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Subsistence After the Spill: Uses of Fish and Wildlife in Alaska Native Villages and the Exxon Valdez Oil Spill

by

James A. Fall

1991

Alaska Department of Fish and Game **Division of Subsistence**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the reports by the Division of Subsistence. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly-accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly-accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures)	first three letters (Jan,...,Dec)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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by

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1991

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Note: not to be used or quoted without prior approval of the author. This paper contains preliminary data which are subject to change upon review. Please contact the Division of Subsistence in Anchorage for a final version of this paper.

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INTRODUCTION

"Nobody's eating anything from the ocean anymore."

-- Village official, Ouzinkie, June 1989

Alaska Native people have lived along Alaska's southern coast for at least 7,000 years (Clark 1984a:136). They have always depended upon the natural resources of the land and, especially, the sea, for their survival. In the 1980s, the Alutiiq people[1] formed the majority of the population in 15 communities[2] extending from Tatitlek in eastern Prince William Sound to Ivanof Bay, 580 miles to the west on the Alaska Peninsula (Figure 1; Table 1). In each of these communities, a mixed, subsistence-based economy and way of life[3] predominated, with seasonal cash employment and commercial fishing supplementing relatively large harvests of wild fish, game, and plant resources for local use. Subsistence hunting, fishing, and gathering played a central, probably indispensable role in the expression of social and cultural values as well as community viability and stability.

On March 24, 1989, the oil tanker Exxon Valdez ran aground off Bligh Reef, dumping almost 11 million gallons of crude oil into Prince William Sound. By August 10, 1989 (Figure 2), the oil had fouled the waters and beaches used for subsistence activities by all 15 of these Alutiiq villages.[4] As the oil spread and wildlife died, anxiety over the safety of eating traditional foods grew to the point where subsistence harvests in some villages virtually ceased. As villagers engaged in subsistence activities, and when they became

1 The traditional language of these communities is called Alutiiq, Sugcestun, Sugpiaq, or Pacific Yup'ik. Its closest linguistic relative is Central Yup'ik Eskimo. The people of Prince William Sound and lower Cook Inlet are also known as "Chugach," and those of the Kodiak Island and Alaska Peninsula areas are called "Koniag." The people today refer to themselves as "Aleuts" (Woodbury 1984:53; Clark 1984b:195-196; Davis 1984).

2 The Alutiiq people also form a sizable minority in several other larger communities, including Cordova, Seldovia, and Kodiak. The other Alutiiq villages are Port Heiden, Pilot Point, Ugashik, and Egegik on the Bristol Bay side of the Alaska Peninsula (Krauss 1982). Except for a few small areas, the subsistence use areas of these latter four places were not affected by the oil spill.

3 As described by Wolfe and Walker (1987:68), mixed subsistence-market economies in Alaska have several characteristics, including relatively high levels of fish and game harvests, a domestic mode of production, non-commercial systems of exchange, and efficient, small-scale technologies. Subsistence production in such systems is supported by cash earnings, which are invested in hunting and fishing activities.

4 Residents of other communities also use these areas for subsistence hunting and fishing. These include, but are not limited to, Cordova, Seldovia, and Kodiak. Many people also use these lands and waters for recreational hunting, fishing, and gathering.

involved in clean-up activities, they observed the oiled lands and waters during the season in which much of the gathering of wild foods occurs. In addition, key harvesters and their equipment were committed to the clean-up efforts, leaving them little time for hunting, fishing, or gathering.

The Division of Subsistence of the Alaska Department of Fish and Game is, by Alaska statute, responsible for gathering information on all aspects of subsistence uses of fish and wildlife in the state.[5] The division is also responsible for disseminating this information to the public and applying the data in the context of resource management and land use planning. After the spill, the division obtained state funding to implement a four part "oil spill response program" (Fall 1990a). One component of this program has been the systematic collection of data about subsistence uses of fish and wildlife resources in the oil spill area in the year following the spill. The purpose of this paper is to present some of the preliminary findings of this research. It focuses on three questions. First, what was the size and composition of subsistence harvests in the year after the spill? Second, how did these subsistence harvests compare with those of other years? Finally, what were some of the reasons for the changes that occurred? As will be shown, a key question became whether subsistence foods had been contaminated by the oil. Therefore, the paper describes efforts to answer this question, and examines the food contamination issue as it affected subsistence uses in five of the study communities. Additional results of the research will be reported in a series of division technical papers now in preparation.

DATA COLLECTION METHODS

Fifteen communities in four subregions were included in the project. These were Tatitlek and Chenega Bay in Prince William Sound; English Bay and Port Graham along lower Cook Inlet; Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions in the Kodiak Island Borough; and Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville on the Alaska Peninsula. The division had conducted baseline research in all of these communities prior to the spill. Among other things,[6] this work

[5] See Fall 1990b and ADF&G 1985 for overviews of the division's program and some of its findings.

[6] Typical baseline studies also include descriptions of hunting and fishing areas, harvest technologies, the social organization of hunting and fishing, resource distribution and exchange, and methods of

had included systematic household surveys, administered in the homes of respondents, which collected demographic, employment, and quantified resource harvest data.[7]

For this post-spill study, the primary method of data collection was a systematic household survey modeled after these previous division questionnaires, supplemented by key respondent interviews and observations throughout 1989 and 1990. Some additional questions were added to the survey instrument which asked respondents to assess subsistence activities in 1989 in comparison with other years. These comments are the source of most of the quotations in this paper. Table 2 lists the kinds of data collected with the questionnaire. The goal was to talk with a representative of every household in the 12 smaller communities and with a 50 percent stratified random sample in the three larger communities of Old Harbor, Ouzinkie, and Port Lions. After approval of the project from each village council or council representative, research began in most of the communities in late January 1990 and was completed in April. In total, 403 households were interviewed, 88.2 percent of the project's goal (Table 3).

Data were coded and entered for computer analysis. Harvest quantities reported in numbers of animals or fish were converted to pounds edible weight using standard conversion factors.

PATTERNS OF SUBSISTENCE USES BEFORE THE SPILL

As noted above, the division has conducted "baseline" subsistence research in each of the 15 Native villages in the oil spill area. Results of this research appear in the division's Technical Paper Series and other publications.[8] For each community, there is comprehensive information for at least one year on harvest quantities, levels of participation in subsistence activities, the seasonal round of subsistence

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preservation and preparation of wild foods. In addition to systematic household interviews, data gathering methods include mapping, participant observation, key respondent interviews, and harvest calendars (ADF&G 1985, Fall 1990b.)

[7] Copies of questionnaires appear as appendices in each Division of Subsistence technical paper.

[8] For more detailed discussions of contemporary subsistence uses in these communities, the reader should consult specific reports in the Technical Paper Series. These include Stratton 1990 on Tatitlek; Stratton and Chisum 1986 on Chenega Bay; Stanek 1985, 1989 on English Bay and Port Graham; Schroeder et al. 1987 and Fall and Walker 1989 on Kodiak communities (also KANA 1983); and Morris 1987 on the Alaska Peninsula communities. Schroeder et al. 1987 contains profiles of contemporary subsistence uses in Alaska at a subregional level.

harvests, maps of areas used for hunting, fishing, and gathering, distribution and exchange of subsistence products, methods and means of harvest, and techniques for preparing and preserving wild foods, as well as demographic and other economic data. These studies establish at least one pre-spill base year by which subsequent changes in subsistence activities can be identified and measured.

The same general categories of subsistence resources are available in all four subregions. These are salmon (usually five species); other fish such as halibut, rockfish, and Dolly Varden; marine invertebrates such as clams, crabs, and octopus; game (land mammals[9]); marine mammals (harbor seals and sea lions); birds (ptarmigan, waterfowl, gull eggs); and wild plants. Also, in the 1980s each community followed a patterned seasonal round of harvest activities, largely conditioned by resource availability. Although some important differences in particular species and timing occur between subregions, the seasonal round for Chenega Bay, depicted in Figure 3, is representative. Note that spring (March, April, May) is a period of renewed activities, with harvests of herring, clams, and birds, among other resources, occurring. Summer is traditionally the busiest time, when people harvest and preserve large quantities of salmon for winter use. Fall is important for big game hunting, waterfowl hunting, and marine invertebrate gathering.

Another important general point about subsistence activities in rural Alaska villages such as those in the oil spill area is that they are usually kin-based. Harvesting and processing groups are generally composed of members of extended families. This integrative function of subsistence uses is also evident in resource sharing patterns. Subsistence foods are often distributed along lines of extended kinship. Figure 4 is an example from English Bay (Stanek 1985:170-171). It shows the distribution of single harbor seal within an extended family network of eight households with 25 people. Such extensive sharing is commonplace in all 15 villages.

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9 One of the major differences between subregions concerns the availability of large game animals. Prince William Sound has deer, black bear, and mountain goats. Lower Cook Inlet has no deer, but there are goats, black bears, and moose. Deer and, to a lesser extent, elk, are available to the Kodiak villages, but there are no moose or black bear, and very few goats. Only the Alaska Peninsula villages have ready access to caribou, and have moose as well. These are also the only study villages in which brown bears are regularly eaten.

Tables 4 and 5 summarize some information about subsistence harvests in the 15 study communities in the 1980s. When these harvests are measured in edible pounds per person, they far exceed those of more populated, urbanized areas of Alaska (cf. Wolfe and Walker 1987). They range from about 200 pounds to over 600 pounds per person per year. These are substantial harvests, considering that the average family in the western United States purchases about 222 pounds of meat, fish, and poultry per person each year (U.S. Department of Agriculture 1983). Reasons for differences between subsistence harvests in Alaskan communities are complex, but include ethnicity, geographic location, annual variations in resource availability, harvest regulations, monetary income, and patterns of cash employment (Wolfe and Walker 1987). The following sections will briefly describe some findings about the dimensions of subsistence harvests for a representative community from each subregion.

Prince William Sound: Tatitlek

Tatitlek, a predominantly Alutiiq community with 101 people in 1988, is the oldest continuously inhabited community in the Prince William Sound area. In collaboration with the village, the division has been engaged since 1988 in a study of subsistence uses in Tatitlek. According to this research, Tatitlek households harvested 353 pounds of wild foods per person in 1987-88 and 652 pounds in 1988-89.[10] Every interviewed household in both years used, harvested, and received wild foods, and all but one shared portions of their harvests with others. Harvests were diverse, with the average household using 22.6 kinds of subsistence foods during the 1988-89 study year. As measured in pounds edible weight, salmon (35 percent of the total harvest in 1988-89), other fish (22 percent), game (12 percent), marine mammals (20 percent), marine invertebrates (7 percent), birds (2 percent), and wild plants (3 percent) all made substantial contributions to the food supply (Figure 5).

[10] This notable increase in reported harvests over the two year period at Tatitlek can be explained by several factors. First, several very active harvesting households declined to participate in the first round of surveys, but decided to join the project in the second year. Second, subsistence salmon fishing regulations were liberalized for the 1988 season. This meant that some households were able to harvest more salmon, and others were willing to report their full harvests. Third, several households interviewed both years had lower harvests in 1987-88 for reasons of poor health or the break down of equipment. Their harvests rebounded in 1988-89 (Stratton 1990).

Lower Cook Inlet: English Bay

The village of English Bay had a population of 159 in 1988, most of whom were Alaska Native. Research conducted in the late 1970s and 1980s (Stanek 1986, 1989; The North Pacific Rim 1981) demonstrated the continuing significance of subsistence harvests for English Bay families. In 1987, the subsistence harvest was about 272 pounds per person. The harvest was composed of 35 percent salmon, 41 percent other fish, 7 percent marine invertebrates, 3 percent game, 8 percent marine mammals, 1 percent birds, and 5 percent wild plants (Figure 6). All but one surveyed household (97 percent) used wild foods in 1987, and 93.9 percent harvested subsistence resources. On average, English Bay households used 25.1 kinds of wild foods in 1987. Because of declining returns of sockeye salmon to the English Bay River system and consequent regulatory closures, subsistence harvests of salmon in 1987 were much lower than previous years. Thus, the total subsistence production for the village was probably substantially lower than earlier in the 1980s.

Kodiak Island Borough: Old Harbor

Old Harbor is the largest village in the Kodiak Island Borough, with 322 people in 1988. Most of the population is Alaska Native. Data collected for 1983 and 1986 indicate that subsistence harvests at Old Harbor in the 1980s were substantial. In 1983, the per capita harvest was 466 pounds, and every sampled household used and harvested subsistence resources. As in other villages of these four subregions, a large variety of subsistence resources was used, an average of 15.4 kinds per household in 1983. The harvest was made up of 45 percent salmon, 13 percent other fish, 7 percent marine invertebrates, 15 percent game (mostly deer), 16 percent marine mammals, and 4 percent birds. Harvests measured in 1986 were similar in size (418 pounds per person) and composition (Figure 7).

Alaska Peninsula: Perryville

The Alutiiq village of Perryville was founded in 1912 after the village of Katmai was destroyed by a volcanic eruption. In 1988, Perryville had a population of 127. Like Tatitlek, English Bay, and Old Harbor, in the 1980s Perryville had a relatively high level of subsistence production, 391 pounds per person in 1984 (Morris 1987). As with the other villages, virtually every household in Perryville used (100 percent), harvested (100 percent), and received (100 percent) wild foods. On average, Perryville households used 21.5 kinds of resources in 1984. The harvest in 1984 was made up of 59 percent salmon, 11 percent other fish, 3 percent marine invertebrates, 22 percent game (caribou, moose, brown bear), 5 percent marine mammals, and 4 percent birds (Figure 8).

FINDINGS: SUBSISTENCE AFTER THE SPILL

This section presents preliminary findings about some aspects of subsistence uses in the study communities in the year after the Exxon Valdez oil spill. Because data analysis is still in progress, findings appearing in the final project reports may differ slightly from those presented here. Other aspects of uses of wild resources which will be addressed in future reports include shifts in harvest areas, patterns of resource exchanges, and the formal subsistence resource sharing programs that arose after the spill. Future papers will also report the results of statistical tests of differences between the communities. These analyses were incomplete when this preliminary paper was prepared.

