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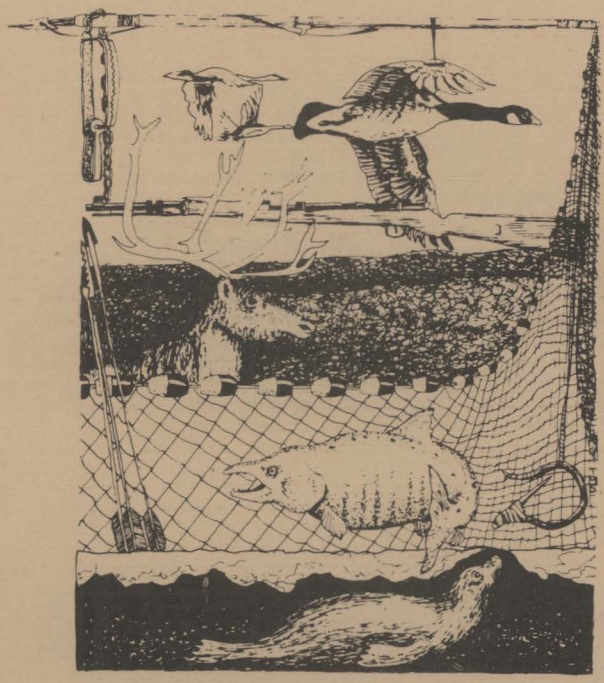
WILDLIFE UTILIZATION AND THE
ECONOMY OF NONDALTON

by
Steven R. Behnke

Technical Paper Number 47



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ABSTRACT

The purpose of this report is to describe the use of wildlife, particularly moose and caribou, as part of the contemporary economy of Nondalton, a community of 180 people in the Iliamna Lake region of southwestern Alaska. The information on which this report is based was gathered between 1976 and 1981 by a combination of participant observation methods, informal interviews, and systematic household surveys. This report is an initial product of a more comprehensive study of fish and wildlife utilization in Nondalton and the Iliamna Lake region.

In the 1970s and early 1980s the economy of Nondalton, like other communities of the Iliamna Lake Region, was based on a combination of cash earning and harvesting local fish and game resources for domestic use. There were few cash earning opportunities available to residents of the region, including a limited number of wage paying jobs, occasional construction work, and firefighting. Nondalton residents were marginally involved in the Bristol Bay commercial fishery compared to residents of villages closer to Bristol Bay.

Harvesting local fish and game resources for food and other domestic uses was extremely important in Nondalton. Large quantities of salmon, moose, caribou, and freshwater fish were harvested. The mean annual harvest per household for three years (1973, 1980, 1981) was 4,432 pounds of edible food product, or 846 pounds per household member. The high cost of imported goods, particularly fuels, the lack of economic alternatives, and fluctuations in monetary income

made production of food and goods from local resources for household use a major component of the village economy.

Moose and caribou were major resources to the people of Nondalton, together supplying about twenty percent of the total harvest by weight in 1981. On the average, about three-quarters of a moose and slightly in excess of two caribou were taken per household in 1980 and 1981. A small group of households actually harvested most of these animals, however, approximately half the households did not harvest moose and about forty percent did not harvest caribou. In 1981 four households (21 percent of those surveyed) harvested ten moose (60 percent of the reported harvest). Meat was widely shared between households in the village.

Variations from year to year appeared in the harvest levels of particular species, and among the harvest levels of individual households, due in part to environmental and economic conditions. However, the mean total household harvest level of combined fish and game resources was relatively consistent over the three years for which harvest data were collected in Nondalton. The size of the moose and caribou harvest during the study period appeared to be limited largely by the expense of effective transportation and storage technology, by traditional ethics which discouraged waste, and environmental conditions. Hunting regulations appeared to play a relatively minor role in determining harvest levels in the village.

WILDLIFE UTILIZATION AND THE ECONOMY OF NONDALTON

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INTRODUCTION

This report describes economic conditions and patterns of wildlife utilizataion in the village of Nondalton in the late 1970s and early 1980s. The report has two primary purposes. First, it provides information about contemporary wildlife use by Nondalton residents. This information includes descriptions of types of wildlife resources utilized by Nondalton residents, seasons of use, harvest methods, and estimates of harvest levels for three annual cycles. This information is useful to a variety of land and resource management agencies for land use planning, for establishing hunting and fishing regulations, and for evaluating the costs and benefits of social and economic change.

In addition to describing general patterns of wildlife use and harvest, this report describes moose and caribou harvests in greater detail. The analysis briefly explores some of the factors which may influence wildlife harvest levels or "demand" for wildlife in the community of Nondalton.

This report is the first product of a long term and continuing study of fish and wildlife utilization in the Iliamna Lake area of Southwestern Alaska. The initial phase of this study focuses on Nondalton, the largest community in this region. A more comprehensive report on the Nondalton portion of the study will be completed in summer, 1982. The current report includes preliminary findings about hunting and wildlife use which will be further elaborated in the comprehensive report.

This report is organized into four parts. The first describes the population, location, and regional setting of Nondalton. This is followed by a brief description of the economy of Nondalton including sources of monetary income, the cost of living, and the seasonal round of fish and game harvest activities. The third section provides a quantitative description of fish and game harvests for three years. The final section focuses on the use of moose and caribou in Nondalton, and describes methods, seasons and areas of harvest, and quantities harvested. This section also discusses the constraints which appear to regulate the size of resource harvests in Nondalton.

METHODOLOGY

This descriptive study of wildlife harvests and the economy of Nondalton is based on information gathered by three basic methods. The most important method was participant observation. The researcher resided in the Lake Clark-Nondalton area from summer, 1976 through fall, 1978, and has maintained close contact with that area from winter, 1978 to 1982. The research design called for the participation in and observation of Nondalton resident's economic activities. From the direct experiences with fishing and hunting activities, data was gathered on a wide range of variables, such as types of resources utilized, methods of harvests, timing of effort, the economic costs and returns of fishing and hunting, among others.

The informal interviewing of selected knowledgeable informants was a second research method. This technique allowed gathering information not directly accessible by participant observer techniques, and provided systematic validations of observation-based data by verbal responses. Informal interviews especially provided information about the methods, scheduling and locations of harvest activities, the uses made of particular resources, social organization, and economic and social change. Maps of Dena'ina place names, travel routes, camps, and harvest areas were developed during interviews.

Systematic interviews of a sample of Nondalton households were conducted in 1980 and 1981 to collect information about quantities of resources harvested and about selected socioeconomic variables. The methodology of these sample selection, and sample size surveys is described in a later section of the report. In addition, the results of a harvest survey conducted in Nondalton in 1973 by the University of Alaska (Gasbarro, 1974) were integrated into this study.

The long-term, multimethod research design increases the likelihood of data reliability and validity. The long period of contact with the community and region, and the diverse research methods used, have provided numerous opportunities to cross-check information. Observation provided evidence that the validity of quantitative measures of harvest levels gathered through the recall method possibly varies between species. In the case of freshwater fish, birds, and small game, there is more likelihood for errors in estimates because people generally do not count or keep track of harvests of such resources. Harvest estimates of larger species, such as moose and caribou, are much more likely to be accurate.

If there is a systematic bias in informants' responses to questions about quantities of resources harvested, it is probably toward understating harvests. This is because some villagers were hesitant to report harvests which occurred out of season or in excess of bag limits. Nondalton people say, for example, that they have frequently understated subsistence salmon harvests on their fishing permits out of fear that, if managers knew how many they were taking, their harvests would be restricted. Some community leaders appear to be reevaluating this strategy and have supported accurate reporting of fish and game harvests.

The survey format was designed to reduce this problem by asking about harvests for the household as a whole, rather than for individuals. In this manner, individual hunters were not identified in field notes or quantitative data. Confidentiality was also assured respondents, who were informed that no individual or household harvests would be reported, but only sample totals. Because of the qualifications, the researcher feels that there was a reasonably high reliability of response, that most people responded with as accurate information as they could.

NONDALTON AND THE ILIAMNA REGION

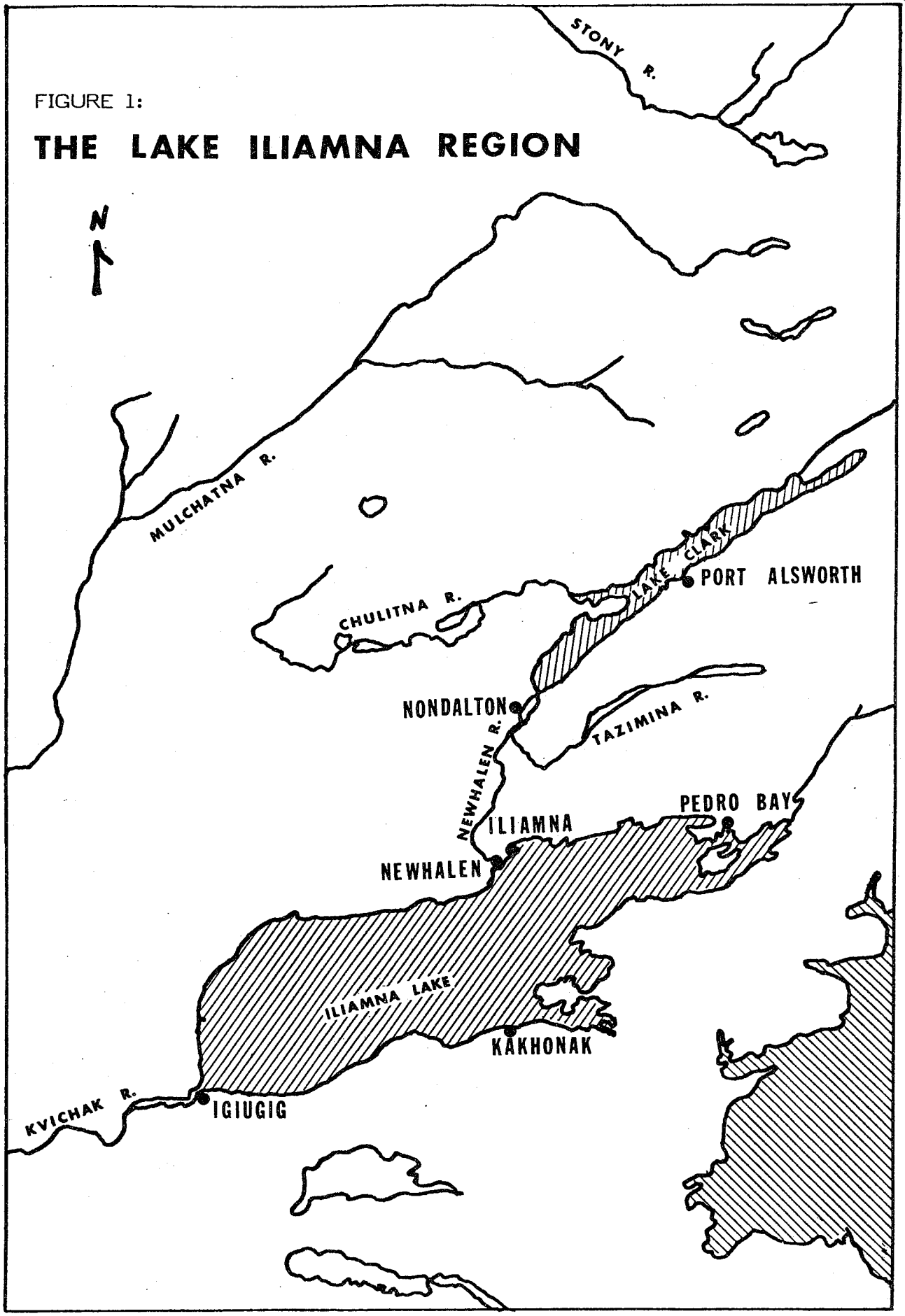
Nondalton

The village of Nondalton is located between Lake Clark and Iliamna Lake, on the northwestern shore of Six-Mile Lake (Figure 1). About 180 people lived in the community year-round in 1981. Most of them consider themselves Dena'ina (or Tanaina, as the name has been spelled in anthropological literature). They are descendants of Athapaskan speaking groups which aboriginally inhabited the drainages of the Newhalen River, Lake Clark, the upper Mulchatna River and the Stony River. Because of this interior population distribution, the dialect which these people speak has been termed Inland Dena'ina to differentiate it from the dialects of the Dena'ina who inhabited Old Iliamna, both shores of Cook Inlet, the Susitna River, and Knik Arm (Kari, 1975). Other Inland Dena'ina, close relatives of Nondalton people, live in Lime Village, 100 miles north of Nondalton; still others live in the village of Stony River, at the mouth of the river of that name.

Nondalton is strategically located on a major waterway, which includes the upper Newhalen River, Six-Mile Lake, Lake Clark, Little Lake Clark, the Tlikakila River, and the Chulitna River. The Tazimina River empties into Six-Mile Lake just across the lake from the village. These waterways and their valleys provide access to a variety of habitat types, including lakes, rivers, spruce-birch forests, open dry tundra, and mountains. These habitats support a wide variety of fish and wildlife.

FIGURE 1:

THE LAKE ILIAMNA REGION



The Regional Setting

Nearby settlements include Iliamna, Newhalen, Pedro Bay, Kakhonak, Igiugig, and Port Alsworth. In addition to these six communities, which had a combined population of about 350 in 1980 (U.S. Census, 1980), another twenty or thirty individuals were living in isolated locations around Iliamna Lake and Lake Clark in 1980 and 1981 (see Table 1).

