, fishing activities occurred during the summer of 1981. More maps are devoted to the locations of sites and fishing gear types than to denoting fishing areas. Data were not derived from map biographies but rather were elicited via interviews with recommended (by the community), knowledgeable key informants and opportunistically field verified in a minority of cases. Salmon fish camp locations were compiled by asking several knowledgeable informants to indicate on a 1:63,360 scale topographic maps the current locations of the summer fish camps of a list of household heads, the responses from key informants were compared, and a locational consensus mapped (Wolfe 1981:23). Fish camp locational data from all study communities were aggregated into a single map (see Figure 17). Secondly, Wolfe mapped the locations of nets, traps, and hooking sites for non-salmonid fish species in 1981 for each study community (see Figure 18 for an example). General salmon harvest areas -- that is the entire area in which salmon were sought or the entirety of all lower Yukon channels -- were mapped as were coastal areas in the vicinity of Stebbins. Additionally, Wolfe mapped very general marine mammal hunting areas depicting snowmachine access to the edge of landfast ice in winter and fall offshore marine mammal hunting areas -- in both cases data from all study communities

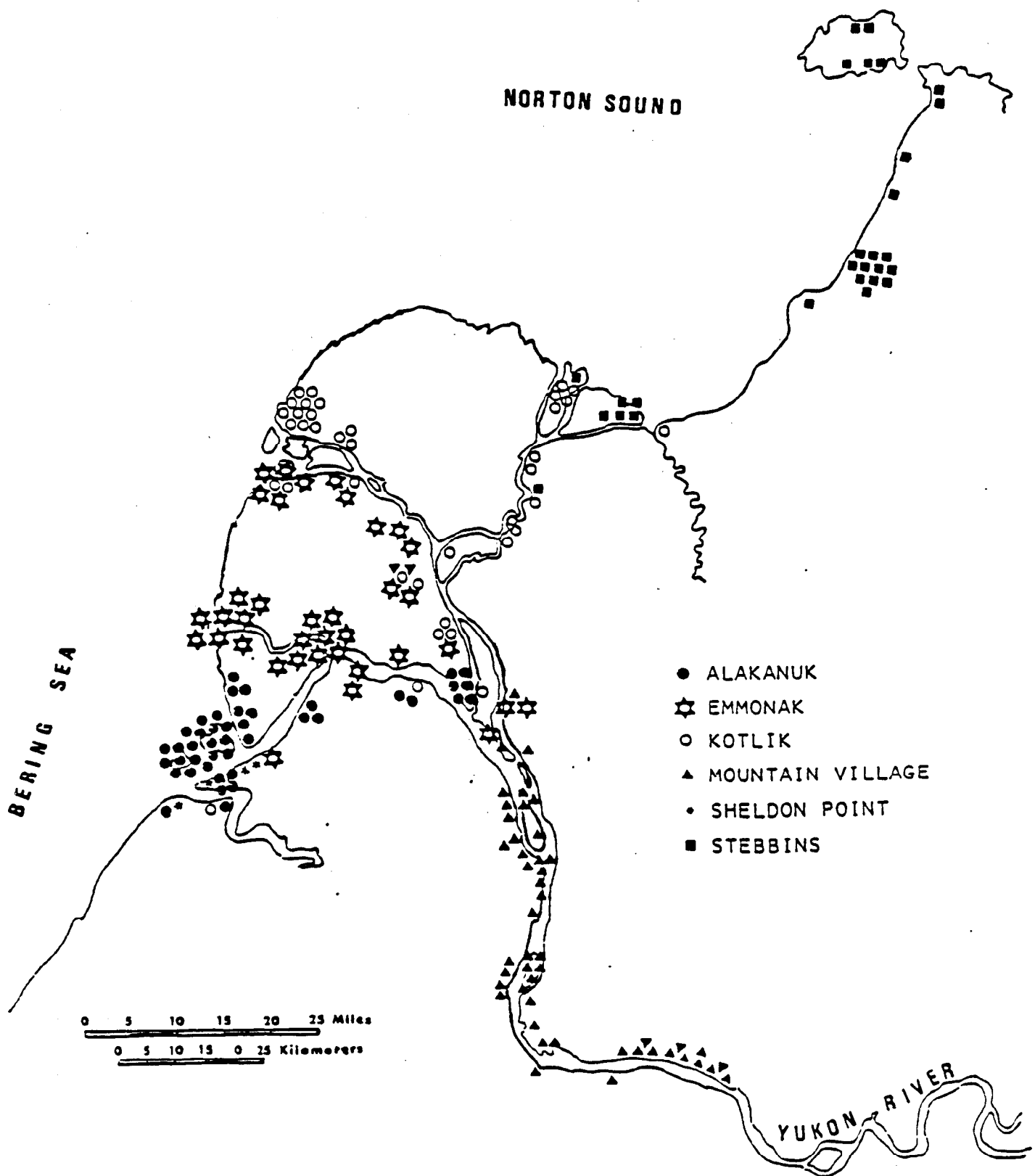


Fig. 17. Approximate locations of summer fish camps of households from Alakanuk, Emmonak, Kotlik, Mountain Village, Sheldon Point, and Stebbins in 1981 (taken from Wolfe 1981:43).

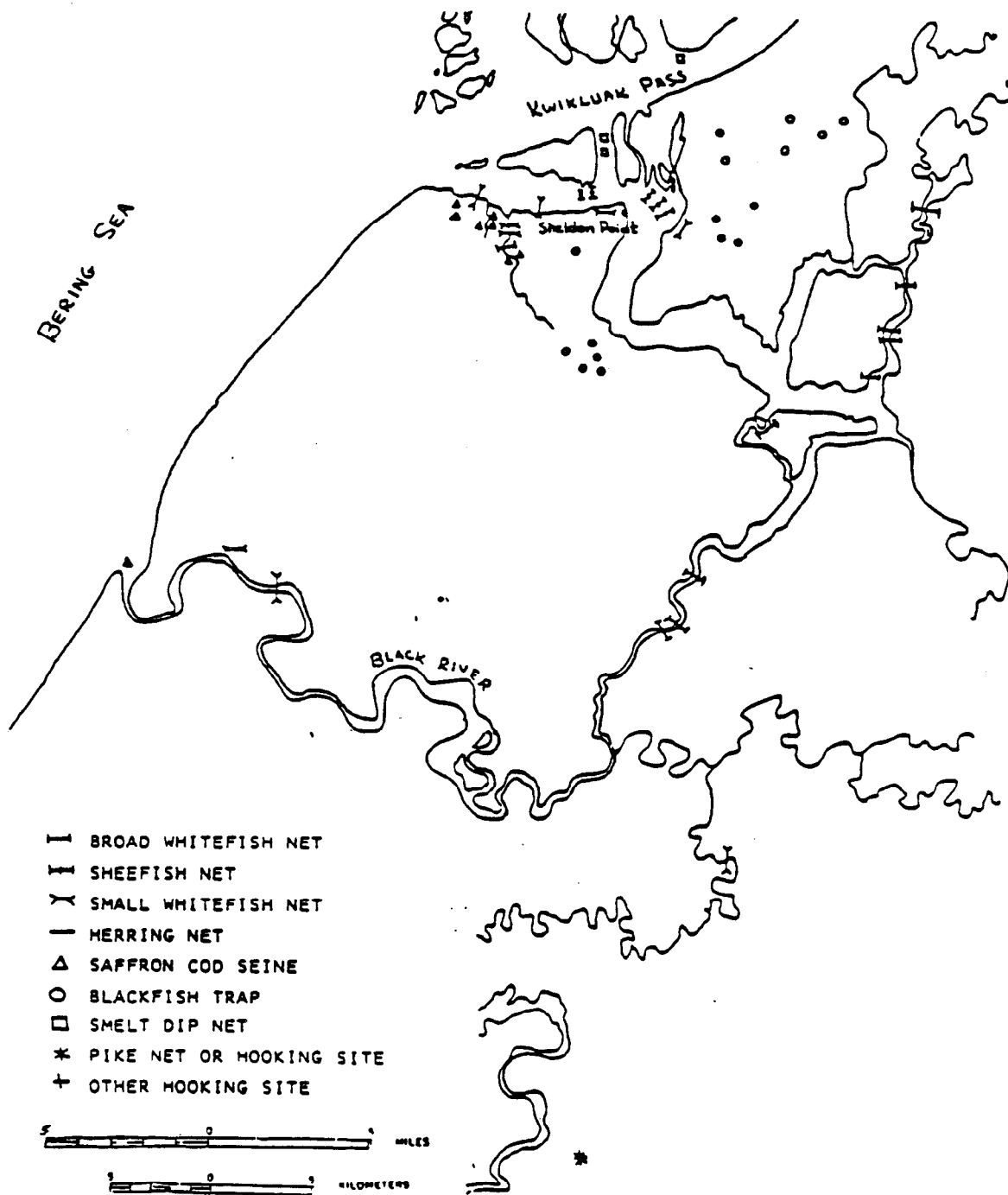


Fig. 18. Fishing locations for non-salmon fish species, June 1980-May 1981 of a sample of households from Sheldon Point (n=7) (taken from Wolfe 1981:117).

were aggregated on a single map. Sample size was 88 households (or a 20.7 percent study area sample). Data were gathered with the assistance of a local bilingual research assistant in each community and were elicited from both spouse and head of households interviewed. Sample sizes from which data are derived are included on most maps.

Analytically, Wolfe (1981) plotted community use areas on a single map for some species to derive conclusions regarding the overlap of community-based subsistence patterns. He analyzed the proximity of salmon and non-salmonid fishing sites to the winter village. Based on mapped and other interview data, Wolfe explored concepts of "territory" in relation to "usufruct rights" in the context of explaining community, household, and individual subsistence patterns. Lastly, by integrating kinship and land and resource use pattern data, Wolfe explored the role of kinship in subsistence patterns.

In conclusion, supporting data included in this study entailed the documentation of the kinship composition of production, distribution, and exchange networks; seasonal rounds; percentage of participation in salmon fishing from winter village sites; harvest levels; the cash sector of the study communities' economies; and consensual conventions relating to land and resource access. This study has been used for resource allocation, subregional planning, and baseline ethnographic purposes despite its roots in industrial impact baseline assessment research.

Two studies, funded by the Minerals Management Service's (Bureau of Land Management) Socioeconomic Studies Program, to develop a

baseline or renewable resource use patterns for the communities of Unalakleet, Gambell, and Savoonga, against which harvest disruption scenarios could be compared, are Jorgensen (1984) and Little and Robbins (1984) respectively. Since both studies were developed by the same consultant firm with similar research designs, they will be treated jointly in this description and subsequent evaluation. Whereas the geographic extent and comparative intensity of use areas are inherently a part of impact assessment studies in general (Usher 1984) and of interest to Minerals Management Service in particular, these studies demonstrate the subordinate role which subsistence mapping methodologies play in this context despite the use of maps in each of the studies. While no precise mapping methodologies are presented in these studies, descriptions of the overall study plan and of the mapped end products can be used to elucidate geographic-based data gathering procedures.

The Unalakleet and St. Lawrence Island research was conducted over a period from April 1982 to January 1983 and from February to August 1982 respectively, although neither field efforts were continuous during these periods. Both made use of bilingual Native assistants. Neither study team employed systematic surveys, formal structured interviews, nor random sampling in any segment of data gathering, but relied instead on anthropological observation, informal and open-ended topically focused protocol interviews, participation, and archival data gathering techniques (Jorgensen 1984; Little and Robbins 1984). "As a result of such focused but unstructured questioning, along with the expertise of the Native field assistants, hunting and

fishing areas were mapped, . . ." (Little and Robbins 1984:5). In general, interviews focused on knowledgeable (key) informants. Little and Robbins (1984) argued that by studying community social networks and the structure and function of community institutions, that a non-random and relatively small sample allowed for repeatable comparisons among families (networks) and institutions and an understanding of the community as a whole. Jorgensen (1984) produced 27 maps depicting 28 species or species categories, including several summary maps for types of resources (such as "all marine mammals"). In all cases, use areas were distinguished by intensity, with one symbol depicting "area of usual extraction" and another symbol depicting "area of more limited extraction," but there are no methodological insights into the criteria used to distinguish between these two types of harvest areas. For all marine mammals, it is noted on the maps that animals are hunted "80 miles west in difficult years." Little and Robbins (1984) mapped 27 species or species categories for both communities or 3 maps, using alphabetic symbols for each species, with upper case letters for one community and lower case for the other. No areas (enclosed spatial dimensions) were associated with species codes. Little and Robbins (1984) mapped camping sites for both Gambell and Savoonga, indicating the number of households using each site..

Supporting data in these studies included harvest statistics, seasonal rounds, methods and means of harvest, use of resources by residents, kinship networks, exchange and distribution patterns, and

the makeup of social institutions. Virtually no analysis connected with the geographic data depicted in the harvest maps was attempted.

The last industrial impact (oil and gas related) study to be described in this context is Braund and Burnham (1984). Its purpose was to provide information on the current patterns of subsistence use of marine resources by the communities of Point Hope, Point Lay, Wainwright, Atkasuk, and Barrow in the North Slope Borough. Coastal lands and offshore areas were the focus of the study in conjunction with the underlying offshore oil and gas developmental concerns driving the study program (Braund and Burnham 1984:174).

Fieldwork was the key means of gathering data except in the case of Wainwright, where previously documented data bases were applied to this project. Key marine resources, including bowhead and belukha whales, seals, walruses, fishes, and birds, were mapped on the basis of interviews with active "knowledgeable subsistence harvesters" aged 20 to 60 years. No harvest areas of inactive hunters were mapped. The number of interviews conducted in each community varied and were noted in conjunction with some of the maps. The focus of the study was on present land and resource use patterns -- that is, the past five year period -- referred to as "intensive use areas," a measure of intensity based on the criteria of recency and possibly continuity through time. Secondly, respondents were asked to delineate the farthest limits they remembered going to harvest a particular species in their lifetimes -- referred to as "maximum use boundaries." Both time periods were delimited by different symbols on 1:500,000 and 1:1,000,000 scale topographic maps reduced for presentation in the

report. Not all resource categories were depicted for each community if, of course, one or more resource categories were irrelevant given the ecological and subsistence patterns of the area. Each map was accompanied by explanatory narrative. Since Atqasuk residents largely obtain marine resources in Barrow, marine mammal harvest areas of the two communities were mapped jointly and spring and fall whaling areas portrayed on discrete maps.

In analyzing mapped data, Braund and Burnham (1984) concluded that current (past five year period) hunting ranges demonstrated continuity with extensivity ranges established by recall of key informants. The Wainwright data were not ideally comparable because they were derived from previous research with a dissimilar methodological framework. This study was only one segment of the larger Barrow Arch Synthesis document of the Outer Continental Shelf Environmental Assessment Program and NOAA's Ocean Assessment Division.

As a result of the 1978 Alaska State subsistence legislation which spawned the creation of the Division of Subsistence within the Department of Fish and Game and the division's legislatively mandated functions described above, virtually all of the research products which have emerged from statewide studies have been (or most likely will be in the future) applied to resource allocation policies and decisions. However, as has been described above, many of the studies have served other primary land and resource planning functions. Since resource allocation has been the primary thrust of much of the division's efforts to date, a very recently published, comprehensive, and long-term study was selected as an example of this category of

subsistence mapping methodologies. Firstly, it was expected that this study would represent the methodological refinement which has evolved in Division of Subsistence research, particularly focused at questions of resource allocation. Secondly, this example is derived from inquiries into patterns of resource harvest and use in the relatively small (273 people), Dena'ina Athabaskan community of Tyonek, located on the northwestern shore of Cook Inlet, a mere 43 air miles from Alaska's largest urban center and within an area subject to fierce resource competition from Anchorage's expanding population and competing land uses associated with non-renewable natural resource development (particularly coal and hydrocarbons), recreation, agriculture, timber, and geothermal energy. This study example, Fall, Foster, and Stanek (1984), is the culmination of multiple short-term or interim research endeavors in Tyonek conducted between February 1980 and January 1984. It is intended to describe contemporary patterns (that is, late 1970s to 1984) of resource harvest and use and, in that context, to map land and water locations of current and historical resource use areas known to knowledgeable residents.

The Fall, Foster, and Stanek (1984) study was not modeled specifically after any other single methodology but rather combined elements of mapping methods developed in previous Division of Subsistence projects. In fact, the final product, differing from other research reviewed above, was a synthesis of multiple mapping methodologies applied to interim products -- for example the sample size and time period mapped varied with the species under consideration and the resource allocation questions being asked of the interim study. In

all cases, land and resource use data were gathered on 1:63,360 scale topographic maps (1:250,000 scale did not provide enough detail) via interviews with individuals or a number of individuals who independently harvest residing in the same household rather than in a group meeting context. Data were derived from these key informants selected on the basis of a long history of use of resources and experiences in Tyonek (i.e. the primary producers of community) for all species during a five year period of time (1978-1982), and individual data were aggregated into community-based land and resource use extensivity maps. A single map for all species categories from 1978 to 1982 was also produced.

Several aspects of methodology varied between the geographic sub-sets of this study. For most of the 14 species or species categories, the study team collected geographic-based data from 39 of the 72 total long-term resident households (see Figure 19 for an example). For the five year period (1978 to 1982), key informant mapped data were verified by a 100 percent sample of long-term households -- that is, by the 33 households which did not contribute to the original development of the maps. Based on supporting harvest and other data, the study team had anticipated that 40 to 50 percent of the households with active resource harvesters provided approximately 90 percent of the community supply of wild foods distributed through sharing and exchange networks) (D. Foster, personal communication 1985). Therefore, it was anticipated that these active harvesters were representative of the remaining households in terms of extensivity of use areas -- a correspondence which was ostensibly verified for only the five

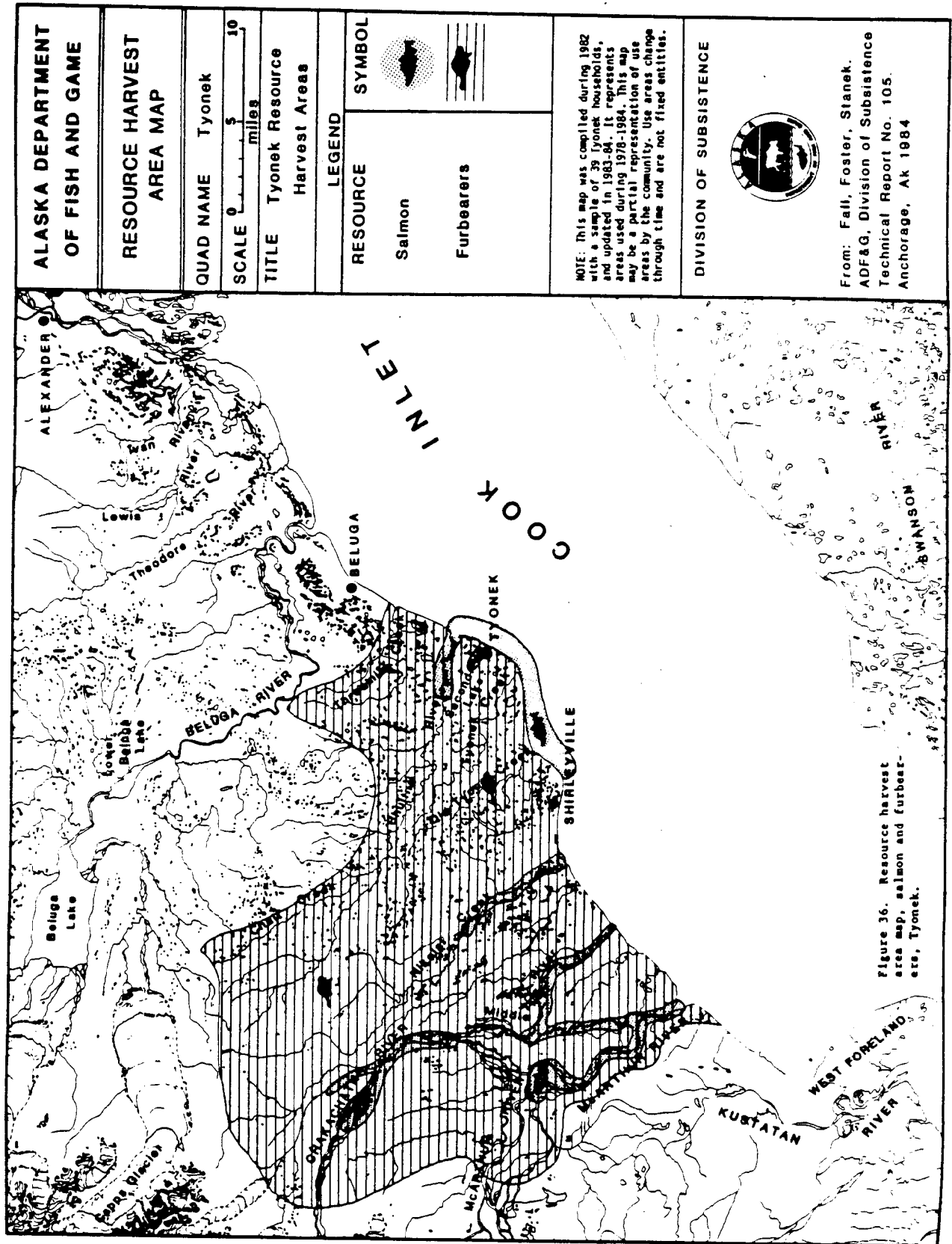


Figure 36. Resource harvest area map, salmon and furbearers, Tyonek.

ALASKA DEPARTMENT OF FISH AND GAME

RESOURCE HARVEST AREA MAP

QUAD NAME Tyonek

SCALE 0 5 10 miles

TITLE Tyonek Resource Harvest Areas

LEGEND

RESOURCE	SYMBOL
Salmon	
Furbearers	

NOTE: This map was compiled during 1982 with a sample of 39 Tyonek households, and updated in 1983-84. It represents areas used during 1978-1984. This map may be a partial representation of use areas by the community. Use areas change through time and are not fixed entities.

DIVISION OF SUBSISTENCE



From: Fall, Foster, Stanek.
ADF&G, Division of Subsistence
Technical Report No. 105.
Anchorage, Ak 1984

year period by the 100 percent sample of households. While the study team states that all 46 active moose hunting households drew maps (Fall, Foster, and Stanek 1984:8), the moose harvest map, which represents a composite of the periods 1978 to 1984, represents a sample of only 39 households according to its legend. Separately, sub-units of the generalized hunting area, defined on the basis of transportation and access means and, more indirectly, on moose distribution and weather factors, were depicted and analyzed on the basis of productivity -- that is, the number of man-days expended per moose harvested per area for 1981. The actual productivity of the sub-units was not mapped nor calculated on the basis of distance, area (harvest per square mile), or other geographic measurements. The only species and time periods for which seasonality was applied to mapping were moose during the months of September and November 1983 and January 1984. These three months were mapped separately because of perceived moose migration and accessibility to moose as a function of weather conditions. Traplines were mapped for the 39 household sample for the period of the trappers life or during his occupancy of the community in cases in which the trappers' age exceeded the tenure of Tyonek as a community, as data suggested the patrilineal inheritance of traplines in historic times (D. Foster, personal communication 1985). Lastly, fish camp and set net sites were mapped.

Analysis of moose hunting in sub-units by access and productivity has already been described. Additionally, the study team ascertained that moose hunting areas reflected regulatory constraints and that there had been some shifts in access corridors and associated methods

and means related to the construction of logging roads in the Tyonek area. These changes involved a decreased reliance on riverine boat harvest patterns and an increased use of vehicles on logging roads as a means of wild resource harvest. These changes were not depicted in a mapped format, however.

Supporting studies included harvest quantities; methods and means; technology; regulatory histories for salmon and moose; community demography; harvest breadth by household percentage; seasonal round; production, processing, and distribution networks; household case studies; habitat maps and narratives; and features of the cash sector of the economy. Thus, mapping in this context was only one of several data gathering techniques, tools of analysis, and end products -- that is, this was not primarily a subsistence mapping study, but mapped data were integrated into the overall wild resource harvest and use configuration of the community of Tyonek.

The final category of the use of subsistence mapping methodologies in Alaskan land and resource use research includes studies which are primarily ethnographically or theoretically focused. In this context one ethnographic example and three more theoretically oriented examples, ~~four~~ one associated with the use of mapping to develop models of traditional land-use areas, the second with the ANCSA settlement and carrying capacity, and the third with the degree to which traditional land-use patterns and territoriality demonstrate continuity with contemporary subsistence harvest patterns -- are considered. Whereas none of these examples could be termed major mapping methodologies per se, each demonstrates the application of subsistence

mapping to the task of basic ethnographic or ethnohistoric description or to hypothesis testing and related model building. These cases, then, are primarily meant to provide paradigms of subsistence mapping application.

