

Special Publication No. SP1992-001

**An Update on Subsistence Uses in Alaska Native Villages Following the Exxon Valdez Oil Spill
[PRELIMINARY]**

by

James A. Fall

1992

Alaska Department of Fish and Game

Division of Subsistence



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Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly-accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H_A
gram	g			base of natural logarithm	e
hectare	ha			catch per unit effort	CPUE
kilogram	kg	all commonly-accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	coefficient of variation	CV
kilometer	km			confidence interval	CI
liter	L	at	@	correlation coefficient (multiple)	R
meter	m	compass directions:		correlation coefficient (simple)	r
milliliter	mL	east	E	covariance	cov
millimeter	mm	north	N	degree (angular)	°
		south	S	degrees of freedom	df
Weights and measures (English)		west	W	expected value	E
cubic feet per second	ft ³ /s	copyright	©	greater than	>
foot	ft	corporate suffixes:		greater than or equal to	≥
gallon	gal	Company	Co.	harvest per unit effort	HPUE
inch	in	Corporation	Corp.	less than	<
mile	mi	Incorporated	Inc.	less than or equal to	≤
nautical mile	nmi	Limited	Ltd.	logarithm (natural)	ln
ounce	oz	District of Columbia	D.C.	logarithm (base 10)	log
pound	lb	et alii (and others)	et al.	logarithm (specify base)	log ₂ , etc.
quart	qt	et cetera (and so forth)	etc.	minute (angular)	'
yard	yd	exempli gratia (for example)	e.g.	not significant	NS
		Federal Information Code	FIC	null hypothesis	H_0
Time and temperature		id est (that is)	i.e.	percent	%
day	d	latitude or longitude	lat. or long.	probability	P
degrees Celsius	°C	monetary symbols (U.S.)	\$, ¢	probability of a type I error (rejection of the null hypothesis when true)	α
degrees Fahrenheit	°F	months (tables and figures)	first three letters (Jan.,...,Dec)	probability of a type II error (acceptance of the null hypothesis when false)	β
degrees kelvin	K	registered trademark	®	second (angular)	"
hour	h	trademark	™	standard deviation	SD
minute	min	United States (adjective)	U.S.	standard error	SE
second	s	United States of America (noun)	USA	variance	
		U.S.C.	United States Code	population	Var
Physics and chemistry		U.S. state	two-letter abbreviations (e.g., AK, WA)	sample	var
<i>all atomic symbols</i>					
alternating current	AC	Measures (fisheries)			
ampere	A	fork length	FL		
calorie	cal	mideye-to-fork	MEF		
direct current	DC	mideye-to-tail-fork	METF		
hertz	Hz	standard length	SL		
horsepower	hp	total length	TL		
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

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This document should be cited as:

Fall, J.A. 1992. An update on subsistence uses in Alaska Native villages following the Exxon Valdez Oil Spill [PRELIMINARY]. Alaska Department of Fish and Game Division of Subsistence, Special Publication No. SP1992-001, Fairbanks.

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Paper presented at the 19th annual meeting
of the Alaska Anthropological Association.

Fairbanks, Alaska

March 27, 1992

CONTENTS

- INTRODUCTION
- DATA GATHERING METHODS
- SUMMARY OF PREVIOUS FINDINGS
- FINDINGS FOR 1990-91
 - Harvest Quantities
 - Range of Resources Used
 - Levels of Participation in Use and Harvest
 - Assessments of Change and Reasons for Change
- CONCLUSIONS
- REFERENCES CITED

LIST OF TABLES

- Table 1. Sample Sizes, Household Survey, 1991
- Table 2. Per Capita Harvests of Wild Resources, Study Communities
- Table 3. Household Assessment of Change of Overall Subsistence Uses, 1990-1991

LIST OF FIGURES

- Figure 1. Subsistence Harvest Areas of Study Communities and Outer Extent of the *Exxon Valdez* Oil Spill
- Figure 2. Per Capita Harvests of Wild Resources, Study Communities
- Figure 3. Per Capita Harvests by Resource Category, Chenega Bay
- Figure 4. Per Capita Harvests by Resource Category, English Bay
- Figure 5. Per Capita Harvests by Resource Category, Ouzinkie
- Figure 6. Average Number of Resources Used per Household, Study Communities
- Figure 7. Average Number of Resources Used, Harvested, Received, and Given Away, Tatitlek
- Figure 8. Average Number of Resources Used, Harvested, Received, and Given Away, Port Graham
- Figure 9. Percentage of Population Participating in Subsistence Activities
- Figure 10. Percentage of Sample Using Resources by Category, Chenega Bay
- Figure 11. Percentage of Sample Using Resources by Category, Ouzinkie
- Figure 12. Percentage of Households Reporting Lowered Levels of Overall Subsistence Uses

INTRODUCTION¹

This presentation is the third in a series ^{of} papers presented at the annual meetings of the Alaska Anthropological Association which have summarized research findings concerning patterns of subsistence use in Alaska Native (Alutiiq) communities following the *Exxon Valdez* oil spill of March 24, 1989 (Fig. 1). This research has been conducted by the Division of Subsistence of the Alaska Department of Fish and Game. The first paper (Fall 1990) focused on the issue of possible hydrocarbon contamination of subsistence resources, the Oil Spill Health Task Force, and the subsistence foods collection and testing program.² The second paper (Fall 1991a) summarized preliminary findings of interviews conducted with 403 households in 15 communities whose subsistence harvest areas had been affected by the spill.³ In April and May 1991, the division conducted a second round of 221 household interviews in seven of these communities, including Chenega Bay and Tatitlek in Prince William Sound, English Bay and Port Graham in Lower Cook Inlet, and Ouzinkie, Larsen Bay, and Karluk in the Kodiak Island Borough. This paper will provide an overview of some of the preliminary findings of this latest round of research.

DATA GATHERING METHODS

As in the previous year's research, the primary method of data collection in 1991 was a systematic household survey using a standard data gathering instrument. In addition to data on resource uses and harvest, information was collected on demography, the cash economy, and assessments of change from the previous year. Initially, the goal was to interview every year-round household in six of the seven communities. The exception was Ouzinkie, where at first the target was the 35 randomly selected

¹ Partial support for the second year of data collection was provided through a cooperative agreement with the U.S. Fish and Wildlife Service (No. 14-16-0007-91-7721). Data analysis was supported in part by the U.S. Department of Interior, Minerals Management Service, Cooperative Agreement No. 14-35-0001-30539. The assistance from both agencies is gratefully acknowledged.

² A final report on these programs is presently in preparation by the National Marine Fisheries Service's Northwest Fisheries Center. See also Walker and Field 1991.

³ The results of the first year's research will appear in four reports in the division's *Technical Paper Series* (Fall et al. forthcoming; Mishler and Cohen forthcoming; Stanek forthcoming; Stratton et al. forthcoming).

households from the previous year's survey. However, time allowed us to expand the sample in Ouzinkie to attempt to include all year-round households. Sample achievement rates are reported in Table 1. Overall, 221 households were interviewed, 84.0 percent of the study goal.

The survey data were coded for computer entry and analysis using the SPSS program. The final results will appear in one or more technical papers as well in the division's Community Profile Database (Paige et al. 1991).

SUMMARY OF PREVIOUS FINDINGS

As noted in the earlier papers (cf. Fall 1991b), division research has documented the continuing significance of subsistence hunting, fishing, and gathering to the economies and ways of life of the communities of Prince William Sound, Lower Cook Inlet, the Kodiak Island Borough, and the Alaska Peninsula. In general, before the spill a very large number of subsistence foods was used in each of these areas, including salmon and other fish, marine invertebrates, land mammals, marine mammals, birds and eggs, and wild plants. Subsistence harvests, as measured in useable pounds per person per year, ranged from about 200 pounds per person to about 600 pounds per person annually. 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 (Wolfe and Walker 1987). In addition, subsistence activities have profound social and cultural meanings in these villages. For example, harvest and processing groups are organized around kinship relations, and extensive sharing of subsistence foods is commonplace.

As shown in Table 2 (cf. Fig. 2), subsistence harvests in 10 of the 15 communities included in the first year's research declined markedly in the first year after the spill compared to most pre-spill study years and pre-spill averages. For example, harvest levels in Chenega Bay and Tatitlek both dropped by about 60 percent and those of English Bay and Port Graham declined by about 50 percent. There was a range of decline in subsistence harvests in the Kodiak villages, from a high of a 77 percent reduction at Ouzinkie to a low of a 12 percent reduction at Akhiok. In contrast, subsistence harvests in the five Alaska Peninsula

villages in the year after the spill were about the same or higher than the single pre-spill year for which data are available.