Although inhabited by diverse ethnic groups and encompassing several diverse environments, the area forms a distinct physical and socio-economic unit which, for purposes of this study, will be called the Iliamna region. Three major bodies of water--massive Iliamna Lake, mountainous Lake Clark, and the Newhalen River which joins them--create a regional focus. These lakes and rivers serve as major transportation routes which have brought diverse peoples into contact. They also support one of the major sockeye salmon runs of the world.

The Iliamna region is a meeting place between several major environmental zones and supports diverse flora and fauna (Williamson and Peyton, 1962). Little is known of the early prehistory of the Iliamna region; it is likely, however, that the region has been inhabited for thousands of years. Fish and game resources continue to play a major role in the economy of the region.

The major fish species present in the Iliamna region include sockeye salmon, arctic grayling, rainbow trout, dolly varden, arctic char, humpback and round whitefish, burbot, lake trout, and northern pike. Moose inhabit the forested and mountainous areas around Iliamna Lake and Lake Clark. Caribou of the

TABLE 1

ILIAMNA REGION POPULATION
1970 and 1980

	1970	1980
Nondalton	184	170
Port Alsworth		22
Iliamna	58	94
Newhalen	88	87
Pedro Bay	65	42
Kokhonak		83
Igiugig	36	33

Source: U.S. 1980 Census (preliminary)

Mulchatna herd range through the area north of Iliamna Lake and small groups of caribou calve and remain year-round in the Stuyahok Hills area east of Iliamna Lake. Brown bear are relatively common and concentrate on the numerous salmon spawning streams during the summer and fall, while black bear are abundant around Lake Clark. Iliamna Lake has a year-round population of seals.

Other land mammals present in the region include beaver, mink, muskrat, tundra and snowshoe hare, land otter, red fox, wolf, wolverine, lynx, weasel, marmot, ground squirrel, and porcupine. Ptarmigan and spruce grouse are present year round, sometimes in huge numbers. Migratory waterfowl, including swan, Canada geese and a number of duck species, including mallard, pintail, greenwinged teal, and old squaw pass through the region in spring and fall. Swans remain through the summer in the area, nesting on small ponds.

Regional Economy and Society

Iliamna Lake has long been a meeting place between diverse cultural groups. The distribution of ethnic groups and population in the aboriginal and early contact period is not well understood since major population movements were underway when Russian fur traders entered the region in the late 18th century (Osgood, 1963; Townsend, 1970, 1973). At the turn of the present century, however, the Iliamna Lake area was a meeting place of the Dena'ina and Yup'ik Eskimo groups (Townsend, 1965, 1973). Increasing numbers of whites were also entering the region as prospectors, trappers, and traders.

Today, the Dena'ina are concentrated in the communities of Nondalton, Pedro Bay, and Iliamna, while Yup'ik Eskimo speakers are concentrated in Kakhonak, Igiugig, and Newhalen. The community of Port Alsworth is predominately Euro-American. There are also significant concentrations of Euro-Americans in Iliamna. A number of people of Euro-American and Dena'ina descent live in scattered locations around the shores of Lake Clark and Iliamna Lake.

As a whole, villages with residents of Dena'ina and Yup'ik descent have maintained relatively distinct identities and social groupings despite long periods of contact. There is considerable interaction between communities, however. Because of this, at a general analytic level it is possible to consider the communities of the Iliamna region as comprising a single social and economic region. Although the bulk of this study focuses on the Dena'ina on Nondalton, it seems worthwhile to examine the characteristics of the region as a whole first. This allows the identification of commonalities, particularly in economic adaptations to the regional environment, and provides a context for describing the economy of Nondalton.

The people of the Ilimana region can be considered a regional society, despite ethnic differences, because of the high degree of social and economic interaction between the different communities. Most of the villages are closely linked by kinship ties. Ties of blood and marriage are particularly close between the Yup'ik communities of Igiugig, Levelock, and Kakhonak and less close between these communities and Newhalen. The Dena'ina communities of Nondalton and Pedro Bay are similarly linked. Other close relatives of these people live in Lime

Village and Stony River in the Kuskokwim drainage. Iliamna also has some families of Dena'ina descent as well as people of Yup'ik and Euro-American descent.

There have been some marriages between people of Yup'ik and Dena'ina descent in recent years. This has created fairly close ties between a few Nondalton and Newhalen families. Other families have members who have settled in Nondalton, Newhalen, Iliamna, and Kakhonak and have created major linkages between those villages.

The communities of the area are linked by two sets of major social ceremonies. The first is "Slavi"--the Russian Orthodox tradition of travelling to other communities and visiting every house in each place at Russian Christmas. The second is late winter carnivals in which dog-racing, visiting and gambling play a large part. The sets of inter-village relationships are much the same in both cases; there is much interchange between Newhalen, Kakhonak, Igiugig and Nondalton, less between these communities and those of the Nushagak River.

A third major linkage is linguistic. Although middle-aged and older people of most of the communities speak either Dena'ina or Yup'ik, English is in common use. Therefore, the three ethnic groups of the area can communicate. Interethnic communication is not recent, however, since people point out that both groups spoke Russian, and that long ago the Dena'ina often understood or spoke Yup'ik dialects.

All the communities of the Iliamna region share a common economy, if that term is understood to mean a social group's system of production, consumption and exchange. Commercial salmon fishing in Bristol Bay, firefighting for the Bureau of Land Management, temporary work on construction within and outside of the region, and trapping have been the major sources of monetary income for most people, regardless of ethnic affiliation, over the last twenty years. Putting up salmon, hunting moose and caribou, and harvesting fresh-water fish species are major sources of "subsistence" income. All communities in the region have a heavy reliance on these resources. For most residents of this region monetary incomes are limited, highly seasonal, and variable from year to year.

The communities of the area are also linked by growing dependence upon the community of Iliamna as a transportation hub and service center. Wien Air Alaska provides daily flights between Anchorage and Iliamna during the summer and three times per week during winter. In the last two years Wien has initiated jet service. The Federal Aviation Administration has a flight service station in Iliamna and there is a state highway facility for maintaining the runway. Several air services operate out of Iliamna, serving primarily the seven communities of the Iliamna. One of three stores in the region is located in Iliamna; the other two are located in Nondalton.

THE ECONOMY OF NONDALTON

The harvests of fish and wildlife for household use and the monetary sector of the economy have both been important to the people of the Iliamna region since the Russian fur trade era (Townsend, 1965, 1966). Opportunities to earn money have historically been highly seasonal and variable from year to year. Trapping, handcraft production, and freighting for prospectors and traders were the major sources of money or credit for Nondalton people early in the twentieth century. Cannery work and commercial fishing provided additional opportunities in the 1930s and 1940s. Some trapping continued into the 1980s but the significance of trapping declined greatly during the 1950s as fur prices dropped in relation to both the cost of living and costs of production. In the 1970s and early 1980s the economy of Nondalton was based on a close integration of production for household use, and monetary income.

The Monetary Sector

This section briefly describes the basic elements of the monetary sector of contemporary Nondalton economy. It describes the opportunities for earning money which were available in the community and in the region during the study period as well as patterns of employment.

As noted in the preceding section, a limited number of wage employment opportunities were available in the Iliamna region. The opportunities which did

exist, such as commercial fishing, firefighting, and construction, were concentrated in the short summer season. A few jobs were available year-round in the village, but these were often part-time or low-paying. Many of the employment options available to residents of the area involved leaving the region for periods of time.

Only four jobs in Nondalton have been relatively long-term, existing over most of the past decade. These included the postmaster, school janitor, water system maintenance, and health aide positions. These jobs were basically year-round, but, with the exception of the janitor position, part-time and low paying. Since the construction of a high school in 1978, the school has been the most important employer in Nondalton, providing three full-time jobs (nine months), and about five part-time jobs.

Construction work occasionally has been available in public works projects for small numbers of people over short periods, such as the construction of Nondalton's water and sewer system in the mid-1970s. Few Nondalton men were employed when a new school was constructed in the village, however. State and federal funds occasionally have provided a small number of jobs such as village administrator and short-term projects such as community hall renovation. Nondalton residents recognized that these jobs were particularly uncertain and vulnerable to funding cuts.

During the study period (1976-1980), three or four Nondalton men worked on construction jobs outside the village as laborers or equipment operators. Two men worked on the Alaska Pipeline during its construction in the early 1970s, for

example. These same men have continued to work seasonal construction jobs outside the village for four to six months in most years, leaving their families in the village.

Other Nondalton people worked seasonally as firefighters. This was particularly important during summers when fishing was expected to be poor in Bristol Bay. Firefighting also served as a source of income for people who were not involved in the Bristol Bay fishery. The Bureau of Land Management has relied heavily on villages, including Nondalton, to provide emergency firefighters. Crews of about 15 people were organized by a village "crew boss" who was responsible for assembling the crew on a few hours notice to be flown to a fire. Individual incomes from firefighting ranged from about two hundred to two thousand dollars for the season. In some years the village fielded one to three crews, including young men and women. Firefighting employment, which was restricted to the summer months, was also highly unpredictable and variable from year to year depending on the severity and locations of fires across the state.

Nondalton residents have participated in the Bristol Bay commercial salmon fishery to varying degrees for more than sixty years. In the 1920s a small number were involved primarily as cannery workers or laborers. During the 1930s and 1940s many Nondalton residents began fishing commercially.

Historically most Nondalton people have had a marginal association with the Bristol Bay fishery, in part because of its distance from Bristol Bay. Residents of the village have not invested heavily in gear or boats in comparison with other commercial fishermen in Bristol Bay. They generally fish only the peak of the

sockeye run. Only three residents of Nondalton owned fishing boats in 1981 and these were all older wooden boats in poor condition. Lack of competitive equipment and the time and cash required to maintain old equipment, has limited the productivity of the few Nondalton boat owners. Nondalton set netters also often have trouble obtaining the gear necessary to compete effectively.

Nondalton residents have adapted their summer economic activities to the highly cyclic nature of the sockeye runs of the Naknek and Kvichak systems. From about 1950s through 1975, peak runs tended to occur at five year intervals, with poorer runs in years between these peaks. As one strategy during this period, Nondalton people attempted to minimize economic losses by not investing heavily in the fishery. In years of poor runs, Nondalton residents, like other people from the Iliamna region, found that their earnings barely covered expenses. Nondalton's distance from the coast added to transportation costs to and from the fishery. Poor gear made it more difficult to compete for the smaller number of fish available in lean years.

Historically, Nondalton people have tended to remain in the village to seek other work when poor fishing was expected. When high runs were predicted, they would return to Bristol Bay. After several years of very poor runs in the early 1970s, Bristol Bay was declared a "disaster area" in 1974. Poor runs were predicted well in advance by the Alaska Department of Fish and Game, and few Nondalton residents fished commercially from 1972 to 1974. In 1974, 73 percent (19 of 26) of the households in Nondalton had members who considered themselves commercial fishermen; none of them made any money fishing in 1973 (Gasbarro, 1974).

As in the case of trapping, historically the credit relationship was an important aspect of commercial fishing for the Nondalton Dena'ina. They purchased boats on credit from the cannery and often relied on credit to purchase a winter's supply of groceries after the fishing season.

As Bristol Bay salmon runs improved in the late 1970s, Nondalton people increased their participation in commercial fishing. Peak years between 1979 and 1981 brought about a major resurgence of fishing by residents of the community. However, entry to the fishery had been limited by legislation during the mid-1970s, with considerable impact on Nondalton resident's fishing opportunities. The Limited Entry Commission weighted 1971 and 1972 particularly heavily in awarding points for fishing participation to qualify for Limited Entry Permits. Many Nondalton residents who felt they should qualify for permits had not fished in those years, and therefore did not receive permits.

In 1980 Nondalton residents owned 25 Bristol Bay limited entry permits. These included 13 set net permits and 12 drift net permits (Langdon, 1981). Three interim use permits were still being adjudicated at the time of this study. The ratio of permits per capita in Nondalton (about 1:6.4) was similar to those in other Iliamna communities which ranged from 1:6 to 1:7 in 1980. This contrasted with most other Bristol Bay communities, where ratios varied from one permit for every two people (Egegik, Pilot Point, Naknek) to one permit for every four people (Togiak, Levelock) (Langdon, 1981). Several younger people who did not own permits worked as assistants for other fishermen in 1980 and 1981.

In 1979 and 1980, the structure of the Bristol Bay salmon fishery was considerably different than in the late 1960s. The capital costs of fishing had increased dramatically, as most fishermen invested in larger, more efficient boats. Canneries no longer provided credit to fishermen, cutting off the major source of investment capital to Nondalton residents. Nondalton people had little access to other sources of credit to finance boats and equipment. Many Nondalton people also had difficulty finding markets for their fish.

Nondalton men with drift permits who did not own boats in the late 1970s began to fish as partners on boats owned by others, generally non-local fishermen who did not have permits. In such cases the share for the Nondalton permit-holder averaged about 30 to 40 percent. In the best case, this system enabled people to take advantage of newer, more efficient equipment, producing larger catches and larger incomes. In the worst case, Nondalton fishermen found themselves the victims of poor partnerships, misunderstanding and bad faith, and in these cases made little money.