Harvest Quantities

As reported in Table 4 and shown in Figure 9, subsistence harvests during the study year ranged from a low of 83 pounds per person in Ouzinkie to a high of 523 pounds per person in Ivanof Bay. To place these harvests in perspective, Figure 10 compares post-spill subsistence harvests with all available pre-spill measurements. Of the 15 communities, 11 had lower harvest levels during the study year than in the

closest previous year for which data are available. This includes all four Prince William Sound and Lower Cook Inlet villages, and five of the six in the Kodiak Island Borough. Two Alaska Peninsula villages showed slightly lower harvests, while the other three were higher than earlier levels.

Table 6 and Figure 11 compare the relative changes in subsistence harvests for each community across study years. Where two pre-spill measurements were available, they were averaged for this comparison. The Prince William Sound communities declined markedly; both villages reported harvests in 1989-90 that were 58.6 percent lower than their averages for previous years in the 1980s. The lower Cook Inlet communities also exhibited sharp declines of 48.5 percent for English Bay and 44.4 percent for Port Graham. Every Kodiak community also reported lower harvests in the study year compared to the average of previous measurements, ranging from 78.1 percent lower for Ouzinkie (the largest relative decline for any village) to 20.2 percent lower at Akhiok. With the exception of Karluk, the relative decline in harvests in the Kodiak Island Borough decreased as the community's distance from the source of the spill increased. The declines in two of the five Alaska Peninsula communities of Chignik Lagoon (10 percent lower) and Perryville (4 percent lower) were relatively minor compared to those of the other subregions. This subregion also contained the only three communities with relative increases: Chignik (4 percent higher), Ivanof Bay (20 percent higher), and Chignik Lake (59 percent higher).

Harvest Composition

Table 5 reports the composition the total harvests for each study community by resource category for the oil spill study year and for previous study years. In 1989-90, the relative contribution of marine invertebrates and birds declined in the Prince William Sound communities compared to earlier averages. There was also a marked reduction in the relative contribution of marine mammal harvests to the diet at Chenega Bay (from 39 percent of all resources in 1985-86 to 3 percent in 1989-90). The relative

contribution of salmon was down in four of the six Kodiak villages and in all five Alaska Peninsula communities. The latter reported relatively larger harvests of fish other than salmon.[11]

Levels of Participation

Despite the oil spill, almost every surveyed household in each community used and harvested subsistence foods during the study year (Table 7).[12] This illustrates that despite the spill, households attempted to obtain certain subsistence foods, but, as seen above, generally in much reduced numbers in most places. Nevertheless, there were notable declines in the percentage of households using particular categories in certain villages. In Chenega Bay, for example, relatively few households used marine invertebrates (22 percent), birds (6 percent), or marine mammals (39 percent). In the previous study year of 1985-6, the percentage of households using these resource categories in Chenega Bay were 100 percent, 56 percent, and 80 percent respectively (Walker et al 1988). Large declines in levels of participation also occurred for marine invertebrates and birds at Tatitlek, and marine invertebrates at Ouzinkie.

Assessment of Changes

As noted above, respondents were asked to compare their uses of particular categories of wild resources during the post-spill study year with those of previous years. If they noted a difference, they

[11] In order to prevent contamination of the catch, fisheries managers restricted commercial salmon openings and areas in the Kodiak and Chignik Management areas in 1989. Removal of salmon from commercial catches is an important source of salmon for home use in some communities in these subregions (Morris 1987, Fall and Walker 1989). Data analysis in progress suggests that these commercial closures evidently resulted in lower home use harvests as well. This topic will be addressed further in a future report.

[12] These levels of participation may be inflated for several reasons. First, for the lower Cook Inlet, Kodiak Island Borough, and Alaska Peninsula, the study year included three months (January, February, and March 1989) before the spill occurred. Second, after the spill, some communities, particularly English Bay and Port Graham, attempted to stock up on certain resources (marine invertebrates in particular) before the oil hit their harvest territories. Third, after the spill many households received gifts of subsistence foods through "formal sharing programs" such as salmon from Tyonek and marine mammals and marine invertebrates from Angoon.

were asked for reasons why the differences had occurred.[13] Assessments of change were requested for salmon, other fish, marine invertebrates, deer (Prince William Sound and Kodiak only), marine mammals, and waterfowl. In total, the 403 households provided 1,770 assessments. Table 8 summarizes the results for all resource categories combined. In only 6 percent of the assessments did households report higher levels of use in the year following the spill, while 40 percent of the responses were that uses had stayed about the same, and 54 percent said uses were lower for some categories than in previous years.

There were notable differences in these assessments between subregions. For lower Cook Inlet and Prince William Sound, most respondents said that lower harvests had occurred (85 percent and 77 percent, respectively). Just under half (46 percent) of the responses from Kodiak Island Borough indicated lower harvests. This percentage was lowest among Alaska Peninsula households, 36 percent of all assessments. The communities reporting the most cases of lower harvests were English Bay (91 percent of all assessments), Chenega Bay (86 percent), Port Graham (81 percent), Ouzinkie (71 percent), and Tatitlek (68 percent).

As also shown in Table 8, most respondents reported that lower subsistence uses during the study year were due to the effects of the Exxon Valdez oil spill. Overall, in at least 55 percent of the assessments of lower harvests, the spill was cited as the cause of the decline, while in 16 percent, non-spill reasons were suggested.[14] Respondents attributed lower levels of subsistence use to the spill in at least 83 percent of the cases of decline in Prince William Sound, 70 percent in lower Cook Inlet, 46 percent in the Alaska Peninsula, and 36 percent in the Kodiak Island Borough (analysis of the Kodiak results is particularly incomplete).

More specifically, as reported in Table 9, fear of contamination of subsistence foods by the oil was the most common reason cited for lower levels of subsistence harvests. Of the 403 interviewed households, at least 33 percent said that fear of oil-contaminated foods reduced their harvests or uses.

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[13] Answers to these questions were open-ended and not a choice of a forced set of responses. Analysis of these interview data is in a very preliminary stage. These data are discussed here to illustrate some general points; household percentages should be considered absolute minimums and may increase upon further examination of the interview results.

[14] Analysis of the remaining 30 percent of the assessments is incomplete, thus these percentages are minimums at this time.

This was a major concern in all the subregions, but highest in Prince William Sound (88 percent of households, followed by lower Cook Inlet (42 percent), Alaska Peninsula (23 percent), and Kodiak Island Borough (22 percent). The other major oil spill-related reasons for lower harvests were the time spent on oil spill clean up (at least 18 percent of the households), and the perception that less resources were available because of spill-induced mortality (at least 11 percent of the households).

Exposure to the Effects of the Spill and Clean-up Activities

Why did this concern about contamination of subsistence resources arise? In part, the answer lies in the number of households that observed the effects of the oil spill directly. Village subsistence activities tend to occur in specific traditional locations. The observable effects of the oil tended to be discontinuous; some beaches were hit hard, others hardly at all. An oil sheen on the water was subject to movement by the tides and currents. People observed oiled birds and sea otters, animals that were particularly susceptible to the oil. Deer were seen feeding on kelp on beaches that had been oiled. Thus several questions arose. How could subsistence users know which beaches and waters were safe to use? If some resources were clearly contaminated, what about those that showed no visible signs of oil?

Table 10 provides an overview of several other measures of relative "exposure" of each study community to the oil spill and subsequent clean-up activities which could lead to the questions raised in the previous paragraph.[15] As noted in Table 10, most surveyed households in the Prince William Sound, lower Cook Inlet, and Kodiak Borough communities had members who were engaged in the oil spill clean-up. The percentage of households with such employment ranged from a high of 93.9 percent in English Bay to 41.3 percent at Old Harbor. Oil spill employment also accounted for a large percentage of jobs held by adults in communities in these three subregions. Although these measures were generally lower for the five Alaska Peninsula communities, there are no readily apparent patterns for distinguishing between communities in the other subregions. It is important to note, however, that most households in the study

[15] As noted earlier, a statistical analysis of relationships between these variables and levels of subsistence harvests is presently underway.

communities had members who observed oiled waters, beaches, and wildlife directly. People who worked on Prince William Sound saw the worst of the spill. English Bay and Port Graham residents worked at Windy Bay and several other badly oiled places. Generally, the degree of oiling and visible direct effects of the oil were lower in the other two subregions, but oil was observed there none the less. As will be discussed in the next section, observations of the oil and its effects led to distrust of the edibility of subsistence resources in general, and, perhaps, a heightened sensitivity towards environmental signals warning of the contamination danger, even if these were not of signs the oil itself.

Another indication of households' concerns about the safety of wild resources is whether they had discarded any subsistence foods because they appeared contaminated (Table 10). Survey results show that such incidents occurred in every community except Akhiok. Surprising, perhaps, is the finding that the communities with the largest percentage of households that discarded subsistence foods were the Alaska Peninsula villages of Ivanof Bay (42.9 percent) and Perryville (40.7). In part, this relatively large percentage relates to a single incident in which some chum salmon harvested at Ivanof Bay and distributed among several families in both communities were subsequently suspected by the harvesters to be oil contaminated. As this news of these suspicion spread, the recipients of the fish disposed of the salmon.

Several programs for providing subsistence foods from other areas of the state to substitute for those normally harvested in the spill area arose after the spill. These "formal sharing programs" operated in Prince William Sound, lower Cook Inlet, and the Kodiak Island Borough. As shown in Table 10, almost every household in these three subregions received some of these foods. However, although many households expressed appreciation for these foods (especially to the Alaska Native villages of Tyonek and Angoon who supplied many of the resources) few households reported that these programs adequately replaced their own traditional harvest activities. Indeed, there were numerous reports of receiving spoiled or suspect foods. Also, some salmon arrived at a time of year when use of traditional preservation methods was impossible. Hence families were faced with an added dilemma of not being able to adequately process and store these foods.

THE ISSUE OF RESOURCE CONTAMINATION AND FOOD SAFETY

"We saw too much oil, and we didn't want nothing to do with [fish]. I guess if you didn't see the oil you wouldn't mind. We don't want to eat them until we find out what's really going on."

-- Respondent, Chenega Bay, April 1990

One of the first signs that people in Tatitlek, the community closest to Bligh Reef, used that warned them that something dreadful might be happening to the fish and wildlife of Prince William Sound was a report of a dead starfish that washed up on the beach. Starfish are not eaten, but they, like other creatures, may act as signs of unseen danger. Soon, reports and images of dead and dying birds and sea otters were commonplace. Furthermore, the residents of Tatitlek and the other villages in the path of the oil soon experienced the damage first-hand when they worked to protect and clean their home areas, as well as when they traveled within their traditional harvest areas. As noted above, these observations raised the issue of whether some beaches, waters, and animals showed signs of oiling, were any safe to use? Were there linkages between what villagers observed and what they could not see?

Consequently, the first question that subsistence harvesters raised following the spill was posed as follows: Are subsistence foods harvested in the oil spill area safe to eat? In other words, is there or is there not a connection between visibly damaged resources and other subsistence foods? When the people in Tatitlek first raised this issue, the Alaska Department of Environmental Conservation (DEC) responded that the best way to know if foods are free from oil is to smell and taste them. This "organoleptic" test is the primary method used by DEC's laboratory in Palmer for checking the quality of commercial seafoods. A health bulletin issued by the Alaska Department of Health and Social Services on May 5, 1989 (ADHSS 1989a) contained similar advice. In part, the message read as follows:

> Great concern exists about the potential impact of the oil upon fish and other seafood. The best tests available at this time are the smell and taste of the fish. If the fish smell or taste of petroleum, they should not be eaten. If they don't, it is almost certainly safe to eat. It is probable that living clams, mussels, and shellfish from intertidal areas are also safe, if the same standards are applied...We are unable to provide absolute assurances at this time and are working to have better information as our highest priority.

Residents of the villages received this advice with skepticism and disbelief. Subsistence harvests in some villages, such as Tatitlek, Chenega Bay, English Bay, Port Graham, and Ouzinkie, virtually came to an end. And in every village as far as Perryville and Ivanof Bay, people noticed unusual behaviors in animals or suspect conditions in some subsistence foods. Clearly, the oil spill had created conditions that were completely unfamiliar to the hunters and fishermen of these villages. Their skills at understanding their environments and making informed decisions had been undermined. Consequently, in many cases they discarded traditional foods or refrained from harvesting entirely for fear that the resources were poisoned.

What kinds of information became available to help subsistence harvesters know if dangers were present in their traditional food supply? When were responses developed to people's questions? The primary response was organized by the federal Indian Health Service (IHS), which formed an "Oil Spill Health Task Force" (OSHTF). This group began meeting biweekly at the Alaska Native Medical Center in Anchorage within a month of the spill. In addition to IHS, regular participants in the OSHTF included the Division of Subsistence, the ADHSS, DEC, the National Oceanic and Atmospheric Administration (NOAA), Exxon, and two regional Native service organizations, the North Pacific Rim for the Chugach villages ("the Rim") and the Kodiak Area Native Association (KANA). The OSHTF served to coordinate and review research on the question of subsistence foods safety, develop a consensus on health issues, and communicate the findings of the studies to the villages.

Consequently, in 1989 two studies were designed to address the question of subsistence food safety after the oil spill. The first to get underway was a "pilot study" developed by the Division of Subsistence. The field portion of this project took place in May 1989. The second study was funded by Exxon, and occurred from July to September 1989. In both projects, samples of subsistence resources were taken from important harvest areas after consultation with village experts and native organizations. In combination, the studies covered sites in Prince William Sound, lower Cook Inlet, and the Kodiak Island area. Village assistants were usually part of the sampling crews. Division researchers and NOAA personnel participated in the Exxon-funded project as well.

After collection of the samples, they were tested for signs of oil contamination. Primarily, these tests were designed to measure levels of polycyclic aromatic hydrocarbons (PAHs) in the bile and edible

tissues of the samples. PAHs are among the most toxic components of petroleum and some are known carcinogens. The federal Food and Drug Administration (FDA) performed these tests for the pilot study, and NOAA's Northwest Fisheries Center conducted the tests on samples from the Exxon-funded project.

No results were available from these projects until late August 1989, when the FDA's findings from the pilot study were released (FDA 1989, OSHTF 1989a, ADHSS 1989b,c). The FDA found that 10 "organoleptically clean" samples had no PAHs or very low levels as measured in parts per billion. Eating foods with those levels did not represent a health risk according to the FDA. But two samples of shellfish taken at Windy Bay and deemed oiled by local assistants in the field had higher PAH values than usually found in areas not contaminated by oil. Insufficient tissue from these samples was available to perform the more detailed tests required for a health risk assessment.