FINDINGS FOR 1990-91

This section will focus on three aspects of subsistence uses and describe some of the changes that have been documented since the spill. These are harvest quantities as measured in pounds useable weight per person per year, the range of resources used for subsistence purposes, and levels of participation in the use and harvest of wild foods. Other characteristics of subsistence uses that were investigated included changes in harvest areas, methods of harvest, and sharing of wild foods. The section will end with a presentation of respondents' assessments of changes in subsistence use and harvest levels, and reasons they gave for these perceived changes.

Harvest Quantities

Preliminary data on total subsistence harvest levels for the second year after the spill are shown in Figure 2. For five villages (English Bay, Port Graham, Ouzinkie, Larsen Bay, and Karluk) these harvests increased over the first post-spill year. For three of these communities (Port Graham, Larsen Bay, and Karluk) subsistence harvests in 1990-91 matched at least one pre-spill year. However, in three villages (English Bay, Ouzinkie, and Karluk) harvests remained below pre-spill averages. On the other hand, subsistence harvests in the Prince William Sound villages of Tatitlek and Chenega Bay showed no overall increase over the year before, and remained starkly below pre-spill levels of harvest.

Figure 3 provides category specific harvest data for Chenega Bay. Harvests of two categories, game and marine mammals, rose in 1990-91 compared to the first post-spill year, but remained well below pre-spill levels. Three categories, other fish, marine invertebrates, and birds and eggs, showed virtually no change compared to the first post-spill year, and remained very low compared to before the spill. Perhaps most striking was the decline in salmon harvests, from 93.0 pounds per person in the first post-spill year to

just 40.0 pounds in ~~1991-92~~¹⁹⁹⁰⁻⁹¹. One possible explanation for this decline is that in 1989, areas normally closed to subsistence fishing near Chenega Bay that had been boomed-off to protect returns of salmon were opened to subsistence fishing by emergency order. A large portion of Chenega Bay's 1989 salmon harvest came from these protected places. However, these areas were again closed to subsistence fishing in 1990.

A second example of changing levels of subsistence harvests is provided by English Bay (Fig. 4). Harvests of two major resource categories, salmon and other fish, rebounded from relatively low levels in 1989, but remained below the single pre-spill measurement. Marine mammals, on the other hand, continued a downward trend. Although harvest measurements do not illustrate this, it is likely that harvests of marine invertebrates also increased in the second post-spill year. The harvest estimate for 1989 is "inflated" in that residents of English Bay made a strong effort in March and April 1989 to harvest as many marine invertebrates as they could before oil from the *Exxon Valdez* spill reached their harvest areas.

Ouzinkie is another good example of post-spill changes to subsistence harvest levels (Fig. 5). Harvests of every category of wild foods increased in ~~1991-92~~¹⁹⁹⁰⁻⁹¹ compared to the first year after the spill. Most harvest levels remained below pre-spill levels, however.

Range of Resources Used

Figure 6 reports the mean number of resources used per household for each study community for the various study years. The range of resources used for subsistence purposes in the villages of Prince William Sound, Lower Cook Inlet, and the Kodiak Island Borough also decreased in the first year after the spill, and were lower than those of Alaska Peninsula communities. For most communities, this range increased in the second post-spill year, but did not return to pre-spill norms.

Figure 7 provides a more detailed example from Tatitlek. On average, households in this village used about 20 different kinds of wild foods in a 12 month study period in 1987-88, and about 23 kinds in 1988-89. In contrast, the average was only about 12 kinds used during the first year after the spill. The range of subsistence resources used during the second post-spill year at Tatitlek rose slightly to 14, but

remained well below either of the pre-spill years. The mean number of kinds of resources harvested per household, received per household, and given away per household in Tatitlek showed a similar pattern.

This pattern at Tatitlek can be compared with the findings for Port Graham (Figure 8). There, as in Tatitlek, the range of resources used dropped almost by half in 1989; however, this average showed a more notable increase in 1990-91, to 17.4 kinds, than in the Prince William Sound village. As at Tatitlek, the average number of kinds of resources harvested, received, and given away per household also rose over 1989 levels, but generally remained below those of the pre-spill measurement for 1987.

Levels of Participation in Use and Harvest

Figure 9 shows the percentage of the sampled population in each community which engaged in any subsistence activity in the post-spill study years.⁴ For the first post-spill year, the highest levels of participation were generally found in the Alaska Peninsula communities, and the lowest in the Prince William Sound, Lower Cook Inlet, and some Kodiak Island Borough communities. Data are available for the second post spill year for seven villages. Participation was up notably at English Bay, Port Graham, and Ouzinkie, showed no change (stayed moderately high) at Larsen Bay and Karluk, but declined at the Prince William Sound villages of Chenega Bay and Tatitlek.

Also, the research has found that participation in the use of certain resource categories declined in the first year after the spill, and has, with some exceptions, bounced back up in the second year. Figure 10 provides an example for Chenega Bay. The percentage of sampled households which used fish other than salmon, marine invertebrates, marine mammals, and birds was much lower in the 12 months after the spill than in the 1985-86 study year. In the second post-spill year, the percentage of households in Chenega Bay using other fish and marine mammals matched the pre-spill level, while the percentage using marine invertebrates and birds, while up from the year before, remained relatively low.

Figure 11 presents Ouzinkie as a second example. For every resource category, the percentage of households using that category was higher in 1991-92 than in the first post-spill year. With the exception of

⁴ Data for this measure of individual participation are generally unavailable for the pre-spill years.

marine mammals, which remained relatively low, the level of participation in the use of each category at Ouzinkie matched at least one pre-spill measurement.

Assessments of Change and Reasons for Changes

The household surveys in both post-spill years asked each respondent if they believed their subsistence uses had increased, decreased, or remained about the same compared to other recent years. If they indicated a difference between years, they were asked for a reason for the change. For the year after the spill (Fig. 12), about 87 percent of the households in the Prince William Sound and 93 percent of the Lower Cook Inlet respondents said their subsistence uses had declined compared to pre-spill levels, most for reasons associated with the *Exxon Valdez* oil spill, as did 56 percent of the Kodiak Island Borough respondents, and 36 percent of the Alaska Peninsula households. More specifically, concerns about contamination of subsistence foods by the spilled oil were the major reason cited for reduced subsistence uses. Overall, 66 percent of the Prince William Sound households, 63 percent of the Lower Cook Inlet households, 23 percent of the Kodiak Island Borough households, and 14 percent of the Alaska Peninsula households reported that this concern had led to a reduction in their overall subsistence harvests in the year after the spill.

Table 3 and Figure 12 summarize some findings concerning household assessments from the second post-spill survey. There were important differences between regions which match the findings discussed above regarding harvest quantities. In the Lower Cook Inlet villages, 57.9 percent of the households said their uses were up in 1990-91 compared to the first year after the spill. In stark contrast, only one Prince William Sound household (3.1 percent) said its harvests were up, while 9.4 percent they were at the same level as 1989-90, and 87.5 percent said they were even lower than the first post spill year. All but one of the sampled households in Chenega Bay and Tatitlek said subsistence uses were still below pre-spill norms. Similarly, most (81.5 percent) of the Lower Cook Inlet households said their uses in 1990-91 had not returned to normal. In contrast, only about half the Kodiak Island Borough reported uses lower

than pre-spill norms, while about 41 percent said uses in 1990-91 were about the same as before the spill, and 9 percent said their uses were higher in 1990-91 than before 1989.

The issue of oil contamination of subsistence foods remained a major concern during the second post-spill year, especially in Prince William Sound and Lower Cook Inlet. This issue was cited as a cause of lower uses by many households. For example, a Chenega Bay respondent said, "I usually fish alot, but I don't want to eat the fish from around here and then find out later that there was something wrong with them and I shouldn't have."

Respondents also noted declines in the population size of some resources, such as marine mammals, some birds, and some marine invertebrates, to which they attribute continued low levels of subsistence use. For example, regarding birds and eggs, a Tatitlek household said,

It was even worse than last year. We are leery of collecting [gull] eggs. There are fewer eggs, and fewer ducks than before the oil spill. The sky is usually black with ducks during herring season, but not this year.

Another Tatitlek household remarked on the decline in the availability of octopus.

[Harvests of shellfish] were even worse than the year before. It was very poor compared to normal. I tried to get octopus but couldn't find any. I could get three a night before the spill. I had to walk ten miles and still didn't find any. I'd still find a few last year, but this year absolutely nothing. I know it is because of the oil spill. They either died or the smell of the oil ruined their homes. That's one of our best foods in the winter.

Quite a few households in 1991 noted that prolonged periods of going without subsistence foods since the spill had caused hardships, and that their desire to again use these foods sometimes outweighed their caution or fears of contamination. As an example, another Tatitlek household talked about seals.