The first of these examples, Nelson, Mautner, and Bane (1982), is an attempt to document Koyukon and Nunamiut subsistence patterns in the past and present, including the significance of subsistence in the Native economy, the knowledge and perceptions which underlie subsistence activities, the role of subsistence activities in overall cultural patterning, and disruptions of traditional land-use patterns (Nelson, Mautner, and Bane 1982:7). The development of these data provided ethnohistoric and ethnographic description of land and resource use patterns associated with the area encompassed by Gates of the Arctic National Park. Field research was conducted in Koyukon River villages and Anaktuvuk Pass (including scattered settlements) from 1975 to 1976. A major component of this data base was the documentation of land areas known and used for subsistence purposes.

The methodology of study involved paid formal and informal interviews with key informants (defined as being "especially knowledgeable"), from the communities of Huslia, Hughes, Allakaket, Alatna, Evansville and Anaktuvuk Pass, to document place names and subsistence areas through household surveys and map interviews. Members from approximately 90 percent of the households in the study area were asked to locate specific places in which they carried out subsistence activities and to define general areas used for procuring various resources over the past two decades (Nelson, Mautner, and Bane

1982:10) (sites and areas were both depicted). The study team selected USGS quadrangles or portions of quadrangles (1:250,000 scale) primarily along drainages of the study area to depict subsistence-related structures or sites (such as caches, cabins, fish camps, etc.), travel corridors, and resource harvest sites or areas (some keyed to seasonality and others to means of harvest). Each resource or resource category was depicted by alphabetic codes and/or symbols and only a single legend was provided at the beginning of the appendix. Harvest areas were distinguished from sites by encircling the species code to depict area (see example in Figure 20). Each specific map area was provided an alpha-numeric code for reference to a master map of the study area (see Figure 21). In addition to the specific maps in the appendix, two very general areal maps (1:2,500,000 scale) of distinct harvest activities (traditional sheep hunting and trapping) were included in the text and distinguished between the use areas of the Anaktuvuk Inupiat and Koyukon Athabaskans. There was no indication of the methodology employed in compiling data for these latter two maps. The two very general maps portray territorial distinctiveness between the Athabaskans and Inupiat in relationship to these two activities rather than the specific harvest patterns within the study area (see Figure 22). Although specific analytic techniques were not described, the study team associated conclusions concerning subsistence range, centralization, mobility, dependency on subsistence, and land ownership patterns with mapped data in the context of the narrative.

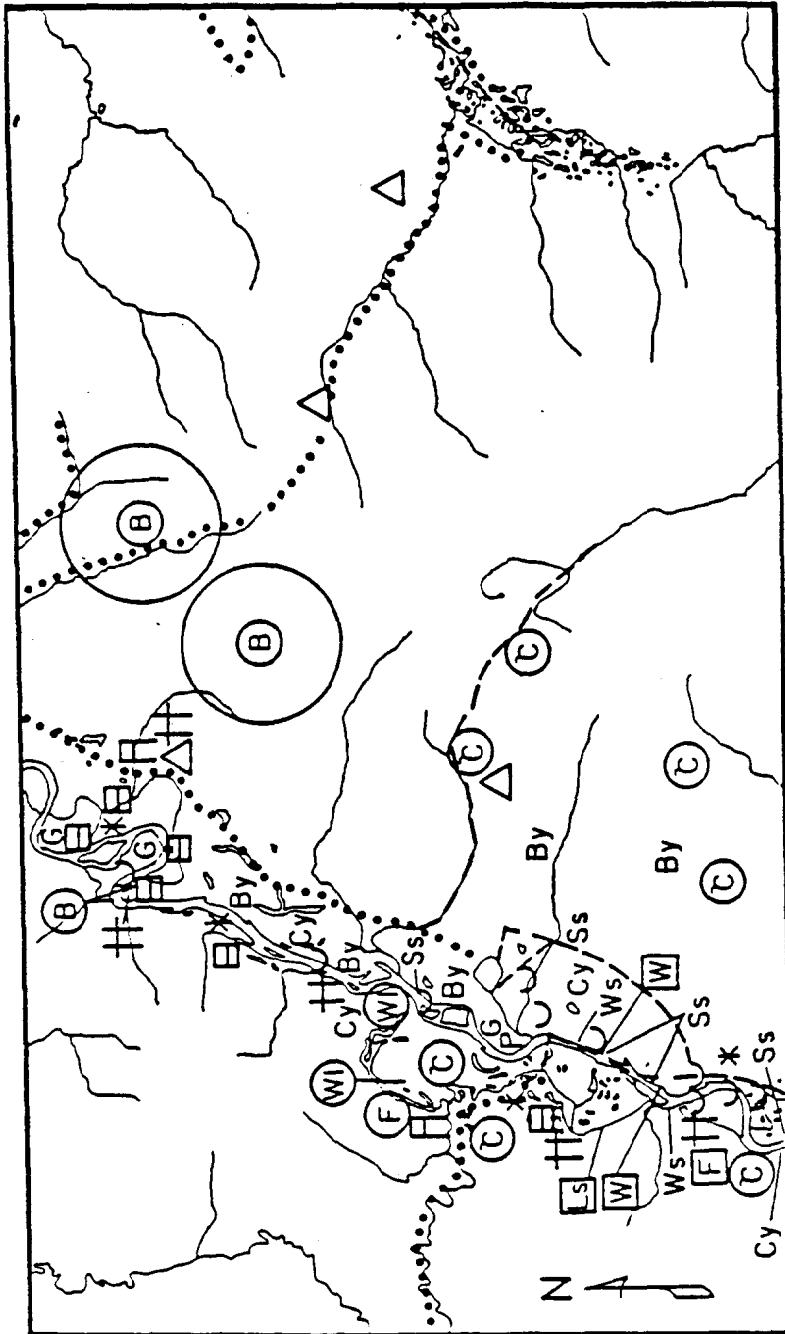


Fig. 20. Resource harvest sites and areas in Section B-3 of the study area (near Hughes on the Koyukuk River) (taken from Nelson, Mautner, and Bane 1982:374).

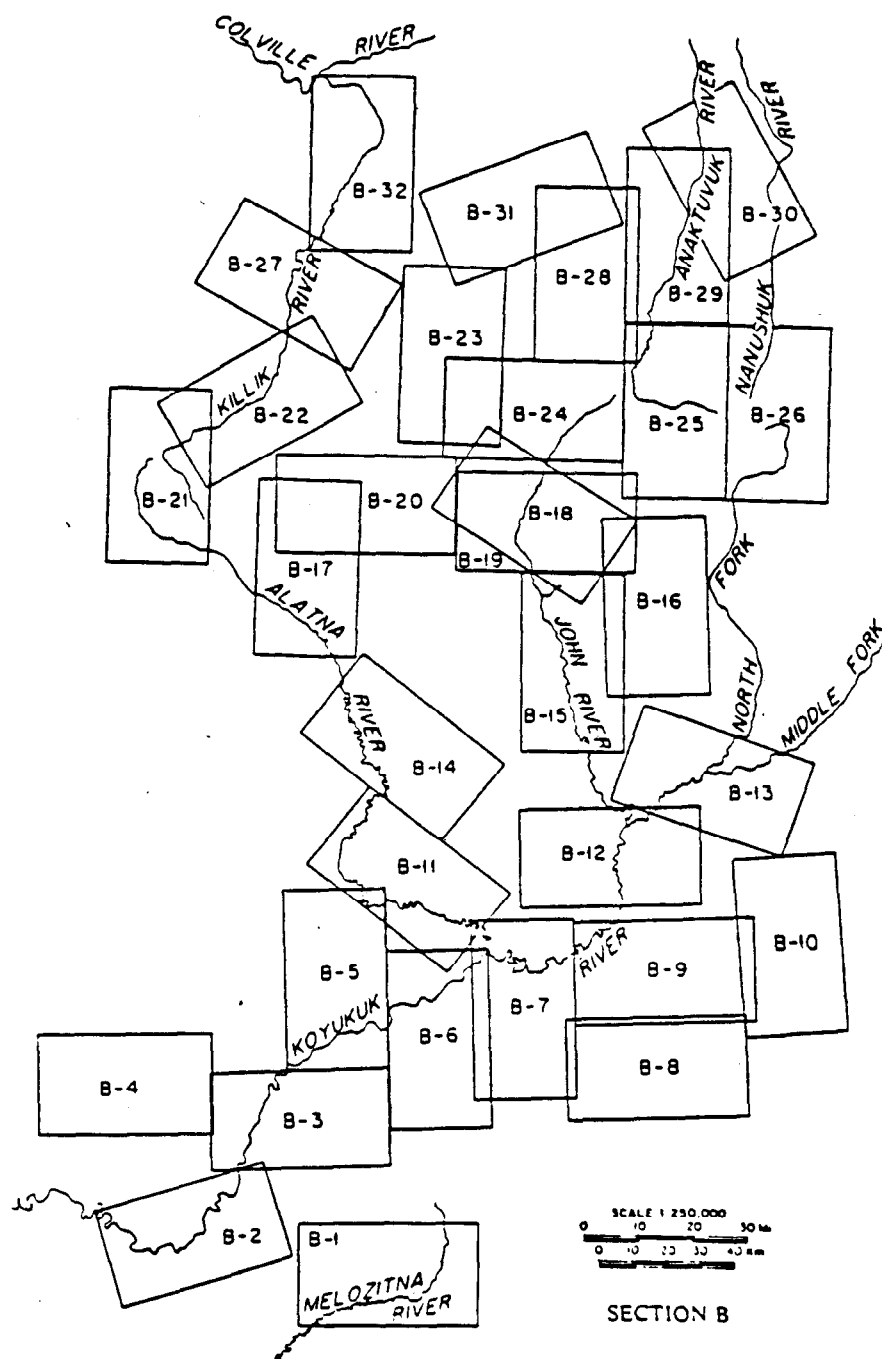
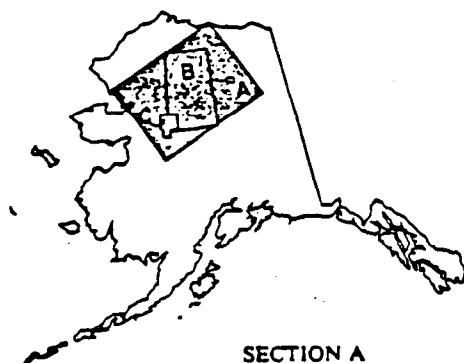


Fig. 21. Distribution of subsistence maps within the study area (taken from Nelson, Mautner, and Bane 1982:371).



SECTION A

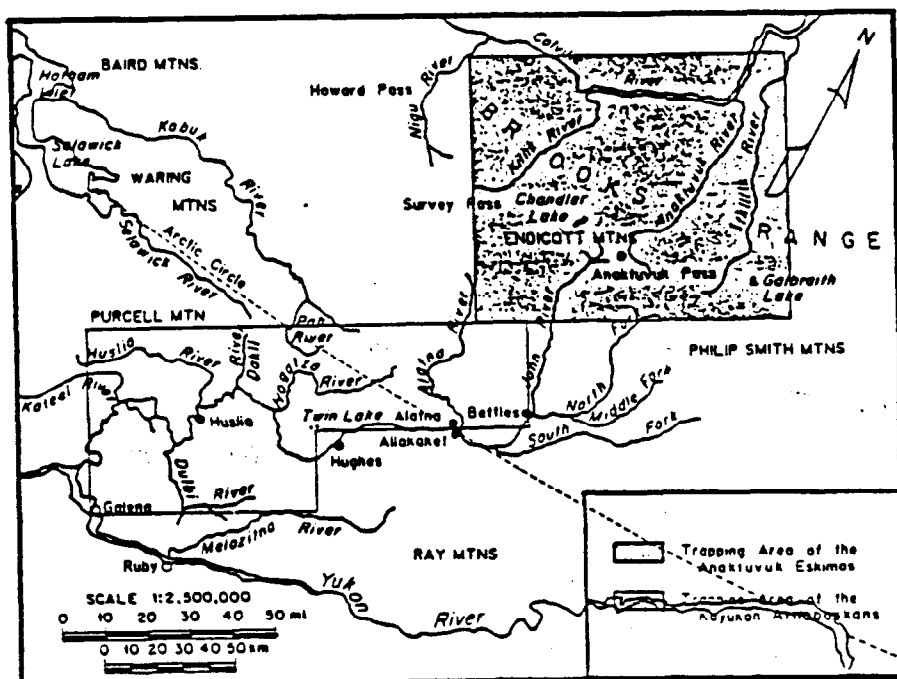


Fig. 22. Traditional trapping areas of Kayukon Athabaskans and Anaktuvuk Pass Inupiat (taken from Nelson, Mautner, and Bane 1982:58).

Supporting studies included relationships between resource fluctuations and subsistence activities, methods and means, cultural beliefs and practices associated with subsistence, harvest breadth, harvest quantities, and caribou migration routes (mapped). As in many other examples of the application of subsistence mapping to the documentation of overall subsistence patterns, mapping was only one of many methodologies employed in this study. This study was applied to planning in the Gates of the Arctic National Park, although it provided subsistence data of greater temporal and spatial depth and ethnographic quality than is usually associated with applied studies.

The first of the theoretical examples is Burch (1981), which was intended to develop a comprehensive model of traditional land use patterns of the Tikirarmiut of Point Hope between 1800 and 1875. This temporal framework was selected as the latest possible period prior to significant Euroamerican influence, referred to as the "traditional period" by Burch (1981:1). Burch's thesis is that the Point Hope economy, and therefore use of the land, was much more comprehensive and sophisticated than either Native theory or literature suggest (1981:2). Research took place during the years 1969 to 1970 and early 1981, incorporating primarily field data, early historic accounts, and relevant data gathered by other researchers.

The methodology employed in this study is unique in this context, because the maps were not meant to depict actual land and resource use patterns for the study period (1800 to 1875) but rather to depict a model of what these patterns may have been traditionally. Since Burch (1981) could not inquire directly from informants about what areas

they used from 1800 to 1875 for resource harvest activities, he reconstructed subsistence patterns geographically based on documented accounts from eyewitnesses, oral histories, knowledge of contemporary human ecological adaptations to the area, archaeology, the distribution of flora and fauna historically and contemporarily, and the application of concepts of hunter-gatherer territoriality to the Tikirarmiut.

Burch identified 315 "major" faunal and floral species, of which 70 were known to have been important to the Tikirarmiut (1981:8). These species varied temporally and spatially by season and by longer-term annual or cyclical fluctuations. However, Burch maintained that despite variation, predictions could be made about the probably location of resources during specific seasons of the year because of species patterning. Additionally, Burch used historical, archaeological, and oral historic data to compile a map of year-round and seasonal settlements (see Figure 23). Seemingly, by comparing the probable seasonal location of resources with the location of known settlements, Burch was able to hypothesize population distribution by season associated with resource harvest activities (see Figure 24 for an example). These hypothesized distributions were based, in part, on the assumption that Inupiat settlement location in the traditional period was a product of food resource availability, water accessibility, wind, terrain, the non-empirical environment, and the mobility of hunters (Burch 1981:37). It is expected that hypothesized settlement patterns also were substantiated by contemporary subsistence patterns. Based upon these data. Burch constructed a model of movement to

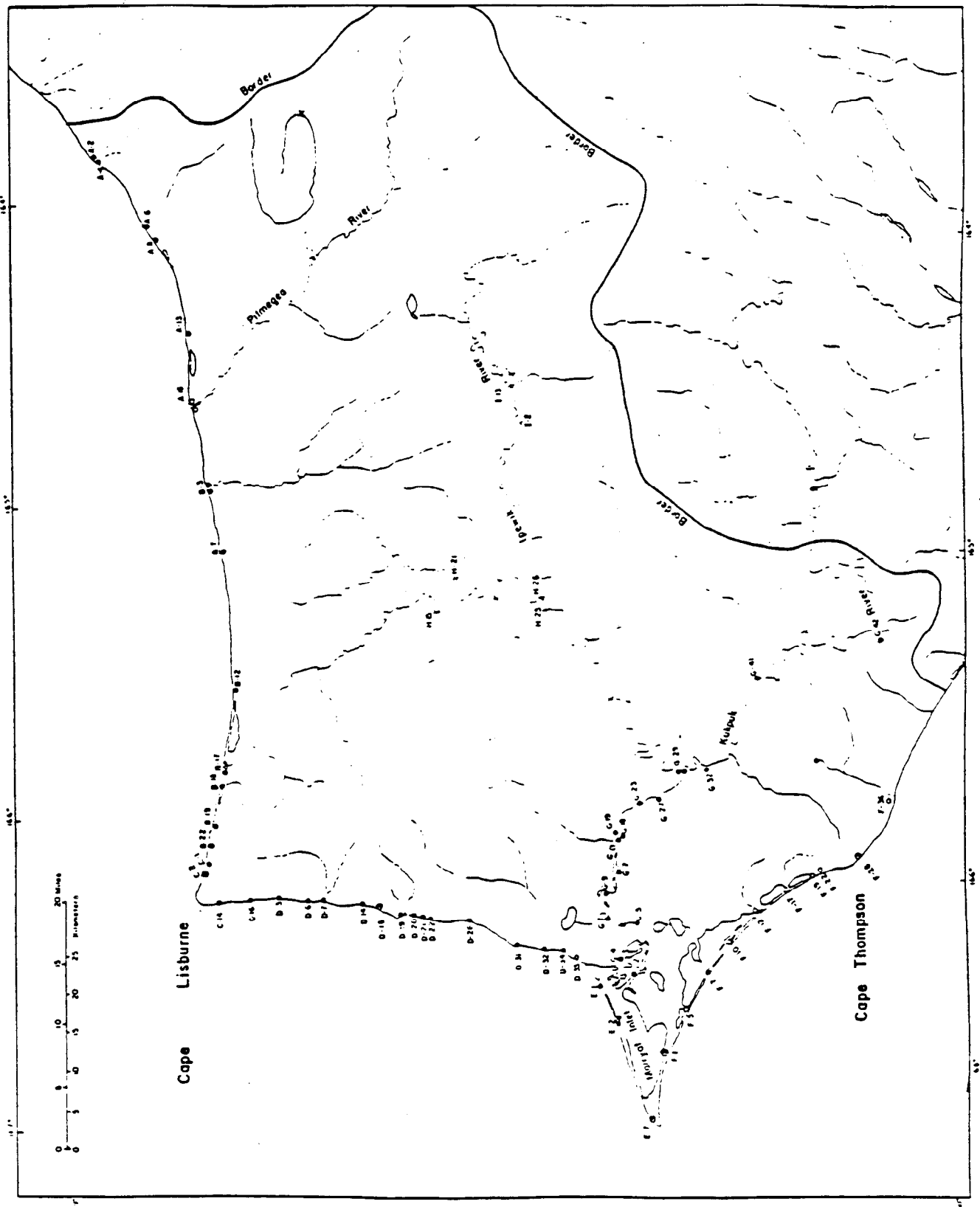


Fig. 23. Map of the Point Hope region showing the location of known settlement sites, 1800 to 1875 (taken from Burch 1981:38).

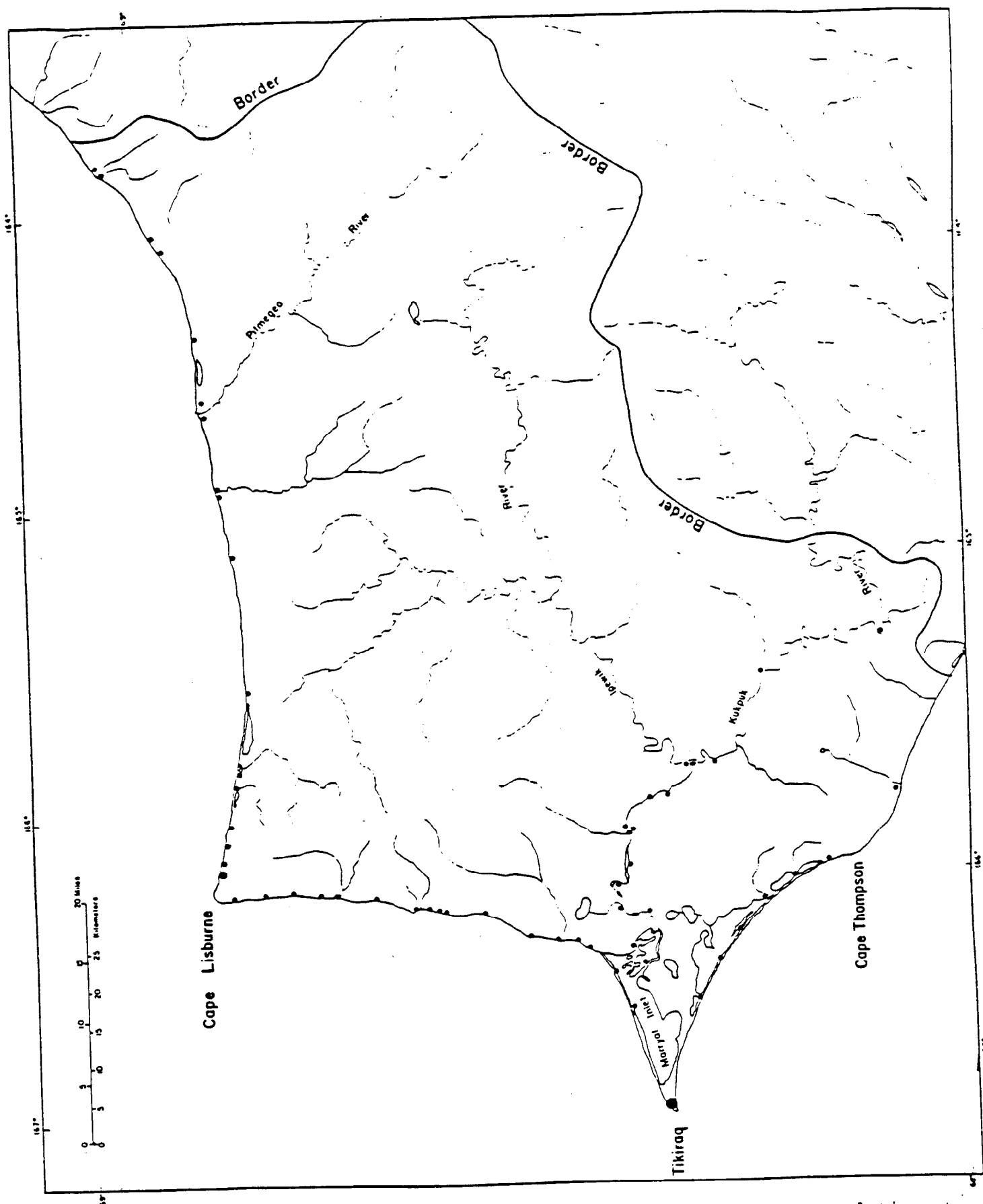


Fig. 24. Map of Point Hope region showing typical distribution of the population at the time of fresh water freeze-up, 1800 to 1875 (taken from Burch 1981:58).

seasonal settlements by resource category (depicted for July) (see Figure 25), winter trails, and location of bowhead whaling crews and whale migratory routes for two areas of the coast in the vicinity of Point Hope (see Figure 26 for an example).

Burch (1981:11) analyzed the relationships between land and resource use areas and group territory using territorial boundaries he had established in previous work in northwest and north coastal Alaska. He provided a formula for calculating the areal extent of hunting activities from any given settlement location based on 19th century Tikiramiut hunting behavior as reconstructed from data sources described above. Burch concluded that a composite map of the settlement-focused subsistence areas would have approximated the area encompassed by the political boundary previously delineated for traditional Point Hope society -- that is, that subsistence use areas were traditionally coterminous with territories.

The members of Point Hope society owned a clearly delimited territory. By "owned" I mean that they were the only people who had a legitimate right to use any land within its boundaries for any purpose. This fact was clearly understood by the members of neighboring societies, whose own territories were similarly defined and controlled (Burch 1981:61).

Burch explained an apparent overlap of adjacent territories as being a case of temporal rather than spatial delineation of territory.