As part of the second study, the Northwest Fisheries Center conducted 365 tests to measure the levels of PAHs in the bile and edible tissues of the samples (Varanasi et al 1990). These tests are highly sensitive, measuring PAH levels down to less than one part per billion. The results of the first round of tests were available by late August, shortly after the results of the division's pilot study. At the request of the state epidemiologist, NOAA then assembled an "expert panel of toxicologists" which met in Seattle on September 14 to review the findings (OSHTF 1989b; ADHSS 1989c,d). The panel concluded that the levels of PAHs found in fish were low and of no health concern. Most shellfish tested were also safe, but some, such as those collected from the contaminated beaches at Windy Bay, had unacceptably high levels of oil contamination and were unsafe to eat. The expert committee concluded that shellfish "should not be collected from obviously oil-contaminated areas."

After receiving the panel's report, the OSHTF reviewed the findings and developed plans to inform the villages of the results. Meetings took place in 10 communities in Prince William Sound, lower Cook Inlet, and the Kodiak Island Borough in September and October 1989.

Also, the state's Section of Epidemiology reported these findings in a health bulletin issued on September 22, 1989 (ADHSS 1989c). In part, the bulletin advised the public that:

> Results of studies to date, combined with available scientific knowledge, provide powerful evidence that Alaskan finfish are and will continue to be safe to eat. Levels of aromatic

> hydrocarbons found to date in finfish are very low and are similar to levels in uncontaminated fish.
>
> Because only a small number of crustaceans (crabs) and mollusks (clams and mussels) have been tested, our recommendations about their safety are more tentative and cautious. Specimens of mollusks taken from heavily oil-contaminated beaches have shown high levels of aromatic hydrocarbons. Shellfish tested from "clean beaches" have shown the presence of aromatic hydrocarbons in higher concentrations than found in uncontaminated areas but at levels that do not represent a serious health hazard. If mollusks are consumed, they should not be collected from areas that are obviously contaminated with oil.

Findings from a second and third round of tests performed at the NOAA laboratory on samples collected in August and September were consistent with those of the first round of tests, according to the conclusions of a second meeting of the expert panel in February 1990 (OSHTF 1990a, 1990b; Varanasi et al. 1990.)

Despite these efforts, many questions remained unanswered for the villages. These concerns appeared, for example, during the village meetings in September and October 1989. Villagers asked why more samples had not been tested from more areas. How could they be sure that resources were safe based upon the limited number of samples and sites examined so far? Also, little or no information was available about other important resources, such as deer, waterfowl, and marine mammals. Village residents also pointed out that health bulletins and news releases often did not reach most of the families in their communities, leaving people uninformed and, sometimes, afraid. Finally, some community representatives wondered why a subsistence foods testing project was being funded by Exxon rather than the state, suggesting a conflict of interest.

Subsequently, both Exxon and the state (through the Division of Subsistence) continued sampling and testing programs in 1990. The Northwest Fisheries Center agreed to conduct the tests for both programs. The division added collection sites near Alaska Peninsula communities. Generally, the purpose of these programs was to monitor conditions near each village to assess if the earlier health advice remained valid. Results from these studies became available during the spring and summer of 1990. Findings continued to be consistent with those of the previous summer. Additionally, tests were run on samples of marine mammals, ducks, and deer. Results for some of the marine mammals were available by June 1990, and the remainder by October 1990. Although indications of exposure of some of the samples to oil were found, PAH levels were well below those considered to represent a health risk. These findings

have been disseminated primarily through a series of newsletters and a video tape produced for the OSHTF by the Division of Subsistence.

In summary, limited information was available to subsistence harvesters to answer their questions about possible oil contamination of subsistence foods only by late August 1989. Complete results of the studies of fish and shellfish did not appear until February 1990, and test results concerning marine mammals, birds, and deer were not available until June 1990 or later. Findings from these studies, and the corresponding health advice, have been consistent: most resources taken from the oil spill area are safe to eat, but people should avoid harvesting at contaminated areas and carefully inspect their harvests for signs of oil. But into the second year after the spill, household interviews found that many respondents still had doubts about the safety of subsistence foods. The next section illustrates how respondents have explained their doubts with examples of signs that the oil is still present. For these respondents, such signs indicate that danger still exists.[16]

CHANGES IN FIVE STUDY COMMUNITIES

This section describes in more detail some of the differences in subsistence uses which the study found between the year after the spill and previous studies. The discussion focuses on some of the causes of the differences, especially the issue of food safety. As noted above, more comprehensive analysis and discussion will appear in a series of technical reports now in preparation.

[16] Evaluation of the subsistence foods testing projects and the villages' responses to the projects' results and corresponding health advice is the topic of ongoing division research.

Chenega Bay

"I don't want to eat off the beach since I seen all the oil."

– April 1990

The oil assaulted the traditional use areas of Chenega Bay more directly than those of any other village, thus it is not surprizing that this research found that subsistence harvests were severely disrupted. Most Chenega Bay households (77.8 percent) worked on beach cleanups, observing the most heavily oiled and damaged areas, and 94 percent of the households feared that resources had been poisoned by the oil. As compared with the average harvests from 1984-85 and 1985-86, harvests at Chenega Bay were down 58.8 percent. This comparison probably underestimates the level of decline. The people of Chenega Bay had returned to western Prince William Sound in 1984 after a 20 year absence. Their former village on Chenega Island had been completely destroyed by a tsunami following the great earthquake in 1964. The villagers were just beginning to reexplore their traditional harvest areas (and in the case of younger people, learn about them for the first time) when the division conducted its earlier research. The villagers also faced inappropriate hunting and fishing regulations, some of which were changed in 1988 after the harvest data were collected. Thus, it is likely that subsistence harvests in the years after the study, and those just before the spill, were considerably higher than those during the first two years of the village's existence. As the division's study (Stratton and Chisum 1986:114) concluded,

> Particularly in the subsistence realm, the village residents are adapting and responding well to their new environment through the reapplication of traditional fishing and hunting practices...The newly relocated population, growing number of children in the local school, and increasing harvest levels of wild resources all attest to a community which is becoming successfully re-established in its traditional territory.

But the oil spill disrupted the Chenega Bay people's resettlement of western Prince William Sound. Comments from villages underscored the sense of loss they felt in being, once again, unable to use traditional foods. For example,

> We're hungry for Native food. I never thought I would be craving for octopus. But I got a liking for it and now when I want it there isn't any.

> I was given some seal taken by [someone] returning from Cordova. It was delightful to get that piece. You wondered whether you wanted to eat it or not. But you did anyway. Because at that point you are hungry for it and you know it. You just think it is going to be OK and you eat it.

Additionally, the Chenega Bay people feared that with resource populations already weakened due to the death of so many animals from the oil, hunting might damage the populations even further. The following comment expresses this concern.

> People thought since there weren't many birds, we shouldn't harvest to protect the population. We saw lots of birds wiped out by the spill...There are areas around here like that. People know they are around, but not in great numbers, so they are left alone.

But, as noted above, most Chenega Bay households cited concerns about the safety of eating subsistence foods as a primary reason for lowered subsistence harvests (Table 9). In comparison with other years, harvests of fish other than salmon, birds, marine mammals, deer, and marine invertebrates were extremely low (Figure 12). An emergency regulation (ADF&G 1989) opened to subsistence fishing several bays that had been protected from the oil by booms. In 1989, several Chenega Bay households took advantage of these openings, harvested salmon, and distributed the fish in the village. In the spring of 1990, Chenega Bay hunters and fishermen continued to travel to more distant locations to unoiled areas for resource harvesting because of their observations of signs of the continued presence of oil near their community.

Tatitlek

> *"I didn't go to the same places [as usual] to hunt because of oil on the beach. I've seen deer eating kelp. I don't want to shoot [a] deer and then find out it has been eating oil."*
>
> – April 1990

In terms of per capita subsistence production, Tatitlek showed the largest decline in the year following the spill, from 652 pounds in 1988-89 to 207 pounds in 1989-90, a difference of 445 pounds (a

68.3 percent decline). When the average of the two previous years is used for comparison, the post spill year's harvest was down 58.8 percent.

As at Chenega Bay, people in Tatitlek perceived a marked decline in resource availability. As two respondents observed:

> There are usually hundreds of black ducks [scoters] around here, [but] this year there's not. [There's] nothing around to hunt. There are areas around here [usually] loaded with ducks. Last year, there were none.

> I've hunted seal for years and years. All my life. This year, [there's] none around. [It's a] poor year for seal. Some trips I go out, [there's] not a one.

As in other villages in the oil spill area, the contamination of their traditional food supply was the foremost question at Tatitlek. Eighty two percent of the households reported that their resource uses declined because of this concern. Consequently, there were notable declines in harvests of most resource categories, especially fish other than salmon, marine invertebrates, and marine mammals. A few Tatitlek fishermen travelled to the Copper River Flats, well outside the oiled areas, and brought salmon back for the community. One person commented,

> I never started getting over the oil spill until I first started smoking the fish in my smoke house. It was total therapy to split the fish and put them in my smoke house. It was the only thing that helped me to recover from the bad feelings I had.

But this same respondent added:

> We were afraid that if the fish hadn't been tested we could be harmed by the fish...We were totally against people eating stuff that hadn't been tested. We told people that it was ludicrous to eat food that hadn't been tested. [But] eventually the craving for those foods took over. And they ate them anyway.

English Bay

> *"The other years at least we had no worries about contamination from oil spills and such. We were able to rely on our seafoods and other resources. How are our seafoods [now]? I've only heard rumors that they may be OK, and yet our monitors are still finding oil tarballs on our beaches."*

-- January 1990

The effects of the oil spill were particularly hard on English Bay because of already depressed salmon stocks that the village traditionally relies on for food. Almost every household in the village observed these effects first hand through employment with the oil spill clean-up. One person described his observations as follows:

> I noticed in Windy Bay that the oil seemed to have smothered everything. I saw lots of dead ducks at Dogfish Bay, but most were washing out to sea. I think the ducks were killed by oil and washed away.

Another person said, "I saw lots of snails dead in the water after the oil spill, and barnacles, mussels and bidarkies [chitons]."

Consequently, many households (67 percent) reported that their subsistence uses were lower in 1989 than previously because they were not sure if these foods were safe to eat. As compared to 1987, subsistence harvests in 1989 were down 48.5 percent (Figs. 11, 16) Consequently, respondents looked upon 1989 as a lost year. As one person put it, "I feel frustrated, like a year of memories being erased." Another remarked:

> There is still lots of oil on Elizabeth Island and Anderson Beach. In some places, there is lots of oil. I think people will wait a couple years before going out [to harvest resources] because they just don't trust it.

Ouzinkie

"The oil spill screwed everything up and people were scared to eat anything out of the ocean."

-- January 1990

Previous measures of subsistence harvests in Ouzinkie, in 1983 and 1986, suggested a fairly stable harvest level (358 pounds per person in 1983; 401 in 1986). This is in contrast to some other Kodiak Island villages such as Karluk and Akhiok that had indicted sharp declines in subsistence harvests between those two years. The data also showed that subsistence harvests were diverse at Ouzinkie, with salmon the resource taken in the largest quantities, but with notable contributions by other fish, marine invertebrates, game, marine mammals, and birds (Figure 13).

As noted above, Ouzinkie demonstrated the largest relative decline in post oil spill subsistence harvests of any of the 15 study communities, 78 percent when compared with the average of the previous two measurements. About three quarters (74.3 percent) of the community's households had oil spill employment. Fear of contamination was reported by at least 26 percent of the households. Typical comments from survey respondents included:

> I'm still scared to eat the shellfish. We haven't eaten any clams this year.
>
> I wasn't sure if the deer were healthy or not, so I was afraid to use them.
>
> I can't go out and get what I want off my beach just to eat without worrying if it is contaminated or I'll get poisoned. . . That's why I don't eat nothing off the beach. I don't eat clams no more.

Chignik Lake

"We won't touch clams after that oil was floating around. Not our family anyway."

-- January 1990

As measured in pounds per person, subsistence harvests at Chignik Lake were 57 percent higher in 1989 than in 1984, the only other year for which comprehensive data are available. Of the 15 study communities, only Ivanof Bay had a higher per capita harvest during the study year. Most of this difference between 1984 and 1989 is due to higher harvests of game, especially caribou, in the latter year (Fig. 14). With its inland location, Chignik Lake is well situated for hunting the Northern Alaska Peninsula Caribou Herd. The community's per capita take of caribou in 1989, as well as its harvest level overall, is very much like those of other Alutiiq communities which depend heavily on this herd, including Port Heiden, Pilot Point, and Egegik (Fall and Morris 1987).

But even at Chignik Lake, families reported that their subsistence harvests had been disrupted by the spill. The people of Chignik Lake travel to Chignik Lagoon and other bays along the Pacific coast to harvest marine invertebrates and other resources. The presence of oil inhibited these harvests. One respondent said:

> After the oil spill, we haven't eaten or harvested clams. There's some brave ones [people] around here that still go and get them. We usually eat bidarkies and sea urchins all the time, but not no more. I heard on the radio there's a cancer-causing thing in the clams.

As shown in Table 9, 38 percent of the village's households reported that concerns about contamination of subsistence foods by the oil spill had lowered their harvests of these resources. Thus, the subsistence uses of families more than 500 miles from Bligh Reef were disrupted as the oil spread to the south and west.

SUMMARY: SOME PRELIMINARY CONCLUSIONS AND OBSERVATIONS

This preliminary report has examined three questions concerning subsistence uses of fish and game in 15 Alaska Native communities whose harvest areas were affected by the Exxon Valdez oil spill. The paper provided an overview of the size and composition of subsistence harvests after the spill. The research found that in most communities, these harvests were substantially lower than in previous years. Especially, subsistence harvests in villages of Prince William Sound, lower Cook Inlet, and some in the Kodiak Island Borough showed stark declines. In contrast, subsistence production in five Alaska Peninsula villages was relatively similar to earlier measurements or higher.