We started craving seal meat. We could only go so long without it. We get tired of eating beef and chicken. We wouldn't touch [seal] that first year after the spill. [Now] subsistence food is on our table at least twice a week.

DISCUSSION AND CONCLUSIONS

In conclusion, the following statement by an English Bay household in 1991 provides a good summary of the ambiguous, uncertain status of subsistence uses in the villages and for many families after the *Exxon Valdez* oil spill.

In 1989, we had nothing [i.e. no subsistence foods]. In 1990, we were scared and confused. We didn't know if we should eat [subsistence resources] or not [i.e. because of concerns about possible oil contamination]. This year [1991] we're going to go for it. We don't care if we die or not. We live mainly ^{on} ~~no~~ subsistence anyway.

To summarize, research by the Division of Subsistence has demonstrated the significance of subsistence uses of fish and wildlife in all the villages whose harvest areas lie within the area affected by the *Exxon Valdez* oil spill. This research has also shown that, in the first year after the spill, subsistence harvest quantities, the range of subsistence foods used, and participation in the use of subsistence foods declined sharply in the villages of Prince William Sound, Lower Cook Inlet, and the Kodiak Island Borough. During the second year, subsistence harvests were up for all but Chenega Bay and Tatitlek, but generally remained below pre-spill averages. Concerns about possible oil contamination of subsistence foods were a primary cause of reduced subsistence uses during the first post-spill year, and continued to affect the subsistence uses of many families, especially in Chenega Bay, Tatitlek, English Bay, and Port Graham, during the second post-spill year as well (cf. Smythe 1990). In addition, households attributed low levels of subsistence uses to observed declines in certain fish and wildlife populations.

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TABLE 1. SAMPLE ACHIEVEMENT, DIVISION OF SUBSISTENCE HOUSEHOLD SURVEY, 1991

Community	Restudy Year (interviewed in 1991)					First Year Sample (interviewed in 1990)					
	Target	Number of Households			Percent	Intrv'd	Number of Households				Percent Re-Interviewed
		Interviewed	Refusals	No Contact			Interviewed	Reintrvw'd	Refusals	No Contact	
Chenega Bay	21	18	0	3	85.7%	18	14	0	3	1	77.8%
Tatitlek	28	17	6	5	60.7%	22	12	2	5	3	54.5%
English Bay	41	35	1	5	85.4%	33	28	1	2	2	84.8%
Port Graham	55	46	2	7	83.6%	48(46) ^b	40	0	3	3	83.3%
Karluk	19	17	1	1	89.5%	14	12	0	0	2	85.7%
Larsen Bay	40	35	5	0	87.5%	34(33) ^c	25	3	0	4	73.5%
Ouzinkie A ^a	29	27	1	1	93.1%	35	27	1	1	5 ^d	77.1%
Ouzinkie B ^a	30	26	2	2	86.7%	NA	NA	NA	NA	NA	NA
Totals	263	221	18	24	84.0%	204	158	7	14	20	77.5% ^e

^a Ouzinkie A represents the 1990 random sample. Ouzinkie B is the remainder of the village households which were interviewed in 1991.

^b Of the 48 interviewed households, two had merged with two others in 1990. Thus, 46 separate households remained. Members of the merged households were included in the 1990 sample. Therefore, 42 of the original 48 households were covered in the 40 interviews.

^c In Larsen Bay, a death eliminated a household. Another death occurred in a second household, and the survivor moved in with another family which was interviewed. Thus a maximum of 32 households could have been reinterviewed. Thus, 26 of the original 34 households were covered in the 25 interviews.

^d Also, a death occurred which eliminated one household.

^e Total of households reinterviewed, refusals, no contact, and moved does not equal 204 because of two households merged with others in Port Graham, a death and a household merger in Larsen Bay, and a death in Ouzinkie.

TABLE 2. SUBSISTENCE HARVESTS OF OIL SPILL STUDY COMMUNITIES, POUNDS USEABLE WEIGHT PER PERSON

<u>Community</u>	<u>Annual Per Capita Harvest in Pounds Useable Weight</u>			
	<u>Pre-spill I</u>	<u>Pre-spill II</u>	<u>1989/1990</u>	<u>1990/1991</u>
<i>Prince William Sound</i>				
Chenega Bay	309	374	148	143
Tatitlek	352	644	215	155
<i>Lower Cook Inlet</i>				
English Bay	289	NA	141	181
Port Graham	227	NA	122	214
<i>Kodiak Island Borough</i>				
Akhiok	519	162	298	NA
Karluk	863	385	251	395
Larsen Bay	404	209	210	340
Old Harbor	491	422	272	NA
Ouzinkie	369	403	89	205
Port Lions	280	333	146	NA
<i>Alaska Peninsula</i>				
Chignik Bay	188	NA	208	NA
Chignik Lagoon	220	NA	211	NA
Chignik Lake	279	NA	448	NA
Ivanof Bay	456	NA	490	NA
Perryville	391	NA	394	NA

^a Pre-spill study years are 1984/85 and 1985/86 for Chenega Bay; 1987/88 and 1988/89 for Tatitlek; 1987 for English Bay and Port Graham; 1982/83 and 1986 for the Kodiak Island Borough; and 1984 for the Alaska Peninsula.

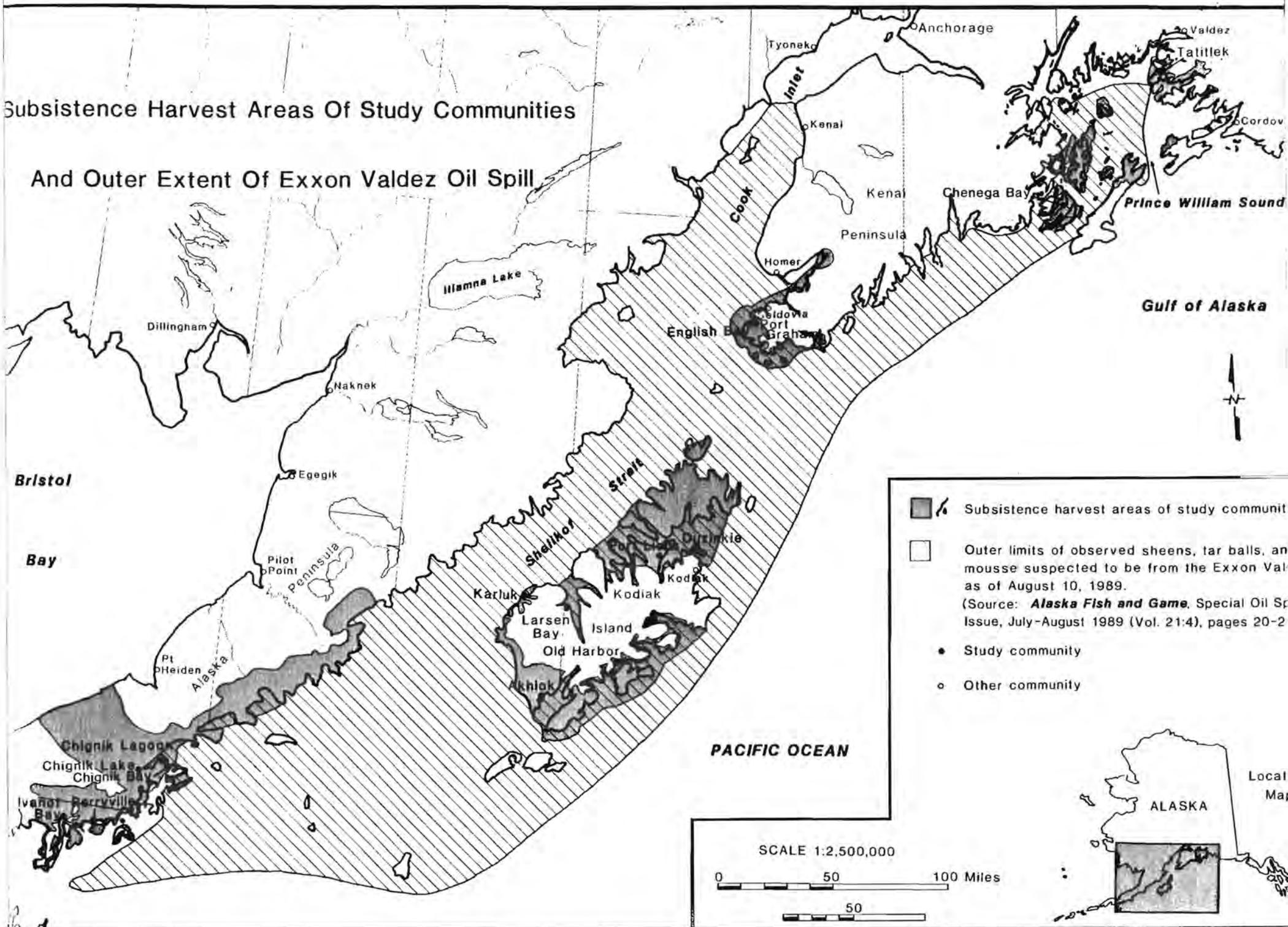
Table 3.
Household Assessment of Change of Overall Subsistence Uses, 1990-1991.