In 1980 and 1981 most Nondalton drift fishermen fished for the Alaska Packers cannery in South Naknek. Most Nondalton people arrived in South Naknek during the first week of June to prepare fishing boats and set up camps at their set net sites. In order to reach the fishing area, people chartered aircraft from Nondalton to South Naknek. A few men came across Iliamna Lake and down the Kvichak River by skiff, a trip which, under good weather conditions, takes a day and costs about fifty dollars for gas and oil. Most Nondalton commercial fishermen stayed through the early July peak of the sockeye run, returning home beginning in mid-to-late July.

Half of the fourteen households surveyed in 1981 had members who fished commercially in the 1980 season. The mean gross earnings from commercial fishing reported by these seven households was $8,442. Household earnings ranged from a low of about $100 to a high of $30,000 (the high case representing the earnings of a household with four members participating in the fishery).

There was greater participation in fishing during the 1981 season. Sixty-eight percent (13 of 19) of the households surveyed indicated that members had fished commercially in 1981. Twenty five members of these thirteen households participated in the Bristol Bay fishery. Ten of the nineteen households owned limited entry permits.

Transfer payments and social security were minor sources of income for the village as a whole, although very important to a few households with disabled or elderly members. These payments may help some families get through periods of low income in some years.

The income data collected in 1980 and indirect evidence and observation indicates that there are wide differences in income between households. Four or five households consistently earn higher incomes than others, but all are subject to significant fluctuations in income from year to year.

Most Nondalton individuals tended to work at a range of jobs, despite the small number of options, rather than specializing in one skill. They tended to avoid being too dependent on any one activity in an economy characterized by seasonal and annual fluctuations. Most households attempted to reduce economic risk by

employing several members of their household if possible. Another major way of diversifying opportunities, reducing costs, and reducing risk was to produce their own food, heating fuel, goods, and equipment.

Living Costs and the Need for Cash

Social, economic, and technological change in the Iliamna region, as in most rural areas of Alaska, has increased the necessity for a household to maintain relatively consistent sources of cash income. The cost of imported products was particularly high in the village of Nondalton in 1980 and 1981 because of its inaccessibility by surface transportation and its distance from transportation and service centers. Goods had to be brought into the village by air or by a combination of water and overland transport. Shelter, food, fuel for space heating, transportation, power generation, and equipment necessary for domestic production were among the major costs in the village. Some of these costs are illustrated with the following examples.

The single greatest cost for a Nondalton household in 1980 and 1981 was fuel for heating, electrical power, and transportation. Most homes in Nondalton, including both the old log buildings and houses built through various federal programs, were poorly insulated and inefficient in use of heating energy. With rapidly rising fuel costs in the late 1970s and early 1980s, these houses began to impose an increasing financial burden on many households.

Just over one-third of the families in Nondalton heated primarily with oil, while the rest heated primarily with wood. Three of the families who heat predominately with oil estimate that they use from 8 to 15 barrels per year (440 to 825 gallons) for space heating.

However, the major expense for fuel for several families was for electrical generation. There is no village power plant in Nondalton, and about twenty percent of the households have small gas or diesel generators to power lights, radios, and tools. About five families have freezers.

Even families without electrical power had significant power costs, since they used gas or kerosene lanterns. These fuels were also expensive in Nondalton, ranging from $4.00 to $5.00 per gallon in 1980 and 1981.

The village water and sewer system has also increased the need for cash in the community over the last five or six years. A $35.00 monthly service charge per household is presently not covering even the cost of fuel oil to keep water circulating in the system. In 1982, the service charge was due to be increased substantially.

During the fall, fuels were delivered at Iliamna by barge from Naknek and could be purchased in bulk by individuals. The fall 1981 bulk price for fuel oil was about $1.30 per gallon. Transportation of drums of fuel across the Newhalen Portage by truck, and then up the Newhalen River by skiff added an estimated $.30 per gallon, plus considerable labor, making fuel oil at least $1.60 per gallon delivered in the village. Many Newhalen families were not able to buy fuel in

bulk, however, due to lack of cash, storage drums, and means of transporting the drums over the Newhalen Portage. Once the barges stopped hauling fuel, during September or October, the price of fuel rose rapidly, reaching $1.93 in Iliamna in October, 1981. Several families bought drums of fuel oil at this cost, increasing the cost in Nondalton to about $2.33 per gallon. During the winters of 1980 and 1981, some fuel oil was flown into Nondalton at a cost ranging from $2.20 to $2.50 per gallon.

The three case examples below illustrate fuel costs for three Nondalton households in 1981. One family which had a freezer and basic appliances ran their generator fairly constantly and purchased fuel in bulk. They estimated the following costs for fuel for heating, cooking and electricity in 1980: space heating, 10 drums of fuel oil at $88.00 per drum; cooking, six 100 pound bottles of propane at $75.00 per bottle; and electricity, 30 drums of fuel oil at $88.00 per drum, for a total of $3,970.00 per year. Another family with a freezer, which supplemented with wood for heating and heated water and ran a clothes dryer with propane, estimated the following costs: space heating, 8 drums of fuel oil at $104.50 per drum; propane for cooking, heating water and drying clothes, 30 bottles at $75.00 per bottle; and electricity, 12 drums of fuel oil at $104.50 per drum, for a total of $4,340.00 per year. Finally, a lower income Nondalton family which heated with wood and did not have electrical power, estimated the following costs for 1981: lighting, about 120 gallons of Blazo at $5.00 per gallon; propane, 15 bottles at $75.00 per bottle; gasoline for snowmachine and chainsaw for obtaining wood, one drum at $110.00, for a total of $1,835.00 per year. Several Nondalton households indicated that they were spending between one-quarter and one-third of their annual gross income on fuels in 1980 and 1981.

Food prices in Nondalton were also quite high, as they are in most small remote communities in Alaska. A survey of prices for typical food items in Nondalton in 1980 indicated food costs were about forty percent higher than in Anchorage. The high cost of air-freight and the small scale of stores in the area contribute to high costs. There was one store in Iliamna in 1980-1981, and two stores in Nondalton (a cooperative village store and a smaller store owned by the village corporation). In addition, two families sold foods out of their homes, primarily candy, pop, and cigarettes, but also occasionally eggs and bread. Most foods, except for frozen items, are shipped by mail to the village. Frozen items must be shipped air-freight to Iliamna and retransported by air-taxi to Nondalton. Air freight rates to Iliamna in 1981 were $.27 per pound, while air-taxis charged $.15 per pound (for 100 pounds or more) for shipment to villages in the region.

Purchasing and maintaining transportation and hunting and fishing equipment was also a major expense to Nondalton families in 1980 and 1981. Since one of the objectives of this study was to explore the effects of inflation, particularly the rising costs of fuel, on subsistence production by Nondalton residents, information on the costs of maintaining hunting equipment was gathered in Nondalton. This information, presented in Table 2 shows that the cost of maintaining a typical complement of hunting and fishing equipment in Nondalton is at least $2,030 per year. This represents a minimal set of gear for supporting the fishing and hunting activities of a household. The costs of fuel for running snowmachines and outboards is also substantial, commonly running $500-$1,000 per year.

In addition to the high costs of mobility for hunting and trapping purposes, the residents of Nondalton had large expenses related to travel outside the immediate

TABLE 2

FIXED CAPITAL COSTS PER YEAR OF HUNTING AND FISHING EQUIPMENT FOR A REPRESENTATIVE NONDALTON HOUSEHOLD (1981)

	Replacement Cost	Life (Years)	Depreciation	Maintenance[5]	Annual Costs
16' Aluminum Skiff	$1,500	9[1]	$166		$166
35 hp Outboard	1,800	3.8[2]	474	$350	824
Small Snowmachine	1,800	3.7[3]	486	350	836
30.06 Rifle	300	6.8[4]	44		44
12 Ga. Shotgun	275	7.5[4]	37		37
.22 Rifle	125	13[4]	10		10
Snares (3 doz.)	64	1.5	43		43
#2 Traps (2 doz.)	120	10[4]	12		12
Salmon Net (50 fathom)	350	6	58		58
			Total Annual Costs		$2,030

[1] n=9
[2] n=19
[3] n=13
[4] based on Wolfe, 1979
[5] informant's estimates of average annual maintenance costs.

area of the village. There are no scheduled air-taxi flights between Nondalton or Iliamna and the Naknek area where Nondalton people fish commercially for salmon. A round trip charter costs about $650.00, though this may be split between three or four people. A round trip flight to Iliamna to go to the store, to visit, or to catch the scheduled flight to Anchorage, costs about $50.00 per person; the round trip from Iliamna to Anchorage costs $150.00.

In part because of the high costs of imported foods, materials goods, and energy, the people of Nondalton have continued to rely heavily on a wide range of local resources, including fish, game, plants, and wood. The limited and highly variable monetary incomes typical of the Iliamna area are not sufficient to enable most Nondalton families to rely solely on store purchases. The monetary incomes are not reliable enough to allow people to be completely dependent on imported goods even when they do have enough money to buy food. There are, of course, non-monetary reasons, to be discussed below, that also perpetuate reliance on local fish, wildlife, and other resources.

It appears that in Nondalton, as in other Alaskan communities, people have found that the best and most efficient use of their limited monetary income has been to invest a substantial portion of it into hunting and fishing equipment and operating costs. This investment, combined with labor for which there are often few other demands, produces a higher return in food than would have been possible if equivalent amounts were spent on imported foods (see Wolfe, 1979, 1981).

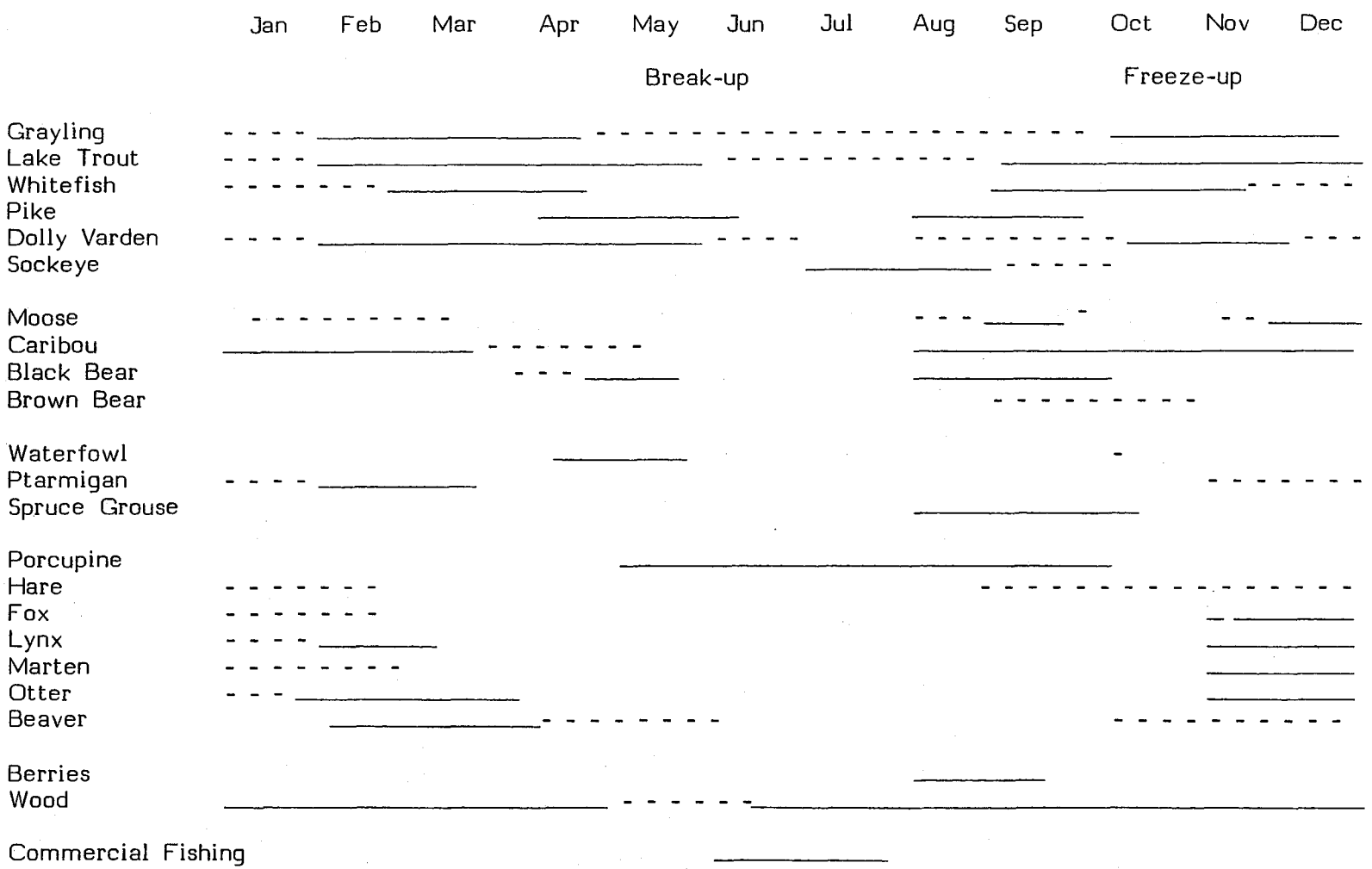
The Seasonal Round of Resource Use in 1981

The second major sector of the economy of Nondalton is harvest of fish, wildlife plants, and other local resources for domestic use and local distribution and exchange. These economic activities in 1981 were closely tied to annual cycles of fish and wildlife populations. Each season brought a different set of economic opportunities to residents of the community. Figures 2 illustrates the general seasonal round of economic activity by showing typical times of harvest for selected resources. As can be seen, during the summer months relatively few fish and wildlife species were sought. The summer period was spent largely on putting up salmon for household use and earning cash. During the rest of the year a wide range of resources were utilized.