Supporting studies included place name data; demographic data; and narratives concerning processes of centralization, missionization, resource depletion, and population decline in the post-contact period. While some other researchers have assumed that subsistence use areas and territories were one and the same, thereby concluding that land

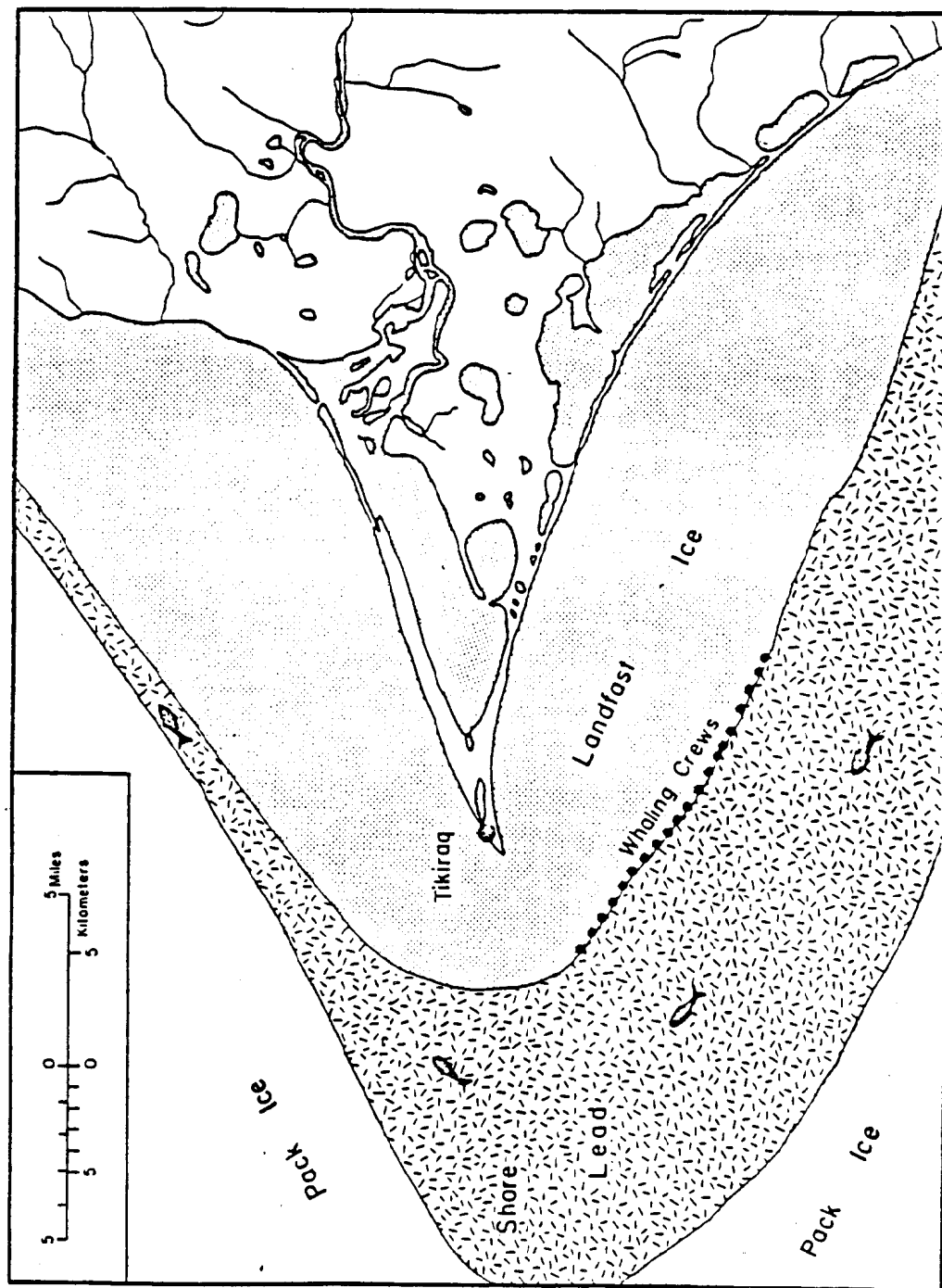


Fig. 26. Map of Point Hope peninsula showing the typical spring whale migration route and the location of whaling crews, 1800 to 1875 (taken from Burch 1981:24, adapted from Foote 1964:7).

and resource use area mapping is redundant, Burch (1981) has provided a model for testing this hypothesis as applicable to the reconstruction of traditional subsistence patterns in the Alaskan context.

The second more or less theoretically-focused example involving land and resource use mapping was intended to examine the relationships between ANCSA land selections and the subsistence economies of the villages of the Calista Region (Burns 1977). This example emerged out of the discipline of geography rather than anthropology. Of particular interest to Burns (1977) was a comparison of the amount of land selected (and therefore potentially available to community and regional residents) by village and regional corporations and the extent of land traditionally and contemporarily used to support local economies. Additionally, he was interested in not mere extensivity of land use but also the actual or specific areas used by residents of each community within the Calista Region. Although this study could also be categorized as a land planning effort, its theoretical significance relates to concepts of hunting-gathering carrying capacity, the need for areal flexibility in hunting-gathering land-use patterning, and the implications of altered land-ownership patterns on changing land and resource use strategies of hunter-gatherer populations.

Methodologically, the Burns study was based on fieldwork (archival data were deemed inadequate) during the winter of 1973 to 1974 in the 56 Yupik villages of the Calista Region and involved mapping of areas used for subsistence activities on 1:63,360 scale USGS topographic maps with individuals or groups of residents (1977:12-15). Since mapped data were portrayed in the study for only 14 villages in

two sub-regions (7 each in the Yukon delta and Upper Kuskokwim River areas), it is unclear from Burns' methodology whether or not all 56 villages were ultimately mapped. The 14 villages from two sub-regions were promoted as representative of subsistence use area patterns vis-a-vis ANCSA land selections characteristic of the region as a whole, based on the view that an administrative unit approach allowed for data consolidation within more culturally homogeneous village groups. Community residents were asked to identify marine mammal hunting, subsistence (as opposed to commercial) fishing (marine and freshwater species), edible wild plant (greens and berries), bird hunting, egg gathering, and wood gathering areas as well as areas employed for any other type of subsistence activity not specifically described above. The 1:63,360 scale topographic maps were connected to ". . . form a single map having the 25 townships on it that constituted the withdrawal area for that village" (Burns 1977:15), and each subsistence map was overlaid with the township grids. In addition, 1:250,000 scale topographic maps were used to map activities occurring outside community ANCSA withdrawal areas. More detailed land-use data were derived from 4 villages (2 each from the Yukon delta and Upper Kuskokwim River areas) and even more complete details were gathered for 3 villages, although it is unclear whether these latter 3 communities were part of the original 14 and, if so, from which sub-region they were selected.

The analysis of these data included a comparison of subsistence use areas to ANCSA withdrawal areas -- specifically, a determination of the number of acres used per capita vis-a-vis the number of acres

awarded per capita under the provisions of ANCSA (3,025 acres as compared with 495 acres respectively) (Burns 1977:154). This analysis led Burns to conclude that residents used all the land in the region, that community use areas overlapped, that topography controlled subsistence activities within an area, and that the geometric shape of ANCSA withdrawal areas bore no resemblance to land-use patterns nor considered the dynamic nature of subsistence strategies.

Supporting studies primarily involved land selection maps and pounds of harvested resources, the latter of which was based on previously gathered Bureau of Indian Affairs data. Despite the methodological weaknesses and naivete of implicit assumptions — that is, specifically that ANCSA land allocations were intended to correspond or even approximate subsistence land-use areas — Burns' (1977) major contribution was to document, albeit somewhat superficially, the extent of land required to support subsistence-based economic systems.

The final example of the use of subsistence mapping as a methodology which goes beyond description in order to address a research problem is Shinkwin and Case (1984), a Division of Subsistence and University of Alaska, Fairbanks cooperative endeavor. In general, this study was intended to describe the society and economy of Nenana Village (the Native segment of the community of Nenana), located at the confluence of the Nenana and Tanana rivers, with an emphasis on modern foraging activities, their role in the local economy, their social organization, and associated land-use patterns (Shinkwin and Case 1984:1). Historical perspectives were derived from the literature and elders, as in the past Nenana Village had been the location

of summer subsistence and mid-winter ceremonial activities. The researchers were aware that Nenana Village residents were formally affiliated with at least two distinct bands (although findings revealed a third band linkage), and they hypothesized that: (1) former band connections would be reflected in contemporary individual land-use patterns; and (2) these band affiliations would be important in current social and economic transactions within the community (Shinkwin and Case 1984:3-4).

Fieldwork during the summer and fall of 1982 provided the majority of data specific to this project, including systematic (open-ended) interviews, a household census and associated genealogies, and household land and resource use maps (1:250,000 scale topographic maps). Although data were gathered for two time periods -- circa 1940 when band organization still prevailed and the study year from the summer of 1981 to the summer of 1982 -- only the latter period was mapped. The study sample included only households with at least one adult Native member. Informants were generally selected on the basis of knowledge and level of participation in resource harvesting activities, and all but two intensively active (or previously active) households were included in the study. Specifically, 22 households were repeatedly interviewed to compile resource use area and other relevant data (2 additional intensively active households did not participate), but, of these, subsistence maps were completed for 20 households (Shinkwin and Case 1984:10). Additionally, 16 other households contributed supplementary qualitative information, but it is unclear from the methodological description as to whether they

contributed to the mapping component of the study. Individual household maps were aggregated into a composite map to ensure the confidentiality of household data. Draft maps were reviewed locally with participation by informant household members prior to the completion of published maps.

Study area maps -- including total wild resource use, moose hunting, waterfowl hunting, and trapping areas, all for the period 1981 to 1982 -- were compared with band area maps at the household level to analyze for continuity between contemporary subsistence areas (by resource category) and former band areas (based on band affiliation of Nenana Village residents during the study period). Based on this analysis the study team concluded that, with the exception of trapping, land and resource use patterns did not reflect band affiliations and associated areas. Further, the analysis disclosed that former boundaries between the three adjacent bands had collapsed and that the community-centered use area during the period 1981 to 1982 encompassed all three previous band territories, being contemporarily bounded by the areal extent of subsistence in adjacent communities. Trapping areas were viewed by Nenana Village residents during the study period, as in the past, to be individually (family) "owned" based on usufruct rights, and permission was required for use of cabins or lines by "outsiders." Not surprisingly, newcomers to the area or teenagers were less familiar with the functional trapping system described above (Shinkwin and Case 1984:83). In general, then, analysis of these data indicated that residence in a contemporary village has replaced the band as the resource-holding group. This

finding is supported by other Athabaskan research in Alaska and Canada:

Other studies using resource use mapping techniques in modern Athabaskan communities also indicate that traditional band boundaries outline contemporary areas . . . [and] that modern use areas associated with a village . . . or a reserve in Canada do not overlap those of other villages in Athabaskan areas (Shinkwin and Case 1981:109).

Supporting studies included demographic data, levels of harvest participation, the social organization of resource use, the range of resources harvested, the history of band settlements, the social organization of settlements, early Nenana history, narratives supplementing mapped data, and narratives describing the harvest and use of unmapped species including plants and berries, sheep, bear, caribou, and small game. As in the case of the Burch (1981) example described above, Shinkwin and Case (1984) suggest a correspondence between band area and band use area (against which Shinkwin and Case compare contemporary Nenana-centered subsistence patterns). Burch refers to "society territories" rather than "band area" and differs from the Shinkwin and Case (1984) model in demonstrating the territorial/use area correspondence rather than assuming its existence. Shinkwin and Case state that they actually derived their assumption of the use area/band boundary correspondence from informant data for the period 1900-1940, but the specifics of their methods in this regard are not clear (1984:93), since this early period was not mapped nor criteria for band territory specifically defined.

Based on the description of northern mapping methodologies presented above, an evaluation of these methodologies in the context

of research questions and scientific method is in order. This provides the subject matter for Chapter 4.

CHAPTER 4

SUBSISTENCE MAPPING METHODOLOGIES IN NORTHERN NORTH AMERICA: AN EVALUATION

INTRODUCTION

The purpose of this chapter is to provide an evaluation of the mapping components of the studies described in Chapter 3, with particular attention to mapping-related methodologies. This evaluation provides not only a comparative analysis of the mapping methodologies applied in the studies described in Chapter 3, but also facilitates the logical development of subsistence mapping guidelines in Chapter 5.

Before the evaluation of subsistence mapping methodologies commenced, it was essential to establish the criteria by which they were to be assessed. It is a premise of this evaluation that subsistence mapping is a formal instrument for the collection, analysis, and depiction of geographic-based land and resource use data derived from participants in primarily subsistence-based socioeconomic systems. When subsistence mapping is regarded as a formal research instrument, it must conform to basic scientific standards, including comparability and replicability. That is, the evaluation is organized by topic, rather than on a case-by-case basis, including a consideration of the statement of problem or intent of the study (has the problem been stated by the researchers and, if so, is mapping an appropriate tool

to answer research questions?); mapping as a data gathering tool (documentation of methodology, sampling, temporal dimensions, technical components, etc.); analysis of mapped data (methods, was intensity considered and, if so, using what criteria?); presentation of mapped data; and an analysis of study conclusions as they relate to mapped information. Examples from case studies presented in Chapter 3 cross-cut these topical dimensions to illustrate strengths or weaknesses as measured by conformity to a scientific model. In addition, other methodological considerations which lie outside of the scientific model (such as the reliability of informant recall) are discussed.

Figure 27 provides a matrix indicating general conformity or non-conformity of each study mapping methodology described in Chapter 3 to central elements of a scientific model. Importantly, the matrix does not indicate the degree of adherence to this model, but examples of quality are discussed in the narrative. It should be noted that only the mapping methodologies of each study are evaluated as opposed to their overall research designs. Studies are identified by author(s) and date in the matrix and are listed in the order in which they were discussed in Chapter 3. The content of each evaluative topic is presented in more detail in the discussion below.

STATEMENT OF PROBLEM

If a research design includes a problem or set of problems requiring the collection and analysis of geographic-based subsistence data, it is reasonable to expect that a mapping methodology should be

Study Example	Statement of Problem	Mapping as a Data Gathering Tool						Data Analysis				Data Presentation			Conclusion
		Doc.	Samp.	Temp.	Inten.	Tech.	Doc.	Temp.	Inten.	Tech.	Desc.	Analy.	Depiction		
Carpenter, Varley, and Flaherty 1959	+	+	+	-	-	+	+	-	+			+	+	+	+
Spencer 1959	-	-	-	-	-	-	-	-	-			+	-		-
Sonnenfeld 1956	+	+	-	-	-	-	-	-	+			+	+	+	+
Tanner 1966	+	+	-	-	-	-	-	-	-			+	-		-
Footte 1961	+	+	-	+	-	+	-	+	-			+	+	+	+
Federal Field Committee 1968	-	-	-	-	-	-	-	-	-			+	-		-
Weinstein 1976	+	+	+	+	+	+	+	-	+			+	+	+	+
Freeman 1976	+	+	+	+	-	+	+	+	+			+	+	+	+

Fig. 27. Subsistence mapping study evaluative matrix. A "+" indicates conformance to a scientific model; a "-" indicates non-conformance to a scientific model (neither indicates the quality of conformance or non-conformance, which varied widely). (See text for a more detailed description of each category.)

Study Example	Statement of Problem	Mapping as a Data Gathering Tool						Data Analysis				Data Presentation		
		Doc.	Samp.	Temp.	Inten.	Tech.		Doc.	Temp.	Inten.	Tech.	Desc.	Analy.	Depiction
Brice-Bennett 1977	+	+	+	+	-	+		+	+	-	+	+	+	-
Union of B.C. Indian Chiefs 1980, Weinstein 1979, and 1 Brody 1982	+	+	+	+	-	+		+	+	-	-	+	-	(Brody Only)
Dene mapping project (Nahanni 1977)	+	+	+	+	-	+		+	+	-	+	+	+	+
MULLER-WILLE 1978	+	-	-	+	-	-		+	+	+	-	+	-	-
Patterson 1974	+	-	-	+	-	-		+	+	-	+	?	?	?
Pedersen 1979	+	+	+	+	-	+		+	-	-	-	+	-	+

¹ Evaluations are based on the composite of the three studies. If evaluated separately, the Union of British Columbia Indian Chiefs 1980 and Weinstein 1979 would have been weak in documenting methodology and presentation and Brody 1982 would have been weak analytically.

Fig. 27. Subsistence mapping study evaluative matrix (continued). (See text for a more detailed description of each category.)

Study Example	Statement of Problem	Mapping as a Data Gathering Tool					Data Analysis				Data Presentation				Conclusion
		Doc.	Samp.	Temp.	Inten.	Tech.	Doc.	Temp.	Inten.	Tech.	Desc.	Analy.	Depiction		
Wright, Morris, and Schroeder 1985	+	+	-	+	-	+	+	-	-	+	+	-	?	+	
Martin 1983	+	+	+	+	-	+	+	+	-	+	+	+	+	+	
Pedersen, Coffing, and Thompson 1985	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Wolfe 1981	+	+	+	+	-	+	+	-	-	+	+	+	+	+	
Jorgensen 1984, Little and Robbins 1984	+	-	+	+	-	+	-	-	+	+	+	+	-	-	
Braund and Burnham 1984	+	+	+	+	+	-	+	+	+	+	+	+	+	+	
Fall, Foster, and Stanek 1984	+	+	+	+	+	+	+	+	+	+	+	+	+	+	

Fig. 27. Subsistence mapping study evaluative matrix (continued). (See text for a more detailed description of each category.)

Study Example	Statement of Problem	Mapping as a Data Gathering Tool						Data Analysis				Data Presentation		
		Doc.	Samp.	Temp.	Inten.	Tech.		Doc.	Temp.	Inten.	Tech.	Desc.	Analy.	Depiction
Nelson, Mautner, and Bane 1982	+	+	+	+	-	+		+	-	-	-	+	+	-
Burch 1981	+	+	-	+	-	-		+	+	-	+	+	+	+
Burns 1977	+	+	-	-	-	+		+	-	-	+	+	+	+
Shinkwin and Case 1984	+	+	+	+	-	+		+	+	-	+	+	+	+

Fig. 27. Subsistence mapping study evaluative matrix (continued). (See text for a more detailed description of each category.)

included in the overall research paradigm and that this methodology should be rigorously connected to one or more of the research problems. Further, the research problem or problems should be narrow enough in focus so that they can, in fact, be addressed by the mapping component of the study, including the temporal, cultural, and geographic parameters of the project's mapping component.

While the vast majority of studies reviewed in Chapter 3 provided statements of problems related to geographic-based land and resource use information -- with the exception of Spencer (1959), who incorporated mapping as an afterthought to the basic methods of ethnography and ethnology, and the Federal Field Committee for Development Planning in Alaska (1968), which was concerned about land claims and land use but failed to connect the study problem to the secondary source maps -- the quality of problem statement varied immensely. For example, although Freeman (1976), Weinstein (1976), and Shinkwin and Case (1984) had very distinct intents -- namely, the documentation of land-use extensivity, an assessment of hydroelectric developmental impact on subsistence use areas, and the relationship between contemporary band residence and affiliation and traditional band territories, respectively -- they are all examples of studies which exhibited problem continuity throughout the course of the research process. Conversely, while Jorgensen (1984) and Little and Robbins (1984) were intended to provide detailed spatial descriptive and analytical (including projective) assessments of wild resource harvest distribution and intensity, they neither directly stated their research problem in this regard nor provided essential linkages between their research

problems and mapped data. Essentially, Jorgensen (1984) and Little and Robbins (1984) are examples of studies which inchoately conform to scientific standards in this regard.

MAPPING AS A DATA GATHERING TOOL

DOCUMENTATION

The most common short-coming of subsistence mapping studies, or studies in which mapping is a design component, is the failure of researchers to adequately document the actual methodology employed in gathering geographic-based land and resource use data. As previously discussed, this deficiency in part may be related to the fact that mapping generally has not been treated as a formal research tool in the discipline of anthropology. In other cases, it is assumed that the use of maps in data gathering is self-explanatory and therefore does not require the same methodological rigor applied to other aspects of research design.

The first sub-category of the use of mapping as a data gathering tool in Figure 27 is referred to as "documentation." In this context, studies were evaluated on the basis of whether or not they described the ways in which mapped data were collected -- that is, methodological documentation. Although most researchers provided some insight into methodological process, the quality of documentation would not permit replication of the research in many cases. For example, Patterson (1974:2) referred to a form which was used to aid in the

collection and assimilation of data, but no form is attached to the actual report. He suggests that data were actually derived from surveys conducted by the Native regional organizations, but the reader is provided no further methodological insights into how information was gathered and, in fact, the maps referred to in the text are not attached to the report. By way of contrast, Freeman (1976) provided such a detailed methodology that it has become a model for many Canadian and Alaskan land use and occupancy studies (for example, Brice-Bennett 1977; Pedersen, Coffing, and Thompson 1985).

SAMPLING

In addition to general documentation of mapping methodology, several components of the mapping research model need to be addressed in detail as evidence of adequate design control. The first of these -- sampling (see Figure 27) -- is essential to guaranteeing research comparability and replicability and is commonly glossed over or eliminated altogether in northern subsistence mapping. For example, Foote (1964), a relatively early model, and Burns (1977), a later example, provided no information on sampling size, selection, or any other relevant criteria. Although Wolfe (1981:20) used neither a randomly nor otherwise formally selected sample on the delta, he mapped opportunistically 20.7 percent of the households in his 6 community study area with a bias towards older, "more knowledgeable" household heads. Whereas, it is assumed that older hunters and fishermen, at least when active, would use a more extensive overall

area for resource harvest, this methodology may omit use patterns associated with particular age and interest segments of the community. Wolfe (1981) attempted to mitigate bias by ground-checking data during a relatively short, single season field period and by reviewing mapped data with other community residents. However, his sampling methodology does not permit the generalization of his mapped data to the community as a whole or the development of an average household use area. Most methodologically common, however, are the more recent studies which strive towards a 100 percent sample but end up with percentages in the 80s or 90s usually biased towards more knowledgeable (and probably older) resource users (for example, Nelson, Mautner, and Bane 1982; Union of British Columbia Indian Chiefs 1980; and Freeman 1976).

Meaningfully, negligible attention has been paid to mapping group behavior within the community, such as partnerships, extended family cooperatives, or tribal or band affiliations. Nelson, Mautner, and Bane (1982) astutely noted the need to map the patterns of resource and land use of Athabaskans who refer to themselves as "partners." Most researchers in rural northern North America are aware that, although they commonly map by household unit, the functional unit of production usually includes an extended family group, the members of which do not reside in the same domicile. Therefore, it is somewhat surprising that mapping methodologies in the more recent studies reviewed have not accounted for the realities of production group composition instead of persistently pursuing household heads as the unit of analysis.

Sample size and composition should be driven by research questions or problems, although the studies reviewed in Chapter 3 shed little light on the relationships between sample selection criteria and research questions. The assumptions that "older is better" in the selection of informants and "more is better" in the selection of sample size have already been mentioned as common themes in subsistence mapping methodologies. In the Dene mapping project, the intent of the research was, for the most part, to map extensivity of land and resource use -- that is, to get at the very greatest distances traveled by Dene in their pursuit of wild resources. This problem or purpose was neatly linked to sample selection in a very purposeful manner, as the criteria for informant choice was based on distance individuals had traveled in their lifetimes. Informants were selected, then, in accordance with a bias towards the most mobile and far-traveling members of the society as was the intent of the study design (T. Abrams, personal communication 1985).

TEMPORAL DIMENSIONS

The third sub-category of evaluating mapping as a data gathering tool in Figure 27 is labeled "temp." for the sake of brevity but refers to whether or not researchers have provided temporal dimensions in collecting mapped data. Subsistence mapping essentially records human hunting, fishing, or gathering behavior or, in most cases, an informant's perceptions of his or her behavior (when mapped data are derived from informant recall). Since social scientists generally

agree that such behavior is adaptive and changes to meet the ecological, economic, demographic, and cultural demands of the environment through time, it is essential to record subsistence-related behavior, including mapped data, in a temporal framework and to ensure an adequate time depth for revealing the range of human adaptation and to meet the needs of relevant research questions. An evaluation of the studies presented in Chapter 3 reveals two primary areas of concern: first, that the study methodology fails to apply or, in some cases, to describe any temporal dimensions to the mapping of subsistence data; and, secondly, studies employ such a narrow temporal focus that the subsistence system in question, and related land and resource use, are depicted in such limited cross-section that the adaptive dynamics of the system are basically lost in a static portrayal. Examples of both kinds of problems are considered.

With the exception of Foote (1961), who mapped two decades a century apart (1850 to 1860 and 1950 to 1960) specifically to document continuity or change through time, the earlier studies reviewed in this context, in which subsistence mapping was either a focus or an undefined part of the overall methodology, failed to specify the temporal dimensions of mapped data (for example, Spencer 1959; Sonnenfeld 1956; and Tanner 1966). There are more recent examples, however, of studies which fail to describe methodologically the period being mapped (Burns 1977) and many others who define the period mapped in the text but fail to note it on the actual mapped product (which then may be used or misused out of the temporal context which appears only in the narrative) (for example, Nelson, Mautner, and Bane 1982; Brody

1982; and Pedersen 1979). Although earlier Division of Subsistence studies not reviewed in this context frequently presented mapped data without a temporal designation on the map, all recent products have incorporated this important qualifier.

The second question -- that is, what is an appropriate period to be mapped when documenting land and resource use by participants in subsistence-based socioeconomic systems -- is infinitely more complex. Initially, the time period for which data are gathered must be connected to the research question(s). It is conceivable that a research question could focus on land and resource use for a very limited time period, and in such a case the mapping methodology should reflect and document this temporal window. However, in cases in which the research questions or problems are related to potential land or resource use decisions which could affect subsistence-based socioeconomic systems, the temporal framework needs to be adequate to encompass the dynamics and adaptive nature of such systems.