REGION Community	Households Surveyed		CHANGE COMPARED TO FIRST POST-SPILL YEAR								CHANGE COMPARED TO PRE-SPILL NORMS							
	Present*		No Response		Higher		Same		Less		No Response		Higher		Same		Less	
	Post	Pre	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
PRINCE WILLIAM SOUND	32	31	0	0.0%	1	3.1%	3	9.4%	28	87.5%	0	0.0%	0	0.0%	1	3.2%	30	96.8%
Tatitlek	16	16	0	0.0%	1	6.3%	1	6.3%	14	87.5%	0	0.0%		0.0%	1	6.3%	15	93.8%
Chenega Bay	16	15	0	0.0%		0.0%	2	12.5%	14	87.5%	0	0.0%		0.0%		0.0%	15	100.0%
LOWER COOK INLET	81	81	0	0.0%	44	54.3%	24	29.6%	13	16.0%	1	1.2%	8	9.9%	6	7.4%	66	81.5%
English Bay	35	35	0	0.0%	18	51.4%	12	34.3%	5	14.3%	0	0.0%	2	5.7%	1	2.9%	32	91.4%
Port Graham	46	46	0	0.0%	26	56.5%	12	26.1%	8	17.4%	1	2.2%	6	13.0%	5	10.9%	34	73.9%
KODIAK ISLAND	95	93	1	1.1%	55	57.9%	20	21.1%	19	20.0%	0	0.0%	8	8.6%	38	40.9%	47	50.5%
Ouzinkie	49	50	0	0.0%	35	71.4%	10	20.4%	4	8.2%	0	0.0%	4	8.0%	22	44.0%	24	48.0%
Larsen Bay	32	28	0	0.0%	16	50.0%	6	18.8%	10	31.3%	0	0.0%	4	14.3%	11	39.3%	13	46.4%
Karluk	14	15	1	7.1%	4	28.6%	4	28.6%	5	35.7%	0	0.0%		0.0%	5	33.3%	10	66.7%
TOTAL	208	205	1	0.5%	100	48.1%	47	22.6%	60	28.8%	1	0.5%	16	7.8%	45	22.0%	143	69.8%

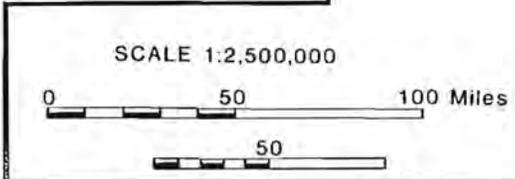
* Pre - Indicates households which were present during the first post-spill year. Pre - Indicates households present prior to 1989.

SOURCE: Division of Subsistence, Alaska Department of Fish & Game, household surveys.

Subsistence Harvest Areas Of Study Communities And Outer Extent Of Exxon Valdez Oil Spill

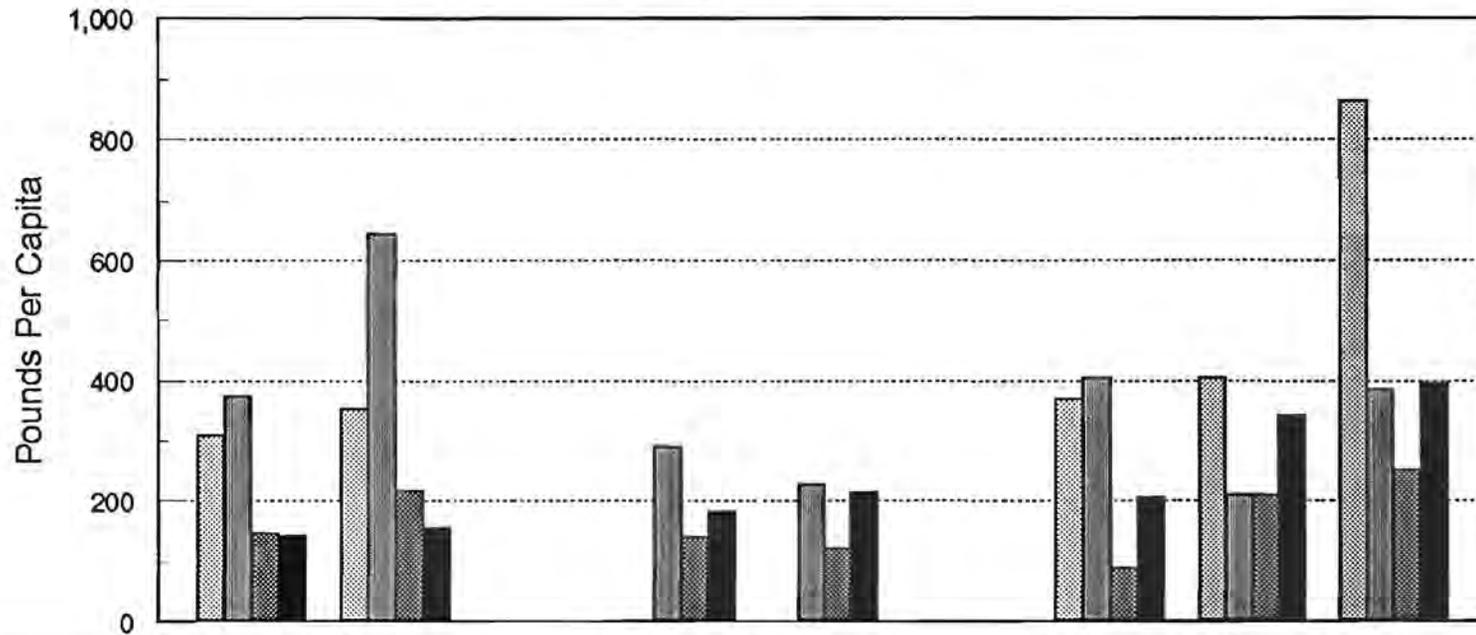


- / Subsistence harvest areas of study communities
- ▨ Outer limits of observed sheens, tar balls, and mousse suspected to be from the Exxon Valdez as of August 10, 1989.
- Study community
- Other community



(Source: *Alaska Fish and Game*, Special Oil Spill Issue, July-August 1989 (Vol. 21:4), pages 20-2)

Figure 2. Per Capita Harvests,
Study Communities



	Chenega Bay	Tatillek		English Bay	Port Graham		Ouzinkie	Larsen Bay	Karluk
Pre-spill year one	308.9	352.0					369.1	403.5	663.0
Pre-spill year two	374.2	644.0		289.0	227.0		402.8	209.0	385.2
Spill Year	148.0	215.0		141.0	122.0		68.8	209.9	250.5
Post-spill year one	143.1	155.2		181.1	213.5		204.9	340.4	395.2

Source: Division of Subsistence, Alaska Department of Fish and Game, Household Survey, 1990-91

Figure 3. Comparison of per capita harvests by Resource Category, Chenega Bay 1984-85, 1985-86, 1989-90, 1990-91