When asked to assess differences in their subsistence uses in the study year compared with other years, most respondents confirmed that harvests were down (54 percent of all assessments of change). In most cases (at least 55 percent), the oil spill was cited as the reason for the decline. This was especially true for the Prince William Sound (83 percent of the assessments) and lower Cook Inlet (70 percent) communities. The dominant oil spill-related reason for lower harvests was fear that subsistence foods had been contaminated by the oil. The majority of the households in most of 15 communities had direct contact with the effects of the spill through their employment on oil clean up jobs, as well as during other travel through their traditional use areas. They saw oil on the beaches, in the water, and on certain animals and birds. Others suspected oiling when they inspected resources they had harvested or had been given.

In addition, reports of dead wildlife and other signs warning of danger led many people to doubt that their traditional harvest areas were safe to use and traditional foods were safe to eat.

By the time reliable information based on tests of resources from specific traditional sites was available to these communities, all of the spring and most of the summer opportunities for subsistence harvesting had passed. Furthermore, after months of observing the danger caused by the spill, many villagers were skeptical that foods could be safe. They demanded more tests from more places on a wider range of species. With oil still present, they argued that the tests should continue and be expanded.

Indeed, it appears that as long as residents of the Native communities of the areas affected by the Exxon Valdez oil spill believe that oil remains in their environment, many will continue to refrain from using subsistence foods. The following report appeared from Chenega Bay in October 1990, more than 18 months after the spill (Evanoff 1990). The report indicated that the people of the village

> Have eaten only a small fraction of the foods they ordinarily live on daily. They reported that indications from wildlife around them make the people very uncomfortable, and they are afraid to harvest subsistence food. An abnormal seal liver, ordinarily firm, was soft and runny. The arm of a starfish fell apart when pulled from the rocks. They have reported several dead eagles and sea gulls, a dead bear and a blind sea lion found during the past month, highly unusual occurrences prior to the spill.

For a people whose survival has long relied upon their knowledge about and observations of the natural world around them, such signs continue to warn of danger. And people continue to respond in a culturally appropriate manner -- with caution. This preliminary analysis of data about subsistence uses in Alutiiq communities following the Exxon Valdez oil spill suggests that while these signs have persisted, certain traditional foods have been avoided by many households. Until such signs disappear and people are able place confidence in their abilities to again interpret and understand their environment, recovery from this disaster will likely remain incomplete.

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TABLE 1. POPULATION AND ETHNICITY, STUDY COMMUNITIES

Community	Population, 1988[a]	Percent Alaska Native, 1980[b]
Tatitlek	101	77.9%
Chenega Bay	68	77.0%[c]
English Bay	159	79.0%
Port Graham	186	87.6%
Ouzinkie	204	94.2%
Port Lions	300	73.5%
Old Harbor	322	92.6%
Larsen Bay	149	83.3%
Karluk	82	100.0%
Akhiok	93	96.2%
Chignik	128	53.4%
Chignik Lagoon	87	85.4%
Chignik Lake	134	89.1%
Perryville	127	92.8%
Ivanof Bay	47	92.5%

[a] Source: Alaska Department of Labor 1990
[b] Source: United States Department of Commerce 1980, 1984
[c] Source: Stratton and Chisum 1986; data pertain to 1985-86. The community was resettled in 1984.

TABLE 2. TOPICAL CONTENT OF DIVISION OF SUBSISTENCE HARVEST SURVEY QUESTIONNAIRE

DEMOGRAPHY. For each household member:

- Birth date
- Birthplace
- Length of residency in community
- Relationship to household head
- Ethnicity
- Level of formal education
- Months resided in village in 1989
- Plus: Information on temporary residents of household in 1989

COMMERCIAL FISHING.

- Participation in each fishery in 1988 and 1989
- Permit holders and crew members by person id number
- Amount of each resource removed from commercial harvests for home use

SUBSISTENCE USE AND HARVEST. For each resource for 1989:

- Did household use the resource?
- Did household try to harvest the resource?
- Harvest quantities by gear type.
- Did the household receive the resource from other harvesters?
- Did the household give away the resource to other households
- Communities involved in the exchange of resources.
- Areas used for resource harvesting (1989, 1988, and "regularly")
- Plus respondent's assessment of the household's use of each resource category in comparison with other years

EMPLOYMENT, INCOME, AND HOUSEHOLD EXPENSES.

- For each person over 16 years of age: job title, employer, location of job, months worked, shift, and amount earned
- Other sources of income
- Household expenses in 1989
- An assessment of 1989 expenses compared with other years

OTHER.

- Respondents' views on trends in sharing and on treatment of elders in the community
- Household's receipt of resources from "formal sharing programs" organized in response to the spill in 1989

TABLE 3. SAMPLE SIZES, OIL SPILL AREA HARVEST SURVEY, 1990

Community	Number of Households			
	Target	Completed	Refusals	No contact
Prince William Sound Subarea				
Chenega Bay	21	18 (85.7%)	1	2
Tatitlek	28	22 (78.6%)	3	3
Subtotal	49	40 (81.6%)	4	5
Lower Cook Inlet Area				
English Bay	41	33 (80.5%)	6	2
Port Graham	61	48 (78.7%)	9	4
Subtotal	102	81 (79.4%)	15	6
Kodiak Island Borough				
Akhiok	13	10 (76.9%)	2	1
Karluk	17	14 (82.4%)	1	2
Larsen Bay	39	34 (87.2%)	4	1
Old Harbor	46 (50%)[a]	48 (104.3%)	2	NA
Ouzinkie	35 (50%)[a]	35 (100%)	5	NA
Port Lions	36 (50%)[a]	36 (100%)	5	NA
Subtotal	186	177 (95.2%)	19	4
Alaska Peninsula Area				
Chignik Bay	39	35 (89.7%)	2	2
Chignik Lagoon	15	15 (100%)	0	0
Chignik Lake	28	21 (75.0%)	0	7
Ivanof Bay	7	7 (100%)	0	0
Perryville	31	27 (87.1%)	2	2
Subtotal	120	105 (87.5%)	4	11
TOTAL	457	403 (88.2%)	42	26

[a] Target was a 50 percent random sample of year-round households.

TABLE 4. COMPARISON OF SUBSISTENCE HARVESTS IN THE 1980S, POUNDS EDIBLE WEIGHT PER PERSON, STUDY COMMUNITIES IN THE OIL SPILL AREA

Community	Harvest in Pounds per Person[a] SLM	OFH	MRI	GME	MRM	BRD	PLT	ALL	Harvest in Pounds per Person[a] SLM	OFH	MRI	GME	MRM	BRD	PLT	ALL	Harvest in Pounds per Person[a] SLM	OFH	MRI	GME	MRM	BRD	PLT	ALL
	1987-88								1988-89								1989-90							
Tatitlek	76	86	17	79	81	4	9	353	230	142	43	75	133	12	16	652	93	16	1	46	48	2	1	207
	1984-85								1985-86								1989-90							
Chanega Bay	64	26	5	55	151	4	4	309	79	62	5	73	143	5	5	361	88	24	<1	20	4	<1	1	138
									1987								1989							
English Bay									94	112	18	9	21	3	15	272	64	30	14	15	12	2	2	139
Port Graham									82	83	15	5	13	3	15	216	42	58	8	<1	8	2	1	120
	1983								1986								1989							
Ouzinkie	156	55	49	37	28	33	NA	358	183	63	29	70	22	30	5	401	26	14	7	19	7	7	3	83
Port Lions	88	91	36	36	8	8	NA	267	153	49	33	73	5	7	4	323	55	33	16	29	<1	3	7	143
Old Harbor	210	63	32	69	74	17	NA	466	178	37	25	61	107	9	2	419	131	38	27	27	23	4	1	250
Larsen Bay	156	64	41	61	54	13	NA	388	98	33	25	39	3	3	4	205	63	38	33	40	19	4	5	203
Karluk	561	78	16	64	82	31	NA	832	250	41	14	44	6	25	2	381	181	14	5	27	4	4	2	237
Akhiok	222	29	49	41	144	34	NA	518	105	6	13	31	1	2	1	158	102	58	47	29	43	8	1	288
	1984																1989							
Chignik	145	20	7	14	5	3	NA	194									105	54	16	16	2	4	4	202
Chignik Lagoon	127	19	15	59	2	7	NA	229									95	43	21	37	0	6	4	206
Chignik Lake	147	14	3	110	3	5	NA	283									145	38	17	216	9	17	7	449
Perryville	229	42	11	85	18	6	NA	391									191	65	22	60	27	8	8	382
Ivanof Bay	275	15	26	96	21	12	NA	445									226	62	55	140	21	17	10	532

[a] Pounds edible weight per person, rounded to nearest whole pound. SLM = salmon, OF = other fish, MI = marine invertebrates, GM = game, MM = marine mammals, BRD = birds and eggs, and PLT = wild plants.

TABLE 5. COMPARISON OF COMPOSITION OF SUBSISTENCE HARVESTS IN THE 1980S, PERCENTAGE OF TOTAL BY RESOURCE CATEGORY, STUDY COMMUNITIES IN THE OIL SPILL AREA

Community	Percentage of Total Composed of:[a] SLM	OFH	MRI	GME	MAM	BRD	PLT
	1987-88						
Tatitlek	22	24	5	23	23	1	2
	1984-85						
Chenega Bay	21	8	2	18	49	1	1
	1983						
Ouzinkie	44	15	14	10	8	9	NA
Port Lions	33	34	14	14	3	3	NA
Larsen Bay	40	17	10	16	14	3	NA
Karluk	67	9	2	8	10	4	NA
Akhiok	43	6	9	8	28	7	NA
Old Harbor	45	13	7	15	16	4	NA
	1984						
Chignik	74	11	4	7	3	1	NA
Chignik Lagoon	55	8	7	26	1	3	NA
Chignik Lake	52	5	1	39	1	2	NA
Perryville	58	11	3	22	5	1	NA
Ivanof Bay	62	3	6	22	5	3	NA

Community	Percentage of Total Composed of:[a] SLM	OFH	MRI	GME	MAM	BRD	PLT
	1988-89						
Tatitlek	35	22	7	12	20	2	2
	1985-86						
Chenega Bay	21	16	1	20	39	1	1
	1987						
English Bay	35	41	7	3	8	1	5
Port Graham	38	38	7	2	6	1	7
	1986						
Ouzinkie	46	16	7	17	8	6	1
Port Lions	47	15	10	23	2	2	1
Larsen Bay	48	16	12	19	2	1	2
Karluk	66	11	1	12	7	2	1
Akhiok	66	4	8	20	1	1	1
Old Harbor	43	9	6	15	25	2	<1

Community	Percentage of Total Composed of:[a] SLM	OFH	MRI	GME	MAM	BRD	PLT
	1989-90						
Tatitlek	45	8	<1	22	23	1	1
	1989-90						
Chenega Bay	64	18	<1	15	3	<1	<1
	1989						
English Bay	46	21	10	11	9	2	1
Port Graham	35	49	6	<1	7	2	1
	1989						
Ouzinkie	32	17	9	22	8	8	4
Port Lions	38	23	11	20	1	2	5
Larsen Bay	31	19	16	20	9	2	3
Karluk	76	6	2	11	2	2	1
Akhiok	35	20	16	10	15	3	1
Old Harbor	52	15	11	11	9	2	<1
	1989						
Chignik	52	27	8	8	1	2	2
Chignik Lagoon	46	21	10	18	0	3	2
Chignik Lake	32	9	4	48	2	4	2
Perryville	50	17	6	16	7	2	2
Ivanof Bay	43	12	10	26	4	3	2

[a] Percentage of total harvest (Pounds edible weight). SLM = salmon, OFH = other fish, MRI = marine invertebrates, GME = game, MAM = marine mammals, BRD = birds and eggs, and PLT = wild plants.

TABLE 6. COMPARISON OF PER CAPITA SUBSISTENCE HARVESTS, STUDY COMMUNITIES,

Community	Percentage of decrease/increase in subsistence harvests during the year after the Exxon Valdez Oil Spill compared with: Most recent previous measurement	Average of all previous measurements
Tatitlek	- 68.3%	- 58.8%
Chenega Bay	- 61.8%	- 58.8%
English Bay	*	- 48.5%
Port Graham	*	- 44.4%
Ouzinkie	- 79.3%	- 78.1%
Port Lions	- 55.7%	- 51.5%
Old Harbor	- 40.3%	- 43.4%
Larsen Bay	- 1.0%	- 31.4%
Karluk	- 24.4%	- 60.9%
Akhiok	+ 82.3%	- 20.2%
Chignik	*	+ 4.1%
Chignik Lagoon	*	- 10.0%
Chignik Lake	*	+ 58.7%
Perryville	*	- 2.3%
Ivanof Bay	*	+ 19.6%

* Only one previous measurement exists

TABLE 7. LEVELS OF PARTICIPATION IN SUBSISTENCE ACTIVITIES, 1989, OIL SPILL AREA COMMUNITIES[a]

	Salmon			Other Fish			Marine Inv.			Game			Marine Mam.			Birds			Plants			Any Resource		
	Use	Atp	Har	Use	Atp	Har	Use	Atp	Har	Use	Atp	Har	Use	Atp	Har	Use	Atp	Har	Use	Atp	Har	Use	Atp	Har
Chenega Bay	100	78	78	85	67	39	22	11	11	94	67	61	39	22	17	6	11	6	72	61	61	100	100	100
Tatitlek	96	59	59	82	50	46	55	32	27	91	64	55	86	36	32	64	46	41	100	91	91	100	100	100
English Bay	97	82	79	76	58	55	91	88	88	73	24	12	85	39	30	42	33	33	67	67	67	100	100	100
Port Graham	92	81	79	79	65	60	71	65	65	27	10	4	60	23	17	50	42	40	54	48	48	96	94	94
Ouzinkie	94	57	57	66	46	46	60	46	46	69	52	43	35	23	23	69	55	55	66	66	63	100	94	92
Larsen Bay	100	71	68	94	56	56	97	79	79	94	59	53	32	12	12	71	50	44	85	79	79	100	91	91
Karluk	93	79	79	71	71	71	86	79	79	100	71	71	57	21	21	79	57	57	100	93	93	100	100	100
Akhiok	100	70	70	100	70	70	100	100	100	100	70	70	100	60	60	100	90	90	100	80	80	100	100	100
Old Harbor	100	83	83	90	67	69	96	83	83	85	54	54	68	27	25	77	54	54	90	85	81	100	98	98
Port Lions	100	72	69	86	55	49	91	83	83	74	44	44	11	3	3	69	49	49	85	85	85	100	94	94
Chignik	97	80	77	89	83	77	89	80	77	83	60	34	34	20	20	66	54	49	89	86	86	97	100	94
Chignik Lagoon	100	67	60	100	67	67	87	53	53	87	47	33	13	7	7	80	47	40	87	80	80	100	93	80
Chignik Lake	95	91	86	86	81	81	81	48	48	95	71	67	71	38	29	81	62	62	100	100	100	100	100	100
Ivanof Bay	100	100	100	100	100	100	100	100	100	100	100	100	86	71	57	100	100	100	100	100	100	100	100	100
Perryville	100	93	89	96	78	74	96	89	85	85	56	44	63	41	26	93	70	67	100	96	96	100	100	100

[a] The study year is April 1989 - March 1990 for Chenega Bay and Tatitlek; for the other communities, the study year is the calendar year 1989.