The seasonal round is portrayed in this figure as beginning with the calendar year. The month of May would be a more appropriate starting point from a cultural-ecological perspective, since spring marks the end of a traditional late winter resource scarcity and move to spring camp.

Incidental harvests are not depicted in Figure 2, which is intended to illustrate the major periods of time when particular resources were actively sought or regularly harvested. The figure also does not directly reflect the seasonal abundance or distribution of fish and wildlife species, since a resource may have been available in the Nondalton area even though it was not being harvested. For example, little effort was devoted during mid-summer to catching grayling, trout, or whitefish in the waters of the area, because people were too busy with other economic activities such as putting up salmon and seasonal wage employment. Figure 2

FIGURE 2. SEASONAL ROUND OF HARVEST ACTIVITY FOR SELECTED SPECIES, NONDALTON, 1971-1981



Usual period of harvest effort _____; Occasional effort— - - - -

does not portray the great degree of variability in timing and level of harvest effort which is characteristic of hunting and fishing activities. Environmental conditions greatly influence when, where, and how harvest activities occur. For example, a warm winter in 1976 meant there was little snow cover, so that snowmachines could not be used for trapping or moose hunting most of the winter. Lake Clark did not freeze and boats were used for trapping in that area in January and February. A period of extreme cold or wind, on the other hand, prevented people from fishing through the ice for two weeks in February, despite the fact that people usually devote considerable time during February and March to ice-fishing. Finally, there are certain resources not depicted in the figure which are also harvested, especially wild plant products. These are not included because of lack of detailed information.

The following section describes the seasonal round of activity in Nondalton in 1981 depicted in Figure 2 to illustrate some of the specific factors which affect harvests, resource use, and economic options in Nondalton. This description is necessarily selective. It is intended to portray the main outlines of the seasonal round, but not all of its complexity.

The beginning of the new year in Nondalton, as in other predominately Russian Orthodox communities in the Iliamna Lake region, was closely tied to religious and social celebrations. During the first and second weeks of January, most activities focused around the Orthodox holidays. People rushed to get foods together for visitors from other villages. At "Slavi," the Russian Orthodox winter holiday, people from villages throughout the Iliamna Lake region and as far as the upper Nushagak River came to Nondalton. In turn, Nondalton residents visited

other communities in the region. Most hunting and trapping activity ceased during this time of important social interchange.

Gathering of firewood for heat and steambaths was a contant activity throughout the winter. In most years, a few men would trap in late January. However, in the first months of 1981 there was no snow in the Iliamna Lake or Nondalton areas. Most people did not consider it worth the effort, expense, or wear on snowmachines to travel long distances to trap. A few made sets for fox, lynx, and marten on the mountain behind the village. Others put out traps down the Newhalen River which they could check by walking. Two families with "three wheelers" used them to check traps.

The beaver regulatory season opened February 1, 1981, but the absence of snow throughout the two month season restricted trappers to areas close to the village. A group of four families camped up on lower Lake Clark in mid-February and used a combination of snowmachine travel and walking to reach beaver houses in that area. Four or five other people trapped for beaver in the Tazimina River and Pickerel Lake areas, located across Six-Mile Lake four miles east of the village. These areas could be reached only by a short snowmachine trip across glare ice and a rough ride through frozen swamp. The equipment used by Nondalton trappers did not hold up well under these rough snowless conditions, and many people had to make major repairs to snowmachines and sleds. One family put out a gill net down the Newhalen River for dolly varden. During trips by three wheeler or snowmachine on the bare ice to check his net, he also checked beaver sets by walking back in from the river about two miles. Many people spent long hours fishing through the ice in front of the village and by the mouth of the

Tazimina River during February and March. On warm, sunny weekends, 40 or 50 people were out fishing. Productivity varied from about one to ten fish per person per hour, mainly grayling, with some lake trout, whitefish, dolly varden, and rainbow trout.

The lack of snow in January and February also reduced opportunities to harvest caribou, although a few which wandered close the lake and village were killed. These poor travel conditions were common between 1976 and 1981. In years with better travel conditions, Nondalton people travel into Chulitna drainage, the upper Talarik Creek, the drainages of the Chulitna, Upper Talarik, and Koktuli Rivers, as well as up Lake Clark to trap and to hunt large game. Traditional hunting areas for caribou were even wider, including the entire upper Mulchatna watershed.

Late spring, the latter part of April and May, was traditionally a time of food shortages and economic stresses for the Nondalton Dena'ina. Travel was difficult during this time, and food stores were usually low. In 1981 the little snow that fell during late winter was gone from the immediate vicinity of Nondalton by April, and smaller lakes and creeks had lost their ice cover, thus ending the season of snowmachine use. A relatively small number of fish and game resources were available in the vicinity of Nondalton during this period of limited mobility. Until the 1960s, it was common for most residents to move to spring camps during the break-up period, particularly along the lower Chulitna River and the Chulitna Bay area of Lake Clark, where beaver muskrat, waterfowl, and fish species such as pike and whitefish could be obtained. One or two families continued this pattern in the late 1970s and early 1980s but the need to keep children in school

made it difficult for others to leave the village. For most families which remained in Nondalton, only small quantites of fish and game resources were harvested during the months of April and May. During this time, many families relied upon fish species such as lake trout and grayling.

Break-up occurred relatively early in 1981: the ice cleared from in front of Nondalton in late April. It was then possible to resume boat travel after the long period of low mobility. People immediately put boats into the water to travel down the Newhalen River. The ice also cleared from the lower end of Lake Clark early so that during the first and second weeks of May a number of persons took boats into Lake Clark. In some years, break-up on Lake Clark has not occurred until nearly a month later, in late May or early June.

With sunny and warm weather in early May, a number of families traveled by boat about 10 miles from Nondalton up into the Snowshoe Bay area of Lake Clark to camp. Weekends were particularly favored for these trips, since school-age children could then go along. On these trips, people fished with hook and line in the area near the mouth of Snowshoe Bay for lake trout and pike. Two families set gill-nets for these species in small bays. Ducks were occasionally shot and people kept a close eye on the mountainsides for caribou and black bear.

In late May and early June three or four Nondalton families camped in the Chulitna Bay area about twenty miles from the village. They hunted muskrat and duck and put out nets for pike. Pike were split and dried for food for the family and dogs. Dried pike was frequently consumed by families during commercial fishing season in Bristol Bay. Pike also were caught by hook and line up the

Chulitna River. Two or three boats went up Lake Clark as far as Chulitna Bay to take a group of children camping as part of an outdoor education class. Lack of gasoline restricted the mobility of Nondalton families in spring, 1981. Gas was flown and sold at a price of $2.75 per gallon in May 1981. Several families mentioned that these high costs caused them to limit their boat travel.

At least five or six families set gill-nets on Six-Mile Lake within two miles of the village during May. These nets were fairly productive, taking mainly lake trout and pike, as well as some burbot and suckers. Three or four families appeared to be relying heavily on the fish for food. Most of the dried salmon from the previous summer was gone. Some fresh fish was used to feed dog teams.

Although little mention is made of flora in this study, the people of Nondalton use a wide variety of plants throughout the year. Spruce, birch, and other woods, used for fuel and tools, are the most common example. The Dena'ina have used hundreds of other plants for food, medicine, coloring, and crafts and Kari (1977) provides Dena'ina plant names and describes Dena'ina use of plants in considerable detail.

By June 8 residents of Newhalen, seventeen miles south of Nondalton, were catching a few salmon. Some Nondalton residents were given fresh salmon from friends or relatives in that community. The first sockeye salmon of the 1981 season reached the upper Newhalen River by about June 20. A few Nondalton people put out nets near the Newhalen River Landing, about eight miles below the village, to harvest the earliest fish. As the run increased, these nets were moved

closer to the village of Nondalton to conserve time and gasoline while checking nets and transporting fish for domestic processing.

Relatively few families participated in the early summer subsistence salmon fishing at Nondalton in 1981, because so many people traveled to Bristol Bay to fish. A few families traveled to Bristol Bay by skiff during the second week of June, while others chartered aircraft. Preparation of gear and boats occupied people until fishing began in earnest in late June. Enough sockeye and kings for fresh meals for the fisherman's family were retained from commercial catches. One or two Nondalton families obtained subsistence salmon permits from the Alaska Department of Fish and Game office in King Salmon, which allowed them to set a separate net to take fish for family use. Families did not dry large quantities of salmon during the short, intense commercial fishing season. Preparation would have taken time from commercial fishing. Also, because of the long distance and expense of travel, it was not considered worthwhile to transport dried fish back to the village at the end of the season. Several families obtained one or two quarts of seal oil from Kvichak River residents to bring back to the village to eat with dried fish.

As can be expected from the seasonal movements of Nondalton residents in 1981, by late June and early July few people were left in Nondalton. Those who remained prepared for the arrival of the main run of sockeye. They also cut and hauled supplies of cottonwood for smoking fish; repaired "fish boxes" for storing freshly caught salmon in the water until they were cut; repaired cutting tables and smokehouses; and prepared drying racks.

About the Fourth of July, several women flew to South Naknek to visit husbands who were commercial fishing during the holidays. At that time only small numbers of sockeye were being caught each day in Nondalton, about 4 to 15 fish per net each day. Just after July 4, the number of salmon reaching the upper Newhalen River and lower Six-Mile Lake increased and catches rose to 20 to 30 fish per day per net. Daily catches peaked by about July 20, with catches of 120 to 130 sockeye per day being possibly. Catches then tapered off toward the end of the month as the main run moved past into Lake Clark, and as people who had been fishing consistently met harvest goals. Table 3 depicts the daily catches of one Nondalton woman who was assisted by her partially disabled husband and grandchildren. She supplied three households with dried fish: herself and her husband; an adult son, his wife, and their four children; and a single, unmarried son who lived alone. In addition, she supplied about 20 salmon to another family which did not fish but usually canned salmon each year, in return for freshly baked bread. This Table illustrates internal restraints on harvest. When household members had as many fish as they could process, they pulled the net out of the water.

Dog teams at Nondalton were usually maintained during summer at fish camps. Dogs were fed with salmon guts, eggs, heads, and other by-products of dried fish preparation, cooked into a mash every couple of days. Cooking for dogs, heating the tents at fish camp, and keeping smoke in the smokehouse required large quantities of wood. Children assisted in getting wood, hauling water, and other chores.

TABLE 3

EXAMPLE OF DAILY SOCKEYE HARVEST BY A NONDALTON WOMAN (1981)

Date	Number of Fish
July 3	2
4	11
5	26
6	26
7	21
8	Net Pulled Out
9	28
10	21
11	37
12	67
13	43
14 - 17	Net Pulled Out
18	82
19	124
20	126
21 - 23	Net Pulled Out
24	65
25	Net Pulled Out
26	26
27	Net Pulled Out
28	26
29 - August 8	Net Pulled Out
August 9	102
10 - 16	Net Pulled Out
17	27 (Plus 2 dolly varden)
18	7
Total Sockeye	867[1]

[1] Salmon catch was distributed among four households, as described in the text.

After people returned from commercial fishing in Bristol Bay, there was a flurry of activity in the village. Many people returned with new boats, motors, and gasoline and began making numerous boat trips up into Lake Clark. Families who did not get a chance to put up salmon earlier in the summer went to fish camps around lower Lake Clark and along Chulitna Bay, where fish stayed bright later into the fall than they did in Six-Mile Lake. By mid-August people began to look for blueberries and crowberries. However, in 1981 as in several recent years, there were poor crops, perhaps due to the lack of winter snow cover.

Apparently, because of large commercial harvests in the Naknek-Kvichak districts and reduced escapements upriver, relatively small numbers of sockeye were available in Six-mile Lake after mid-July. Nondalton residents who returned to the village in mid-to-late July from commercial fishing to put up fish for household use said they found it difficult to fill family food stores. Salmon for subsistence use at that time were taken with set nets near the village or from camps previously described. Weather was relatively dry in 1981, and fish dried much better than they had the previous summer, when wet weather soured much drying salmon.

Old fish camps scattered along the Newhalen River two to five miles below Nondalton were not occupied during summer, 1981, although nets were occasionally set in these locations. Fish camps closer to the village, particularly at the narrows where the Newhalen River begins, were occupied and used by about eight families. Two families constructed new smokehouses and tent-frames at fish camps relatively close to the village. This was the first time in several years that major improvements had been made to fish camps in the area, indicating a

general trend toward locating fish camps closer to the village. This may have been related to the high costs of fuel for traveling back and forth between the village and fish camp.

People who did not commercial fish in 1981, including young and middle aged men and several women, were employed as firefighters in early summer 1981. In addition to the Bureau of Land Management, which has commonly hired Nondalton firefighting crews in the past, the State of Alaska hired about fifteen Nondalton men and women as firefighters in 1981.