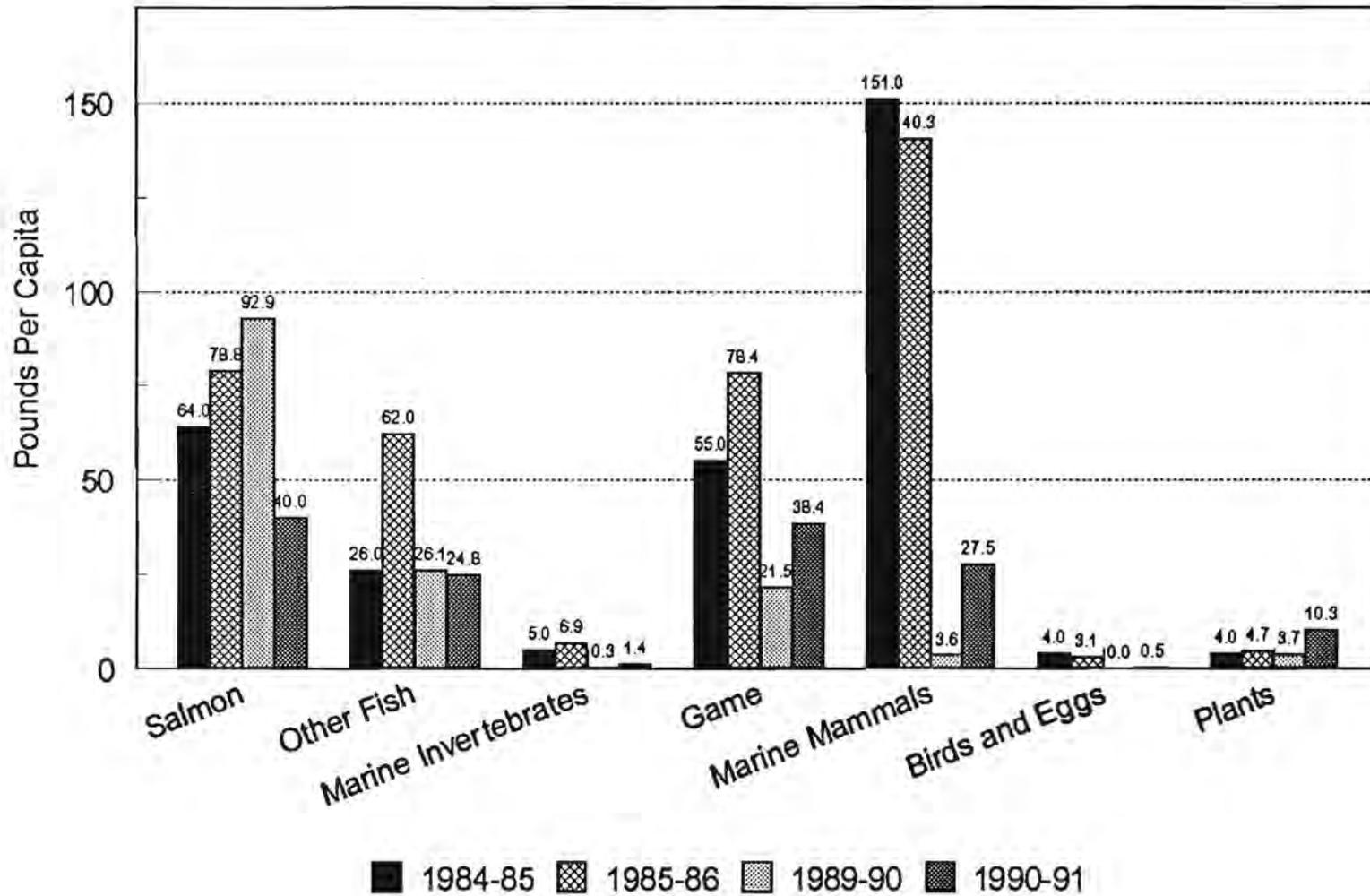


Figure 4. Comparison of per capita harvests by Resource Category, English Bay 1987, 1989, 1990-91

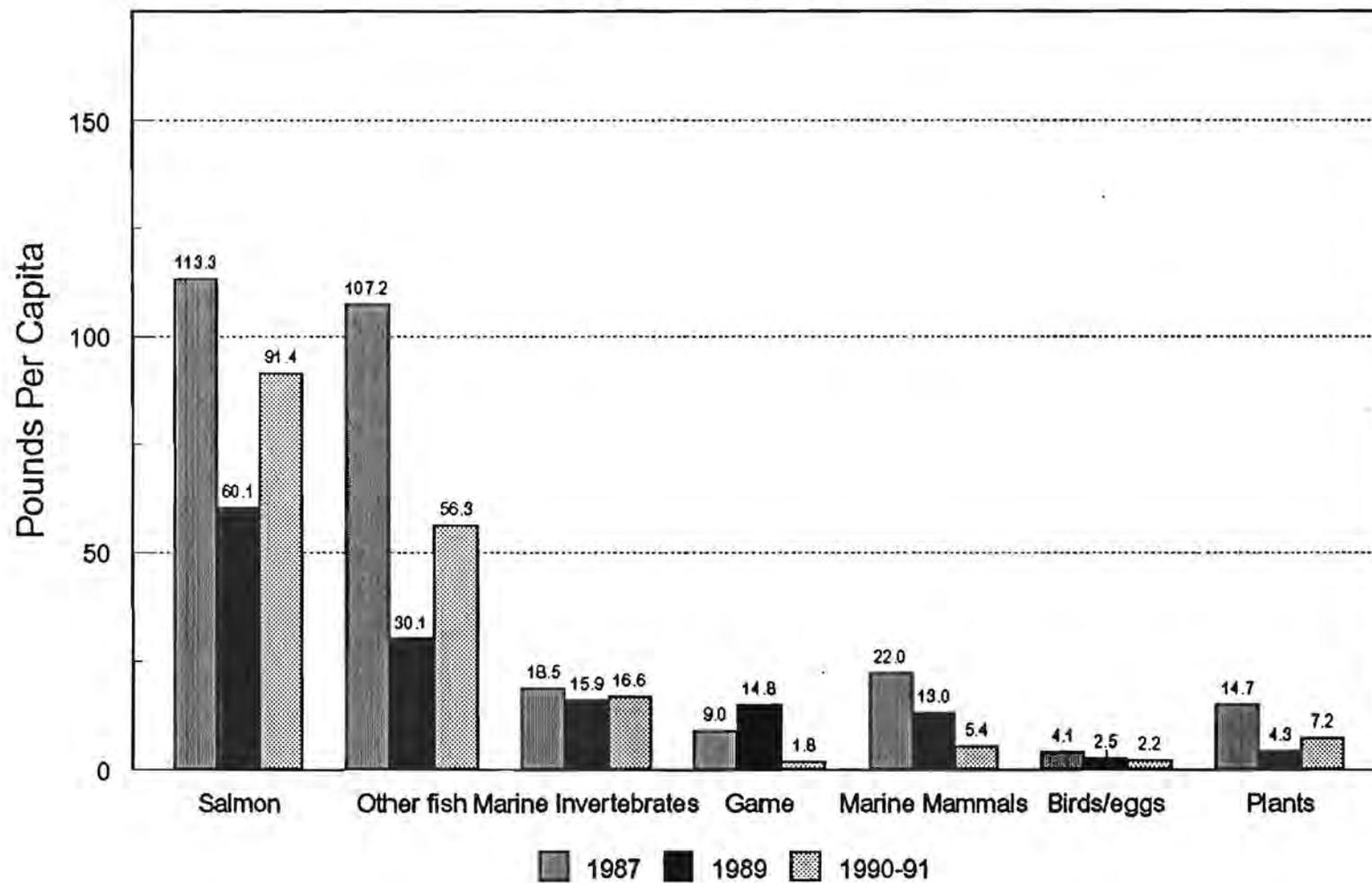


Figure 5. Comparison of Per Capita Harvests by Resource Category, Ouzinkie 1982-83, 1986, 1989, 1990-91