Source: Division of Subsistence, Alasks Department of Fish and Game, Survey 1990

Table 8. ASSESSMENT OF ALL RESOURCES.

REGION/Community	Change in Harvest/Use						Reasons for Less					
	Higher		Same		Less		Non-Spill		Oil Spill		Analysis Incomplete	
	#	%	#	%	#	%	#	%	#	%	#	%
PRINCE WILLIAM SOUND	4	2%	46	22%	163	77%	7	4%	136	83%	20	12%
Tatitlek	1	1%	35	31%	76	68%	4	5%	60	79%	12	16%
Chenega Bay	3	3%	11	11%	87	86%	3	3%	76	87%	8	9%
LOWER COOK INLET	9	3%	35	12%	257	85%	31	12%	181	70%	45	18%
English Bay	3	2%	8	6%	114	91%	16	14%	95	83%	3	3%
Port Graham	6	3%	27	15%	143	81%	15	10%	86	60%	42	29%
KODIAK ISLAND	76	9%	384	45%	395	46%	73	18%	141	36%	181	46%
Ouzinkie	5	4%	36	25%	101	71%	5	5%	39	39%	57	56%
Port Lions	17	10%	74	46%	71	44%	12	17%	27	38%	32	45%
Old Harbor	26	10%	148	59%	76	30%	31	41%	22	29%	23	30%
Larsen Bay	16	10%	57	35%	88	55%	12	14%	32	36%	44	50%
Karluk	9	11%	33	41%	39	48%	5	13%	12	31%	22	56%
Akhlok	3	5%	36	61%	20	34%	8	40%	9	45%	3	15%
ALASKA PENINSULA	16	4%	242	60%	143	36%	38	27%	66	46%	39	27%
Chignik	7	5%	75	59%	46	36%	15	33%	20	43%	11	24%
Chignik Lagoon	2	4%	30	61%	17	35%	5	29%	11	65%	1	6%
Chignik Lake		0%	70	80%	17	20%	4	24%	12	71%	1	6%
Perryville	5	5%	54	50%	49	45%	14	29%	16	33%	19	39%
Ivanof Bay	2	7%	13	45%	14	48%		0%	7	50%	7	50%
TOTAL	105	6%	707	40%	958	54%	149	16%	524	55%	285	30%

Table 9. OILSPILL-RELATED REASONS FOR REDUCTION IN SUBSISTENCE HARVESTS.

REGION/Community	Households Surveyed	Less Resources Around Due to Spill		Fear of Contamination		Too Busy Working to Obtain Sub. Foods		Other Reasons	
		HH	%HH	HH	%HH	HH	%HH	HH	%HH
PRINCE WILLIAM SOUND	40	18	45%	35	88%	9	23%	26	65%
Tatitlek	22	10	45%	18	82%	4	18%	9	41%
Chenega Bay	18	8	44%	17	94%	5	28%	17	94%
LOWER COOK INLET	81	12	15%	34	42%	35	43%	10	12%
English Bay	33	10	30%	22	67%	12	36%	8	12%
Port Graham	61	2	3%	12	20%	23	38%	2	4%
KODIAK ISLAND	177	2	1%	39	22%	20	11%	9	5%
Ouzinkie	35	0	0%	9	26%	2	6%	4	15%
Port Lions	36	1	3%	10	28%	7	19%	1	3%
Old Harbor	48	0	0%	7	15%	2	4%	1	6%
Larsen Bay	34	1	3%	9	26%	5	15%	2	12%
Karluk	14	0	0%	3	21%	2	14%	1	17%
Akhiok	10	0	0%	1	10%	2	20%	0	0%
ALASKA PENINSULA	105	14	13%	24	23%	7	7%	22	21%
Chignik	35	3	9%	4	11%	3	9%	10	50%
Chignik Lagoon	15	4	27%	2	13%	2	13%	4	33%
Chignik Lake	21	0	0%	8	38%	0	0%	5	38%
Perryville	27	6	22%	6	22%	2	7%	3	17%
Ivanof Bay	7	1	14%	4	57%	0	0%	0	0%
TOTAL	403	46	11%	132	33%	71	18%	67	17%

NOTE: Analysis of all household responses is incomplete. Therefore, percentages are minimums.

TABLE 10. MEASURES OF OIL SPILL EXPOSURE: DISCARDING OF RESOURCES AND OIL SPILL EMPLOYMENT

	Percent of Sampled Households:			
Community	Discarding Resources due to Contamination Concerns	Receiving Resources Through Formal Programs	With Oil Spill-related Employment	Percent of all Jobs that were oil Spill-related
Tatitlek	13.6	90.9	77.3	45.9
Chenega Bay	22.2	94.4	77.8	40.0
English Bay	9.1	93.9	93.9	70.3
Port Graham	22.9	95.8	72.9	54.5
Akhiok	0	100.0	90.0	35.7
Karluk	14.3	100.0	78.6	41.3
Larsen Bay	20.6	91.2	79.4	44.2
Old Harbor	12.9	93.7	41.3	21.7
Ouzinkie	11.6	82.9	74.3	35.4
Port Lions	10.4	86.1	58.3	32.8
Chignik	17.1	0	2.9	1.1
Chignik Lagoon	13.3	0	6.7	2.7
Chignik Lake	28.6	0	4.8	1.4
Ivanof Bay	42.9	0	14.3	4.2
Perryville	40.7	0	40.7	21.1

Source: Division of Subsistence, ADF&G, Survey, 1990; preliminary data.

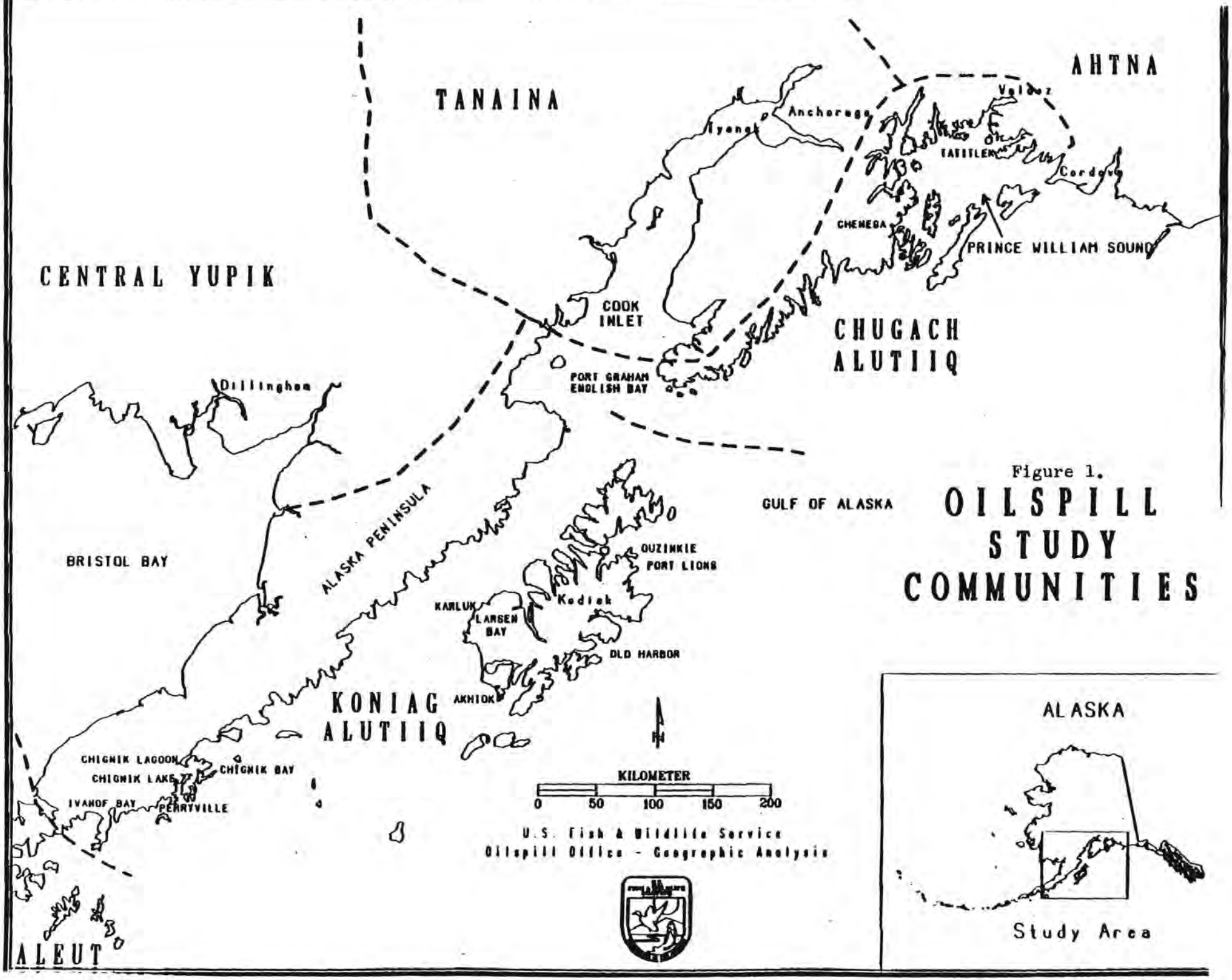


Figure 1.

OILSPILL STUDY COMMUNITIES

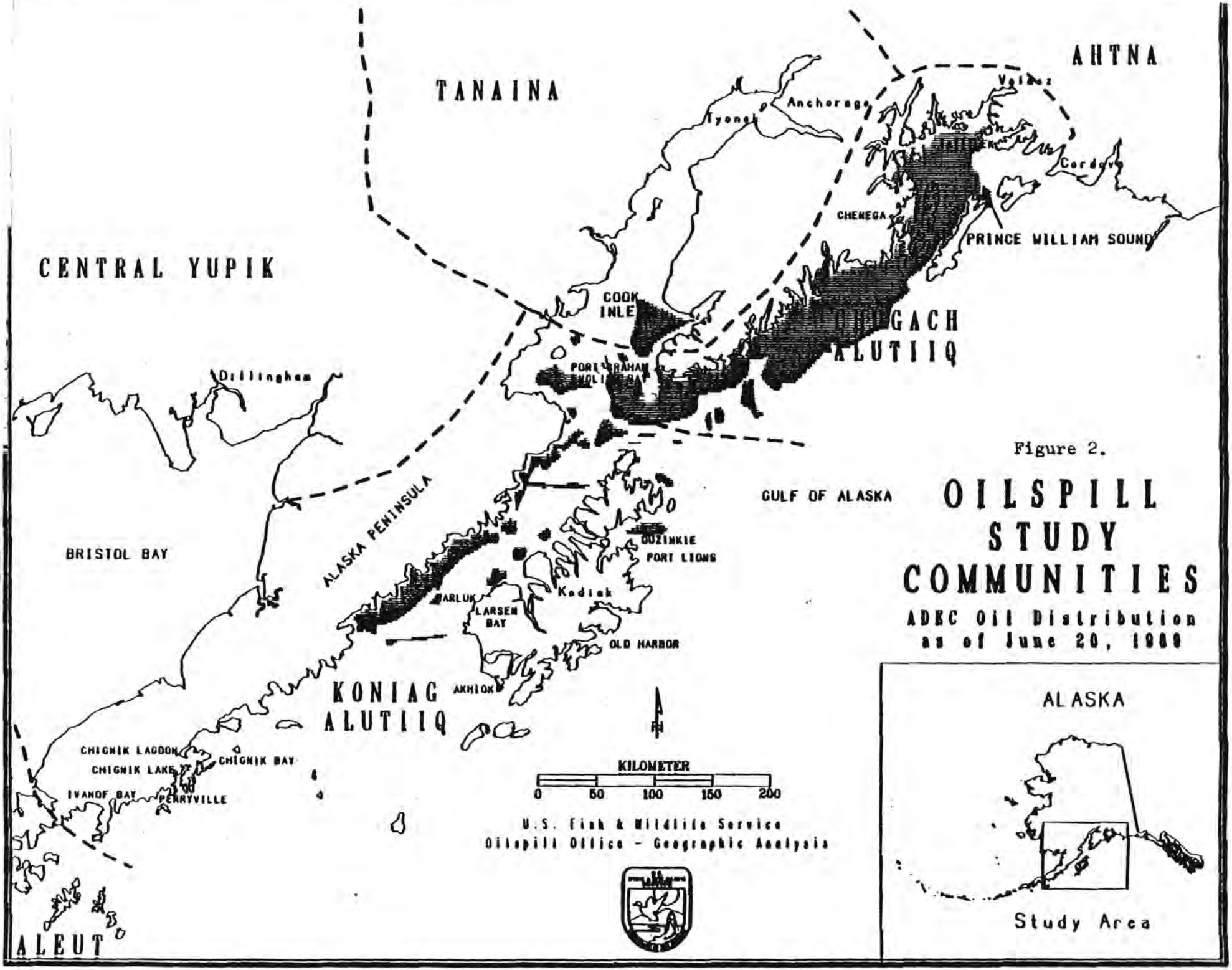


Figure 2.