Three elderly couples from Nondalton spend most of the summer living at Lake Clark, where they caught and dried salmon. They occasionally hunted small game such as porcupine, which were particularly numerous in 1981.

During the sockeye run, through July and early August, Nondalton people ate a particularly heavy fish diet. By middle and late August they were increasingly interested in getting meat; people frequently said they were tired of fish. The caribou regulatory season in Unit 9B opened August 10, but caribou remained high in the mountains around Lake Clark. People watched for caribou on the mountain close to Kijik Lake and Snowshoe Bay, on Lake Clark, and the mountain east of the Newhalen River ten miles from the village. Two or three groups of people walked up into these mountains to hunt caribou and black bear. People also watched the shores closely as they traveled by boat, and occasionally spotted a caribou or moose. Four or five parties went up the Chulitna River as far as the Nikabuna to the Lakes area and took at least one caribou which was shared between four households. The water was high and it was easier than usual to get

so far up river. Caribou were said to be more plentiful on the upper Chulitna River, but the long distance and shallow water usually discouraged effort in that area during fall. One or two of the local hunting lodges occasionally provided meat to some families in the village. Meat from several caribou, moose, and black bear, harvested by hunters the lodge flew out, was brought back and made available to the village.

Moose were seen relatively frequently on the lower Chulitna River throughout the fall by Nondalton people. One family which was camped on Lake Clark through the latter part of August and early September putting up salmon for dogfood, made about six trips up the Chulitna River. They caught pike and whitefish, picked berries, and saw moose each time. In early September, when they had put up about 1,000 sockeye, they made one last trip up the river and killed a young bull moose. The family returned to Nondalton the next day with the moose meat, hung it for a day, and then spent about two days cutting and wrapping it. The meat was shared primarily between the household of the man who shot it and his son's family. These families were among the few in the village which had freezers, and most of the meat was frozen. The moose lasted the two families, totalling eight people, about three or four months.

At least four other households looked for moose around the shores of Lake Clark and Little Lake Clark, and along the banks of the lower Tlikakila River, as well as the Chulitna River. Some traveled over 150 miles by boat and spent two to ten days hunting moose with mixed success. Nondalton residents say that increased aircraft and boat traffic in the Lake Clark area over the last ten to fifteen years have made moose increasingly wary, and that moose tend to stay

back away from the waterways more than they did in the past. This, they say, makes it more difficult to take moose in the fall. Although there were no major storms, several hunters were caught for a day or two while traveling on upper Lake Clark by wind and heavy waves while looking for moose. In some years, wind storms have lasted for weeks at a time during September and October, preventing people from hunting in Lake Clark during much of the moose season.

Two Nondalton people had a local pilot fly them to a small lake north of Lake Clark where they shot a moose. This moose was shared among at least five interrelated households. Other Nondalton households received meat from relatives in the Iliamna area, who had killed moose and caribou in the fall.

Nondalton residents were also busy hauling fuel during August and September. Gasoline and fuel oil had to be hauled by truck over the portage from Iliamna, and then by skiff upriver from the Newhalen Landing to Nondalton.

The opening of school in September once again limited family mobility, since parents preferred not to leave children alone in the village. Much of the long distance traveling by boat, and camping, shifted back to weekends.

Freeze-up of creeks and small ponds and the first snowfall occurred during late October, but Six-Mile Lake was late in freezing in 1981. One or two men traveled down the Newhalen River by boat to put out otter and fox traps in early November. As the weather got colder, the use of boats declined, and two families with three-wheelers used them to travel out to check traps.

After Six-Mile Lake froze, in early November, people began to fish through the ice for grayling, dolly varden, whitefish, and lake trout. Several older women were the most serious producers of fish; as long as the wind was not too cold, there were always people fishing. With the lake frozen, people were able to cut wood southeast of the village and haul it back by snowmachine. Wood cutting continued to be a major activity throughout November and December, although the lack of snow made transporting the wood difficult and was hard on snowmachines and sleds.

Moose season was open from December 1 to December 30 in GMU 9B, and either sex could be taken. In December 1981, just as in 1980, there was little snow in the entire Iliamna Lake area and people throughout the area had difficulty in traveling. Throughout the month of December in 1980, for example, Nondalton people tried to kill caribou and moose. The lack of snow and cold weather prevented people from getting into areas where the animals were located. Even when moose or caribou were located, they were difficult to approach because the cold weather magnified sounds. In late December, however, when the weather warmed slightly, people intensified efforts to get meat; particularly, they said, in order to have meat on hand during Russian Christmas.

As can be seen, fishing hunting, and trapping activities comprised a significant component of the Nondalton economy. Summer was a critical period of time for earning money and preparing and storing salmon, a staple food. The village economy during other seasons revolved around the harvest of a wide range of local resources for household use.

FISH AND WILDLIFE HARVESTS IN NONDALTON DURING 1973, 1980, AND 1981

Preceeding sections have described general problems of hunting, fishing, trapping and remunerative employment within the economy of Nondalton. This chapter provides quantitative data that illustrate the dependence of Nondalton residents on local fish and game resources. Annual harvests of subsistence resources reported by samples of Nondalton households over three years are presented to supplement the more general descriptions of the Nondalton economy. Whereas the preceding section described the general organization of economic activities through time, this section provides estimates of actual levels of subsistence production for three different years based on a sample of households.

Methodology

The goal of this portion of the study was to produce quantitative information about subsistence harvests by households in Nondalton. The estimates of harvest levels were derived from three surveys conducted in Nondalton over an eight year period; in 1974, 1981 and 1982. All three surveys were similar in methods and content and were based on questioning members of sample households about their total harvest for the year preceding the survey.

Information about Nondalton harvests in 1973 was obtained from a survey conducted in summer 1974 by the Institute of Social, Economic and Government Research, University of Alaska. The purpose of that study was to determine how extensively Bristol Bay residents utilized the region's fish and wildlife, and how certain social and economic factors influenced harvests (Gasbarro and Utermohle, 1975). A questionnaire was administered to as many household heads as possible in 21 communities in the Bristol Bay region, including Nondalton and all of the villages of the Iliamna region except Port Alsworth. A summary of village harvest information was obtained from the principal investigator of the study, and portions of this unpublished information are presented below. Twenty-five of an estimated thirty households in Nondalton were included in the 1974 survey.

A similar questionnaire was administered to a smaller sample of households in Nondalton in January 1981 as part of this current study. The survey was designed to collect information on household harvests of fish and wildlife, as well as on other selected variables, including participation in commercial fishing, costs of transportation and energy consumption.

A sample of about one-third of the households in the community was desired, and the households to be questioned were selected to include knowledgeable, active informants, as well as a range of incomes. Lack of data about the households prevented use of a rigorously stratified sample, but based on recommendations of other community members, ten households were originally selected. Interviews with these households resulted in additional information about four other households, making a total of fourteen households in the sample. This constituted

a 40 percent sample (n=14) of the 35 households identified in Nondalton in 1981. Sixty-seven people, 39 percent of the village population, lived in these households.

Information collected in this survey and in subsequent interviews indicated that the 1981 sample was probably somewhat biased toward more economically secure and productive households. The people acknowledged by others to be more knowledgeable about hunting and fishing matters were probably also more active and successful providers. If this is the case, estimates of average harvests are higher than an average which included all Nondalton households would have been.

In February 1982 a sample of Nondalton households was questioned about their harvests during calendar year 1981. An attempt was made to include as many households which had participated in the 1981 study as possible. In addition, an attempt was made to include a greater proportion of less active, potentially less productive households. The 1982 sample comprised 19 households, or 54 percent of the 35 households identified in 1981. Eleven of the 14 households surveyed in 1981 were included in the second survey. The surveyed households included 60 percent of the estimated 1981 population of 180 people.

Numbers of animals harvested per household have been converted to pounds edible weight to provide a standard unit of measure to compare the relative contribution of various resources to the household food economy. The methods used to derive standard edible weights are described in Appendix I. This comparative technique does not account for nutritional differences in food products or for the cultural evaluation of the importance of a food resource. Consequently, "pounds edible weight" should not be interpreted as a valid measure of the relative "importance"

of a food resource in the economy of Nondalton. Estimating importance must take into consideration dietary, evaluative, and a number of other factors.

One methodological problem, which reinforces the need for understanding economic units before designing studies of this kind, was that households are not always the important economic units in Nondalton. That is, household units are not the same as units of production, units of exchange, or units of consumption. Several households surveyed included people who were dependents of people in other households, or who participated in productive activities only as part of another household. They may have considered their production to have occurred in that household. Several of the surveyed households provided most of the meat and fish used by other households. These interconnections would make it methodologically unsound to determine total harvests in a village from a random sample of household units. Ideally, a survey of this kind could identify harvests of particular individuals, and then trace the disposition of the fish and game as distribution or exchange occurred to other people and households. This method would be feasible only for a small number of resources, a few people, or over very short periods of time. Generally, people cannot remember all of the details of such exchanges over a year's time. Further research is planned to examine distribution and exchange for specific resources in villages of the Iliamna Lake area.

Household Harvests of Fish and Wildlife

The mean annual harvest per household of fish and wildlife species in Nondalton in 1973, 1980, and 1981 are presented in Tables 4 and 5. As previously described, harvests are expressed as pounds of edible food products.

Table 4 shows that Nondalton families were highly dependent upon local food resources harvested from the land and waters around the village. Average food output per household for local use over the three years was 4,432 pounds. There was a marked degree of consistency in average household harvests between the three years. The 1980 average harvest, which was the greatest of the three years, was 16.5 percent larger than the 1973 harvest, which was the smallest. As shown in Table 5, average output per household member ranged between 738 and 1,036 pounds.

These average household harvests are very comparable to harvests reported in 1981 for six Yukon Delta communities, where the average food output per household for local consumption was 4,597 pounds in 1981. Average food output per household member in those six communities was 783 pounds (Wolfe, 1981).

Table 6 shows the percentage of the sampled Nondalton households which reported harvesting particular species. As in the case of harvest quantities, there is variation from year to year. These figures indicate that not all households harvest the full range of resources and that even such basic resources as fish, moose, and caribou were harvested by fewer than 70 percent of households in Nondalton.

TABLE 4

MEAN HOUSEHOLD HARVESTS BY POUND OF SELECTED FISH AND GAME RESOURCES, 1973, 1980, 1981 FROM A SAMPLE OF NONDALTON HOUSEHOLDS

	1973 (n=25)	1980 (n=14)	1981 (n=19)
Fish			
Sockeye	2,614	3,985	2,883
White Fish	57	18	36
Grayling	44	23	65
Pike	28	5	14
Burbot		1	1
Char/Dolly Varden	2	10	29
Rainbow Trout	9	9	21
Lake Trout	68	64	39
TOTAL FISH	1,811	4,115	3,088
Land Mammals			
Moose	518	366	483
Caribou	576	332	347
Black Bear	32		47
Brown Bear	4		26
Porcupine	34	14	27
Snowshoe Hare	11	4	8
Tundra Hare		6	3
Beaver	114	114	143
Lynx	2		
TOTAL LAND MAMMALS	1,291	836	1,084
Birds			
Duck	4		7
Goose	9		4
Ptarmigan	13	5	5
Spruce Grouse	3	3	7
TOTAL BIRDS	29	8	23
TOTAL SUBSISTENCE FOOD HARVEST	4,142	4,959	4,195

TABLE 5

MEAN HARVESTS IN POUNDS* PER HOUSEHOLD AND HOUSEHOLD MEMBER

NONDALTON, ALASKA

		1973 (n=25)	1980 (n=14)	1981 (n=19)
Subsistence Output Per Household	Mean	4,142	4,959	4,195
	Range	0 - 10,171	0 - 10,962	0 - 14,213
Subsistence Output Per Household Member	Mean	803	1,036	738

*Edible weight.

TABLE 6

PERCENTAGE OF SAMPLED NONDALTON HOUSEHOLDS HARVESTING SELECTED SPECIES

1973, 1980, 1981

	1973 (n=25)	1980 (n=14)	1981 (n=19)
Sockeye	76	71	58
Sockeye Fall Fish		21	37
Whitefish	48	50	63
Grayling	56	64	63
Pike	32	35	26
Burbot		29	16
Char/Dolley Varden	20	50	63
Rainbow	32	43	63
Lake Trout	60	50	58
Moose	52	50	53
Caribou	60	71	68
Black Bear	24		32
Brown Bear	4		21
Porcupine	60	50	63
Snowshoe Hare	44	35	47
Tundra Hare		7	16
Beaver	36	43	63
Lynx	8	14	5
Duck	28	0	42
Goose	16	0	16
Ptarmigan	64	43	32

Systematic information about harvest effort was not collected in these surveys so it is not possible to determine how many of the households who did not harvest a particular resource had attempted to harvest the resource. This research indicates, however, that a relatively small group of Nondalton households accounted for most of the harvest in 1980 and 1981, while another relatively small group harvested very litte. These variations are described in more detail in the discussion on moose and caribou harvests.