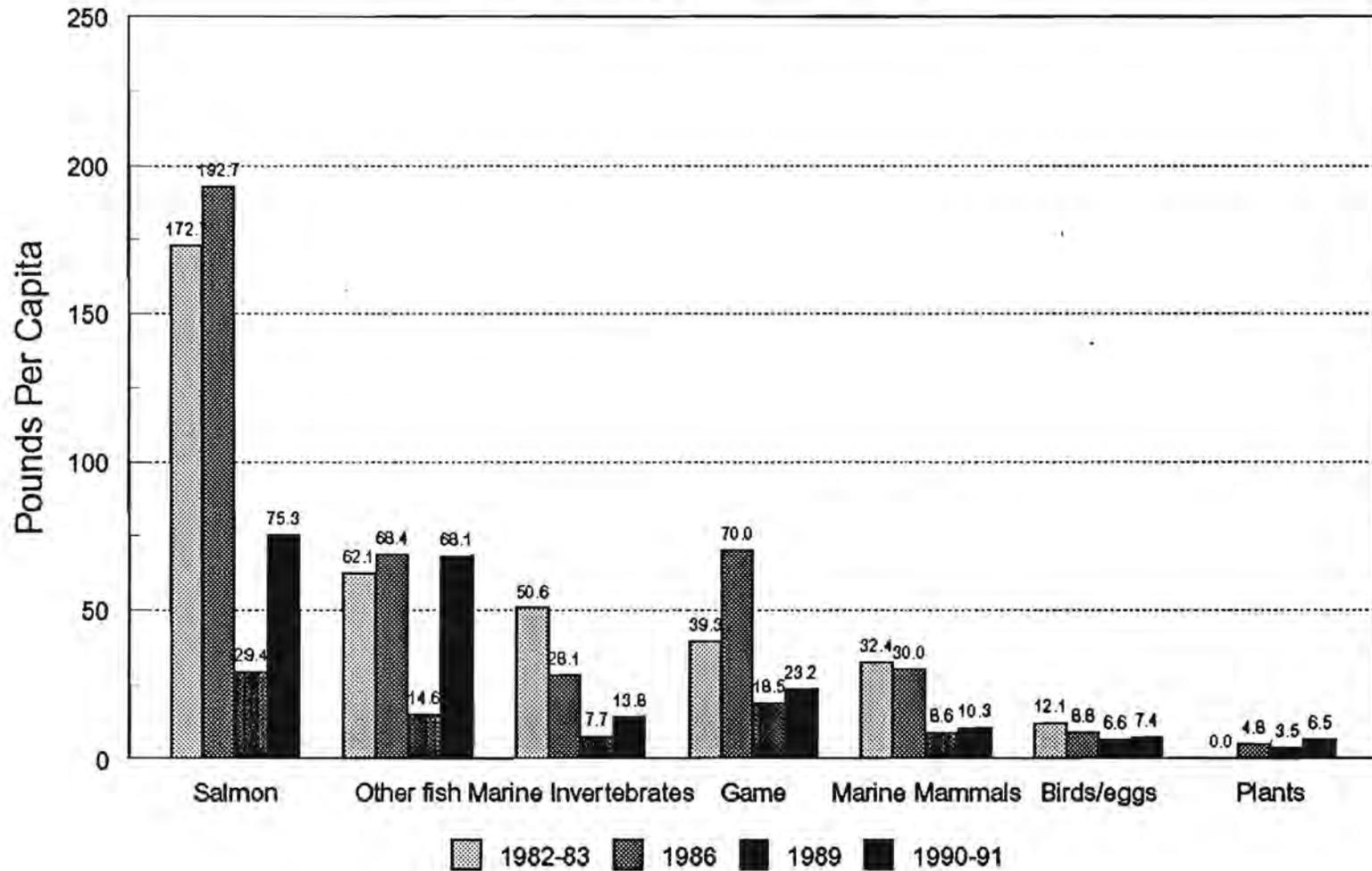
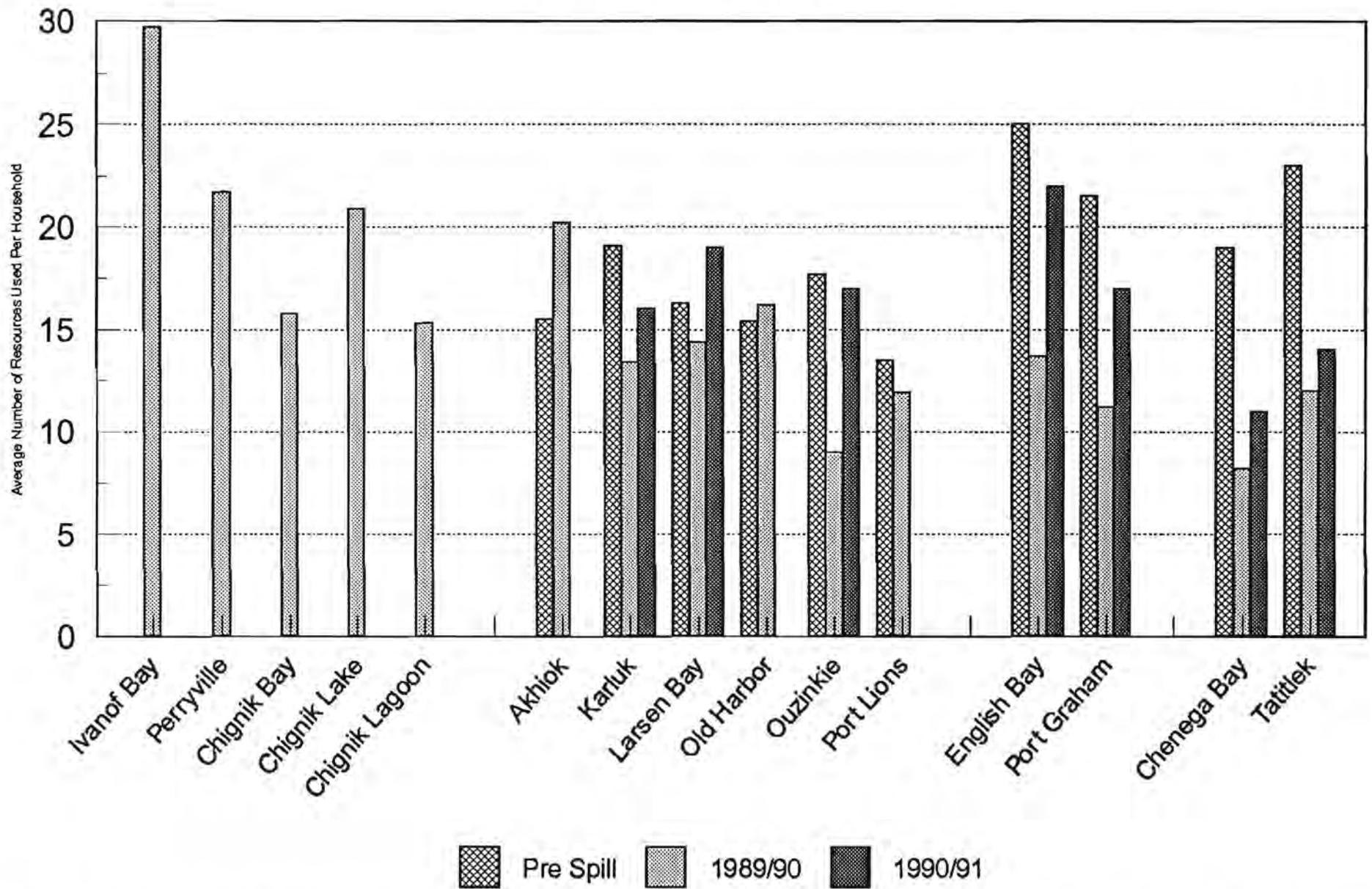


Figure 6. Average Number of Resources Used Per Household, Study Communities



Estimates of Kodiak Pre Spill levels underestimate the range relative to later measurements because species-specific data were not collected for ducks, geese, and some marine invertebrates.

Figure 7. Average Number of Resources Used,
Harvested, Received, and Given Away
Tatitlek, 1987-88, 1988-89, 1989-90, 1990-91