One means of developing a longer-term temporal perspective is the map biography, which emerged from the Canadian Inuit land use and occupancy study (Freeman 1976). The map biography -- a means of gathering land use data for the entirety of an individual's lifetime -- has been a model for numerous Canadian and Alaskan studies (for example, Brice-Bennett 1977; Pedersen 1979; the Dene mapping project; and Martin 1983). The map biography can be used differentially, however, depending on whether the time period is equivalent to the life span of the oldest member of the community or whether this period is broken down into meaningful segments. In the former example,

whereas the temporal duration is adequate to portray the extensivity of land use within which adaptive change has occurred, there are no means to document differential use patterns within this period. In fact, the Freeman (1976) model was temporally subdivided primarily to reflect changes in Inuit land use patterns related to contact with Euroamericans and to the development of permanent communities and associated sedentarism. Questions associated with the interrelationships between hunter-gatherer land use patterns and centralization and associated trends towards sedentarism are relevant to all northern North American research with indigenous populations and, most likely, to hunter-gatherer research worldwide, since these have been common themes of cultural change in an international perspective. Finally, the quality of analysis directly reflects the relevance of temporal subdivisions into which land and resource use data are gathered, since arbitrary time periods may cross-cut ecological, economic, demographic, or other factors which have influenced land and resource use patterns, thereby masking the revelation of significant changes in the spatial dimensions of subsistence configurations. For example, Pedersen, Coffing, and Thompson (1985) depicted only land-use patterns associated with community residency, thereby omitting data for periods of greater individual or family nomadism. In fact, the map biography approach as employed in the Alaskan context has generally been community-based in focus. In the Canadian context, it is essential to assess in what ways reserve placements and membership have impacted land use patterns, since in some cases reserves have no association with traditional homelands and use areas (Brody 1982:252). In seeming

contradiction to this point, however, the northeastern British Columbia study did not map different time periods, as researchers stated that informants saw no meaning in differentiating land and resource use areas over the course of their lifetimes (Brody 1982:174).

At the opposite end of the spectrum are studies with questions and potential applications associated with the long-term viability of the subsistence system but mapped data representative of only a single year period (for example, Weinstein 1976; Wolfe 1981; Little and Robbins 1984; and Jorgensen 1984). Whereas Shinkwin and Case (1984) mapped only a single year's harvest data, they compared these to traditional band territories assumed to represent traditional use areas. In the only regional planning study reviewed in this context (Wright, Morris, and Schroeder 1985), the temporal framework for which spatial data were gathered was generally post-snowmachine, since it was believed, on the basis of other data, that this was a more recent period, with time depth adequate to reveal annual variation, and demonstrate the most relevant features of contemporary land use associated with modern transportation technology (i.e. the snowmachine). In this case, however, the "traditional" or even much of the late historic period is lost to the decision-maker using the mapped data base. In general, unless a study design calls for only a specific year's or a few years' data, it is advisable to document as lengthy a period with as great a detail as possible, since it provides the researcher(s) and data users with a better understanding of the dynamics or functioning of land and resource use in the overall subsistence-based system. Additionally, whereas mapped data may be

gathered for a specific purpose and associated questions, it is frequently used and extrapolated beyond the intent of the study for which it was gathered. In such cases, data temporal breadth may aid in a more accurate comprehension of land and resource use patterns.

For the most part, research incorporating subsistence mapping has focused on living populations and depended on informant recall for spatial subsistence data from time periods in the past. However, two studies presented in Chapter 3 (Burch 1980; and Foote 1961) addressed research questions which encompassed temporal limits beyond the life span of the study population. In these cases, researchers developed means for ascertaining land and resource use patterns from sources other than the actual users -- namely, early documentation, oral history, and archaeological records. In the Burch (1981) case, he asserts to have reconstructed a model of the spatial dimensions of land use rather than a reconstruction of actual subsistence patterns. The concept of modeling has applicability to contemporary as well as to historic land and resource use patterning and is discussed in more detail in Chapter 5.

Finally, although not indicated on Figure 27, seasonality of land and resource use patterns is a temporal component of data gathering of considerable significance in describing hunter-gatherer subsistence. Since hunters-gatherers depend on wild resources which fluctuate in numbers, availability, and accessibility throughout the year, mapping land-use areas in association with species or species categories for a single annual period rather than by relevant season fails to illustrate the dynamics of the land-use system during an annual round.

Although Foote (1961) provided an early model which incorporated the mapping of seasonal variation in land and resource use areas, many subsequent research endeavors ignored the relevance of seasonality in the gathering of mapped data (for example, Freeman 1976; Brice-Bennett 1977; Nelson, Mautner, and Bane 1982; and Brody 1982). Brice-Bennett (1977) self-critiqued the Labrador study in this respect and assessed that a disregard for this dimension was unnatural to informants in data gathering, especially in regards to seal hunting (which is conducted in open water or on ice dependent on the the season) and caribou hunting (which involves snow cover in inland hunting and coastal hunting under conditions of no snow). Informants felt uncomfortable lumping these seasonally, very spatially different, activities on a single map. The apparent lack of interest in seasonality in many studies which include subsistence mapping may reflect the time and associated costs incurred in more detailed mapping but also may reflect a prevailing interest in documenting the extent of land use as opposed to understanding the role of land and resource use in overall socioeconomic systems.

INTENSITY

As discussed in Chapter 3 in association with the Inuit land use and occupancy research (Freeman 1976), the gathering of spatially-focused mapped subsistence data based on some measure of intensity has been avoided by many researchers because they feel there is no adequate criteria for valuating the relative worth of land segments or

particular resources to the people who harvest and use them. It is also the opinion of some researchers that to establish a value for particular areas of land or associated resources would add validity to the concept that compensation can be paid for loss of or disruption to land and resources (M. Asch, personal communication 1985). Nonetheless, 4 of the 25 studies depicted in Figure 27 specifically mapped using some measure(s) of intensity -- that is, applied criteria by which some areas and resources could be said to be more intensively used than others.

Intensity as an element of subsistence mapping is based on the assumption that particular areas or resources have more value to participants in the system than do others. The problems associated with mapping for intensity are complex -- that is, what criteria should be used to determine value?; how do these criteria vary from year to year?; can one part of a systemic whole be evaluated as having greater or lesser importance than others when flexibility and resource interdependency characterize hunter-gatherer systems?; by whose world view or perspective is the valuation being made (the participant or the observer)?; how can non-economic components (such as ideologies related to land and animals) be evaluated by economic measures?; what are the comparative ethical responsibilities of social scientists making such valuations to participants in the system and to agencies asking the questions which provide support for the research?; how do researchers elicit valuative data from informants who may not perceive various spatial units or resources to have differential value?; and many other questions. Although considerations of intensity are

fraught with the complexity only hinted at above, very specific measures of intensity can be elicited in subsistence mapping provided informants are aware of their potential use and the data are presented in a framework of qualification which minimizes potential misunderstanding and misuse of the mapped information. It is in this context that the studies which used measures of intensity as depicted in Figure 27 are evaluated.

Of the studies described in Figure 27, Weinstein (1976) is the earliest to gather mapped data based on a measure of intensity -- in this case, pounds harvested within particular areas and along trap-lines. Since the purpose of Weinstein's study was to document the extent of dependency on wild resources and analyze the potential impact of a hydroelectric project on the overall subsistence economy of the James Bay Cree, undoubtedly the measurement of intensity was associated with concepts of compensation based on pounds harvested by location as a measure of intensity. Weinstein (1976) relied on informant recall for a one year period to document harvest totals by location. The problems with Weinstein's method are two-fold: first, he bases his measures of intensity (pounds harvested per area) on a single year's data, which may vary widely from the "norm" if such a phenomena even exists in hunting-gathering economic systems; secondly, his method assumes that harvest area is equivalent to critical habitat for the species in question -- an assumption not generally substantiated by biological data. That is, the hunter may be more impacted by habitat disruption occurring outside of his harvest area if the critical habitat of the species on which he depends is destroyed or

altered significantly. This factor is particularly applicable to migratory or highly mobile species.

Another example of subsistence mapping employing a measure of intensity is Braund and Burnham (1984). In this case the researchers mapped both lifetime use areas and areas used within the last five years by active hunters. While other researchers have recorded use areas for different time periods, Braund and Burnham (1984) assigned a level of higher importance to the areas used over the previous five-year period and referred to them as "intensive use" areas (as opposed to the wider spatial boundaries referred to as "maximum use" areas). This criterion is biased towards a specific period of use rather than any other measure of value, such as duration of use, harvest potential, long-term accessibility, long-term efficiency, ideological value, or others.

Fall, Foster, and Stanek (1984) mapped intensity based on man-days per moose harvested per area for a single year (1981) (areas were sub-units of the generalized hunting area, as described in Chapter 3). This method resulted from specific resource allocation questions related to access (road versus waterway), efficiency, moose distribution, and weather in that particular regulatory year and was not applied to the study as a whole. Whereas this measure of intensity may have proved to be useful for answering specific regulatory-related questions, the researchers did not attempt to apply it to other mapped data in this study. This is an example of a very specific application of intensity measure for a sub-set of questions in a larger, more comprehensive design.

The final example of gathering mapped subsistence data for purposes of demonstrating intensity from the studies evaluated in this context is Pedersen, Coffing, and Thompson (1985). The criterion for measuring intensity in this case is caribou kill sites, which shares the weakness described for Weinstein (1976) of potentially establishing a higher value on harvest area than on critical habitat. The researchers in this study were keenly aware of this problem and would object to land-use decisions placing priority on harvest areas over critical caribou habitat if they did not correspond spatially (S. Pedersen, personal communication 1985).

In recent years the demands for valiative measures of land and resource use by governmental agencies have escalated in response to policies supporting increased control over public lands and resources. One school of thought maintains that those in power will make land-use decisions regardless of the quality or quantity of data available to them related to the spatial dimensions of subsistence (Usher 1979). Therefore, the argument goes, it is preferable to provide measures of intensity to hopefully influence this process. In general, this argument has not been openly accepted by social scientists who are well aware of the complexity of the issue and political overtones. Those who argue at the opposite end of this spectrum state that to become involved in mapping subsistence intensity in any form lends credence to the view that non-participants in the subsistence system should be making such determinations and fear that any effort to map intensity would be potentially detrimental to their study populations. Both of these models in part reflect political rather than purely

academic concerns. In the absence of political overtones, it is important to note that the development of a variety of models for assessing subsistence-related intensity would substantially facilitate the more comprehensive understanding of subsistence-based socioeconomic systems, but the application and qualification of such models must conform to the most rigorous scientific standards. It is expected that measures of intensity will be applied with more frequency to short-term, problem-specific subsistence research which lacks the longer-term, far-reaching land and resource use implications of many of the studies reviewed in this context. The problem of intensity resurfaces in the data analysis section of this chapter and in Chapter 5.

OTHER TECHNICAL CONSIDERATIONS

There are several additional technical considerations related to the use of mapping as a data gathering tool which were not criteria for evaluation in Figure 27 but which should be mentioned before moving on to data analysis. The first of these involves the scale and detail of the base map upon which data are collected. The basic principle which should guide the selection of a base map, as indicated by the studies reviewed in this context, is using a map which allows informants to easily identify areas of relevance to them in their pursuit of fish, game, or plant resources. In fact, generally hunter-gatherers perceive more detail in their natural environment as a result of their reliance on wild resources:

. . . people who depend upon their ability to locate themselves in space carry in their heads very complex and detailed spatial schemes. (Brody 1982:5)

Knowledge of land use and all that goes with it is essential to survival and errors may mean the difference between life and death or, minimally, the difference between a successful or non-successful subsistence pursuit. Therefore, informants from whom mapped data are elicited must be able to visualize enough environmental detail in the base map to enable them to portray, as accurately as feasible, the spatial dimensions of their subsistence pursuits.

In the studies reviewed, map scale varied to some degree in accordance with environmental complexity. Whereas Pedersen (1979) stated that 1:250,000 scale USGS topographic base maps provided adequate detail for his work on Alaska's arctic coast, research on Prince of Wales Island, with its complex coastlines composed of bays, coves, reefs, inlets, straits, and numerous small offshore islands on which beach, muskeg, and alpine resource harvests occur, required the use of 1:63,360 scale USGS topographic maps. Brice-Bennett (1977) commented in detail about problems regarding not only map scale but also map detail. In the process of using an inexpensive 1:250,000 scale map void of contours, color contrasts, and some bodies of water, informants had great difficulty in locating particularly inland areas in which caribou were hunted in hilly terrain or drainages which had been eliminated for purposes of simplification. Because of the complexity of the Labrador coastline, the scale was not adequate to identify use areas involving the smaller coves or points of land and, as a result, patterns were generalized (Brice-Bennett 1977:99). In

part related to scale and detail, some of the Inuktit hunters drew core areas of resource harvest and land use, others entire expanses of the country they covered while hunting, and yet others kill sites, both planned and opportunistic (Brice-Bennett 1977:100). Scale and detail, then, need to be inextricably linked with the nature of the environment, the characteristics of hunting-gathering behavior within that environment, and the level of detail demanded by research questions.

Although the discussion of sampling made some mention of group versus individual data gathering, the topic of data collection was not evaluated per se in Figure 27. Techniques for eliciting data regarding land and resource use have involved some very diverse methods in the case examples in Chapter 3. Probably the most unstructured and poorly documented (and therefore the least replicable) of the methods are found in Jorgensen (1984) and Little and Robbins (1984). These two oil and gas development-related studies, with a common methodology, used no formal data gathering instruments (e.g. maps or surveys) in collecting information on the location of land and resource use activities. The methodology is poorly documented, but it is suggested that data were obtained via informal conversations, observations, overhearing conversations between resource users, and having a local assistant provide mapped data. Although more structured than the methods just described, the use of group meetings for purposes of data collection are similarly wanting in terms of replicability and data control. Some studies (for example, Brice-Bennett 1977) used group meetings to establish the general extent of land-use areas, but

employed the map biography as the primary data collection tool. Others have used group meetings as a community review process after individual map biographies have been gathered from less than a 100 percent sample of the population and aggregated to identify areas not included by informants (for example, Pedersen, Coffing, and Thompson 1975; and Martin 1983). In other cases (such as Wright, Morris, and Schroeder 1985), data were gathered from both individual and small group contexts, depending upon the community and time limitations, as this was an entire regional effort intended to depict the maximal extent of land-use since snowmachines were introduced to residents of the Bristol Bay Region.

The methodology providing the greatest data control involves a single informant interview. Although many studies have stated that the map biography is, in fact, their data gathering tool, in some cases the individual map biography is actually a "household biography" representing data provided by the household head, spouse, and other productive members of the domestic unit (for example, Freeman 1976; Pedersen, Coffing, and Thompson 1985). Although this method undoubtedly broadens the scope of information gathered, primarily as a function of age and sex as the principle determining division of labor, it makes comparability between individual map biographies difficult if not impossible. Additionally, household comparability is not possible because the methodological intent is to map individuals and there is no systematic means by which other household members are incorporated into the map biography process.

For the vast majority of mapping studies, as for most hunting-gathering research in general, informant recall is the primary means of data gathering (Usher 1984).

Informant recall is the basis of all anthropological research in the many societies around the world possessing an oral, as opposed to a written, history. . . . People in a non-literate culture are trained from childhood to remember accurately. For boys, and then men, in a hunting society the greatest emphasis in training is placed on accurate recall of environmental information (Freeman 1976:52)

Social scientists are aware of the fact that there are "better" or "more reliable" informants and that some people are specialists or authorities in regards to some aspects of a group's corpus of knowledge (Freeman 1976:52). Additionally, memory attrition is inevitable for more distant time periods. Nonetheless, researchers report that there is a high value placed on reliability or accuracy of information transmitted orally, since misrepresenting facts deliberately or inadvertently is considered to be a serious moral transgression among some northern populations (Freeman 1976:55).

However, subsistence researchers, aware of critiques leveled against the use of informant data in scientific method, have developed means for assessing the reliability of informant recall. In the study methodologies reviewed in this context, the Inuit land use and occupancy model (Freeman 1976) was the most detailed and systematic in assessing informant reliability. Study team members cross-checked for internal consistency among members of a single group, since it is highly unlikely that there would be any conspiracy to transmit erroneous land and resource use data. Consistency of data between groups were checked, comparisons between oral and written records

established, continuity through time related to environmental constraints identified, and family and partnership data compared. Additionally, subsistence mapping resulted in distinct community patterns with moderate degrees of overlap, suggesting community data consistency. Pedersen, Coffing, and Thompson (1985) employed ground and aerial observations to verify the accuracy of harvest and camp site and transportation corridor data. Based on verification in the Freeman (1976) project, examples of Inuit recall were deemed to be highly reliable, with due allowance made for cultural selectivity, within living memory from young adulthood for at least a half century. Crossing generations, recall of major events remained significantly reliable approximately a century after occurrence, with some loss of original intent and the formalization of the information into legendary narrative (after two or three centuries content has become fragmentary) (Arima 1976:35). All in all, subsistence maps were evaluated by several researchers as depicting a reality and integrity rarely achieved in social science (for example, Freeman 1976; Brody 1982; and Pedersen, Coffing, and Thompson 1985).

There is the question, however, of the level of detail recalled by hunter-gatherers regarding specific harvest activities. In the best of all possible situations, a participant observer or resource harvester would record the actual route taken during the course of a harvest activity. A second best method would be an immediate post-harvest activity interview within the 24-hour period after the activity is complete. In reality, however, most researchers have had to map land and resource use patterns based on informant recall, and

obviously detail of the recollection atrophies with time. It seems probable that, due to their significance, the kill sites of major species might be better retained than hunting routes or harvest information involving secondary or peripheral species. As recall proceeds backwards in time, less and less detail is accounted for and general harvest areas of more important species compose the bulk of the data base. Nonetheless, the detail of hunting-gathering data recalled by subsistence users is unquestionably greater than would be the case for non-subsistence users (who depend on documentation to recall history) experiencing the same events, so care must be taken in evaluating the reliability of informant recall regarding land and resource use on the basis of western standards.

As previously mentioned, because of the reliance on informant recall, subsistence mapping is actually a record of land and resource use data in a spatial and temporal framework as perceived by participants in subsistence-based socioeconomic systems. As Brice-Bennett (1977) concludes:

The lines drawn on the maps are themselves only notional; they represent a summary of seasonal, annual, and individual variations in land use. Their meaning is not fixed or absolute. They are neither a natural frontier of hunting activity nor the limit to which animals are pursued. (3)

It is well known that participants in subsistence mapping may differentially interpret the questions asked of them by the researcher: is information being requested about areas of search, pursuit, harvest, or retrieval?; is information being sought regarding intended or opportunistic harvest?; only primary or all species?; for one season or all seasons?, under what weather conditions?, for individual or

group activities?; for the furthest distances they have traveled from point of origin or only distances related to successful harvest?; and many other variations on the themes presented in data gathering protocols. It is expected that, as mapping methodologies become more sophisticated, greater control over and understanding of data gathered through informant recall will be achieved.

Lastly, the organization of data gathering by species is highly variable among subsistence mapping studies and was not evaluated in Figure 27. There was no example of a study which gathered data for every species harvested individually -- that is, with no lumping of species into species categories. The tendency has been to map species of importance in the research questions (more accurately, of importance to the agency sponsoring the research) by taxonomic categories derived from western science and by names for species commonly used in the biological sciences. Some subsistence researchers have vested considerable effort and time into understanding the natural world as perceived by subsistence users -- that is, into comprehending concepts from the ethnosciences (ethnozoology and ethnobotany) of the study population (for example, Fall, Foster, and Stanek 1984). The level of species detail has been closely linked again with research questions and also with study time and funds. For some species, further complications arise out of mapping for an entire year period without reference to seasonality. For example, for some groups the harvest of seals in open water is as distinct from the harvest of seals on ice as is the harvest of totally different species from that of seals. In other cases, hunter-gatherers subdivide what western scientists term a

single species into several classifications based on sex, age, size, season, and other factors.

The real rub comes, however, not in details of lumping or splitting species, but in the concept of mapping land and resource use on a species-by-species basis. As Brody (1982) describes, he didn't map by species because:

. . . they [the Indians of northeastern British Columbia] may choose their hunting area with a particular species in mind, but once there they hunt whatever they can find. The answer to the question, "Where do you hunt mule deer?" is the same as the answer to the question, "Where have you hunted moose? black bear? spruce grouse?" In fact, because moose is the most highly valued and the most widely distributed of the species hunted, the outer boundary . . . is indistinguishable from the outer boundary for all types of hunting -- with the exception of goats and sheep. . . The hunters of this region, however, see their main use of the land as a generalized hunt for ungulates; they are reluctant to point to special areas or particular locations for such hunting because . . . you never know where you might find one of the locally important animals. (152)

As Brody (1982) points out, however, trapping, fishing, and berry picking are somewhat more specific to location and can more successfully be mapped accordingly. One might expect similar problems, however, in mapping fish by species for people who rely primarily on multiple species at a single site or obtain other species incidental to their primary prey. It is evident in reviewing the studies portrayed in Figure 27 that those researchers most thoroughly and sensitively familiar with their study populations are best able to gather spatially-referenced harvest data in a manner relevant to the larger socioeconomic and sociocultural systems.

ANALYSIS OF MAPPED DATA

DOCUMENTATION

For these purposes, any study which did more with mapped land and resource use data than depict, in a descriptive and ethnographic sense, land-use in space and time was evaluated as conducting analysis of geographic-based subsistence data in Figure 27. Denoting the presence or absence of analysis, however, suggests little about the quality or quantity of analytic processes in each case. In the first analytic column in Figure 27, labeled "documentation," studies were evaluated on the basis of whether or not they included documentation of the type of analysis which was anticipated to be applied to the mapped subsistence data. As in the case of documentation of data gathering procedures, it was expected that a description of methodology to be used in data analysis is standard scientific procedure.

In most of the earlier studies (Spencer 1959; Sonnenfeld 1956; Tanner 1966; Foote 1961; and the Federal Field Committee for Development Planning in Alaska 1968) in which subsistence mapping was generally only one of several methodologies employed in the study, either no analysis was conducted (such as in the case of Spencer 1959) or analytical processes were not described (Foote 1961). The majority of more contemporary studies approached methodological descriptions of analysis more rigorously.

TEMPORAL DIMENSIONS

Studies were evaluated as having conducted temporal analysis if they minimally compared use areas for two different temporal periods. The two most common means of providing for temporal comparisons in the studies reviewed involved data distinctions on the basis of seasonality of harvest and on the basis of years of harvest. Foote (1961) is an early model which applied both of these analytical criteria, comparing four seasons (spring, summer, fall, and winter) for the years 1850 to 1860 and 1950 to 1960, in order to demonstrate continuity of use through time. The only other study reviewed in this context to employ both seasonal and annual temporal distinctions is the Dene mapping project, which has computerized land and resource use data so that it can recall by season and year as needed (T. Abrams, personal communication 1985).

Other studies have focused on use pattern distinctions between years based on criteria established by researchers to be significant. Freeman (1976), an excellent example in this regard, for the most part distinguished between the "traditional" period (prior to the local arrival of traders), the trade period, and the period in which permanent settlements became the most common dwelling location for most Inuit of the Northwest Territories. The actual years associated with these periods varied depending on the historical dynamics of local areas. The research team expected to see changes in land-use patterns related to increasing reliance on trade and trends towards centralization. The northeastern British Columbia land use and occupancy

project's (Brody 1982; Union of British Columbia Indian Chiefs 1980; and Weinstein 1979) participation in temporal analysis should be strictly qualified, as it was only done for a sub-sample of hunters from a single reserve (East Moberly Lake). Although Brody (1982) argued that temporal distinctions were not meaningful to resource users in their sample and therefore not incorporated into the research methodology, the pre- and post-1961 analysis done for the East Moberly sub-sample clearly identified shifts in subsistence patterns associated with mineral and homesteader developments in the area.

The most detailed temporal analysis reviewed was Fall, Foster, and Stanek (1985), which portrayed the distribution of moose hunting effort for September and November, 1983 and January, 1984. This analysis addressed biological and related human use research questions associated with the fish and game regulatory processes of the State of Alaska.