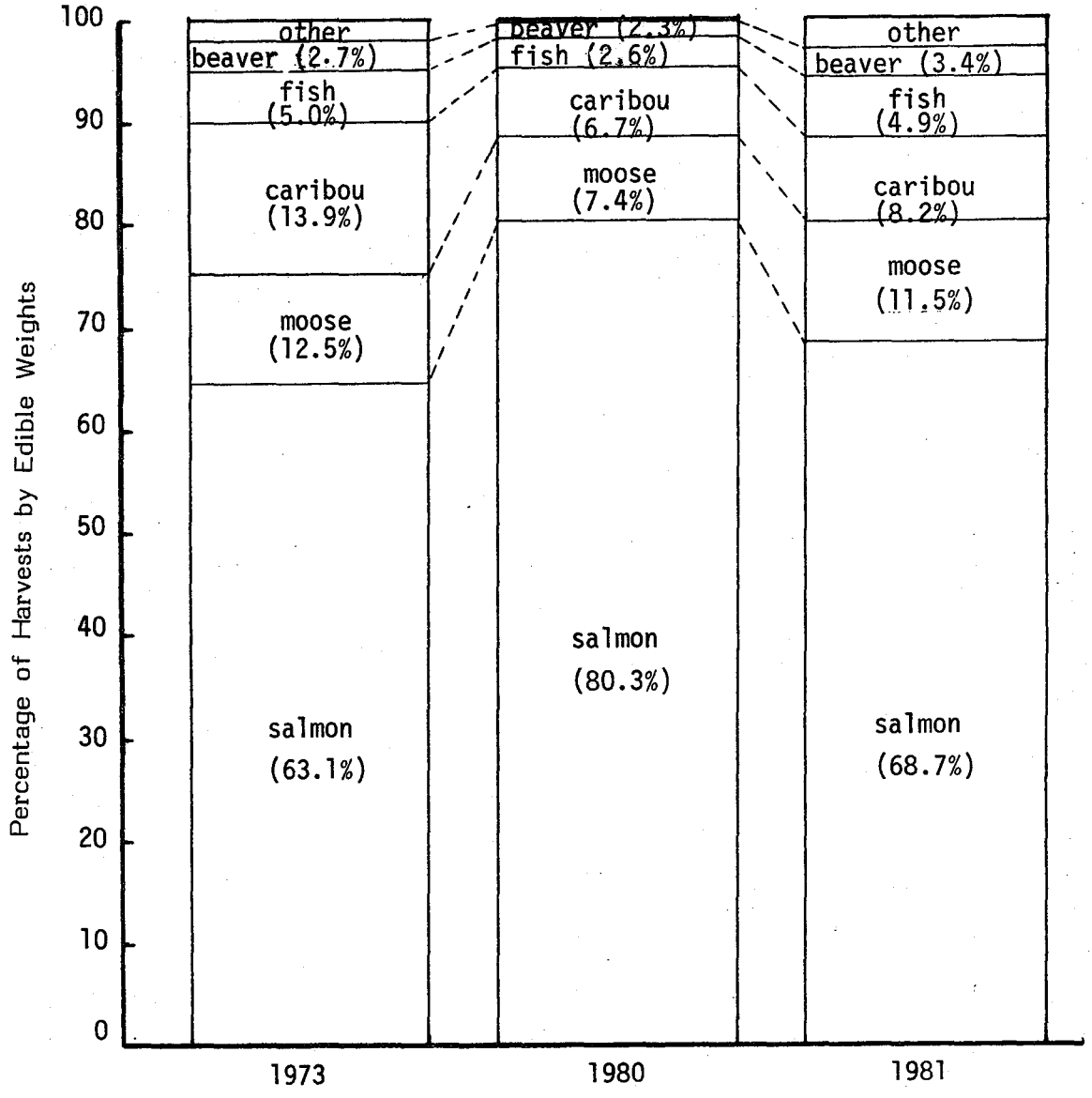
Figure 3 illustrates the composition by weight of the Nondalton fish and wildlife harvest for 1973, 1980, and 1981. Salmon provided the bulk of this harvest, accounting for 63 to 80 percent of the harvest by weight over the three years. Moose and caribou, supplying roughly equal amounts of meat, accounted for the next most significant quantities, followed by freshwater fish species and beaver.

The large proportion of sockeye salmon in the harvest is indicative of the major role salmon plays in the Nondalton economy. It is not only a staple food for humans, but also for dogs. The large quantities of salmon harvested also underscore the significance of other species to Nondalton residents, who note that people cannot live by fish alone.

This report does not attempt to explain why Nondalton households harvested the quantities of specific resources that they did, or why these varied between the three years. Much more research and information would be needed in order to address these questions. Obvious differences between the three years, which may account for some of the variation, are discussed below, however.

FIGURE 3

PROPORTION OF NONDALTON SUBSISTENCE HARVEST, BY WEIGHT
SALMON, MOOSE, CARIBOU, BEAVER AND FRESHWATER FISH
1973, 1980, 1981



The differences in harvest between the three years (Table 4 and Figure 3) are partially explained by differences in economic conditions, weather, and resource availability in those years. In 1980, for example, salmon accounted for 80 percent of the total harvest by weight, compared to 63 percent in 1973 and 69 percent in 1981. One significant difference between these years was the magnitude of the 1980 sockeye escapement to the Kvichak drainage, which was one of the largest ever recorded (Alaska Department of Fish and Game, 1980). Despite this large run Nondalton people did not earn very much money or spend much time commercial fishing in 1980 due to a fishermen's strike in Bristol Bay. Therefore, many families devoted a high degree of effort to putting up salmon for home use. There was also much rainy weather in July and August 1980 and people had trouble getting fish dried without spoiling. One household, for instance, said that about 1,000 of their fish spoiled due to wet weather. These fish were used to feed dogs, and additional fish were taken late in the summer to dry for human use. These conditions apparently led families to increase production in order to make up for the spoiled portion. The large run of sockeye made it possible for people to take the additional fish. Harvests of moose and caribou in 1980 were affected by the lack of snow in December, which made it nearly impossible to travel by snowmachine.

In 1973 Nondalton incomes were extremely low (approximately $5,600 per household [Gasbarro, 1974]). Salmon returns to Bristol Bay were very low from 1971 to 1973 and no one in Nondalton fished commercially in 1973. Not enough information is available to evaluate whether production for household use was expanded to meet increased needs, reduced because of lack of cash for harvesting equipment and fuel, or maintained at approximately the same level as preceding

years. Noticeably larger numbers of moose and caribou were taken that year, however, reflecting better winter travel conditions that year.

In 1981 many Nondalton residents participated in the Bristol Bay commercial fishery and were therefore gone from the village during the peak of the sockeye run in Six-Mile Lake. Sockeye returns to the Lake Clark drainage were relatively low. These circumstances may account for the relatively low participation in subsistence salmon harvesting in 1981 (Table 6). It is interesting to note that salmon harvests in 1981 were still relatively large compared to 1973, despite the lower participation rate. More information on salmon use and harvests will be presented in a later, more comprehensive report on resource use in Nondalton. In 1981, as in 1980, caribou harvests were constrained by lack of snow and poor travel conditions, as reflected in the average household harvests in Table 4.

MOOSE AND CARIBOU UTILIZATION IN NONDALTON

This section examines moose and caribou hunting and harvests by Nondalton residents. Preceding sections described the general seasonal round of activities, including when moose and caribou hunting generally occur. This section examines how moose and caribou are used by Nondalton residents and general temporal and spatial patterns of moose and caribou hunting and harvest.

The Significance of Moose and Caribou

Moose and caribou are particularly important wildlife resources to the people of Nondalton. As shown in Table 4, only salmon provided more pounds of protein to Nondalton residents than did moose or caribou. Nondalton residents view moose and caribou as large animals which can potentially provide households with a large proportion of the food they need, in the form of high quality meat, with relatively low expenditures in time and money. "They are our supermarket", people say, in describing the variety of foods and materials which a moose or caribou supplies.

The Dena'ina have a thorough knowledge of moose and caribou anatomy, and specialized terms for the butchering parts of large game. Table 7 lists some of the Dena'ina names for these butchering parts and the uses made of them. They also have an extensive vocabulary describing moose and caribou by sex and age. Some of the terms are described in Table 8.

In addition to using almost every part of the animal for food, in 1981 some Nondalton Dena'ina used moosehide as rawhide for snowshoe webbing, and softened or tanned caribou and moose hides for mukluks. At least one older woman continued to use caribou sinew for thread in sewing fur articles of clothing in 1981. Nondalton residents frequently contrasted their complete utilization of large game carcasses with the use made of these animals by outside hunters. From their perspective, outsiders commonly left much of the edible meat of the animal in the field.

TABLE 7

USES MADE OF MOOSE AND CARIBOU PARTS
BY NONDALTON DENA'INA

Butchering Part	Dena'ina	Preparation and Use
Heart	k'kuz'in'	cooked on stick when camping; fried in pan; boiled.
Kidney	k'jech'a	fired; boiled
Liver	k'ezet'	fried; boiled
Moose stomach	k'chundiyes	contents cleaned out of main pouch, then coagulated blood scooped up from body cavity and placed in pouch. This was used for dogfood plain, or cooked with other dogfood in winter; had high food value.
Small pouch	k'chilaqa jijegha	small sack near stomach. Could be pegged with a stick and formed into kettle for boiling water and cooking meat in.
Moose "book"	k'di'in	portion of gut with folds located close to the stomach; washed and eaten raw
Brisket	k'yits'ena	boiled
Neck meat	k'entułchunda	Boiled
Front quarter	k'gguna	boiled; fried; meat dried; bones boiled for marrow
Hind quarter	k'qakena	boiled; meat dried; sinew saved
Nose	k'enchix	boiled until tender, skin peeled off, then sliced
Tongue	k'tsila	boiled and treated as nose
Lower backbone	k'yina	boiled; stewed
Sirloin	k'q'iliha	cooked on stick over fire; steaks fried
Tenderloin	kiyints'aq'a	steaks fried; sinew saved for sewing thread

TABLE 7

(Continued)

Backfat, hump	vakeshlaha	a choice part; boiled
Head		stewed; boiled and cooled for "head cheese"
Hoof		boiled, cooked, and eaten
Hide		hair removed and used as "rawhide"; for webbing in snowshoes and lashing on sleighs. Softened and smoke tanned for leather
Main Intestine	k'ench'ik'a	cleaned and boiled
Meat in Rutting Season	k'talnigi	

Source: Behnke, 1978; Kari, 1977; Tenebaum, 1975.

TABLE 8

INLAND DENA'INA TERMS FOR MOOSE AND CARIBOU

MOOSE	k'uhda'i
Bull	k'tiya k'eyich'a
Bull in rutting Season	k'talnigi
Young moose separated from mother	k'eghtghiyi
Cow	deyuzhi
Cow and calf	vedechiga gilani
Calf	k'dechiga
Moose "bell"	veq'usa
CARIBOU	vejex
Bull	dugilin
Young bull	veda gilani cheg'i k'ilin
Yearling bull	nulida
Cow	vejexshla
Calf	k'kuha
Center Antler or "palm" of large caribou; "sunshade"	ventuq' tauazha

Source: Kari, 1977.

The Availability of Moose and Caribou

Nondalton people believe that moose and caribou are relatively abundant in the region surrounding the village, but they note that major changes have occurred in the distribution and abundance of both species. Until the 1930s, for example, both moose and caribou were extremely scarce in the Lake Clark, Chulitna River, and Six-Mile Lake areas, and Nondalton hunters had to travel north into the upper Mulchatna and Stony River drainages to find them. Since that time, both species have become more numerous in the vicinity of Nondalton, although people have assessed that there was a period of decreasing abundance of moose in the mid-1970s in the Lake Clark area. Other Nondalton people mention that moose have become more wary since aircraft and boat traffic began increasing in the Lake Clark area in the 1970s. Moose appeared to avoid the lake shores and riverbanks more than they did in previous years. However, in the late 1970s and early 1980s, Nondalton residents said that moose numbers in the Chulitna drainage were increasing. They also said that caribou were increasing in abundance and becoming available more frequently close to the village.

Despite the perceived relative abundance of these resources, Nondalton people have experienced difficulty in harvesting moose and caribou during legal hunting seasons in recent years. Weather and travel conditions have greatly limited the accessibility of moose and caribou during both fall and winter. Moose have tended to stay higher in the mountains in early winter during recent years because there has not been enough snow to drive them down into the valleys. This same lack of snow for long periods of time each winter over the last six years has made snowmachine travel difficult. During several of these winters, lakes and creeks

remained open much of the winter. Nondalton residents have been confined to travel on the higher areas and mountains behind Nondalton where there is snow. Poor winter travel conditions also exacerbate another recurrent problem noted earlier--that of the expense of maintaining and operating snowmachines.

Hunting Patterns

Two basic patterns of caribou and moose hunting, corresponding to the time of year when hunting occurred, existed in Nondalton in the 1970s and more currently in the early 1980s. During the open water season, hunting methods revolve around the use of boats in conjunction with walking. During winter, when snow and ice conditions permit, snowmachines shape the pattern of hunting. Aircraft are rarely utilized for transportation purposes for hunting by Nondalton residents; in 1981 one non-Dena'ina resident of the village owned and operated a small plane.