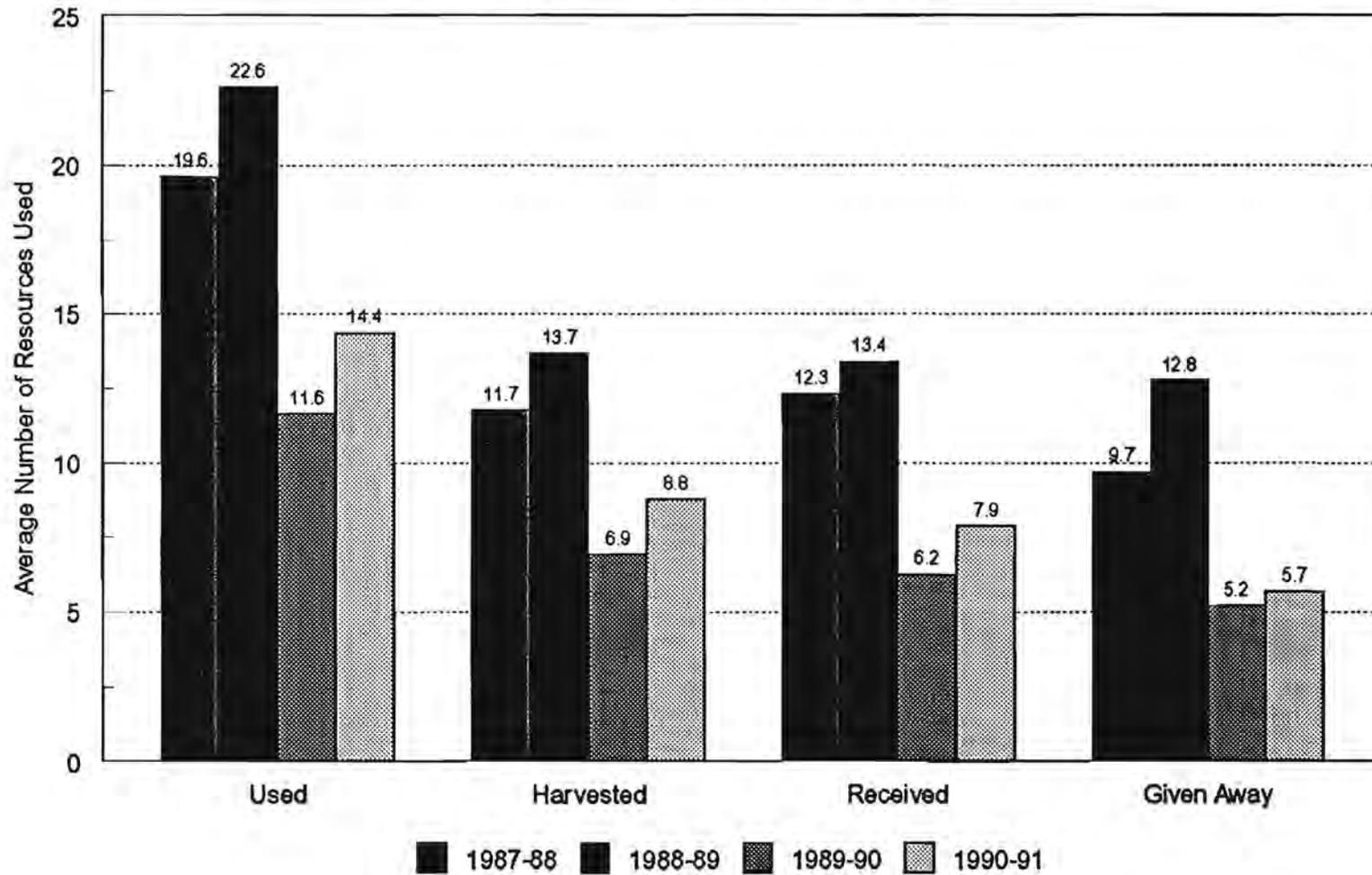
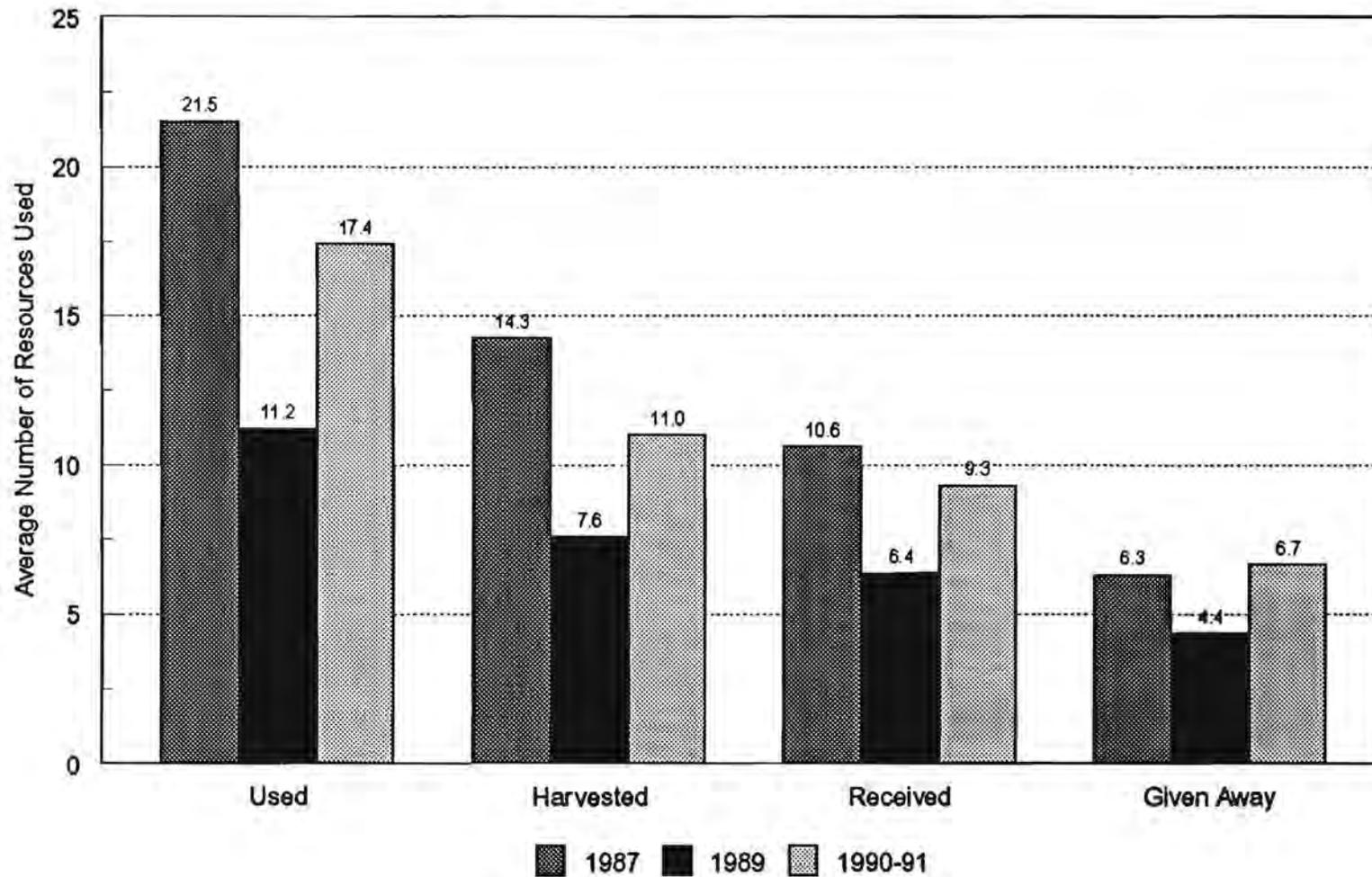
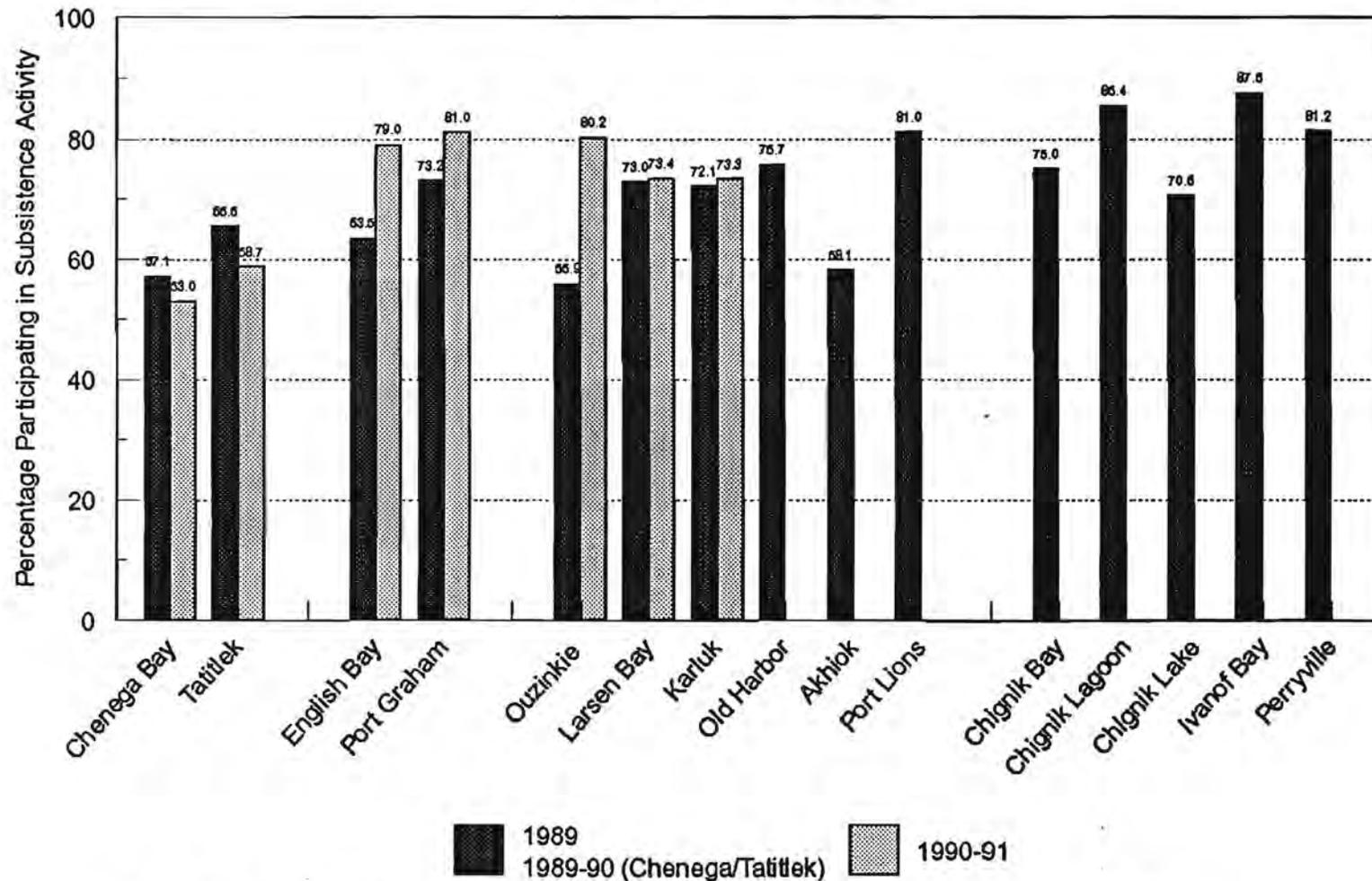