OILSPILL STUDY COMMUNITIES

ADEC Oil Distribution as of June 20, 1989

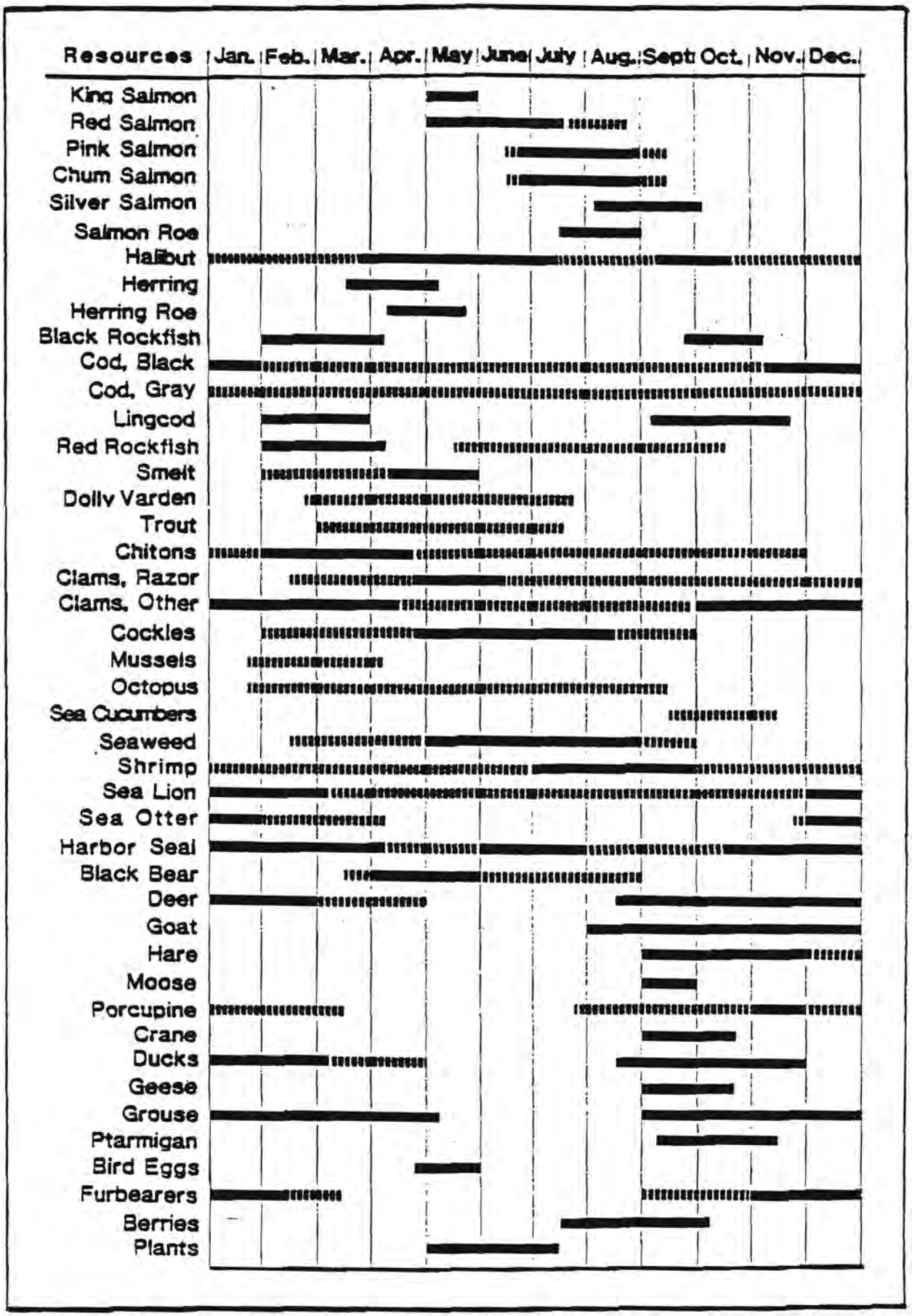
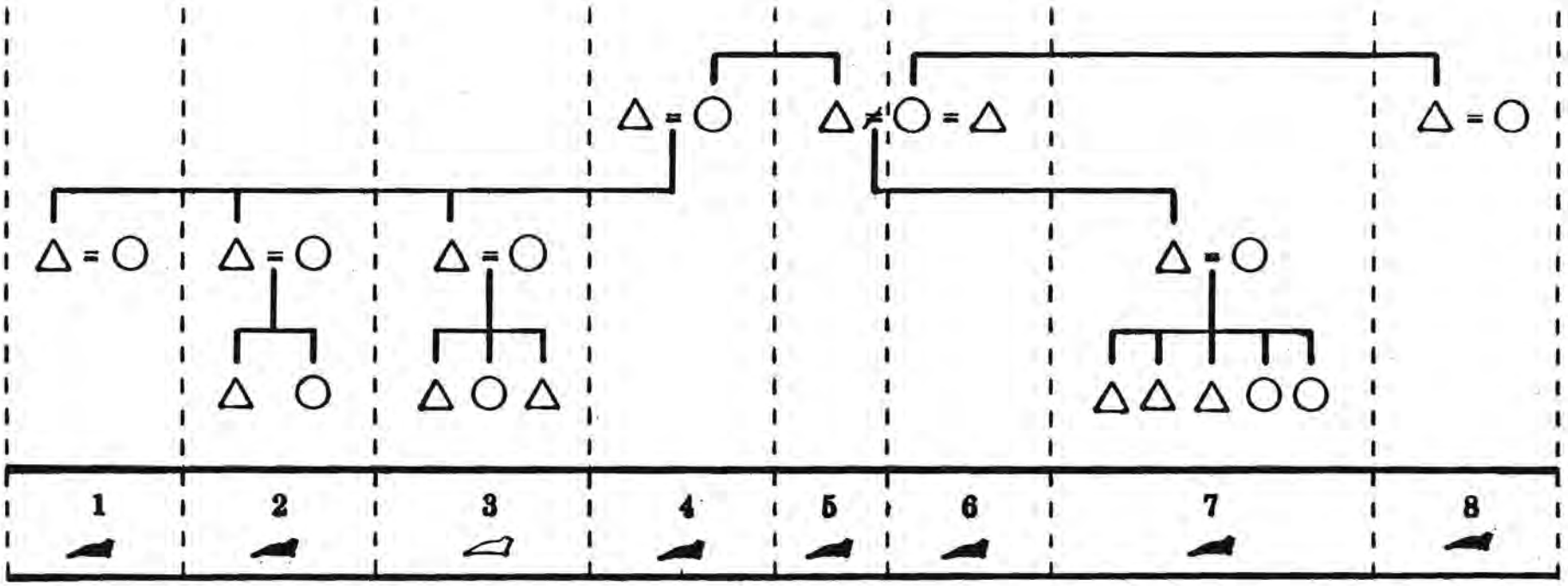


Figure 3. Seasonal Round of Harvest Activities, Chenega Bay 1984-1986. (Solid line shows usual harvest season. Broken line indicates occasional effort.)



SHARING OF SUBSISTENCE FOODS

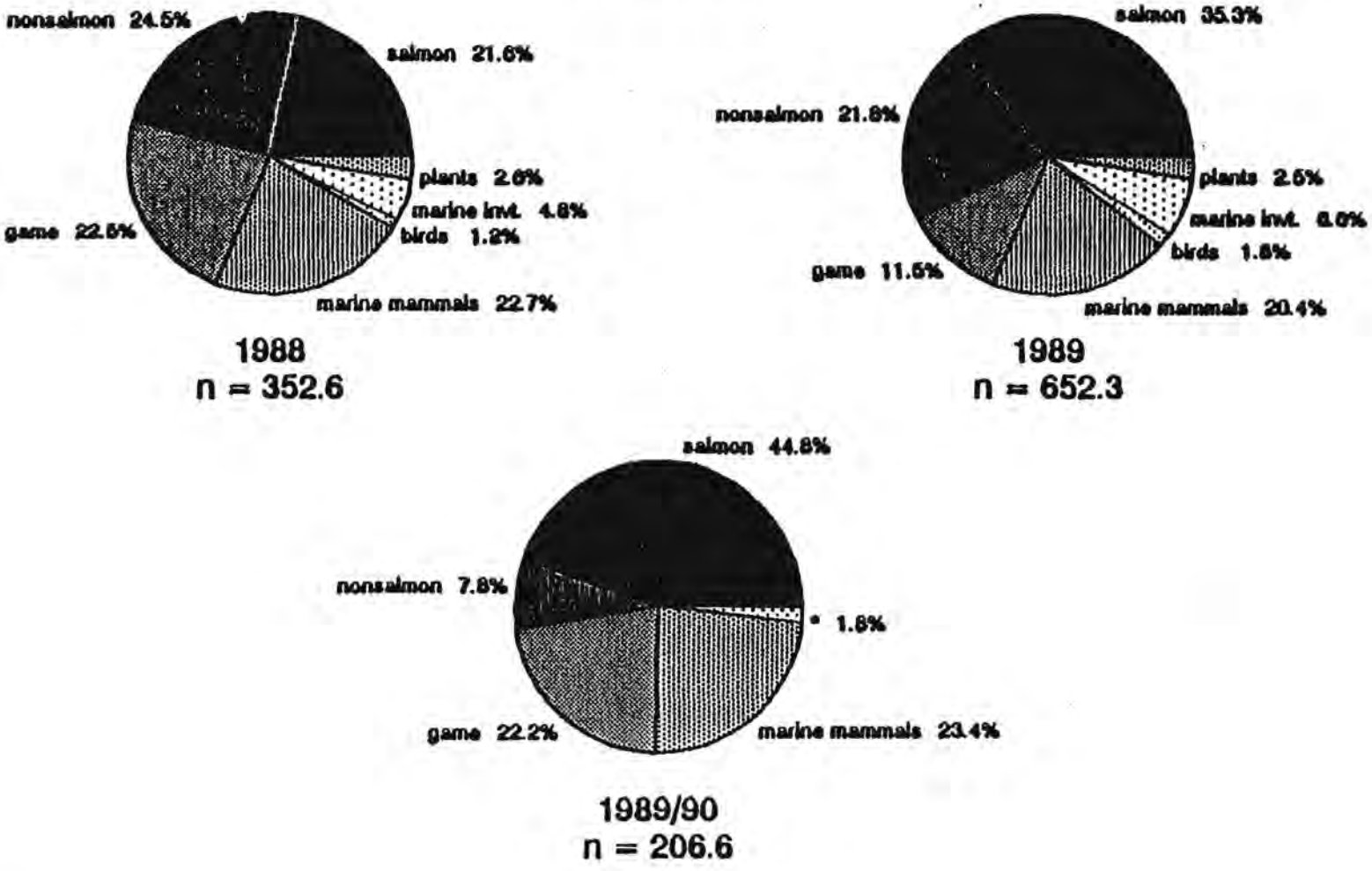
Sharing of subsistence harvests is widespread in all the Alutiiq communities. This example is from English Bay, lower Cook Inlet. A hunter in Household (HH) 3 (A) shot a harbor seal while on a hunting trip with his partner, his cousin (MBS) in HH 7 (B). The partners split the seal equally and in turn shared it with six other households. The households with elders (HHs 4, 5, 6, & 8), at their request received most of the fat, the flippers, and the lungs. Others received fat, ribs, roasts, liver, kidneys, and the heart. In total, 8 households with 25 people used portions of the seal. All the housholds were linked by kinship ties.

KEY

- Harvested Seal
- Received Seal
- 1 Household Unit
- Male
- Female
- = Marriage Link
- ≠ Divorce

Figure 4. Distribution of a Seal, English Bay

Harvest Composition Comparison
Tatitlek



* birds = .07%
marine invt. = 0.4%
plants = 0.7%

Figure 5. Composition of Subsistence Harvests Pounds Edible Weight per Person, by Resource Category. Tatitlek, 1987-8, 1988-9, and 1989-90.

Harvest Composition Comparison
English Bay

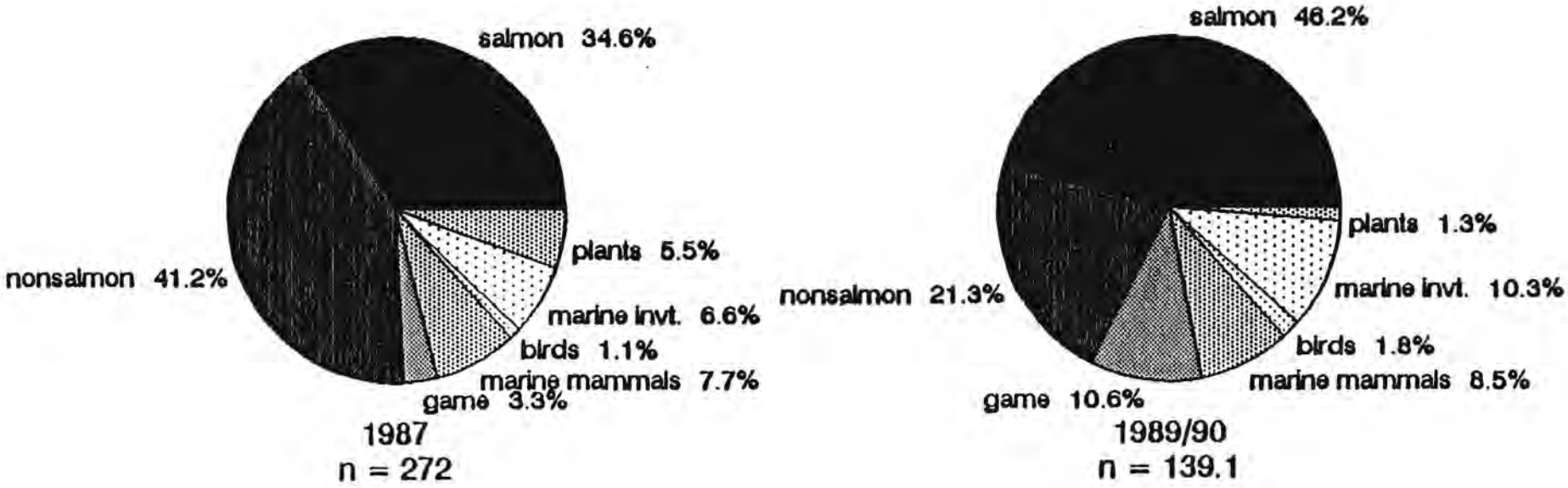
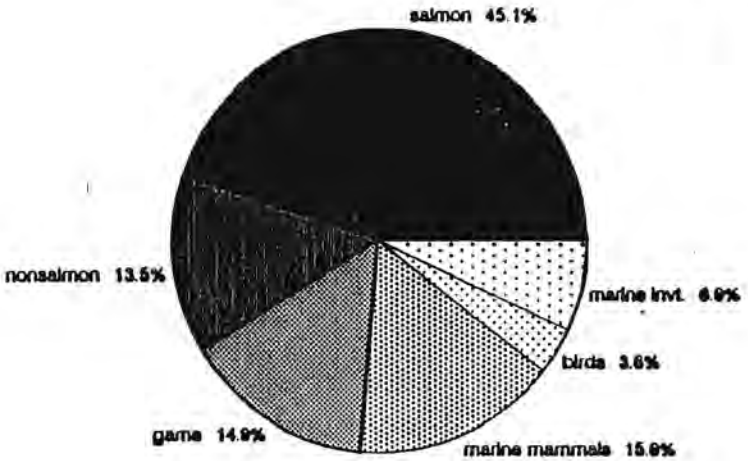
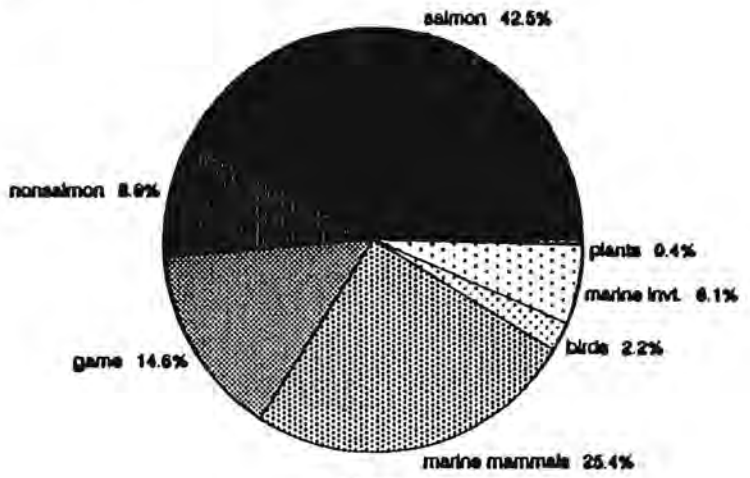