In considering the temporal dimensions of data analysis, two significant points emerge regarding seasonal and annual variation in resource use patterns. First, there is limited utility to mapping land and resource use patterns in the absence of seasonality if one intends to contribute to an understanding of the dynamics of the subsistence system through mapping. If mapping extensivity of land and resource use is the only goal, seasonality may be of less importance, although informants report difficulty in mapping species harvests without reference to seasonality -- that is, they perceive the researcher's questions to be somewhat crude. It should also be remembered that hunter-gatherers may not perceive seasonal cycles in

the same way as agro-industrial populations -- the four season approach. In regards to annual variation, whereas the map biography concept provides the time depth needed to incorporate variations in the extent of land and resources uses resulting from longer term ecological, economic, and cultural change, the dynamics of changing use patterns are masked if temporal distinctions are not made and analyzed in the mapping process. The temporal units chosen should relate to hypothesis testing (such as Shinkwin and Case 1984 or Foote 1961), knowledge of significant events in the local history of the study area which may have influenced subsistence patterns (such as Freeman 1976), and the inclusion of as much detail as possible (such as is applicable to the Dene mapping project case) in order to identify meaningful periods not anticipated in the research design phase.

INTENSITY

The earliest of the reviewed mapping studies to employ a measure of intensity in analysis was Sonnenfeld (1956) (see Figure 27), who calculated the number of square miles used per hunter for Alaska's arctic slope as a comparative measure in assessing whether or not a proposed reserve was of adequate size. The use of square miles as a measure of intensity reoccurs in the work of Müller-Wille (1978), Hoffman (1976) in Freeman (1976), and Pedersen, Coffing, and Thompson (1985). Due to ecological diversity and problems in determining and using calculations of square mileage in the resource pursuits of marine hunters and fishers, this measure can be applied most

effectively to analyzing different use patterns between resource users (individuals or families) within the same study population, such as was the case in Pedersen, Coffing, and Thompson (1985). Within the same group, a measure of square miles used per production unit can serve to assess reliability of informant recall, based on the assumption that hunters sharing key variables (e.g. age, technology, number of dependents, etc.) exploit a similarly-sized geographic unit. With qualification and in conjunction with other ecological, cultural, and socioeconomic data, such a measure could also be applied to comparing use patterns between study populations. Finally, both Müller-Wille (1978) and Hoffman (in Freeman 1976) used square mile measures of intensity to analyze temporal changes in land use patterns associated with centralization and other factors of cultural change. Pedersen, Coffing, and Thompson (1985) went one step further in using this analytical tool by comparing the number of square miles associated with the harvest of each resource category, although they astutely warn the reader against extrapolating the outcome of this measure into an evaluation of the relative importance of different resources to the study population.

Weinstein's (1976) mapping of intensity in association with the James Bay hydroelectric project is the only example reviewed which employed pounds harvested per areal unit (in this case, 100 square kilometers). In his analysis, Weinstein assigned a level of importance to each 100 square kilometer grid in direct proportion to the quantity of resources harvested in that unit. The major problem with this study lies, not in the use of pounds as a measure of intensity,

but in the fact that the pounds harvested are calculated for a single year period and therefore fail to account for variations in the cyclical nature of resource availability and the potential uniqueness of the study year's data. Although this study reveals patterns of productivity, it is discomfoting to speculate on the value of compensatory or mitigating measures which potentially could have been based on these data.

Fall, Foster, and Stanek (1985) employed a measure of intensity commonly associated with resource management -- namely, catch per unit effort (CPUE). This measure was used to assess the relative productivity of sub-areas in association with other variables (e.g. weather, access, species distribution). Whereas application of this criterion to short-term resource management and allocation questions was undoubtedly useful, and the method a potential model for subsequent studies requiring similar economic or energetics questions, the short~~-time~~-depth in this case limits the applicability of its findings.

Carpenter, Varley, and Flaherty (1959) provide a relatively unique example of measuring intensity through a technique based on the observation that when informants draw maps, they exaggerate the size of and record greater detail for areas with which they are most familiar. It is common assumption in behavioral geography that degree of familiarity bears a direct relationship to level of use. No other studies concerned with subsistence mapping reviewed in this context employed cognitive analytical models.

Finally, Braund and Burnham (1984) assessed the intensity of areal use on the basis of temporal criteria -- namely, they assumed that areas used within the previous five years for the harvest of wild resources were more "intensively" exploited by users than were the remainder of areas used in their lifetimes. While this method encompasses areas used most recently, the "intensive" designation might assign a higher value to areas infrequently utilized (but used within the past five years) than to areas important in the long-term but, for one reason or another, temporarily abandoned. In fact, it could be argued that in a dynamic and cyclical environmental system in which humans must respond knowledgeably to longer-term patterning of wild resource availability, duration rather than recency of use may be a more meaningful indicator of intensity.

As previously stated, since policy-makers have an escalating interest in questions of intensity related to land and wild resource use, pressure is being placed on researchers to develop and apply analytical measures of intensity to subsistence mapping. While some of the criteria used to analyze for intensity in studies reviewed in this context were adequate to respond to more narrowly-focused questions, their simplicity (i.e. limited criteria) makes them less well suited to adequately assessing the overall relative importance of land-use areas to populations dependent upon them for food, raw materials, and other more difficult to quantify values. Therefore, for questions regarding more inclusive land-use planning decisions, if social scientists are to be involved in the valuative process as it applies to the spatial dimensions of land and resource use, analysis

should include a complex of relevant criteria and address not only the value of a segment of land and associated resources to the subsistence-based system but also an assessment of the loss of these land and resources to the system in a temporal perspective which is as broad as feasible.

TECHNIQUES OF ANALYSIS

In previous chapters, it has been pointed out that not only is subsistence mapping a relatively new and undocumented research tool, but also that anthropologists conducting land and resource use mapping generally have negligible training in the methods of geography and its sub-discipline of cartography. Further, in the description and evaluation of studies reviewed in this context, the absence of common analytical techniques and nomenclature is apparent. Fundamental to the scientific process is the documentation, with clarity and thoroughness, of procedures and techniques used in scientific analysis. In this section, the techniques documented and used for data analysis are evaluated in light of these criteria and the overall limitations resulting from the relative immaturity of subsistence mapping as a research tool.

One commonly employed analytical technique in subsistence mapping is areal comparison. Several studies have compared the distribution of land and resource use areas for different temporal periods or between groups, thereby arriving at conclusions regarding continuity or discontinuity of the spatial components of subsistence through time or

between populations (for example, Foote 1961; Freeman 1976; Brice-Bennett 1977; Shinkwin and Case 1984; Wolfe 1981; and Nelson, Mautner and Bane 1982). However, none of the studies presented in this context actually described how conclusions were derived, although the reader is led to believe that researchers do so by actually or figuratively overlaying the spatial data from one time period or group on that from another and then arriving at some more or less subjective view about the degree of fit between the two. One wonders how or to what degree such an overlay would have to vary to be judged discontinuous as opposed to continuous -- what is the cutting edge in such an evaluation? In addition, analyses of this type note only the similarities or dissimilarities between the perimeters of use areas rather than variations in internal patterning. Several studies hinted at features of internal differentiation of land and resource use, employing terms like "core area," "core hunting area," intensively used area," and "area of usual extraction" in opposition to terms describing remaining (and seemingly less utilized) zones (for example, Jorgensen 1984; Brody 1982; and many others). In some cases, these distinctions were made only in narratives and not mapped. Again, the criteria for delineating the dichotomy generally went undocumented. It is expected that those studies with computerized data bases may have analyzed, or been able to analyze, the degree of conformity of use areas through time or between groups with more quantitative measures (Freeman 1976; the Dene mapping project; the northeastern British Columbia East Moberly Lake component; Pedersen 1979; and

Pedersen, Coffing, and Thompson 1985), but there were no presentations of statistical criteria in the examples reviewed.

The sole statistical measure applied to area analysis was number of square miles or kilometers used or available per productive unit (i.e. hunter or family) or per species (Sonnenfeld 1956; Muller-Wille 1978; Burns 1977; and Pedersen, Coffing, and Thompson 1985). In these examples, analytical techniques were more defined, but comparisons between cases are problematic, because areas were not calculated on the basis of uniform demographic units.

Other less commonly employed analytical techniques, some of which deserved more rigorous documentation, include catch-per-unit effort, indicators of reliability, continuity of use areas between cohorts, indices of conflicting land use, and harvest quantities per unit area by species. Examples of each of these techniques are briefly considered.

Fall, Foster, and Stanek (1984) employed catch-per-unit effort for moose for a brief period in 1981 by sub-unit in an attempt to calculate relative sub-unit productivity. Although it would have been preferable to advise the reader unfamiliar with the concept of "man-day" (frequently employed in fish and game management studies) as to how it is calculated, the authors depicted "man-days per moose per hunting area" in tabular format, providing a single year measure of intensity for moose for Tyonek hunters.

Brody (1982), Hoffman (1976), Pedersen, Coffing, and Thompson (1985) and others described employing methods of informant reliability analysis based on consistency of use areas between individuals,

between individuals and groups, and between different temporal periods for the same group. However, the specifics of these analytical techniques were not reported so are difficult to analyze in this context. Pedersen, Coffing, and Thompson (1985) used aerial and ground verification of transportation corridors and kill and camp site locations to, in part, accomplish these same ends.

Of similar ambiguity, continuity of use areas between cohorts is mentioned in Brody (1982) as an analytical tool. Whereas it is logical to assume that this form of analysis would involve a comparison of subsistence areas between age cohorts, the researchers in the northeastern British Columbia land use and occupancy project did not shed light on this methodology.

There are several examples of studies which focused analytical concerns on areal comparisons between subsistence use areas and zones of developmental or other impact (for example, Sonnenfeld 1956; Foote 1961; Weinstein 1976; Pedersen 1979; Burns 1977; Nelson, Mautner, and Bane 1982; and Martin 1983). These can be seen as analyses focused on competing land and related resource uses. Despite the complexities involved in analyzing the variables associated with competing land uses (whether the competition comes from the establishment of a national park, a homestead parcel, or a hydroelectric dam), the state of the art in using mapping as a tool of analysis in this regard has been limited primarily to superimposing land and resource use data over the mapped extent of the proposed project. One of the many critical variables neglected in such simplistic analysis derives from the fact that critical habitat and harvest areas commonly are not one

and the same -- a point clearly noted by Pedersen, Coffing, and Thompson (1985).

In this regard, Weinstein (1976) is noteworthy in adding another dimension to his competing land use assessment -- namely, by mapping pounds harvested by species categories per unit area. Despite the temporal weakness of the Fort George data base, mapping was used in this context to correlate more than a single variable in the spatial analytical process.

In general, then, the primary critiques of analytical techniques used in reviewed studies are two-fold. First, in large part researchers suggest that they have undertaken analysis of spatially connected data but fail to document the methodology for doing so -- hence for arriving at conclusions on the basis of such analysis. Second, although there are multiple reasons discussed above for social scientists to avoid analysis which maybe used for compensatory or other valiative decisions, if they opt to undertake analysis of mapped subsistence data, they should apply the same level of scientific rigor to this analysis as commonly applied to other types of systematic research.

DATA PRESENTATION

In scientific research, it is not only essential that a study be methodologically sound both in terms of data gathering and analysis, but also that the information derived from the research process be presented in such a manner that conclusions relate meaningfully to the

data base and that independent verification of conclusions can be conducted by a reviewer. In subsistence research, geographic-based hunting, fishing, and gathering data are most meaningfully presented in the context of maps. It is therefore essential, for these purposes, to evaluate subsistence maps on the basis of criteria which assess both the substance and form of data presentation. In Figure 27 each of the reviewed studies is evaluated on the basis of whether or not it included a presentation of both descriptive and analytical components of the data base in mapped format and to what degree the depiction of the data in maps allowed for relevant interpretation (quality of presentation, termed "depiction" in Figure 27).

Essentially all studies presented descriptive data in mapped format, as can be seen in Figure 27. In one case (Patterson 1974), there were no maps accompanying the text, but maps were described in some detail in the narrative and made reference to throughout. However, the quantity of data included in these maps varied greatly. Substantively, geographic-based subsistence data were provided along a continuum of detail from individual informant or household maps, overlaid one on top of the other, which depict a group pattern (Brody 1982; appendix in Pedersen, Coffing, and Thompson 1985) to regional or sub-regional composites with no distinctions between individuals, households, or communities (Nelson, Mautner, and Bane 1982) (see Figures 12 and 22 respectively). Most researchers contemporarily have been wary of providing individual or household level data because of concerns for informant anonymity, and community or reserve use pattern aggregates have been the norm (for example, Freeman 1976 in Figure 10;

and Weinstein 1976 in Figure 6). However, Freeman (1976) (see Figure 9) and Pedersen, Coffing, and Thompson (1985) varied from community-based patterns by portraying, respectively, trap lines and kill sites on an individual or household basis.

The lumping or splitting of species categories provides another measure of descriptive detail in subsistence mapping. The selection of species or species categories for distinct portrayal is closely linked to research questions, as species "importance" may reflect the policy focus of the study, the views of biologists, or the emic perceptions of the study population. Additionally, the research budget and temporal restrictions undoubtedly influence the degree of species detail gathered as do theoretical perspectives about the value of species-by-species mapping (Brody 1982). For example, Sonnenfeld (1956) portrays all hunting, trapping, and fishing on a single map for the Barrow area (see Figure 28), whereas Freeman (1976) distinguishes between 19 separate species or species categories in the Inuit land use and occupancy maps.

Another measure of descriptive detail in the geographic portrayal of subsistence data is seasonality. As indicated in Figures 9 and 10, the Inuit Land Use and Occupancy Project model (Freeman 1976) did not present land and resource use data by seasons. By way of contrast, the Dene mapping project has the potential for presenting all data to reflect seasonal variation, as did Burch (1981) (see Figures 24, 25, and 26) Foote (1961), and others for focus species (for example, Fall, Foster, and Stanek 1984).

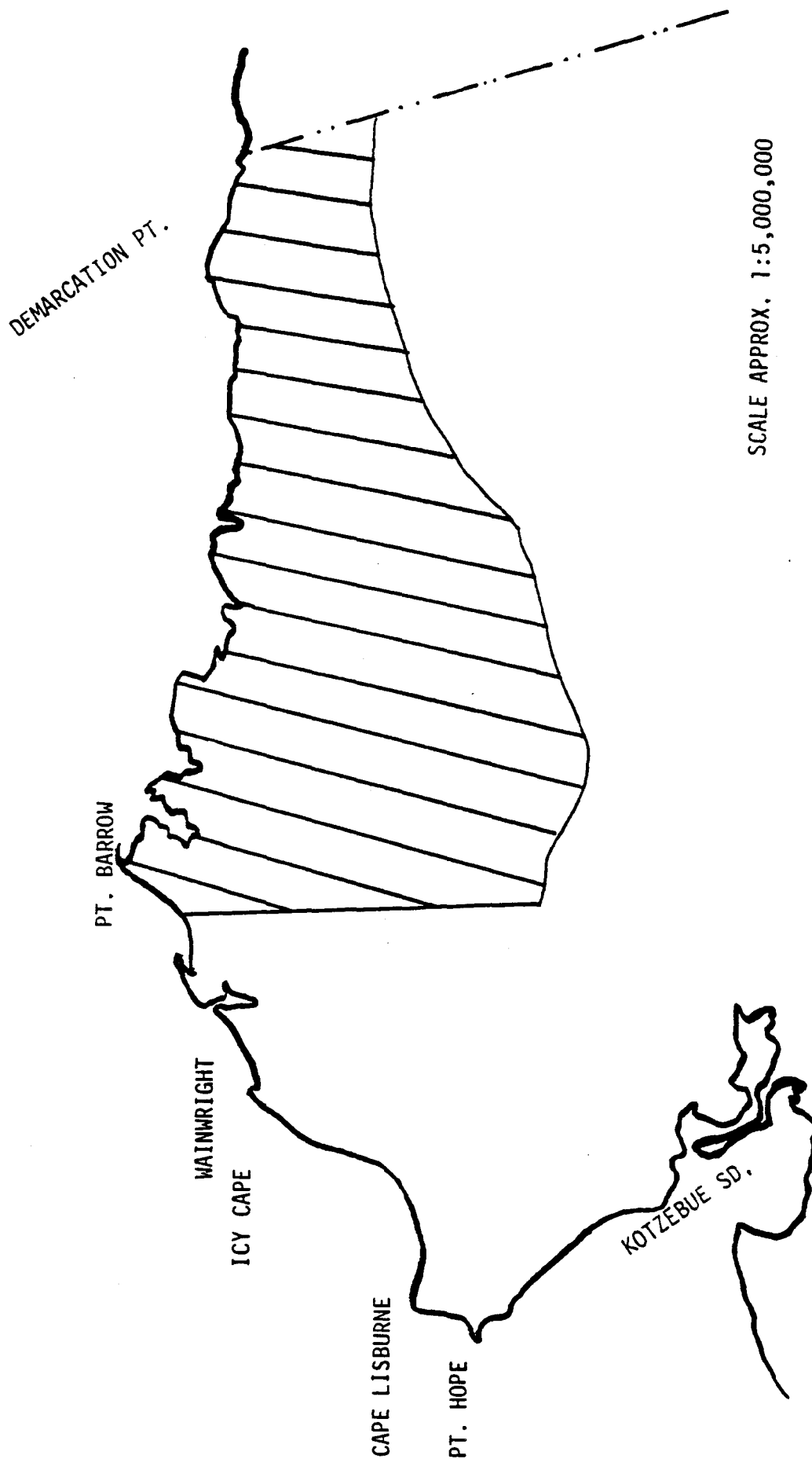


Fig. 28. Barrow trapping-hunting-fishing area according to the village council, May 17, 1947 (taken from Sonnenfeld 1956).

Finally, researchers and their informants have differential perceptions about how land and resource use data should be presented. In response to the question, "where do you hunt moose?," an informant may provide information by travel corridor (lines), kill site (points), general area (enclosed space), a combination of more than one of the above, or some other dimension not common to western perceptions of geographic data (Brody 1982; Tuan 1974). While none of these perceptions are less valid than the others considering the nature and processes of hunting behavior -- search, pursuit, dispatch, and retrieval -- and the fact that resource use occurs in minimally a three-dimensional world portrayed on two-dimensional maps, they do provide different degrees of specificity of subsistence behavior.

In Figure 27 each study was evaluated on the basis of whether or not maps were used analytically -- that is, if a relationship between use area and some other geographic variable (including the same use area at another point in time) was presented in the report to illustrate analytical links, the study was positively evaluated. As revealed in Figure 27, some studies which conducted analyses of the spatial components of hunting, fishing, and gathering failed to present mapped illustrations of the data upon which the analyses were conducted but, instead, presented the analysis in narrative form (for example, Müller-Wille 1978). The vast majority of studies reviewed presented analytically-related conclusions not supported by the presentation of maps.

For purposes of analysis, maps were most frequently used to illustrate the similarities and differences of land and resource use

patterns within the same area for two or more different periods of time. These temporal periods ranged from decades, such as in the cases of Foote (1961) and Burch (1981), to months, such as illustrated for a single species in the case of Fall, Foster, and Stanek (1984). While the usual method for presenting data from different temporal periods involved the inclusion of maps depicting subsistence areas for each time segment researched, in a few cases composite maps were developed to illustrate the variables of analysis (for example, Braund and Burnham 1984).

Spatial comparisons of potential conflicting land uses were the next most common means of presenting analytical mapped subsistence data. With the exception of Pedersen, Coffing, and Thompson (1985), all studies reviewed in this context imposed subsistence use areas over base maps which included the designated areas of potentially conflicting use. Examples include the areas to be impacted in the case of the James Bay hydroelectric project in Weinstein (1976); the areas to be included in the Sam Creek subdivision land disposal in the case of Martin (1983); and the areas withdrawn by the federal government as part of Gates of the Arctic National Park in Nelson, Mautner, and Bane (1982). Conflicting land use mapping criteria would also include territoriality associated with community or ethnic group affiliation, examples of which were provided by Wolfe (1981), Nelson, Mautner, and Bane (1982), Shinkwin and Case (1984), and Burch (1981).

Other analytical variables mapped in the studies reviewed include productivity as measured by pounds harvested (Weinstein 1976) and kill site locations (Pedersen, Coffing, and Thompson 1985) and compensation

(Burns 1977 and Sonnenfeld 1956) based on the settlement of indigenous claims. In one case (Jorgensen 1984), areas were differentiated analytically but the author failed to provide the criteria on which the differentiation hinged.

In Figure 27 the criteria for evaluating subsistence maps for clarity, comparability, detail, relevancy to study, autonomy from narrative, and overall adherence to scientific standards of data presentation were applied to each study in the column termed "depiction." Unlike other categories in Figure 27, this segment of the evaluation is somewhat subjective in that the quality of compliance to criteria were assessed rather than merely the presence or absence of conformity to a scientific model. It should be noted that the quality of maps in large part may be a product of funding over which the researcher frequently has little or no control. On the other hand, the inclusion of some aspects of key information may cost the researcher little or nothing yet may substantially increase the overall, responsible applicability of the study.

Of central importance in this analysis is the relevancy of subsistence maps to the overall study of which they are a part. For example, there is negligible connection in regards to subsistence between the meaningful ecological and social data presented in Spencer (1959) and his mapping of Nunamiut and Tareogmiut territory. Similarly, the Federal Field Committee for Development Planning in Alaska's (1968) subsistence maps derived from Foote (1961) and Oswalt (1967) were too general and peripheral to the overall regionally-focused land claims documentation to be of substantive use to the question of

Native claim's settlement. By way of contrast, the Freeman (1976) study, particularly developed for the purpose of Inuit land claims, presented detailed and extensive temporal, spatial, and resource-specific data in a clear and comprehensible format.

There are many features of map detail that were considered in evaluating each study, including scale; direction; symbols; legend; contours; inclusion of camps, communities, and roads; and date of base map. Each of these deserve brief comment in regards to subsistence map depiction.

It is essential that any map include a notation of scale on the map proper. In the majority of subsistence maps reviewed, 1:250,000 was most common, although the range varied from 1:5,000,000 (for example, Sonnenfeld 1956) to 1:63,360 (for example, Burns 1977). In some regards, the 1:250,000 scale is inadequate to portray the details of complex ecological zones, such as indented coastlines, coves, small bodies of water, topographic diversity, and site-specific harvest areas. On the other hand, it provides a useful scale for presentation as it encompasses the entirety of a community-based harvest area and can easily be presented in standard report format. Scale of 1:1,000,000 is too large for any detailed presentation of land and resource use data except for very stylistic and generalized representations. Weinstein (1976) noted that the 100 square kilometer grid which he imposed over mapped data for analysis was, in his opinion, too large or gross to meaningfully represent actual harvest locations.

Direction indicators on subsistence maps permit the reader to orient the spatial distribution of data towards a broader

representation of the earth's surface. The absence of indicators of direction, although more common in earlier studies, is somewhat disorienting, as can be seen in reviewing maps from Weinstein 1979 (an example of which is depicted in Figure 11).

It is conventional for mapped data to be accompanied by a legend explaining the notations used upon the map. Some of the major studies reviewed in this context included no legend (such as Brody 1982 or Burch 1981) or only a single legend at the beginning of the presentation of maps (Freeman 1976) making reference difficult for the reader. Legends should include symbols and their definitions to enable appropriate map interpretation.

Symbols should be used to denote areas (Fall, Foster, and Stanek 1984), travel corridors, (the Dene mapping project), sites (community, camp, or kill sites, for example) (Pedersen, Coffing, and Thompson 1985), species, gear types (Wolfe 1981 provides an excellent example of the use of symbols to depict fishing gear types), topographic features (Martin 1983), temporal periods (Braund and Burnham 1984), cultural or ethnic distinctions (Nelson, Mautner, and Pane 1982), and others. Symbols should be large and simple enough to easily comprehend (size was a problem in Wolfe 1981 and simplicity and clarity a major problem in Little and Robbins 1984), yet precise enough to allow identification of the geographic area or species of interest (poorly achieved by Little and Robbins 1984). In general, symbols are most difficult to read on blue line or poorly reproduced maps (such as Weinstein 1979 and Burns 1977). Contour lines deserve a special comment in regards to subsistence mapping symbology. Since the

harvest of particular species may require topographic differentiation, the use of elevation contours may portray more meaningfully land and resource use patterning (a critique which Brice-Bennett 1977 applied to the absence of elevation contours in the Labrador project). Another use of contours or isarithms was applied by Weinstein (1976), who connected points of equivalent harvest quantities. This use of contours is problematic, in that harvest quantities are discontinuous values and therefore can be differentially interpreted in terms of connecting contour lines (Haggett, Cliff, and Frey 1977) — that is, to some degree harvest isarithms are a product of researcher subjectivity.

Finally, there are supplemental criteria linked to scientific method which were applied to the studies in question, including notations regarding sample size, temporality, data sources, and data qualifications. Since maps are routinely removed from their report context and adapted to other studies, it is important that scientific qualifiers be included on the map proper — that is, the map should be able to stand somewhat alone without being misrepresentative of the data on which it is based.