As mentioned previously, during the fall considerable traveling is done between the village and the fish camps and boat landing on the Newhalen River. Hunters watch for moose while traveling by boat. Nondalton residents also look for moose, caribou, and bear when traveling by boat to fall fish camps and berry picking locations on Lake Clark and Chulitna Bay. Animals spotted on the lakeshore or on a hillside near the water are pursued. If the animal is observed on a mountainside further away, a group of people may decide to walk inland to attempt to take the animal. Caribou and black bear are more likely to be harvested in this manner than are moose.

Trips also are specifically made to look for moose around the shores of Lake Clark and Little Lake Clark and up the Tlikakila and Chulitna rivers. Families or groups of related men travel in one to three boats for several days, stopping periodically to walk and search for moose in likely areas. The groups camp at night and slowly cruise along the shore in early morning or late evening in hope of spotting a moose. A number of locations noted as particularly good areas for moose hunting were regularly visited in the fall. These places included several bays in lower Lake Clark, the mouths of tributaries emptying into the lake, including the Kijik, Current, Big (Tlikakila) and Chokotonk rivers, and numerous smaller creeks. Sometimes boats are taken up the Big (Tlikakila) River to the vicinity of Otter Lake in search of moose.

The Chulitna River is another major moose hunting locale. Nondalton people take boats up the Chulitna throughout the open-water season for a variety of activities, and moose are killed when located close to the river. A major hunting method is to drift the river with the outboard shut off, particularly in the evening, hoping to surprise a moose coming out on the riverbank. High rocks providing good views of rivers, sloughs, and surrounding country are used as vantage points for locating moose.

During the summer, caribou tend to stay far back in the country north of Lake Clark, and residents generally do not expend much effort to find them. A few caribou move into the hills and mountains close to the lake, however, and small numbers frequently may be seen on ridge tops and mountain sides on the north side. In 1981 the regulatory season for caribou opened in mid-August, and a few groups of people walked up into the mountains in the Kijik Lake and Snowshoe Bay

area to kill a caribou, although brush and rugged terrain limit this practice. A small number of caribou may have been taken in this way by Nondalton people each year during the 1970s.

A small number of caribou which wander into the lower country in late summer or fall also are taken by people traveling by boat on Lake Clark or the Chulitna River. Almost every year a few caribou have been killed on Chulitna Bay on Lake Clark and in Snowshoe Bay. Long trips are occasionally made up the Chulitna River to the Nikabuna Lake vicinity to look for caribou or moose. In August, when the caribou bulls are particularly fat, their meat is preferred, while cows are normally more highly valued late in the fall and in the winter.

In some years a few Nondalton people have had pilots fly them into the "Caribou Lakes" (Upper Koksetna River) or other areas north of Lake Clark to hunt moose or caribou. People say that the expense of chartering aircraft greatly limits this practise for villagers, even though it would increase the likelihood of getting meat in the fall.

Generally little hunting is done during the freeze-up period in late October or early November, when it is frequently too cold to operate a boat, but when there is seldom enough snow to use snowmachines. After creeks freeze and snow falls, Nondalton people begin to travel onto Hoknede mountain behind the village to make sets for fox, lynx, and marten and to watch for moose and caribou tracks. In years of little snow, the mountain has been a particularly important trapping and hunting route, since there often is sufficient snow to allow snowmachine travel, even when the ground in the lower country is bare. When there is

sufficient snow, Nondalton people travel around the northern end of Hoknede Mountain into the Chulitna drainage to trap and to look for game.

During the 1970s and early 1980s, small bands of caribou generally have been available in the Chulitna River Valley, (15 to 20 miles from the village) throughout winter and into spring. When the wind blows from the south or southeast, Nondalton people travel the mountain trail behind the village or around the Hinmore Cache trail to the Chulitna Valley, expecting to find caribou closer to the village. Caribou also are sought in the Upper Talarik and Upper Koktuli drainages. If caribou are not found closer to the village and there are good snow conditions, hunters travel into the Mulchatna drainage in the Tutna Lake area about 30 miles northeast of Nondalton.

When caribou tracks are spotted by a hunter in winter, they are usually followed. If animals are located, the hunter attempts to drive his snowmachine close enough for a shot. However, caribou frequently are spooked by snowmachines, even at long distances. In rough, partially forested areas, it is often hard to get close enough to shoot. If several snowmachines are traveling together, one driver may attempt to swing around to head the caribou toward the waiting hunters. If the caribou run into a patch of timber, hunters try to circle around the woods to find an open area where the animals might be spotted.

In the winter, moose occasionally are taken in areas near Nondalton or while traveling by snowmachine on Six-Mile Lake, lower Lake Clark, or in the Chulitna drainage. Often they are located while people are engaged in other activities, such as trapping, wood-hauling, or caribou hunting. In years when there has been

little snow during the December moose season, including 1976, 1977, 1980, and 1981, Nondalton hunters have tended to concentrate their winter moose hunting in the mountains north and west of the village where snowmachine travel is possible. These rough travel conditions frequently damage snowmachines and sleds. Hunters commonly spend one or two nights camping so that they do not have to make the rough trip from the village so frequently and to increase their chances of finding game. Most winter moose and caribou hunting by Nondalton residents during the study period occurred within a twenty or twenty-five mile radius of the community.

Moose and Caribou Harvests in Nondalton in 1973, 1980, and 1981

Average per capita and per household moose and caribou harvests in Nondalton in 1973, 1980, and 1981 are shown in Table 9. These data were gathered from surveys described previously.

These averages may be misleading in one respect. Although for the sample as a whole less than three-quarters of a moose and about two caribou were harvested per household in 1980 and 1981, this statistic masks the great variability in harvest between households. In all three of the survey years, only about 50 percent of the households harvested moose, while a little over 60 percent harvested caribou (see Table 6). A small number of households regularly take a relatively large proportion of the moose and caribou harvested in Nondalton. In 1981, for example, four families (21 percent of those surveyed) harvested ten moose or 60 percent of the reported harvest. In all three years of the survey,

TABLE 9

MEAN NUMBER OF MOOSE AND CARIBOU HARVESTED
PER HOUSEHOLD AND HOUSEHOLD MEMBER IN NONDALTON
1973, 1980, 1981

	1973	1980	1981
Households Surveyed	25	14	19
Percent of Households	83 %	40 %	54 %
People in Surveyed Households	129	67	108
Moose Reported Harvested	25	10	16
Moose Harvested Per Household	1.00	0.71	0.84
Moose Harvested Per Person	0.19	0.15	0.15
Caribou Reported Harvested	97	26	42
Caribou Harvested Per Household	3.90	1.90	2.20
Caribou Harvested Per Person	0.75	0.39	0.39

less than 25 percent (ranging from 14 to 24 percent) of the households in the sample took 60 percent of the moose.

When household harvests by pounds of fish and meat produced are considered, the variation among households is equally striking. The five most productive families in 1981, with about 30 percent of the population of the surveyed households, accounted for 65 percent by weight of the meat and fish produced by sampled households. At the other extreme, the 5 least productive households, with 15 percent of the population, produced less than 1 percent of the total.

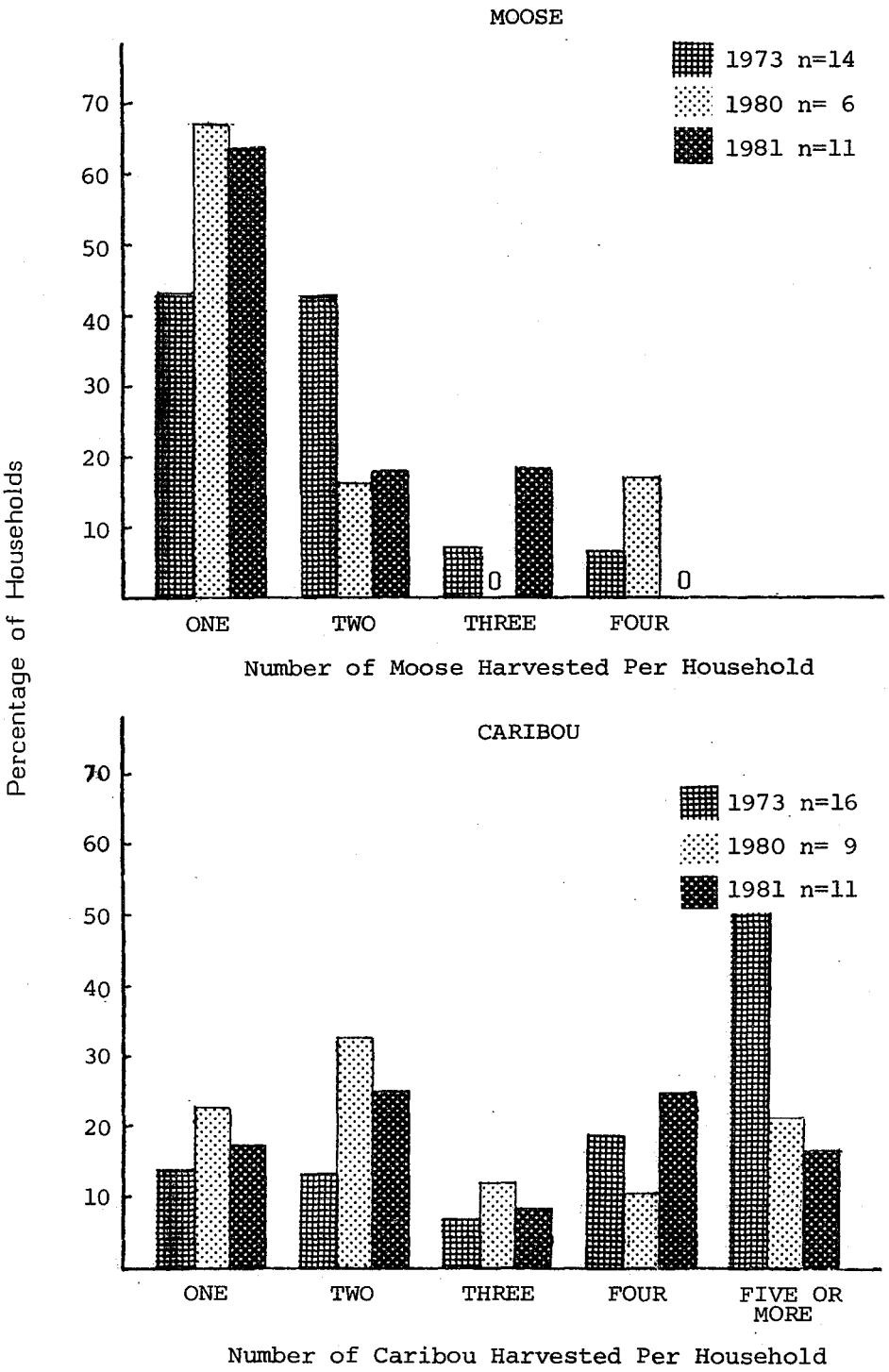
Table 9 shows that moose harvests ranged from .71 to 1.00 moose per household, while caribou harvest ranged from 1.90 to 3.90 per household. Of the three years, the highest moose and caribou harvests both occurred in 1973, while the lowest both occurred in 1980. As previously discussed, the low moose and caribou harvests in 1980 were probably due to poor winter traveling conditions (i.e. lack of snow). The harvests in 1973 may be more typical for the community since this year had normal snow cover.

The percentage of Nondalton households which reported harvesting one or more moose and caribou is shown in Figure 4. As this figure illustrates, in 1980 about 65 percent of the households harvesting moose took only one animal, while about 17 percent of the households took 2 animals, and another 17 percent took 4 animals.

Similarly, the figure shows that approximately 41 percent of the households which harvested caribou took 4 or more animals in 1980 and 1981. The pattern of

FIGURE 4

PERCENTAGE OF NONDALTON HOUSEHOLDS HARVESTING ONE OR MORE MOOSE AND CARIBOU



harvest of both moose and caribou in 1973 differed considerably from that in 1980 and 1981. In 1973 a much greater proportion of the households reported taking two or more moose than was the case in two recent years. About 50 percent of the households taking caribou in 1973 took 5 or more caribou, compared to about 20 percent taking 5 or more in 1980 and 1981.

Discussion: Limitations on Harvest

Harvest levels of resources used by Nondalton residents appeared to be regulated primarily by factors internal to the local economy and society. This is suggested by the similarities from year to year in harvest figures illustrated in Table 3. Mean total outputs by weight per household were similar for the three years sampled: 4,142 pounds in 1973; 4,959 pounds in 1980; and 4,195 pounds in 1981. Harvest levels of particular species varied from year to year, but total output seemed to remain relatively stable. Determinants of this total output are probably complex. As is argued later, legal regulations are probably not a major limiting factor. Instead, a complex combination of other varieties served to regulate both the total harvest and species-specific harvest. Some of these factors are briefly identified below.

First, at the most general level the total population of consumers, including people outside the village which Nondalton residents supplied with food, and dogs kept by villagers, sets some minimum and maximum bounds for the amount of food required by the community. However, not enough research has been done to assess the extent to which population size is an accurate predictor of subsistence

output for a region. Taken alone, population size is probably not a good predictor of subsistence harvests of particular species. Multiple other factors of ecology, economy, and culture are mediating variables between the size of a population and food production outputs. This study did not address the relative proportion of foods purchased and locally produced.