Figure 6. Composition of Subsistence Harvests, Pounds Edible Weight per Person, by Resource Category, English Bay, 1987 and 1989.

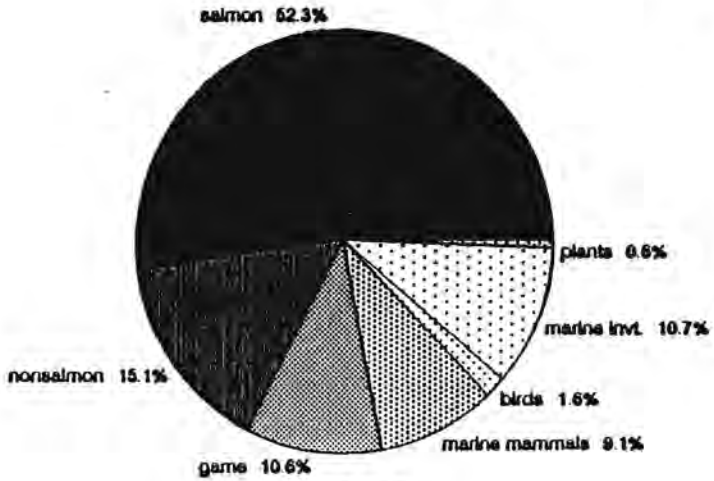
Harvest Composition Comparison
Old Harbor



1983
n = 465.3



1986
n = 419.1



1989/90
n = 250.2

Figure 7. Composition of Subsistence Harvests, Pounds Edible Weight per Person, by Resource Category, Old Harbor, 1983, 1986 and 1989.

Harvest Composition Comparison
Perryville

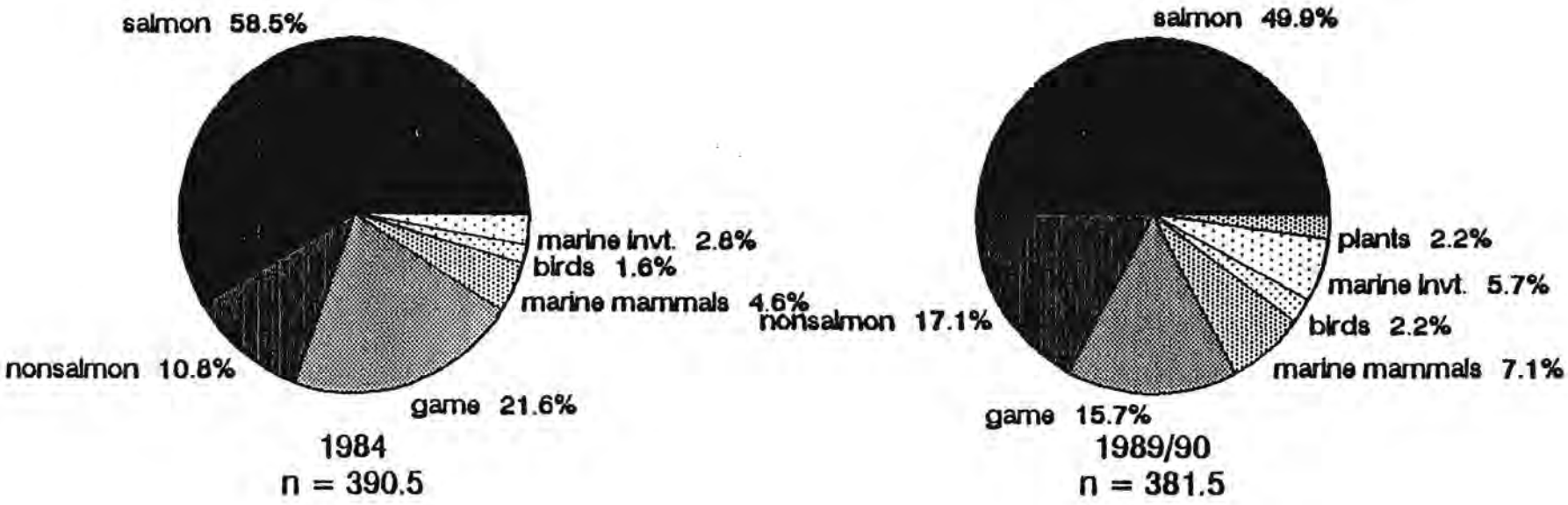


Figure 8. Composition of Subsistence Harvests, Pounds Edible Weight per Person, by Resource Category, Perryville, 1984 and 1989.

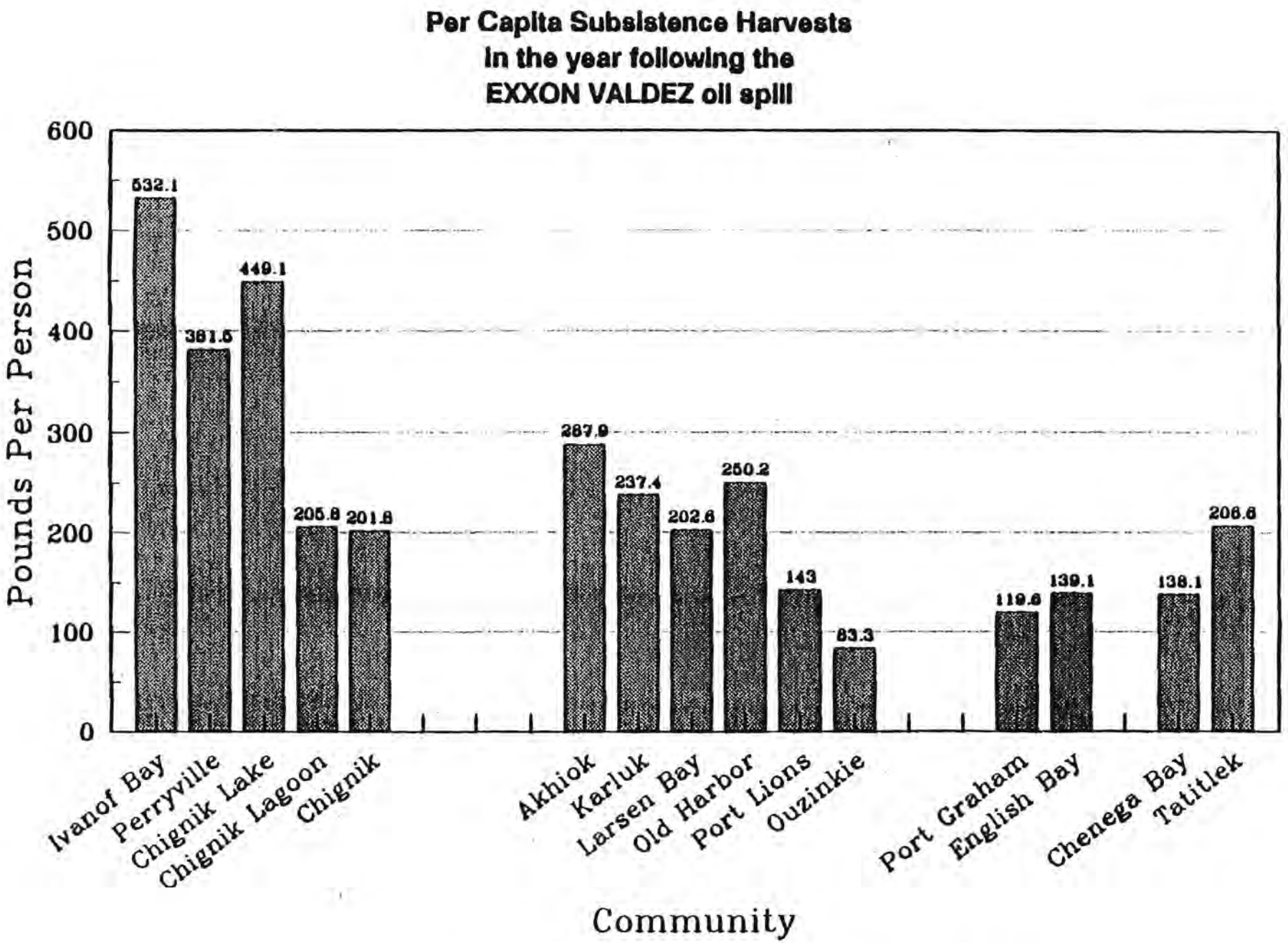
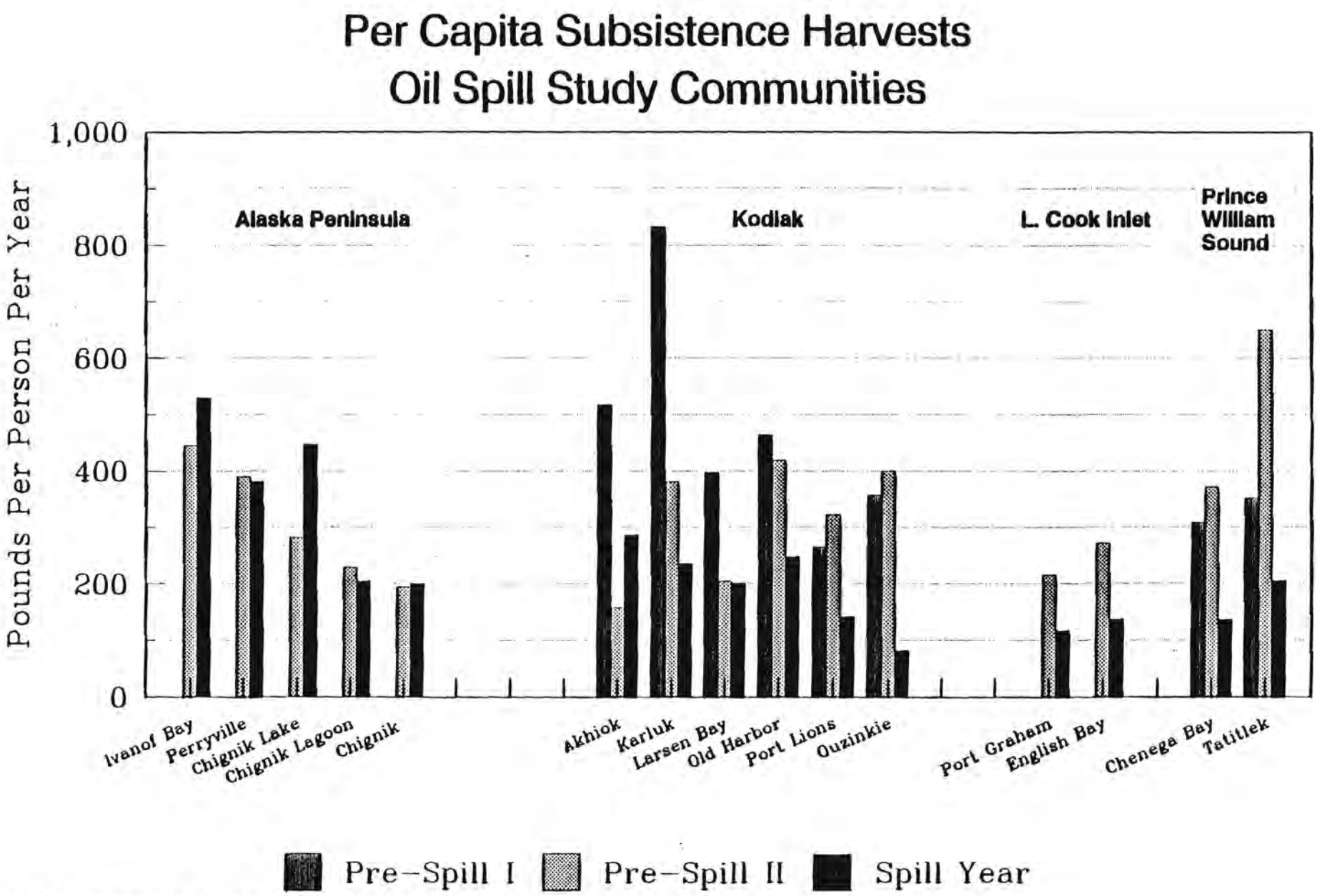


Figure 9. Subsistence Harvests, Pounds Edible Weight per Person, in the Year Following the Exxon Valdez Oil Spill.