The inclusion of sample size on subsistence maps provides a gauge of the representativeness of the study data, especially if the sample size is expressed both numerically and as a ratio or percentage. For example, if map biographies are gathered from male heads of household, "n" should be expressed as the total number of male heads interviewed and the percentage of total male household heads in the study population. As can be seen by the example, not only the size and ratio of

the sample needs to be noted but also the criteria for sample selection (e.g. male heads of households, total adult male, total households, etc.). In the studies reviewed, there were very few cases which conformed with even a portion of this standard -- that is, Wolfe (1981); Fall, Foster, and Stanek (1984); Pedersen, Coffing, and Thompson (1985) in part; and Wright, Morris, and Schroeder (1985) present "n" and criteria but no ratio. None of the major Canadian studies incorporate any part of this standard in presentation of mapped data.

The record for including temporality -- that is, the time period represented by the data -- is much better. Foote (1961) was the earliest of the studies to note the time periods represented by the data, as does Freeman (1976), Weinstein (1976), Burch (1981) and the majority of the Division of Subsistence reports. Other Alaskan examples, such as Burns (1977), Jorgensen (1984), and Little and Robbins (1984), are deficient in this respect. The omission of temporality on the map proper is particularly negligent, as the map portrays land and resource use areas in a cross-section of time, which should not be extrapolated to the past or future because of the dynamics of subsistence systems diachronically as discussed in some detail above. In addition, application of mapped subsistence data require some concept not only of the absolute years represented in the data but of the time depth portrayed.

The Division of Subsistence has provided a noteworthy example in more recent research of linking maps to the overall study by reference to the division or specific project of which the map is a part.

Again, since maps are often removed from their study context, a designation of data source provides a link which otherwise may be lost in application of geographic-based subsistence data.

Finally, each map should include a summary qualifier which warns the data user about the dangers inherent in application of the mapped subsistence data beyond the study context, intended purpose, and limitations. The intimate links which should exist between mapped land and resource use data and the specific research questions driving the study (which, in turn, represent the intent or purpose of gathering spatial subsistence data) have been a recurrent theme throughout this chapter. Therefore, mapped subsistence gathered for a specific purpose, time period, sample, species, area, and other variables, may be totally inappropriate as applied to another set of research questions. Initial qualifiers focused on study limitations:

. . . the lines drawn on this map merely represent outer limits of our current documentation (July 1978) of the perceived subsistence geography on the North Slope (Pedersen 1979:8).

Mapping of resource uses stretching further back than one year might reveal substantially wider land use patterns as might mapping of future resource use patterns longitudinally (Wolfe 1981).

Additionally, they were not always included on the map proper. The major Canadian land use and occupancy studies have not appended summary qualifiers to mapped data, although several (Freeman 1976; Brice-Bennett 1977; Brody 1982) have discussed the limitations of the geographic portrayal of subsistence data in considerable detail. The Division of Subsistence, in its most recent publications, has adopted the most responsible research policy in this regard, by mandating that

all mapped products include a general, summary qualifier, two examples of which follow:

Resource use areas change through time and are not fixed entities. Land outside these areas should not be considered to be less important to community residents (Pedersen, Coffing, and Thompson 1985:120).

This map was compiled during 1982 with a sample of 39 Tyonek households, and updated in 1983-84. It represents areas used during 1978-1984. This map may be a partial representation of use areas by the community. Use areas change through time and are not fixed entities (Fall, Foster, and Stanek 1984:123).

Both qualifiers incorporate the concept of subsistence systems being dynamic and imply that any particular spatial representation of subsistence may not be representative of other temporal periods or segments of the study population. The Pedersen, Coffing, and Thompson (1985) qualifier goes one step further into the area of valuation and intensity by specifically warning the data user about deriving assumptions about relative value of lands and resources within and without bounded areas on subsistence maps.

CONCLUSIONS

As a final evaluative measure, each study reviewed was assessed to determine whether or not the maps supported the conclusions in the text (see Figure 27). For the most part, studies evaluated in this context, to greater or lesser degrees, integrated mapped subsistence data with narrative data in support of research conclusions. Notable examples in this respect include Weinstein (1976), Freeman (1976), the Dene Mapping project, and the northeastern British Columbia project

(as depicted in Brody 1982) from the Canadian context and Foote (1961); Wolfe (1981); Purch (1981); Martin (1983); Fall, Foster, and Stanek (1984); and Pedersen, Coffing, and Thompson (1985) from the Alaskan context. However, in the case of studies with a primary objective of mapping extensivity of land and resource use (for example, Freeman 1976), the ability of the researcher to support conclusions with maps is somewhat less complex than the corresponding task for the researcher who employs mapping to test hypothetical relationships between variables (for example, Shinkwin and Case 1984).

For the most part, cases which failed to comply with this criteria did so because of the peripheral nature of the maps included in the studies. Examples of subsistence maps being relatively unrelated to the study outcome include Spencer (1959), Tanner (1966), Field Committee for Development Planning in Alaska (1968), Jorgensen (1984), and Little and Robbins (1984). In one case, the researcher failed to provide maps to support his conclusions (Müller-Wille), although he clearly had used geographic-based data derived from his own field researchers and that of others to support his findings. In the final case (Nelson, Mautner, and Bane), the problem relates to the ambiguous nature of how maps were presented in the document -- that is, mapped data comprehension was severely restricted by the absence of details such as the names of geographic features and community locations and by the fragmented manner in which they were presented in the appendix. The two composite maps (e.g. traditional sheep hunting and trapping areas) included in the text were useful in depicting the ethnic distinctiveness of use areas (Koyukon Athabaskan as opposed to

Anaktuvuk Pass Inupiat) but too general to reveal more specific subsistence data (see Figure 22).

As the use of mapping in subsistence research becomes more standardized and conforms more closely to scientific method, it is expected that the linkages between geographic-based subsistence data and conclusions will be better defined. Additionally, the standardization of research methodologies will facilitate inter-study comparisons, hypothesis testing, and the development of theory through the use of maps. It is the purpose of Chapter 5 to integrate the strengths of the methodologies reviewed in this context, techniques from related social sciences, a concern for research questions, and the methods and findings of the field test segment of this project in southeastern Alaska (Prince of Wales Island) into a set of comprehensive subsistence mapping methodological guidelines, applicable to southeastern Alaska cases and in conformance with a scientific model of research.

CHAPTER 5

SUBSISTENCE MAPPING: GUIDELINES FOR THE DEVELOPMENT OF A RESEARCH TOOL

INTRODUCTION

It is the purpose of this chapter to provide guidelines for the use of subsistence mapping as a data gathering and analytic research tool. These guidelines have emerged from the review and evaluation of mapping methodologies which have been applied to subsistence research in northern North America, from a consideration of the use of mapping more generally in the disciplines of anthropology and geography, from models applied to the study of hunting-gathering adaptive strategies (for example, optimal foraging strategy models), and from a field test of a mapping methodology conducted in southeastern Alaska. Of particular importance in this regard is the concept that subsistence mapping be employed as a research tool, as opposed to its use as a peripheral, often irrelevant, or haphazardly conceived supplement to other study methods. As a research tool or method subsistence mapping is subject to scientific standards, including adequate documentation, association with a research problem or set of problems, controlled data collection and analysis, and a manner of presentation which supports conclusions. If subsistence mapping is applied to research in accordance with these

standards, the resultant study should be both replicable and potentially comparable.

The theme which has permeated this study is that there is no single mapping methodology which can address all research questions or be applied to all ecological, cultural, or temporal contexts. More specifically, whereas all mapping methodologies should conform to the scientific standards described above, variations in all dimensions of the methodology are not only possible but highly desirable -- that is, the methodology should be keyed to the problem. In addition, there may be more than one mapping method with applicability to the same research question.

In Chapter 1 examples of subsistence-related research questions with spatial components which could be appropriately addressed by mapping methods were described. A concise review of some of the more relevant of these basic questions is useful as preliminary to the development of methodological guidelines, since it is these questions which should drive the particular configurations of the mapping method. Potential question or problem categories include, but are not limited to, the following: (1) what is the extent of land and related resource use by members of a study population?; (2) how have these land use patterns changed through time?; (3) to what degree do land and resource use areas coincide with group concepts of territoriality?; (4) by what criteria are areas and associated resources differentially used by members of a study population?; (5) how do the use patterns of one population differ from those of another?; (6) how do land and resource use patterns respond to changes in resource

availability or accessibility?; (7) how do changes in modes of production influence land-use patterns?; (8) what are the effects of centralization and related sedentarism on land-use patterns?; (9) what are the effects of competing land and resource uses on the spatial dimensions of subsistence patterns?; (10) how have changes in harvesting and transportation technology influenced land-use patterns?; and (11) what are the land-use requirements of participants in subsistence-based socioeconomic systems?

It is, of course, not feasible in this context to develop methodological guidelines applicable to all of these questions or others not reiterated above. Therefore, the organization of this chapter will proceed as follows. Two hypothetical and one field-tested study, which combine several of the research questions listed above and associated relevant mapping methodologies, are applied to a community in southeastern Alaska in conformance with the standards of a scientific model, thus providing a meaningful format for the presentation of methodological guidelines. The identity of the community is not revealed in this context to insure that the hypothetical studies and findings are not interpreted by readers as having direct applicability to the study community. In addition, the field-test study is only particularly represented in this context for purposes of developing methodological guidelines; therefore community identification should occur in conjunction with the complete representation of findings in a separate report (see Ellanna and Sherrod 1985). In Case A (the first hypothetical example, the research question is: what changes have occurred in the extent of land and resource use by residents of the

study community through the course of their lifetimes? In Case B (the field-test case), the effects or impacts of commercial timber harvest (specifically clear-cutting) on wild resource use patterns are assessed. In Case C (the second hypothetical case), the research question asks what is the relationship between changes in commercial fishing technology and land and resource use patterns through time?

Although the study community is unnamed in this context for reasons described above, in order to develop meaningful methodological guidelines, pertinent community characteristics must be established. The community is located near the mouth of a sockeye stream on the western shore of one of larger islands in southeastern Alaska characterized by a complex coastline which includes bays, inlets, estuaries, large salt-water lakes, straits, reefs, and numerous small offshore islands. Additionally, the island is large enough to support mountains, which reach an elevation in excess of 3,000 feet, salmon-spawning streams, freshwater lakes, and ravagable rivers. The island has been the site of long-term human habitation by Tlingit Indians. Within the past century, commercial fishing has provided the primary context for both subsistence and cash production, and within the past 50 years commercial timber harvesting has expanded from isolated coastal camps to encompass the majority of the island. Accompanying this expansion was the development of a major road network which now laces the island. The study community is relatively small (approximately 500 in winter with an increase of 50 or more transients during summer months) and composed predominately of long-term Tlingit residents. Contemporarily year-round, full-time employment opportunities

are limited and most cash is derived from seasonal wage employment and domestic production in the form of commercial fishing. The community is linked to the mainland by the Alaska Marine Highway system, which has facilitated, since its inception in 1974, an increase in the use of the island by "outsiders" for resource extractive or other purposes.

This setting, then, provides the arena in which the development of methodological guidelines, addressing the three research questions described above for the same southeastern study community, can proceed. The initial step in this methodological development is to refine the research questions and place them in relevant theoretical perspectives.

THE RESEARCH QUESTION: WHEN IS MAPPING AN APPROPRIATE TOOL?

At a very rudimentary level, the use of mapping in subsistence research is appropriate when the spatial dimensions of hunting-gathering behavior are a focus or component of inquiry. In the context of this review, it has been apparent that mapping methodologies have been predominately associated with applied research. Most frequently, researchers have sought to document the spatial dimensions of land and resource use as they relate to governmental policy in relationship to decisions involving public lands or the management of common property resources. Examples of non-applied uses of subsistence mapping or the application of mapping to hypothesis

testing have been relatively rare, and the few cases reviewed have had potential for incorporation into public policy (for example, Burch 1981; Müller-Wille 1978; and Shinkwin and Case 1984). As has been pointed out, the spatial extent of land and resource use has not been the sole or, in some cases, even the primary interest of public policy, but instead demands for valiative measures of land and resource use by participants in subsistence-based socioeconomic systems have escalated.

The case studies developed in this chapter reflect the dominant applied focus of research which has engaged subsistence mapping methodologies, while simultaneously aiding in the development of a more holistic comprehension of hunting-gathering strategies and subsistence-based economic systems (a theoretical contribution). If possible, dual application of research problems to applied and theoretical questions is desirable and makes the most efficient use of funds committed to such studies. The flip side of this coin is the need for the more rigorous standards of academic research to be brought to bear on applied research, as in theory the quality of public policy focused studies potentially may contribute to more informed decision-making on the part of governmental agencies.

The first research question (Case A) diachronically explores the dynamics of the areal boundaries of harvest activities by members of the study community. This question is intended to gather data on both the extensivity of land and resource use -- a common goal with the majority of major Canadian mapping efforts to date (e.g. Freeman 1976;

and the Dene mapping project) -- and the spatial dynamics of the subsistence system through time.

In regards to the question of extent, in the not too distant past, when hunting-gathering societies were more pristine or remote, the extent of land and resource use could be considered a primary use territory. Such territorial boundaries provided a method of access control and, in conjunction with other social and religious practices, functioned to preserve essential resources within the group territory (Usher 1982) -- resources which were managed essentially by the local population. These controls and management techniques functioned homeostatically to provide a level of stability for resources, users, and the extent of areas exploited. Contemporarily, traditional mechanisms of control have been subordinated to regional, state, or national land and resource use policies, regulations, and enforcement. Additionally, centralization has brought together non-homogenous groups within the same use areas, thereby also disrupting traditional mechanisms of land and resource control (Usher 1982). Therefore, since traditional mechanisms for maintaining a homeostatic balance between populations of hunter-gatherers and their natural environment minimally have been restricted and, in some cases, rendered obsolete, the mapping of areal boundaries without temporal differentiation fails to reveal patterns of response to externally-imposed controls over land and resource use. The research question in Case A is designed to address both the question of extent and the dynamics of changing land-use patterns diachronically.

The second research question (Case B) deals specifically with the effects of agents of change (in this case commercial timber harvest) on the spatial dimensions and related systemic characteristics of subsistence-based economies. Fundamental to an assessment of change is the documentation of a baseline of land-use patterns, with as great a time depth as possible, and a historic record of previous agents of change and associated response on the part of the study population. Additionally, current factors influencing land and resource use patterns apart from the primary focus — namely timber harvest — must also be addressed and, to the extent possible, controlled for in order to isolate and identify the impacts of logging-related phenomena.

There are four central elements of the subsistence-based socio-economic system most subject to impact by agents of change which directly influence the natural environment. These include destruction or disturbance of habitat, species, harvesting areas or sites, and related cultural (including economic) systems. For example, implicit in clear-cutting is dramatic alteration of habitat upon which some species in the food chain depend. Impacted habitat may or may not be used by local people for resource harvest. In the event that an impacted area had been used prior to logging, its use levels or potential abandonment would be documented in subsistence mapping with an adequate time depth and temporal distinctions. However, in the event that an area was not the site or even type of habitat in which harvest-related human activity occurred, it may lie outside the boundaries encompassed in extensivity mapping. In such a case, while use areas may not be directly impacted, critical habitat and

associated animal populations may be adversely or otherwise affected, thereby indirectly influencing the spatial patterns and related strategies of human resource harvest. In the realm of cultural and economic impact, the effects of logging may be multidimensional, only a few components of which are mentioned here by way of example. Local residents may perceive the logging activity to be the source of "outsiders" crossing traditional territorial boundaries and competing for valued resources without the consent of the local group. Implicit in the concept of territorial intrusion is the disruption of local mechanisms of land and resource control described in Case A and the perceived severance of delicately-balanced human-environmental ideological relationships. Economically, the commercial activity may provide limited local employment frequently of a nature which temporally conflicts with resource harvest activities.

Finally, impact-related research questions may involve the application of a criterion or criteria to quantitatively measure intensity of use of areas or resources. The ultimate intent of such quantification is to provide an indicator of loss for application to compensatory or other mitigating measures. The indicator of loss is divided into two categories -- the first is that of relative contribution to the overall subsistence economy and the second is the cost of replacement in kind to members of the impacted society (for example, the replacement costs for a deer would include additional travel to locate another deer and associated manpower and other related costs). Basic concepts from optimal foraging theory maintain that the

replacement deer would cost more than the original (Winterhalder and Smith 1981).

The third question (Case C) is more grounded in standard anthropological theory related to cultural change and can be conceptualized as more academic in intent, although its application to applied problems associated with commercial fishing regulations and limited entry is indisputable. As in Case B, the intent in this context is to control, as much as possible, variables other than that which is the focus of the study -- in this case, access to or use of commercial fishing technology. Additionally, as in Case B, the assessment of the relations between land and resource harvest and access to and use of commercial fishing technology requires the development of a baseline against which shifts in subsistence patterns related to commercial fishing can be compared.

The theoretical importance of this research question is multidimensional. In the process of centralization and associated loss of the mobility which involved minimally seasonal settlements or camps away from the winter village, has commercial fishing activities and technology compensated for or replaced traditional settlement patterns while providing for continued resource harvest opportunities? Secondly, centralization has resulted in more intensive use of areas proximal to communities -- also referred to as "core areas" (see Weinstein 1976 for an example). As a consequence of this phenomena, those individuals with access to transportation technology, which lends itself to speedy and far-ranging travel from a central village, have a decided edge in the pursuit of wild resources. In this context, it

could be expected that those individuals engaged in commercial fishing may be more successful in wild resource harvest activities than others not involved in this commercial endeavor -- basically a stratification based on technological access.

In overview, then, the examples presented above for the three cases provide a model for evaluating the appropriateness of mapping as a methodology in subsistence research which includes geographic or spatial components. Relevant applications and theoretical contexts were also provided in association with the three cases. Within an actual research context, the problem or set of problems about which the study will pivot merit yet more detailed documentation, including a review of pertinent theoretical, ethnographic, and historical literature adequately cited. The intent of the research and its potential applicability should be equally well documented. If the spatial components of research are only one part of a larger, more holistic study, the spatial and non-geographic elements must dovetail into a well-integrated and coherent design. It is at this point in the methodological developmental process that mapping as a data gathering tool is considered.

GUIDELINES FOR THE COLLECTION OF GEOGRAPHIC DATA

DOCUMENTATION

It is the responsibility of any researcher to thoroughly and accurately record in detail the methodology employed in the data gathering component of a study. Most usually, the methodological aspects of both data gathering and analysis are documented in the same section of a report (normally entitled "methodology" or some variation thereof). It is not possible for a reviewer to evaluate, compare, or replicate the data base presented in a study context in the absence of such documentation.

FORMULATION OF PERTINENT QUESTIONS

Whereas the research problem or set of problems pose the more encompassing questions to be asked of the data, a sub-set of more specific questions must be formulated to direct the data gathering process. The formulation of these pertinent, specific questions is presented on a case by case basis in this context.

In Case A mapping is intended to portray the outer boundaries of land and resource use during the lifetimes of study community residents and to reflect temporal changes in this boundary associated with significant socioeconomic events. The most appropriate tool for gathering extensivity data for such a lengthy temporal period is the

map biography, which basically entails the mapping of all areas used by an individual during his or her lifetime keyed, in this case, to meaningful units of time. The determination of which units of time are meaningful can be made by developing an extensive knowledge of the history of the community and deriving temporal subdivisions from this information; or by the delineation of temporal periods within the map biography by drawing the most extensive area used in the individual's lifetime and then indicating areas of lesser extent and noting beginning and ending years of use.

In Case B, a more detailed application of the map biography is employed. Informants are asked to report the specific areas they have exploited for resource harvest and to indicate the years during which each area was used. The focus in this case is not on extent of land and resource use but on the dynamics of use, particularly in association with commercial timber harvesting activities. In this case, mapped data must be linked to habitat type (e.g. beach, muskeg, forest, mountains or alpine meadows), means of access (e.g. foot, road, or boat), duration of trips for primary species, and reasons for ceasing to use a particular area. As previously discussed, harvest areas and critical habitat for species may not be one and the same. It is essential, then, to determine the details of habitat involved in harvesting so that it can be compared with critical resource habitat and habitat altered by commercial logging activities. Means of access are relevant to the study question, as road building has been a by-product of commercial logging on the island. A key component of the impact question, then is to what degree do local residents shift

from other more traditional modes of access to vehicular means of conducting resource harvest activities. Information regarding duration of harvest trips for primary species sheds light on the effects of centralization, wage employment, and changing modes of transportation. Data on the perceived reasons for areal abandonment are central to impacts assessment. In addition, intensity of use is measured by mapping the location of kill sites and subsistence net fishing sites and gathering harvest estimates for the previous five-year period. These measures of intensity provides an indication of relative areal productivity over the short-term for the purpose of assessing differential areal valuation. The five-year period is selected because informant recall of harvest site data is considered to be relatively accurate for major species during a temporal period of this expanse. It should be noted that harvest quantities were gathered for a single year in the field test, but it is expected that five years of data, if possible to elicit, would provide a much more accurate assessment of productivity.

In Case C, mapping is focused on identifying differential land and resource use patterns associated with access to and use of commercial fishing technology. As in Case B, a modified form of the map biography is used to portray the land and resource use patterns of informants during the course of their lifetimes keyed to the years in which they owned or otherwise had access to specialized commercial fishing technology (i.e. purse seiners, power trollers, and in excess of 20 foot hand trollers) as opposed to years when they did not. In addition, mapped data are linked to the specific type of commercial

fishing boat used, the role of the informant on the fishing crew (e.g. captain, second-in-command or "hand," and crew), and seasonality of harvest by species or species categories. The question of boat type has relevance to mobility, in terms of range and under circumstances of inclement weather, and duration of harvesting trips. The role of the informant on a fishing crew is associated with the degree of access he or she has to commercial fishing technology, especially during non-commercial fishing periods. Frequently, higher ranking members of a fishing boat crew are also included in harvest activities organized by the boat captain using technology other than the fishing boat (Langdon 1977). Seasonality of harvest has implications for assessing the use of commercial fishing vessels for non-commercial resource harvests and the ability of crew members to harvest resources via commercial vessel under less advantageous seasonal conditions.

Lastly, in this case a measure of intensity based on harvest quantities is useful in testing hypotheses about differential productivity of individuals having access to commercial fishing technology versus those who do not. Since informant recall of harvest quantities, especially regarding species of lesser importance, diminishes more readily than areal data, it is not reasonable to expect that valid harvest quantities could be elicited for more than a five-year period. In Case C, however, many informants who previously were commercial fishermen were unsuccessful in their bid for a limited entry permit or, since, have lost the permit for a variety of reasons. For many, non-involvement in the commercial fishery has exceeded a

five-year period, so that a comparison of productivity pre- and post-commercial fishing may not be feasible.

TECHNICAL CONSIDERATIONS

The next step subsequent to detailing the specifics of the larger research questions is making decisions regarding a complex of factors which relate to the suitability of the maps for these research questions. Since most of these factors have applicability to all of the case examples, this discussion is relevant for all cases.

The base map employed in data gathering should be the most recent U.S. Geological Survey or other standard base series for the area under study. This map should include primary human-related features, such as roads, structures, and navigational aides in addition to topographic contours and natural features such as rivers, streams, lakes, swamps, and others. Map scale should be as equally detailed as the natural environment is complex. In the southeastern Alaska context with its complex coastlines, the most readily available base map which meets the criteria of detail, while not proving to be unmanageable in the field setting, is the 1:63,360 scale map.

The development of species or species categories by which data are to be elicited from informants should emerge from an analysis of relevant categories of animals or plants as perceived by local residents (emic analysis) as opposed to a taxonomy developed in accordance with a western scientific model. Whereas the researcher indisputably needs to be able to convert animal or habitat categories into units

meaningful to resource management or land-use decisions, data gathering must be meaningful to respondents. This prerequisite places a premium on preliminary researcher familiarity with the essentials of resource use in minimally the general area in which the study is set. Although none of the cases are species specific, a particular researcher concern for one or another species can lead to a more detailed set of questions regarding that species. In Case B, for example, it is anticipated, based on biological knowledge, that clear-cutting has more direct impact on Sitka black-tailed deer than other resources. Therefore a line of questioning focused on deer harvest by habitat type, access, temporality, and quantity harvested was successful in developing a more comprehensive understanding of the impacts of commercial timber activities on that species. In this context, habitat types thought to be meaningful to the researchers did not totally coincide with folk taxonomy -- specifically, many hunters did not distinguish between muskeg and alpine meadows (both lacked trees). Additionally, study area hunters distinguished between upland or mountain deer and coastal or lowland deer, assessing their difference to be one of a species level not recognized by western biologists.