Weather and climatic conditions, in combination with their technological limitations, appeared to be major influences on harvest levels of moose and caribou. Winter travel conditions were frequently very poor between 1976 and 1981. The snowpack was often limited or non-existent; in winter 1976-1977, lakes and creeks did not even freeze. This greatly limited the periods of time when Nondalton hunters could travel by snowmachine for caribou and moose. As described in several places in this report, mild winters and lack of snow made it difficult for Nondalton hunters to find moose and caribou in winters of 1980 and 1981. Weather and snow depth also increased moose and caribou distribution patterns and locations, and hence increased the costs, in time and cash, of hunting.

The costs of transportation technology at Nondalton relative to monetary income imposed major constraints on hunting. A high proportion of Nondalton households lacked basic equipment, such as snowmachines and outboard engines, needed to predictably and efficiently harvest large game. Low incomes and high costs prevented many households from acquiring these items.

Other significant limitations on harvest were alternative uses of time and the opportunity costs of hunting. Due to consistent and increasing needs for cash, Nondalton residents eagerly took whatever jobs were available in the community.

Even part-time jobs tended to tie people to the community during work days, and reduced the time available for certain types of subsistence production. Similarly, the need to haul wood nearly every day also limited the time available for other forms of subsistence production for many families. A small number of families with relatively higher incomes were able to "purchase" additional time for subsistnce production by using fuel oil for heat instead of wood. This relieved them from some of the burden of constant wood gathering and provided more time for other activities. As mentioned previously, low incomes and high cash needs have apparently prevented many households from purchasing the transportation equipment they would need to increase mobility enough to overcome these time constraints.

Storage preparation, methods and capacity affected the timing and extent of harvest. Although a particular resource might be available in abundance, there had to be some way to preserve and store a surplus in order to make it worth harvesting more than could be immediately used. The size of the smokehouse set an upper limit on the number of salmon which could be processed. The lack of freezers in Nondalton, which did not have community electricity, was a major constraint on the fall moose harvest. Although more effort could be devoted to hunting and more moose could often be harvested in the fall, Nondalton hunters appeared to limit their harvest to what could be used by their households and the households of their relatives without spoilage. A small number of moose therefore were taken and distributed widely within the village in the fall.

Ideology was also a limitation on harvest. Nondalton Dena'ina had strong traditional beliefs about the proper treatment of animals. Probably the most

powerful of these in contemporary society was the belief that game should not be wasted. As previously noted, the Dena'ina prided themselves on their complete utilization of fish and game, and contrasted their practices with those who they perceived as "trophy hunters." Small children were scolded for killing small birds or animals for the fun of it. Frequent comments about waste and misuse of game served as a means of continuous social controls ensuring that hunters constantly kept their active needs in mind when planning to harvest or while hunting. "We take only what we need, and we never waste any fish or game," summarizes this ideology. This abhorrance of waste also reinforced social values such as sharing; if a hunter killed more game than he could use before spoilage occurred, there was a strong incentive to distribute the excess to other households.

Further restraints on harvest, internal to Nondalton social and economic system, were found in producer's desire to reduce costs, time and effort, and to minimize risk. If a game species were a long distance away, and there was only a small chance that it would be located (perhaps because of poor tracking conditions or weather), the producer was unlikely to go out hunting.

Nondalton producers also balanced social objectives in deciding how much effort, time, or money to devote to particular harvest activities at particular times. On one hand, there was prestige to be gained from bringing back game and distributing it to relatives. On the other hand was the desire to be with family or relatives, and to stay in the community with the comforts of home. Again, these restraints operated in the context of other factors, such as desire for particular foods or the availability of hunting equipment.

The role of hunting regulations in controlling wildlife harvests in Nondalton is difficult to assess. This study focussed on general patterns of resource use and harvest, but not on details of illegal harvest, an obviously sensitive and difficult area to research. People responded well to questions partially because potentially sensitive areas were avoided. Therefore this study has not been able to answer questions about the importance of harvests which are out of season or in excess of bag limits. Hunting regulations have probably played some role in restricting harvest of wildlife, however, regulatory seasons, for example, reduce the time during which animals can legally be taken. Bag limits are potentially restrictive in view of the customary patterns described above, since a small proportion of hunters take a large percentage of the wild resources. Compared to weather, technology and local economic conditions, legal restrictions do not appear to play a major role in determining how much fish and game is harvested by Nondalton residents.

In summary, it appears likely that the harvest levels of moose, caribou, and other resources used by Nondalton residents were primarily regulated by factors internal to the local economy and society, as well as by weather and travel conditions. Legal restrictions played a relatively minor role in determining harvest levels.

SUMMARY

During the 1970s and early 1980s residents of the village of Nondalton, like the people of most of the surrounding communities of the Iliamna Lake region, continued to harvest a wide range of fish and wildlife species. The contemporary Nondalton economy in 1981 was based on a close integration of domestic production and cash income. Sources of cash income were limited, seasonal, and variable from year to year. Most Nondalton families spent a high proportion of their limited cash income on imported energy in the form of oil and gasoline. Domestic production of food was necessitated by the high cost of imported food and fuels. A major portion of the local food supply was derived from fishing, hunting, and trapping. Local food resources play a particularly important role in buffering households against fluctuations in wage earning opportunities and variations in cash income.

For three years for which harvest data were collected, it was estimated that a Nondalton household produced an annual average of 4,432 pounds dressed weight of local fish and game resources for domestic use. This was an annual average of 846 pounds per household member. Salmon was the largest harvested resource by weight, followed by moose, caribou, freshwater fish species, and beaver.

The moose harvest for Nondalton averaged just less than one moose and just over two caribou per household in 1980 and 1981. As these harvests occurred under poor hunting conditions, they may underestimate typical harvest levels. Average household harvests in 1973 of one moose and four caribou may be better estimates of typical harvest levels. Moose and caribou were important resources to the

people of Nondalton, together supplying 14 to 20 percent by dressed weight of the subsistence foods harvested by Nondalton residents in 1980 and 1981.

A substantial proportion of the moose and caribou harvest was produced by a subset of Nondalton hunters. For example, in 1981 four families or 21 percent of households surveyed accounted for 60 percent of the reported harvest. Forty-two percent of the households surveyed in 1981 and 57 percent of the households surveyed in 1980 did not harvest any moose. However, these households utilized moose and caribou as meat was shared by successful households in the village.

Significant limitations on moose and caribou harvests were imposed by environmental conditions, including weather and snow conditions, the costs of hunting, lack of freezers in Nondalton, and by residents' abhorrance of waste. All of these factors appear to interact to limit Nondalton residents' moose and caribou harvests from year to year. Hunting regulations appear to play a relatively minor role in determining harvest levels by Nondalton residents.

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APPENDIX

Appendix I

Calculation of Edible Weights of Fish and Wildlife Species Harvested by Nondalton Residents

Since the fish and game reported taken in the harvest surveys were not weighed, nor have any actual weights of the portions used after butchering has been made, it has been necessary to estimate average weights in order to convert numbers of animals taken into pounds of meat. A number of sources were used to estimate reasonable average live weights and factors for converting live weights to edible product. These sources are cited below. The term "live weight" refers to the assumed average weight of fish and game harvested by Nondalton residents. "Edible weight" refers to the portion used for human consumption, except in the case of sockeye, where it also refers to fish used for feeding dogs. The live weights and edible weights of each species is provided below.

A conversion factor of 60 percent is used to derive the edible portion of moose, caribou, and blackbear. This is felt to be conservative; conversion factors of up to two-thirds are often assumed for domestic beef. As noted in this report, the Dena'ina use almost every part of moose and caribou, including intestines, head, nose, and leg bones.

The conversion factor of .70 used for calculating the edible portion of fish species assumes relatively complete utilization of flesh as well as common use of heads for food. Since a large percentage of the remaining 30 percent ("waste") is used as dogfood, actual weights of fish used are understated. In the case of most fish, for example, backbones, and rib sections, and the flesh remaining on them after the fish are filleted, are commonly dried and stored for use as dogfood.

Moose

Live Weight	900.00
Conversion Factor	.60
Edible Weight	540.00

The age-sex composition of the Nondalton moose harvest is not known. A large proportion are harvested in winter and a high percentage are cows. For purposes of this calculation, it was assumed that the average weight of moose taken by Nondalton residents would be slightly less than the average weight of an adult cow moose. The greater weight of adult bulls taken should roughly compensate for the smaller size of younger animals harvested. A. W. Franzmann reported that the average October weight of 17 Alaskan cow moose was 987 pounds. Adult males ranged up to 1,310 pounds. Moose 16 - 18 months old (both sexes) average 614 pounds (Schmidt and Gilbert, 1978).

Caribou

Live Weight	250.00
Conversion Factor	.60
Edible Weight	150.00

As with moose, the age-sex composition of caribou taken by Nondalton residents is unknown. Most harvest occurs in winter and presumable is skewed toward females. The average live weight of 19 caribou (13 females, 6 males) from the Alaska Peninsula in the post-rut period (October - December) was 254 pounds (Skoog, 1968, 26). Caribou of the Mulchatna herd, harvested by Nondalton residents, are assumed to be of comparable size. Palmer (1926 reported in Skoog, 1968, 36) reported that the average live weight of 17,000 reindeer from western Alaska was 260 pounds, and that the average dressed weight of these animals was 150 pounds. As is the case with moose, Nondalton Dena'ina make very complete use of the caribou carcass' and a conversion factor of 60 percent is felt to be conservative.

Black Bear

Live Weight	165.00
Conversion Factor	.60
Edible Weight	100.00

An "average" adult male in summer weighs about 180-200 pounds and may be 20 percent heavier in fall. Females are usually smaller (Alaska Department of Fish and Game, 1978). Little information is available about sex ratio of bear harvested by Nondalton residents.

Brown Bear

Live Weight	400.00
Conversion Factor	.25
Edible Weight	100.00

Most mature males weigh between 500 and 900 pounds. Females weigh one-half to three-quarters as much (Alaska Department of Fish and Game, Wildlife Notebook Series).

The people of Nondalton have harvested only a small number of brown bear in recent years, and mainly make use of the fat and a small amount of meat. A small amount of hide is used for crafts, such as skin boot soles.

Beaver

Live Weight	40.00
Conversion Factor	.50
Edible Weight	20.00

Winterhalder (1977, 210) cited the estimated average weight of northern Canadian beaver as forty to fifty pounds. Beaver caught in the Lake Clark and Newhalen River drainages appear to fall in this range. Most Alaskan adult beaver weigh 40 to 70 pounds (Alaska Department of Fish and Game, 1978, Wildlife Notebook Series). The lower end of the range was chosen as an average weight to compensate for kits harvested.

Porcupine

Live Weight	16.00
Conversion Factor	.50
Edible Weight	8.00

Alaska Department of Fish and Game, 1978. Average weights of porcupine are estimated at 15 to 18 pounds.

Arctic Hare

Live Weight	8.00
Conversion Factor	.70
Edible Weight	5.60

Alaska Department of Fish and Game, 1978. Average weights of arctic hare are estimated at 6 to 12 pounds.

Snowshoe Hare

Live Weight	3.50
Conversion Factor	.60
Edible Weight	2.00

Average weights of snowshoe hare are estimated at 3 to 4 pounds (Alaska Department of Fish and Game, 1978).

Ptarmigan

Live Weight	1.00
Conversion Factor	.70
Edible Weight	.70

Alaska Department of Fish and Game, 1978.

Sockeye Salmon

Live Weight	5.70
Conversion Factor	.70
Edible Weight	4.00

Naknek-Kvichak district sockeye average weight, 1969 - 1980 (Alaska Department of Fish and Game 1980).

Lake Trout

Live Weight	3.80
Conversion Factor	.70
Edible Weight	2.70

Average of 368 lake trout, Lake Clark; Alaska Department of Fish and Game files, Records of 1964 Commercial Test Fishery at Lake Clark.

Whitefish

Live Weight	1.40
Conversion Factor	.70
Edible Weight	1.00

Average of 2,713 whitefish (assumed to be both humpback and round) harvested at Lake Clark. See above.

Pike

Live Weight	4.00
Conversion Factor	.70
Edible Weight	2.80

Size of pike taken by Nondalton residents varies greatly, and depends on area, time, and methods of fishing. This average greatly underestimates weight of spring-caught pike in Chulitna Bay, for example, which may go as high as 20 pounds. Four pike caught in the 1964 Lake Clark test fishery averaged 3.5 pounds. (See above).

Arctic Char, Dolly Varden, Rainbow Trout

Live Weight	2.00
Conversion Factor	.70
Edible Weight	1.40

The average weight of fish of these species taken by residents of the Nondalton area was assumed to equal approximately one-third the maximum weights of char (5 lbs, 4 oz); dolly varden (5 lbs, 3 oz); and rainbow trout (5 lbs, 2 oz) reported by Russell (1980, pp. 48, 69, 98) taken in the Lake Clark, Mulchatna and upper Stony River drainages.

Grayling

Live Weight	1.00
Conversion Factor	.70
Edible Weight	.70

Nondalton residents reported average weight of grayling taken through the ice near the village to be about one pound. The maximum live weight reported by Russell (1980, 57) for Lake Clark - Mulchatna region was 1 pound, 14 oz.

Burbot

Live Weight	1.50
Conversion Factor	.70
Edible Weight	1.00

The maximum live weight of 3 pounds reported for burbot in Russell (1980, 64) was reduced by 50 percent to provide an assumed live weight for burbot taken in the vicinity of Nondalton.