Two previous study years exist for Kodiak and Prince Wm. Sound. One previous study year exists for AK. Peninsula and L. Cook Inlet

Figure 10. Comparison of Subsistence Harvests, Pounds Edible Weight per Person, Before and After the Exxon Valdez Oil Spill.

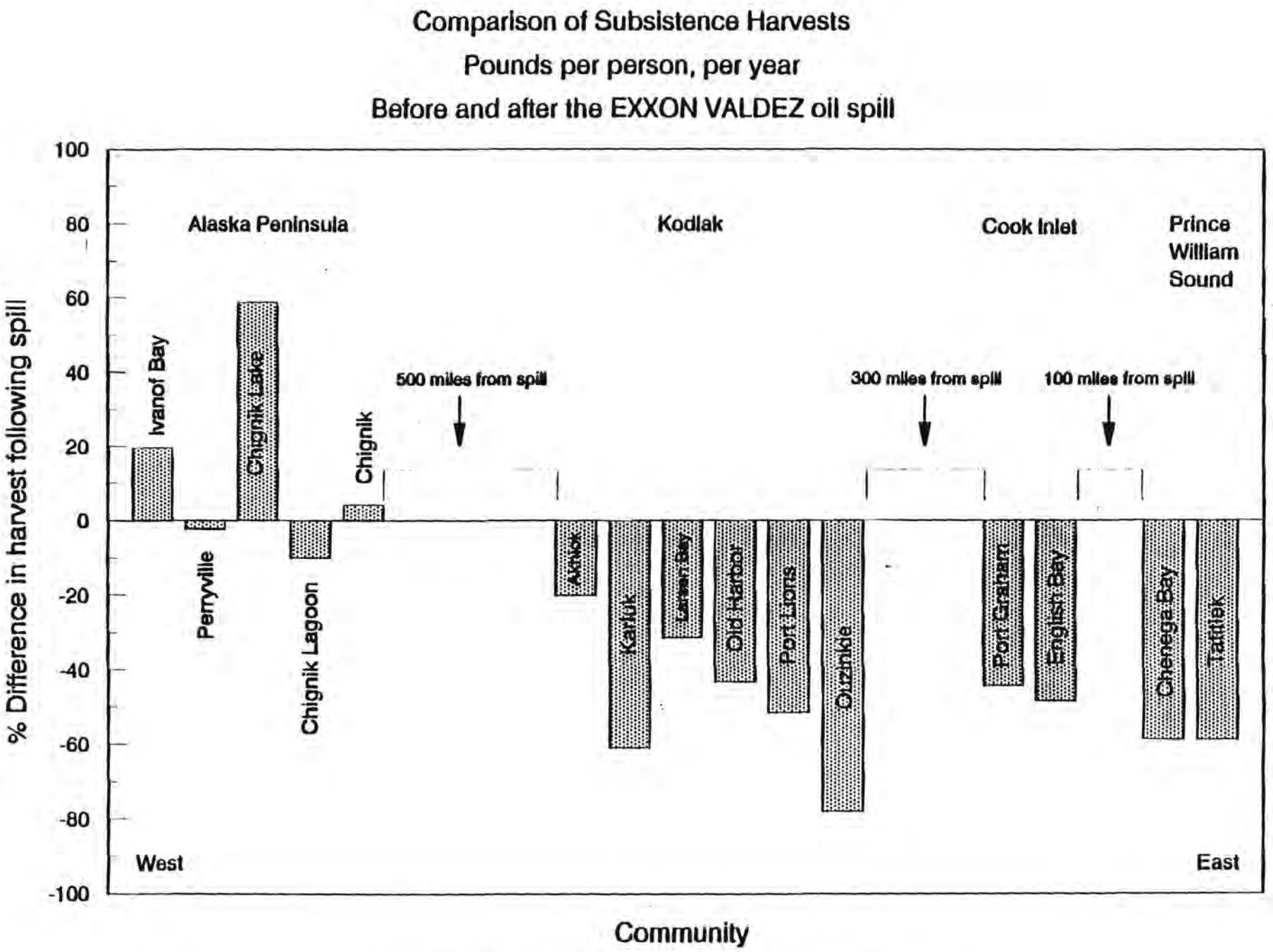
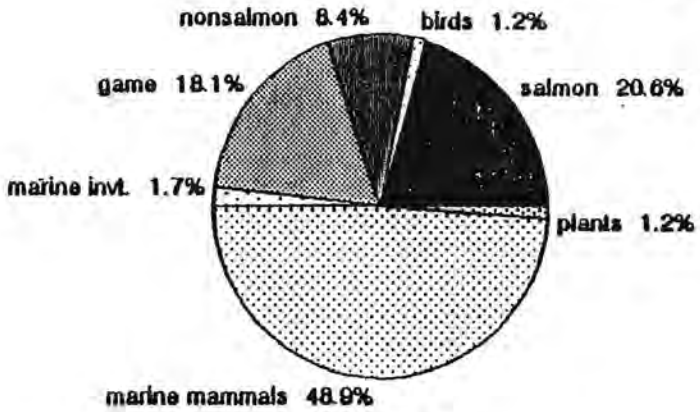
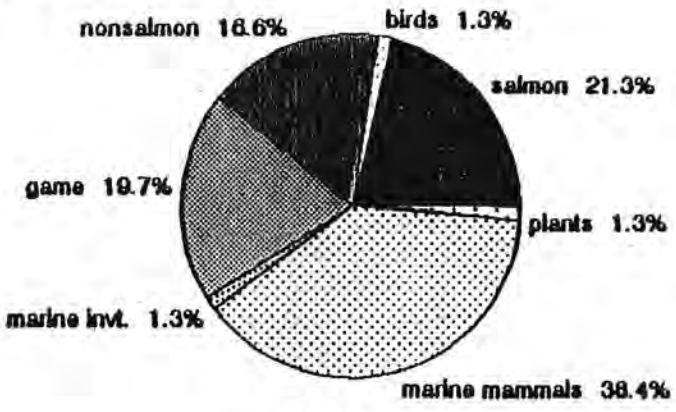


Figure 11. Difference in Subsistence Harvests, Before and After the Exxon Valdez Oil Spill.

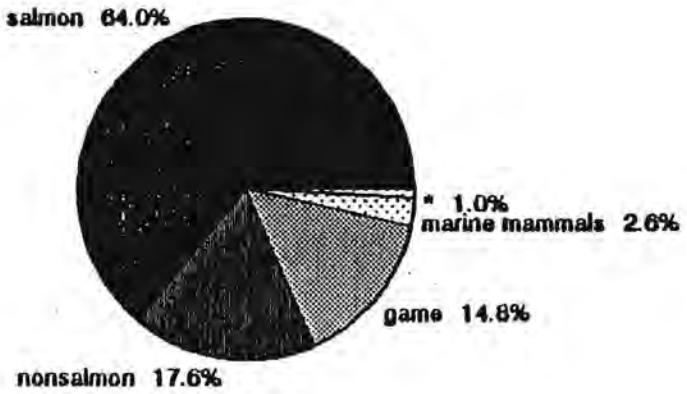
Harvest Composition Comparison
Chenega Bay



1984/85
n = 308.9



1985/86
n = 371.6



1989/90
n = 138.1

* birds = .07%
marine invt. = 0.2%
plants = 0.7%

Figure 12. Composition of Subsistence Harvests, Pounds Edible Weight per Person, by Resource Category, Chenega Bay, 1984/85, 1985/86, and 1989/90.

Harvest Composition Comparison
Ouzinkie

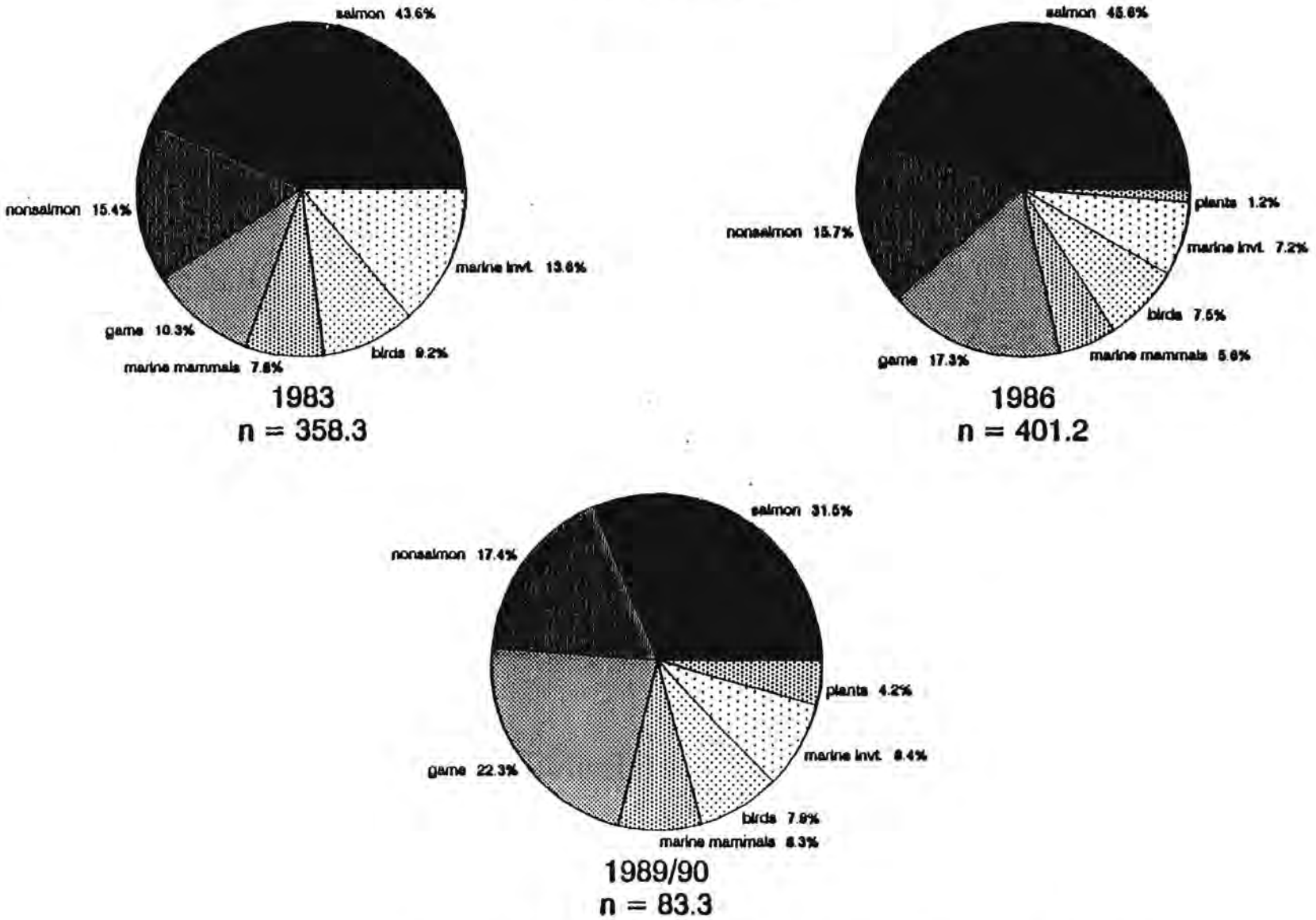


Figure 13. Composition of Subsistence Harvests, Pounds Edible Weight per Person, by Resource Category, Ouzinkie, 1983, 1986, and 1989.

Harvest Composition Comparison
Chignik Lake

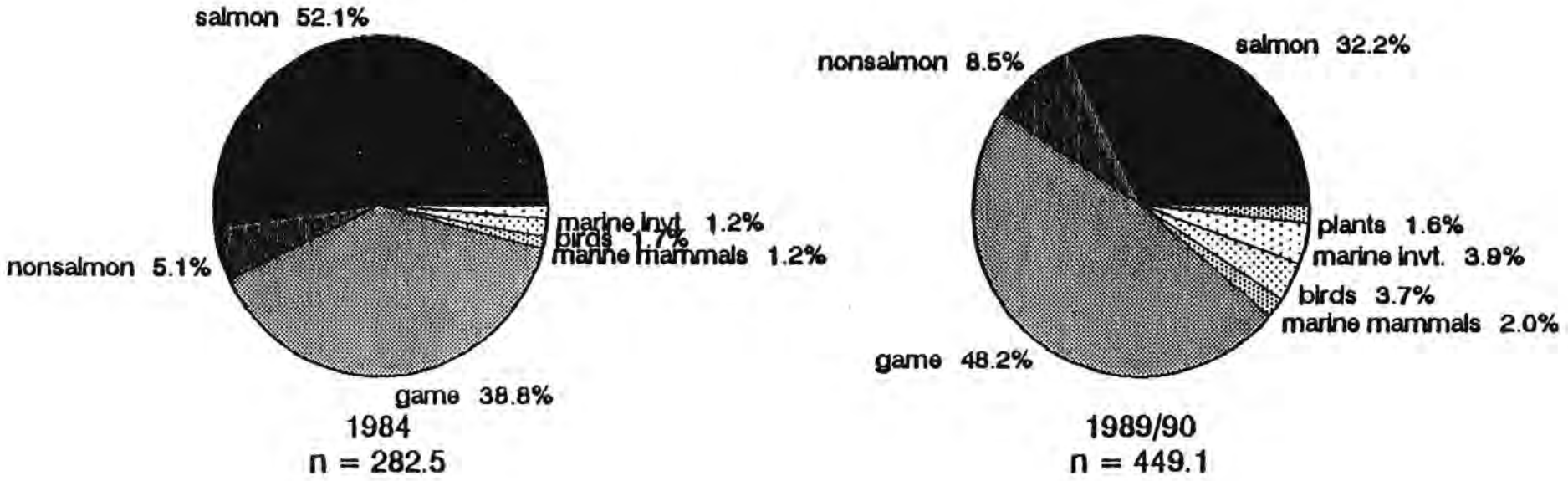


Figure 14, Composition of Subsistence Harvests, Pounds Edible Weight per Person, by Resource Category, Chignik Lake, 1984 and 1989.