Figure 8. Average Number of Resources Used,
Harvested, Received, and Given Away
Port Graham, 1987, 1989, 1990-91

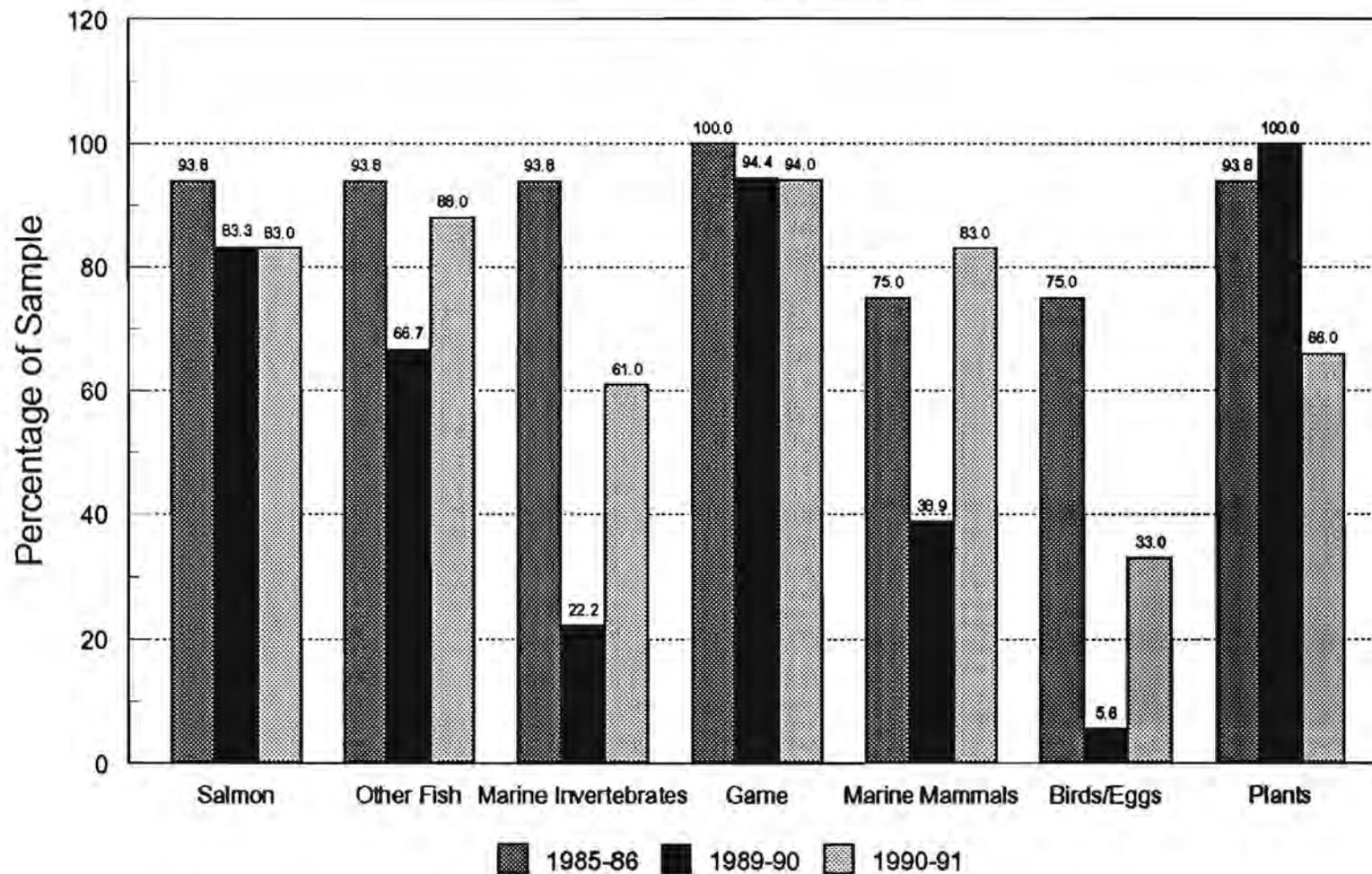


**Figure 9. Percentage of Population Engaging
in Subsistence Activities, Study Communities
1989, 1989-90, 1990-91**



Source: Division of Subsistence, Alaska Department of Fish and Game, Household Survey, 1990-91

Figure 10. Percentage of Sample using Resource
by Category, Chenega Bay,
1985-86, 1989-90, 1990-91



Source: Division of Subsistence, Alaska Department of Fish and Game, Household Survey, 1990-91

Figure 11. Percentage of Sample Using Resources by Category, Ouzinkie, 1982-83, 1986, 1989, 1990-91

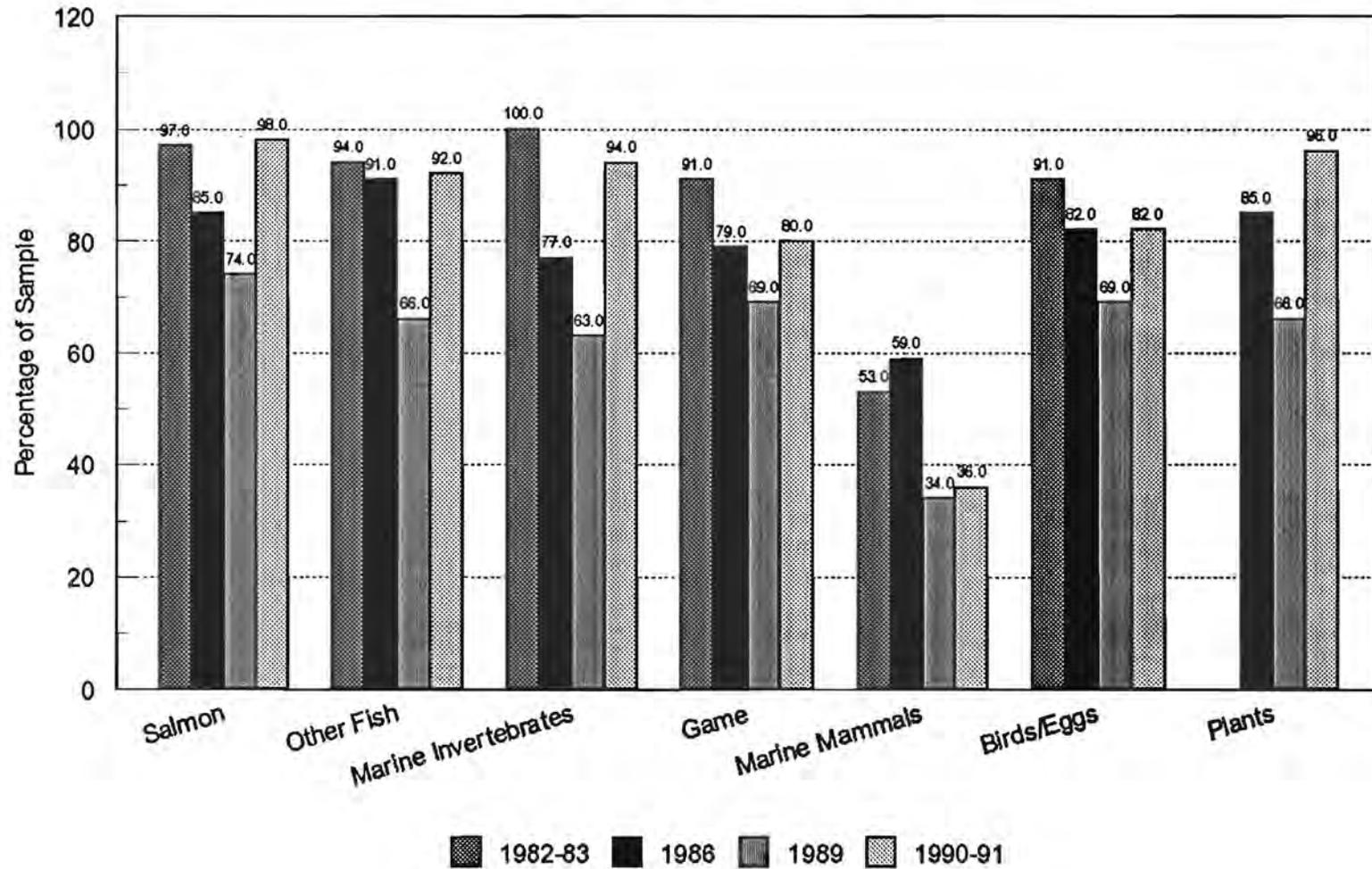


Figure 12. Percentage of Households Reporting Lower Levels of Overall Subsistence Use