As previously discussed, most of the principle Canadian mapping studies and some of the more recent Alaskan efforts have emphasized the importance of employing local Native people in research capacities, not merely for purposes of providing bilingual options in interviewing, but also to gain rapport, political acceptance of the study, emic critiques and insights into the study process, actual

data, and, in some cases, acceptance of the competing land-use(s) which is the focus of the study (Usher 1984). Under no circumstances should the last motivation, which is akin to ideological prostitution, be incorporated as a reason for employing local research assistants. The other extreme in this regard, as discussed by Francis 1980, is decidedly more ethical but possibly untenable -- that is, to employ no outside researchers or technical assistants in the study process because of data confidentiality. Although the Dene mapping project most closely approximated this model, it employed professional non-Natives in the minority and professionally trained and untrained local people in the majority. In terms of guidelines for the three southeastern Alaska projects, it was deemed highly advisable to enlist the aid of minimally one paid local assistant and preferably more if feasible. In Case B, a local assistant was employed to introduce the study to household heads and set up interviews. Additionally, he provided critical assistance in establishing the criteria for informant selection, evaluating species categories, and developing the interview protocol as it related to the socioeconomic and cultural patterns of the study community. Unquestionably he aided in the receptivity of the study project community-wide. In fact, the selection of local assistants must be sensitively done so as not to alienate significant segments of the community -- that is, by being aware of social and political subdivisions or factions within the overall study population.

SAMPLING

In this segment of the guidelines, some basic principles of sampling are presented as they relate to the three study cases and to scientific method. However, the number of variations in sampling methodologies derived from the set of basic principles and associated with the idiosyncracies of all possible study questions are too great to be discussed in any single context.

In Case A, as in other extensivity examples reviewed in Chapters 3 and evaluated in Chapter 4, key informants are the desirable source of data for developing the extent of land and resource use and changes in these patterns through time. In fact, the meaningful temporal periods described above can be established through the comparison of key informant mapped data. Key informants are selected in a systematic manner and include both males and females and different age groups as discrete respondents, since sex and age are the key variables about which the division of labor in hunting-gathering societies pivots. In the studies reviewed in this context, age and sex distinctions have not been applied systematically to gathering mapped data.

There is more than one way to systematically select key informants. In Case A, inquiries are made of individuals, who in some way represent their community (e.g. a participation in community-based organizations, elder status, etc.) and who represent all known community factions and age and sex cohorts, regarding the names of potential key informants who, in their opinion, have been the most active resource harvesters and traveled the greatest distances in pursuit of

harvest activities in their lifetimes. After multiple lists are generated, names of individuals who appear on the lists can be scored on the basis of their reoccurrence. The top score becomes the first informant, the next becomes the second, and so forth. If any informants finally selected are unwilling to participate in the study, the researcher proceeds to the next named individual and so forth until redundancy becomes apparent in the data gathering process. Key informant data are aggregated by species categories and temporal periods.

Aggregated data are then presented to as many non-key informant households as feasible (a 100 percent sample should be the goal in a community of 300 or so residents, with sample size in larger communities dictated again by redundancy). Non-key informant household members review the aggregated key informant data for the purpose of ensuring that all of their use areas fall within the boundaries derived from key informant interviews. Variations noted by reviewers are recorded and ultimately integrated into the composite map. The number of non-key informants and their age and sex are documented by the researcher.

In Case B, key informants were selected in the same manner as described in Case A with two exceptions. Since habitat and biological studies indicated that the species of importance to human harvesters most subject to disruption by clear-cutting was Sitka black-tailed deer, only male key informants were selected. Secondly, as it was anticipated that employment history may influence different subsistence patterns, it was deemed necessary to include occupational

criteria with age in the selection of key informants. Occupational criteria included participation in commercial fishing in any capacity, logging, timber processing, and individuals who had never worked in either the commercial fishing or timber industries.

After key informant data preliminarily had been aggregated, meaningful cultural-biological units were identified — that is, discrete, named areas which were meaningful to key informants in relationship to resource harvest — and plotted on a base map. Subsequently, a random sample of households (approximately 25 percent) was selected for purposes of eliciting harvest quantities for a one year period and , most important in this context, gathering histories of use for each spatially discrete cultural-biological unit plotted on the base map. Therefore, a random data base was collected against which key informant data could be compared to assess the degree to which mapped information could be generalized to the entire community.

In Case C, sets of key informants are selected. As in Case B, due to the nature of resource harvest activity in question (i.e. commercial fishing), only male key informants are included in the selection process as few local women are actively involved in large-scale commercial fishing. The first set of key informants are selected on the basis of the following criteria: age group membership (minimally three categories are delineated for the study population as a whole); involvement in commercial fishing at any stage of their lives; representative of all major gear types (purse seiner, power troller, and large hand troller); and use of local resources for domestic consumption during some portion of their lives. The second

set of informants functions as a control group. Their characteristics parallel those of the first set with the exception of involvement in commercial fishing. In the case of each set, sample size should approximate 15 percent of the households with a member who meets the criteria established above -- a total sample of 30 percent of the households of the study community. Land and resource use patterns are then mapped for both sample sets as described above, including associated harvest quantities of primary species for a five-year period prior to the year of study.

TECHNIQUES OF DATA COLLECTION

In this segment of methodological guidelines, the three cases can be addressed simultaneously, as techniques of data collection are basically independent of the specifics of the research question. In particular, the primary means of gathering mapped data and the way in which they are recorded are considered.

Participant observation and observation, hallmark methods of anthropological research, have limited applicability in gathering mapped land and resource use data for hunter-gatherers. Inherently, hunting-gathering behavior is highly mobile in space and time and only a small segment of resource harvest activities are performed by large groups as opposed to individuals, partners, or small kin-based units. More importantly, obviously it is not possible for researchers to accompany even a large sample of harvesters in a study population during any given research period, span lengthy temporal units, nor

independently survey the expanse of area used by a hunting-gathering population. Conversely, participant observation and observation are extremely useful means of gaining insights into the spatial configuration of subsistence activities or providing a level of verification or reliability of data derived from informants. Nietschmann (1973), Nelson, Mautner, and Bane (1978), and Wolfe (1981) provide examples of the use of participation and observation in studies with mapping components.

For gathering mapped data, informants are the most logical source from whom land and resource use information can be obtained. There are theoretically two means of eliciting the spatial components of subsistence data from informants: self-reporting and informant recall. The strengths and weaknesses of each are considered here.

Hypothetically, the term "self-reporting" indicates that the harvester records or transmits to a researcher spatial information on travel routes and harvest sites which then can be mapped. There are several problems inherent in self-reporting, however. Resource harvest data may be proprietary within an extended family or other social group. That is, information of this type normally may not be shared because to do so would result in increasing competition in the areas which successful hunters use. Maintenance of control over the information increases the hunter's probability of success and decreases his costs. It might be suggested that information given anonymously could overcome this dilemma. However, if the information is to be available to the general public, then the prospect of such information being used by others looms large and becomes an impediment

to accurate self-reporting. In the Canadian context, there have been attempts to resolve this dilemma by placing mapped data under the control of a community, regional, or cultural association (for example, the Dene mapping project) which determines when and how data will be used. Although in Canada such schemes have probably produced more accurate self-reporting, the application of these mapped data has been limited and generally they have not been available to other researchers. In addition, the contemporary political situation in the United States may not lend itself to assuring the propriety of information gathered under the auspices of federal funding. In addition, since mandatory self-reporting for some species for location of kill sites and harvest quantity is a tool used by fish and game management authorities in the Alaskan setting, it is not highly regarded by many participants in subsistence-based economies in the state. Some Alaskan researchers have used self-reporting in the form of harvest calendars with varying degrees of success to gather data on the quantity of fish or game harvested, but generally these instruments have not been applied to spatial data.

Informant recall, then, has been the primary means by which spatial data regarding fish and game harvest have been gathered to date and is recommended to be the most logical means of collecting such data in the context of these guidelines. As discussed above, although varying degrees of confidence in the reliability of spatial data derived from informant recall have been expressed by researchers and data users, assessments of reliability derived from the Canadian context have indicated a high degree of validity overall with

attrition in detail as the time depth between event and recall increases (Arima 1976; Usher 1984; and Brice-Bennett 1977). It has been convincingly argued that hunter-gatherers place a high value on and are trained from an early age to be aware of their natural environment and human activities associated with land and resource use. Means for assessing reliability of informant recall are discussed in the section on analysis.

Informant recall of spatial subsistence data, then, refers generally to the process of conducting inquiry with an informant through the use of a base map and appropriate tools for recording these data (usually mylar overlays and colored pens). In Case B, however, a survey instrument was used in conjunction with a base map to elicit spatial data by culturally and biologically significant (to the study population) areal units which had been established on the basis of data collected via the map biographies of key informants (see Figure 29). It should be stressed that the degree to which surveys are viable mapping tools is intimately dependent upon the quality of the data base from which survey questions are derived. In Case B, respondents specifically indicated the years during which they had used each numbered area for resource harvest.

As previously described, harvest behavior is comprised of several distinct components, including search or scan, location of fish or game, pursuit and retrieval (primarily in the case of game), and dispatch or harvest. In association with these behavioral phenomena are corresponding spatial phenomena which include travel corridors, camp sites, net sites, intercept points, trap lines, kill or harvest

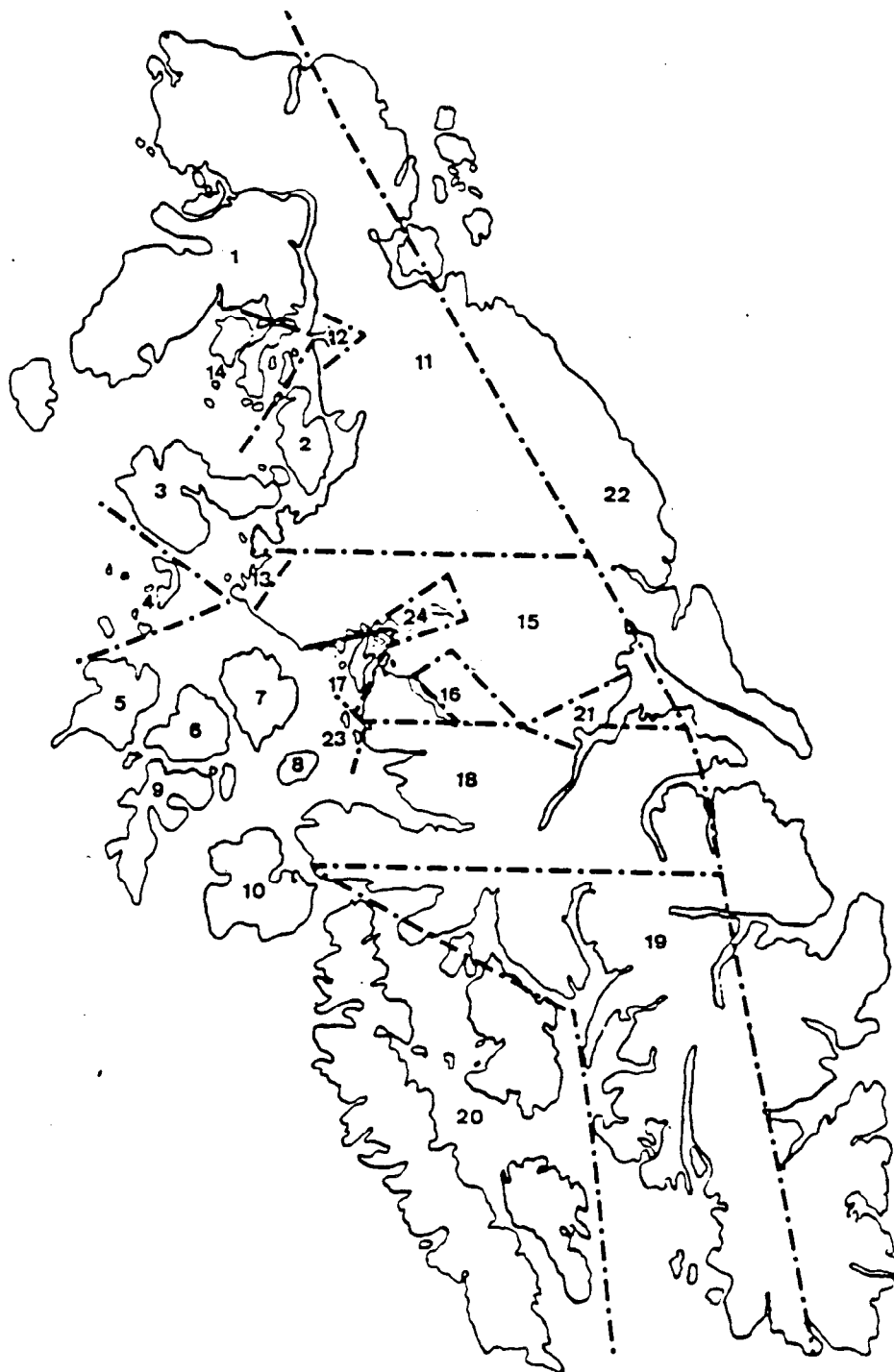


Fig. 29. Base map with numbered cultural-biological units used to elicit spatial data via survey in Case B.

sites, pursuit or retrieval paths, general harvesting or search areas, specific search areas, and harvest areas (primarily in the case of marine fishing). Not every subsistence map needs all of these levels of detail -- that is, the detail of depiction should correspond to the level of detail mandated by the relevant study question.

The spatial dimensions of resource use behavior outlined above should be characterized differently in the mapping process. Lineal behavior, such as traveling, trapping, and pursuing, should be characterized by lines on maps. Locational phenomena, such as camp sites, net sites, intercept points, and kill sites, should be depicted by the use of points or spatially focused symbology (such as net symbols in Wolfe 1981). Areal behavior, such as general specific scanning or harvest areas as in the case of fishing in larger bodies of water or collecting plants, should be characterized as enclosed areas on maps. Figure 30 presents examples of these types of subsistence depiction.

In the course of documenting information on maps, it is essential that the researcher clarify to the informant the specific types of behavior being elicited and be shown examples of appropriate recording methods. Brice-Bennett (1977) noted that in the Labrador study context, informants provided resource use information in no consistent or standardized format (i.e. areal, lineal, point-specific, etc.) making analysis difficult and comparability between key informant map biographies awkward. In the context of these guidelines, it is recommended that informants be provided with the opportunity and tools for actually drawing spatial information on maps after being provided with specific details of the kinds of behavior to be mapped and

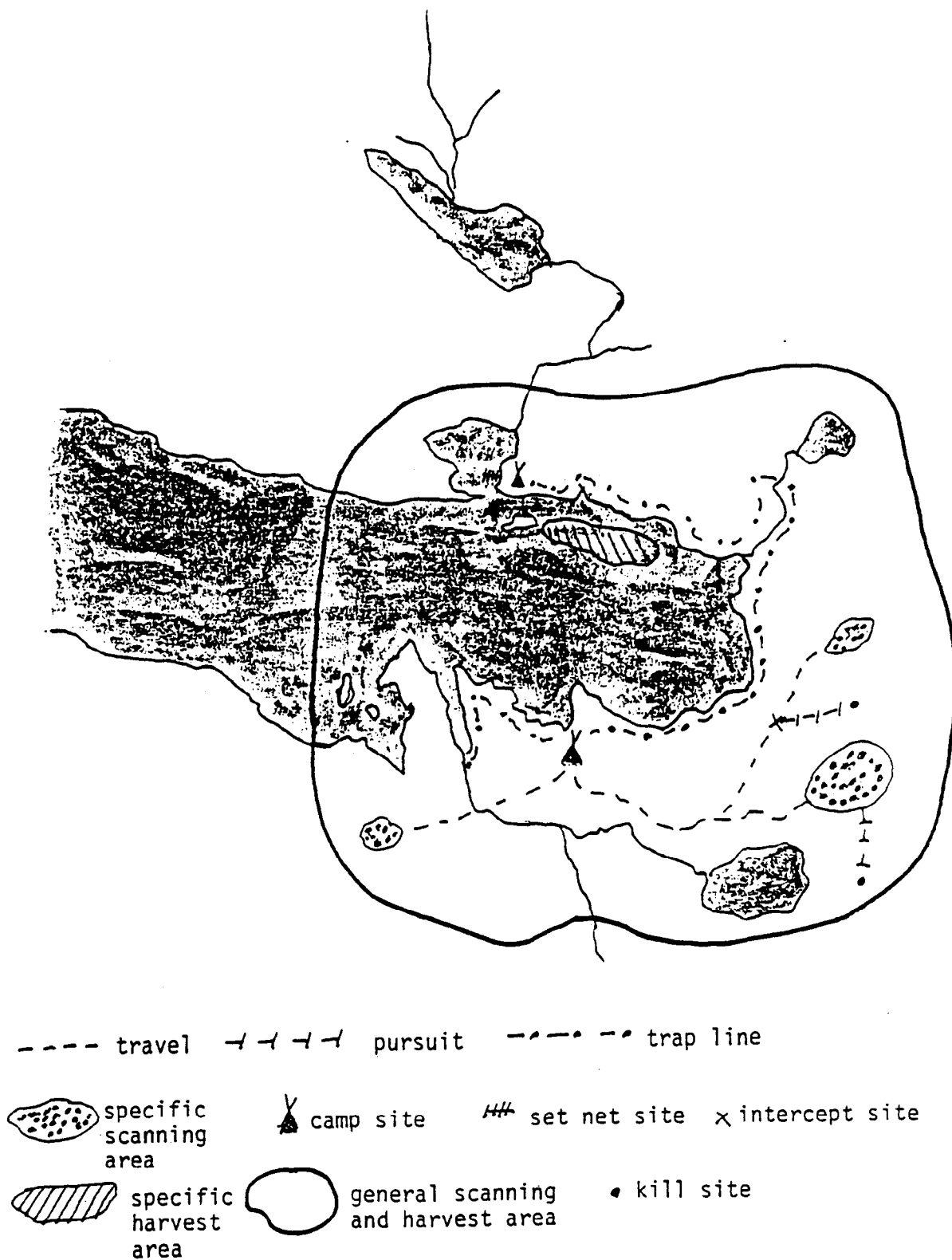


Fig. 30. Examples of notations used in recording subsistence behavior.

Careful instruction on the manner of depiction necessary. While the researcher may best be able to standardize depiction if he or she conducts the actual mapping, the gain in terms of standardization is overshadowed by the loss of content resultant from adding an additional level of interpretation.

TECHNIQUES OF DATA ANALYSIS

INTRODUCTION

In spatial analysis, a distinction can be made between exploratory and explanatory analysis. In exploratory analysis the data base is surveyed with an intent to identify and reveal patterns and preliminary conclusions regarding the nature of the phenomena being studied. In explanatory analysis, the intent is to obtain an understanding of the nature and magnitude of the causal relationships revealed in the patterning. This section of the guidelines presents examples of both exploratory and explanatory levels of analysis. However, it should be noted that the dichotomy is primarily one of research intent rather than analytical technique. Since identical techniques of analysis can be applied to different research questions and multiple techniques applied to the same research question, it is most logical to organize this section around techniques rather than cases, although examples are demonstrated by application to the case studies.

As discussed in Chapter 4, a basic and serious fault of many of the mapping studies evaluated was the failure of researchers to

document details of analysis of spatial data. In term of guidelines, then, the important of thoroughly documenting analytic methods cannot be overstressed.

DESCRIPTIVE ANALYSIS

The first level of spatial analysis in any subsistence study is descriptive. The mapped data collected from individual informants can be descriptively analyzed at one or more levels. The most elementary level would be that of the individual case -- basically a presentation of raw data. For purposes of anonymity, this level is generally not recommended for publication, with the possible exception of its inclusion in the presentation of a case study with the explicit permission of the informant.

Any aggregation of mapped data above the individual level for purposes of describing the resource area of a social unit is also classified as descriptive analysis in this context. Although aggregated data can depict the use area of a set of partners, a kinship group, or some other unit of production or group sharing some common characteristics (for example, a map of resource use areas of all commercial fishermen in Case C), by far the most common form of aggregated data in subsistence mapping to date has been community-based mapping (see Figure 13 for an example from Brody 1982 which is reserve-based and depicts individual maps as well as the composite). While some community-based maps depict resource use by species category (such as in the case of Tyonek represented in Figure 19), the

intent behind the presentation is not comparative (i.e. comparing the use areas of two species categories) but rather is to reduce the number of maps presented in the report.

In regards to applicability to the three cases, descriptive analysis would be the initial but not the final level of analysis for all examples. In Cases A and B, the extent of land and resource use by all community informants for all periods of time are presented in a single composite map. In Case A, extensivity of land and resource use is one of the research questions which is therefore answered in the process of developing this elementary analytical level. In Case B, no part of the overall research question is answered solely on the basis of this level of analysis. However, descriptive analysis provides an areal extent in which timber harvest activities must be examined for their effect on subsistence. In Case C, data are collected from two distinct samples -- that is, commercial fishermen and non-commercial fishermen -- and each is aggregated separately at this elementary level of analysis. No part of the research question in Case C is answered solely on the basis of descriptive analysis.

BASIC COMPARATIVE ANALYSIS

Basic comparative analysis refers to the contrasting of two or more spatial distributions of phenomena on an intuitive level and is basically exploratory in nature. Basic comparative analysis differs from more complex comparative analysis in that no quantitative methods are employed to assess degrees of similarity and dissimilarity.

Throughout the mapping studies reviewed and evaluated in Chapter 3 and 4 respectively, researchers commonly arrived at conclusions regarding the similarity or dissimilarity of areal distribution of subsistence-related phenomena through time or space without revealing any standard measures by which assessments were made (for example, Foote 1961 in regards to continuity through time; Shinkwin and Case 1984 in regards to areal continuity).

In subsistence studies reviewed in this context, basic comparative analysis has been the most common level of analysis employed beyond the descriptive stage. Typologies of comparative analysis have varied considerably in the degree of sophistication attributable to questions they have addressed. Examples of potentially meaningful application of basic comparative analysis can be made to the three study cases. In all cases, this level of analysis can be used to explore the relationships of two or more data sets.

In Case A, these data sets are composite maps by temporal periods — that is, all use areas for the entire study population are aggregated by each of the three temporal periods for purposes of comparison. This level of analysis is subject to quantification (see the next section), so at this stage the degree of overlap between the data sets can only be intuitively assessed unless they exhibit no overlap or are identical in configuration (a nominal level of statistical analysis).

In Case B, the relationships between the location of commercial timber harvest activities (e.g. roads, clear-cuts, and logging camps) and the distribution of subsistence use areas both pre- and post-

logging activities were examined with attention focused on potential regions of competing use and decreased or increased exploitation on the part of resource users of the study community. Additionally, temporal data sets were compared to reveal trends of change which may involve causal relationships other than those associated with commercial timber activities. Finally, subsistence harvesting areas were compared to habitat maps to evaluate the importance of different environments in terms of harvesting productivity based on documented kill sites for major species over the past five years. This juxtaposition provides an identification of primary harvesting habitat. Comparative analysis in this case provides the majority of data necessary to address the research question.

In Case C, a basic comparative analysis is made between the two sample groups (commercial and non-commercial fishermen) to identify distinctions in land and resource use patterns of the two informant samples. The existence of variation lends itself to quantified analysis which would provide a more refined level of comparison and, ultimately, a more comprehensive data base for addressing the study question.

In general, basic comparative analysis has been overemployed in research involving subsistence mapping. In particular, this category of analysis has been used when a quantifiable method would have been more suitable considering the nature of study questions. Notable examples reviewed in Chapter 4 include Brody's (1982) assessment of the reliability of informant recall, Foote's (1961) evaluation of continuity through time from the mid-1800s to the mid-1900s, Braund

and Burnham's (1984) assessment of intensive use areas, and Wolfe's (1981) assessment of the degree of community resource area integrity on the Yukon delta.

QUANTITATIVE ANALYSIS

In the context of this report, quantitative analysis refers to the process of applying numerical values or continuous quantity scales to spatial analysis. There are three central reasons related to why quantitative analytical methods generally have not been applied to the analysis of mapped subsistence data. The first and perhaps foremost reason relates to the general quality of spatial subsistence data gathered in northern North America to date, which, in large part, are not appropriate for statistical analysis because of the imprecise and unsystematic manner in which they were gathered and documented. This general evaluation and some exceptions have been dealt with in some detail in the course of this study. Secondly, quantitative analysis has not been applied, in part, due to inadequate funding and staff time. This problem could be overcome to some extent by more precise definition of research problems and detailed, relevant research design development. Thirdly, some researchers have failed to use quantitative analytical techniques because of unfamiliarity with quantitative methods as applied to spatial analysis or concerns regarding the potential application of these data. This final explanation for the under-utilization of quantified analytical methods is the focus of discussion in this context. Finally, it is not possible given the

scope of this study to provide models for all quantitative techniques for analyzing spatial subsistence data, nor would it be desirable given the level of statistical expertise of many researchers engaged in subsistence mapping. The intent herein is to provide some general concepts and formulas which can be executed by the statistically naive researcher and comprehended by the users of these guidelines who have limited statistical experience or training. Reference is made to sources which provide greater quantitative detail and complexity for those who have their appetites whetted in regards to quantitative spatial analysis and the skills necessary to investigate the topic to a more prodigious technical depth. Models are applied to the cases, although the discussion is organized topically.

The quantitative analysis of spatial data is predominantly an analysis of location or spatial distribution. The initial task in such analysis is the transformation of locational data into a mathematical format, so that a comparative measure of location can be made. The most precise means of comparison includes the assignment of a unique value to the location of each mapped phenomena -- a point in the case of phenomena with a focused spatial location (such as kill site, intercept point, etc.) and a set of points in the case of a line or area (such as a harvest area, trapline, etc.). The conversion of field data to a point specific mathematical format can be accomplished by placing an "x" and "y" axis over the mapped data. This allows for the assignment of a discrete set of coordinates to any point on the map and allows for the comparison of the location of any individual phenomenon with another.

While this level of numerical conception of mapped phenomena allows for the most complex statistical analysis, it also requires the most detailed and accurate data base. Inherently, the gathering and documentation of subsistence data are not precise or accurate enough to merit this analytical techniques, as variation by even a matter of a pencil width on map scales normally used in land and resource use mapping would significantly alter the quality of the analysis. Additionally, considerable cost is incurred in the computerized coding, analysis, and storage of these data bases, and they are too cumbersome to be manually manipulated.

Unlike the system based on "x" and "y" axes, which record data as occupying specific points or sets of points, two other methods of converting mapped information to a mathematical format register mapped data as falling within or outside of a bounded area. The level of accuracy of the areal approach is directly related to the size and shape of the analytical unit.

The most common arbitrarily designated areal unit is the grid or quadrant (Rogers 1974). The grid or quadrant is created by imposing a network of standardized squares over the map. Data then appear within the boundaries of a specific square with numerical coordinates, and thus the grid, not the point, becomes the unit of analysis (see Figure 6 for an example).

An alternate method of delineating a map into analytical areal units is the regional approach -- the "region" in this context refers an analytical rather than a social or political unit. One method of defining regions is for the researcher to designate the location and

perimeter of this spatial unit of analysis. The other method is to use areas or territories which are perceived by the study population to be unique or distinct on the basis of some set of criteria. This latter method was employed in Case B.

While the regional method lacks the standardization of the grid or quadrant system and is not conducive to certain statistical procedures, it is not biased by the assumption of equal plane inherent in the grid method. The equal plane assumption is that the earth's surface is flat and uniform lacking physical or cultural barriers which may markedly affect human behavior related to subsistence activities. A knowledgeable researcher can tailor regions and compensate for physical and cultural barriers. The grid and regional systems preferably should be considered as being complementary as opposed to mutually exclusive, because each provides different types of analytical information.

Following mathematical transformation of mapped data, statistical analysis can be conducted. One common method of spatial analysis employed by geographers is the measure of random distribution (Lewis 1977; Unwin 1982). While methods of random distributional analysis are appropriate for addressing the location of phenomena over a relatively large, uniform area (e.g. churches in Kentucky), subsistence behavior occurs in intimate association with seasonal, spatial, longer-term temporal, and ecological variability over a relatively small area. Therefore, it does not lend itself meaningfully to random analytical procedures. Additionally, the major focus of random distributional analysis is exploratory in that a primary goal is to

uncover patterns or clusters of phenomena. The fact that hunting-gathering behavior is patterned is well-documented and apparent. The use of random distributional analysis to identify the patterned nature of hunting-gathering behavior is problematic, however. This method functions best with a large sample and a relatively uniform plane -- conditions not normally obtained in research on hunting-gathering patterns. For example, in the case of southeast Alaska with its complex coastline, the distribution of resource and land use activities can, in large part, be discerned by observational analysis with less associated costs. While it is expected that random distributional analysis may have applicability to certain narrowly focused research inquiries (such as the placement of fish racks within a large community or the location of traps on the arctic coast), the broader spectrum spatial questions of hunting-gathering behavior are more amenable to area as opposed to locational analysis.

One method of area analysis, which has been employed in studies involving subsistence mapping (for example, Pedersen, Coffing, and Thompson 1985; Burns 1977), is the quantitative measure of area -- that is, square miles or square kilometers. This measure of area provides a means of comparing the size of one or more data sets, such as the number of square miles used for resource harvest by commercial fishermen versus non-commercial fishermen in Case C. Other examples include the number of square miles used in each of the relevant temporal periods in Case A and B and the number of square miles of land and resource use which are affected by logging. Square mile (or

kilometer) measures can be applied to individuals, groups, or species (Pedersen, Coffing, and Thompson 1985 used all three measures).

The conversion of mapped data into square miles or square kilometers is accomplished by overlaying a grid network of the appropriate unit size on the subsistence map and tabulating the number of square miles or square kilometers which fall inside the data boundaries.

While square miles or square kilometers provide a quantitative measure of size, they do not allow for the comparison of overlap or continuity. As questions of conformity or non-conformity frequently appear in subsistence mapping studies, a quantitative measurement of conformity for use in comparative analysis is desirable. The method presented in this context is not as complex as some methods for determining conformity used by geographers (for examples, see Lewis 1977). However, it provides a quantitative measure in a format most familiar to social scientists -- that is, the percentage, as calculated by "the percentage of individual conformity" and "the percentage of mutual conformity."

The percentage of individual conformity is used to measure the percentage of area of one data set shared with another. In Case C, for example, this formula could be used to measure the percentage of area used by non-commercial fishermen that is also used by commercial fishermen and the converse. This measure of conformity is calculated by first converting the data to a grid network. The number of grids falling within the intercept of the data sets are tabulated and this total is divided by the total number of grids within the study data set for which the indication is to apply and multiplied by 100:

$$\frac{\text{number of grids within the intersect}}{\text{total number of grids for the set being analyzed}} \times 100$$

or

$$\frac{x}{x^1} \times 100$$

x = number of grids within the intersect

x¹ = total number of grids for the set being analyzed

It should be noted that the percentage of individual conformity for non-commercial to commercial fishermen, in this case, may not equal the percentage of individual conformity for the converse. This technique of analysis can be applied to comparing the areas for each of the temporal periods in Case A or of one of the periods to a composite of the others. In Case C, this method can be employed to measure the degree of overlap between areas of subsistence activity and those of commercial timber harvest.

The second measure of conformity is the percentage of mutual conformity. This measure indicates the degree of conformity for two or more data sets -- that is, the average shared area for the sets being compared. It is calculated by overlaying all study sets to be compared and calculating the percentage of individual conformity for each data set. The percentage of individual conformities are then added and divided by the total number of sets to produce a

mathematical mean as a percentage. This mean is the percentage of mutual conformity. For example, given three data sets (x,y, and z), the formula would appear as follows:

$$\frac{\frac{x}{x^1} + \frac{y}{y^1} + \frac{z}{z^1}}{n} \times 100 = \text{percentage of mutual conformity}$$

n = 3 (for 3 data sets referred to as x, y, and z)

As with an arithmetic mean, measures of standard deviation and variance can be applied to the percentage of mutual conformity.

The percentage of mutual conformity can be applied to Case A to measure and state the degree to which use areas have changed through time. Additionally, measures of standard deviation and variance can be used to express the dynamics of changing land and resource use areas.

As in Case A, the percentage of mutual conformity can be used to measure changes in use areas through time keyed to specific meaningful impacts in Case B, including, and most importantly, commercial timber harvest. Secondly, this measure could be used to explore the relationships between the use areas of key informants and groups of key informants sharing common variables.

In Case C, this method could be employed to assess mutual conformity of commercial to non-commercial fishermen and to explore for mutual conformity by commercial fishing gear type.

One means of assessing intensity of use employing the grid system is provided by Weinstein (1976) (see Figure 6). In this example, harvest quantities are tabulated per grid unit. In Case B, kill sites per unit of area as delineated by the grid similarly provide a measure of areal productivity as do harvest quantities for the past five-year period in Cases B and C. It should be noted that Weinstein (1976) found the size of grids employed in that study (100 square kilometers) to be too gross for detailed analysis, and the environmental setting in that case was less complex than in southeastern Alaska. The researcher needs to explore the size of grid most appropriate to the area of study, but a one square mile grid may provide adequate detail and be easy to apply to a 1:63,360 scale base map.

Finally, another quantified measure of intensity of use can be derived by tabulating the number of users exploiting a specific unit of area as defined by the regional or grid systems. An example of this measure was the use of a survey instrument for gathering spatial subsistence data from a random sample of informants in Case B.

Once mapped data are converted into a quantifiable format, analysis for intensity of use become relatively simple to perform. The problem is not how to evaluate for intensity but rather determining when the measure is appropriate or meaningful. This question must be answered on a case-by-case basis.

DATA PRESENTATION

Data presentation involves a discussion of the manner in which mapped data should be portrayed in research documents and the types of mapped or related data which are appropriate in study products. This discussion is general to all cases, but specific examples are provided on a case-by-case basis.

Of central concern to data presentation is overall clarity and comprehensibility of the mapped product. Throughout the course of Chapters 3 and 4, studies were reviewed and evaluated on the ability of the data user to decipher the information presented in mapped format. In fact, the figures presented in Chapter 3 were among the most comprehensible and clear and others, which would have been substantially meaningful, were omitted because of their overall poor quality of depiction.

As a general guideline, maps presented in a final product should be of a quality that allows a critical review of the information which forms the substance of the map. Features of such quality include the following: the identification of topographic and other features (directional, human-made, etc.) necessary to mapped data interpretation; appropriate and readable symbology; scale of depiction suitable for the study questions; complete and detailed legend; a descriptive figure title including the temporal period portrayed in the map and information about the size and composition of sample; reference to data source or report of which the map is a part; a qualifier as to data limitations; and a high standard of reproductive resolution.

The second concern lies with the type of data to be presented in a study product. Minimally, maps included in the report should provide enough information to allow the reviewer to weigh the merits of the argument presented in the text. These maps should include adequate examples of descriptive and analytical data in order to substantiate study conclusions. Examples of both descriptive and analytical maps have been discussed in this chapter and examples referenced in Chapter 3.

In terms of study cases, the following map types are recommended. In case A, descriptive composite maps of each of the three key temporal periods and a composite of all temporal periods for areal extent are essential. For analytical purposes, a single map showing the three temporal periods superimposed upon one another is also necessary. In Case B, descriptive maps portraying the composite areal extent of harvest activities of key informants, and the location of timber harvest activities are presented. Maps depicting data analysis include the graphic presentation of the spatial dimensions of land and resource use by temporal period; comparisons between temporal periods; comparisons between subsistence areas and the location of commercial timber harvesting areas; comparisons between the location of kill sites and commercial timber harvesting areas; a depiction of quantification of regional use based on data derived from the random survey; and a depiction of regional productivity for key species based on five-year harvest data and individual use areas derived from the random survey. In Case C, descriptive maps present the respective use areas of commercial and non-commercial fishermen. Analytical maps

include a comparison of the areas used by the two groups; a composite map depicting changes in individual use areas in relation to possession or loss of commercial fishing technology; and comparisons between the use areas of individuals possessing different types of commercial fishing technology.

Modeling, a stylized composite of behavioral patterns, has been employed in the presentation of subsistence data in mapped format by Alaskan researchers (for example, Burch 1981; Nelson 1973). Burch (1981) employed modeling for a period of time preceding that of the lifetimes of informants, as previously described, using oral history, early historic documentation, ethnographic analogy, habitat data, and archaeology as data sources for his model (see Figures 23, 24, 25, and 26). In this example, modeling is the only means by which subsistence data from a period with no living representatives can be depicted. It should be noted that Burch's (1981) data were not areal but rather locational in nature -- that is, he seasonally mapped a model of population distribution relative to resource use. Nelson (1973) used a model to depict trapline patterns of contemporary Gwich'in Athabaskans in the Chalkyitsik area of Alaska (Figure 31). He employed modeling because of his assessment that mapping the actual traplines of his study population would be too complex.

Other appropriate applications of modeling would include the use of models to ensure anonymity of individual informant land and resource use data. However, using modeling as a means of protecting anonymity of a contemporary community is not practical in regard to the applied use of such data, since most projects are focused on

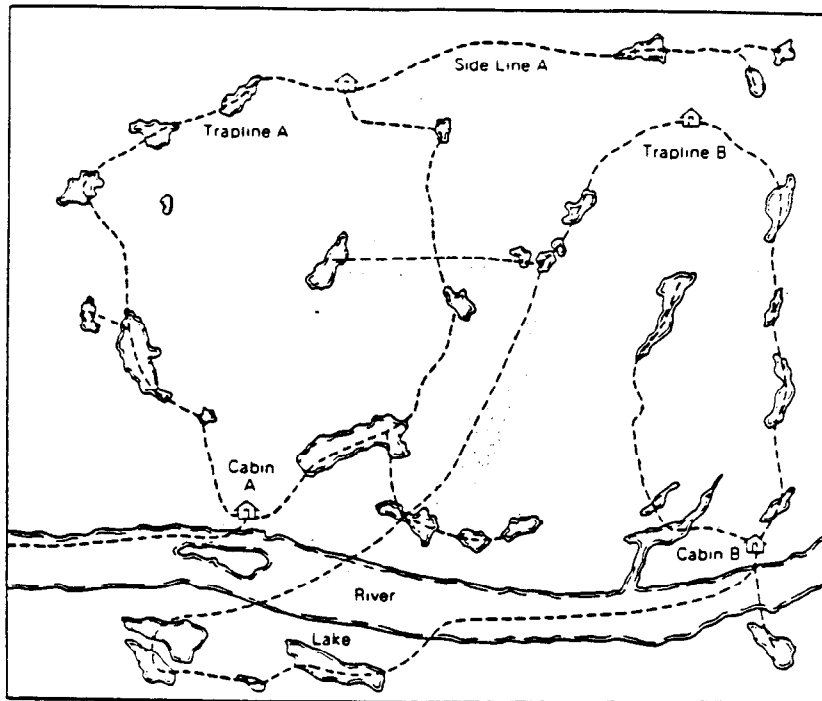


Fig. 31. A schematic of two neighboring traplines
(taken from Nelson 1973).

community-specific impacts assessments or baseline documentation. However, modeling as a method for describing, analyzing, and depicting the spatial components of subsistence systems has considerable theoretical potential. Case C provides a research question suitable for the development of a model assessing the relations between technological change and centralization.

It is suggested in this context that researchers consider the use of other graphic formats for the presentation of the spatial dimensions of subsistence data. An example of this for the community of Tyonek was described in Chapter 4 (see Figure 19 and the evaluation of Fall, Foster, and Stanek's 1985 analysis of catch-per-unit effort for moose). In Case B, frequency polygons are employed to depict differential levels of use through time (Figure 32). In this example, derived from the random survey, the percentage of households using a culturally-biologically important area or unit through time is depicted. Other forms of graphic and tabular representations may meaningfully contribute to the process of presenting spatial subsistence data, but these should be seen as supplementary to rather than a replacement for mapped data.

As in any form of scientific research, the data user normally has only the narrative and graphic presentations within a study product from which to evaluate the degree to which the study problem has been addressed by the data leading to a set of conclusions. The presentation of data is not only the vehicle for connecting research problems to conclusions but is additionally the mechanism by which inter-study comparisons and study replication or verification can occur. It is

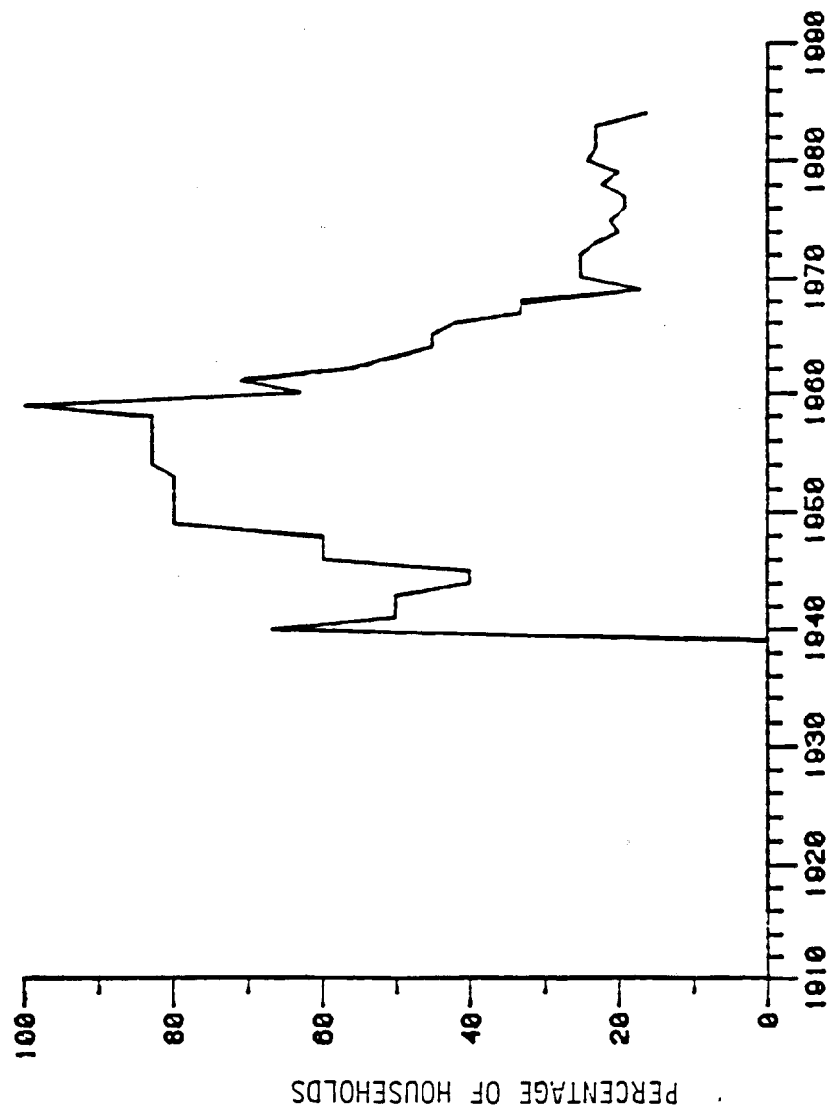


Fig. 32. The use of a culturally-biologically important unit or area through time by the percentage of households in the randomly selected survey sample (taken from Ellanna and Sherrod 1985).

anticipated that with increased vigilance of the scientific community over the documentation, methods of data gathering and analysis, and presentation of data relating to the spatial dimensions of subsistence, that subsistence mapping research can proceed to the level of sound inter-community comparisons and theoretical development.

CHAPTER 6

CONCLUSIONS: THE FUTURE OF SUBSISTENCE MAPPING

In the course of this review and evaluation, subsistence mapping methodologies have been considered in light of their relationships to the study of spatial phenomena in both anthropology and geography and the sociopolitical and academic milieu's from which questions regarding the land and resource use patterns of hunter-gatherers have emerged. Although global examples of land and resource use mapping were considered in the development of context, the focus of review and critique was subsistence mapping methodologies in Canada and Alaska. The review and evaluation took place within the framework of a scientific model, although no evaluation of the appropriateness of research questions was attempted. On the basis of this review and evaluation, data from related disciplines, and a field test in southeastern Alaska, guidelines to subsistence mapping were developed and presented in accordance with the prerequisites of a scientific model. These guidelines were primarily organized about three southeastern cases -- two hypothetical and one actual -- including elements of research problem identification and refinement, data gathering, data analysis, and data presentation. It was determined early in the course of the study that methodological guidelines, while structured about a sound scientific research core, had to vary in other details in accordance

with research questions -- that is, although all mapping guidelines should meet methodological standards derived from scientific method, there is no single model applicable to all research questions.

The primary weakness of studies employing subsistence mapping methodologies was the failure to document information concerning the data gathering and analytical components of the studies. Secondly, some researchers failed to treat mapping as a systematic research tool in most respects. Lastly, there were some studies which failed to recognize the limitations of subsistence mapping -- that is, they did not include adequate supporting data. In fact, it should be stressed that even in cases in which the areal extent of land and resource use by hunter-gatherers was the primary question (for example, Freeman 1976; the Dene mapping project; and Pedersen 1979) -- the most basic or elementary level of application of subsistence as a research tool -- extensive supporting sociocultural and socioeconomic data were necessary if any insights regarding the nature of subsistence-based systems were to be extracted from the spatial data. Freeman (1976), for example, developed two volumes of supplementary data. On the other hand, the Dene mapping project basically was restricted to the inclusion of spatial components of subsistence data.

In regards to the strengths of research incorporating subsistence mapping, an understanding of the spatial dimensions of subsistence-based socioeconomic systems is essential to a holistic comprehension of such systems, including their attributes and dynamics through time and space. Additionally, subsistence mapping can shed light on the more general questions of the relationships between centralization and

land and resource use by hunter-gatherers -- a critical topic in a global perspective and on the assessment of the impacts of technological change on subsistence behavior. However important and fascinating such questions are theoretically, the application of data regarding the spatial components of subsistence-based systems and associated hunting-gathering behavior to the development of land and resource use policies is potentially more beneficial in the short-term to resource users affected by governmental decisions. Such a view, however, is predicted on the assumption that governmental agencies can comprehend data bases presented to them and, as importantly, that they will act in good faith on the basis of ~~the~~ information with ~~which~~ they are provided in deciding between competing land and resource uses.

Trends which have been identified in the course of this research have appeared concurrently in both the Canadian and Alaskan settings. One obvious trend has been the proliferation of the use of mapping as a research methodology since the mid-1970s. ~~While not uniformly so,~~ subsistence mapping methodologies have become more sophisticated in terms of data collection and, more limitedly, in techniques of data analysis. In regards to analysis, the potential for geoprocessing -- the computerization of spatial data -- has widened the vistas for electronically-based analysis. However, the costs of entering and manipulating computerized spatial data remain excessive. In addition, the advantages of electronic processing are only as good as the data base is ~~valid~~ and the relevance of the questions being asked of the data. Lastly, there is a growing awareness of the potentials for the use of subsistence mapping methodologies in addressing systemic level

questions regarding subsistence-based socioeconomic systems -- as exemplified by the funding of this project. Since the nature of hunting-gathering systems is such that they are intimately linked to their land and resource base, and the spatial and related temporal demands of this linkage are pivotal for the system as a whole, it is surprising that mapping has not played a larger systematic role in such research in the past. Unfortunately, the methodological expertise for employing subsistence mapping in systemic, theoretically-focused research has not kept pace with the rapidly expanding interest in the use of this tool.

The future of subsistence mapping as a methodological tool relates to its strengths and weaknesses as portrayed in this study as well as to the sociopolitical climate in regards to land and resource use policies. Some projections of and suggestions for future work are offered here.

Throughout this study reference has been made to the effects of centralization of indigenous peoples on their land and resource use patterns. As previously described, subsistence mapping provides a useful tool for developing more thorough and comprehensive insights into this poorly understood phenomena. This encompassing question is central to the understanding of social and economic impacts associated with centralization and may shed light on the larger question of the factors involved in the development and functioning of urbanization -- a question of worldwide interest and applicability. Specifically, what processes are involved in the urbanization of hunter-gatherer populations?

Subsistence mapping methodologies have direct applicability to the study of optimal foraging, which to date has lacked the spatial dimensions necessary for a total understanding of the energetics of hunting-gathering societies. Additionally, optimal foraging theory should contribute to the use of subsistence mapping as a methodology for addressing system questions about the behavioral strategies of hunter-gatherers.

Questions related to changes in transportation technology in association with land and resource use patterns can be explored with the aid of data collected via subsistence mapping. The dissemination of western technology to rural areas and subsistence-based societies and the expansion of western travel modes (such as aircraft) and travel corridors (such as roads) to more remote populations have markedly altered patterns of mobility. However, the specifics of these processes of transition are poorly documented, partially in regards to their spatial dimensions. Hopefully, subsistence mapping will provide a methodological tool for studying these processes as they affect subsistence-based societies.

The refinement of subsistence mapping methodologies is expected to give rise to more meaningful measures of the differential use of land and resources -- that is, measures of intensity in regards to land and resource use. As described in this study, there are multiple criteria which can be applied to subsistence behavior in order to derive measures of differential land and resource use, including harvest totals (productivity), frequency of use, duration of use, recency of use, catch-per-unit effort, number of species harvested per

unit (diversity of use), and many others. Most of these criteria have spatial components which lend themselves to description and analysis through the use of subsistence mapping. ~~It is important to note, in this regard, that~~ measures of intensity should not be equated with valuation. The relative value of land and resources can only be assessed by the individuals actively participant in their use.

Finally, while it is anticipated that the quality of mapping research will increase as more attention is focused on this method, the nature of subsistence mapping studies may shift from land-use planning and resource management to more complex social and economic assessment studies. This shift, if it occurs, will be related to an awareness on the part of land-use planners and resource managers that subsistence mapping does not provide easy answers to questions regarding competing land and resource uses and that mapping methodologies, if conducted in a scientifically sound manner, are costly in terms of money and time.

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