

SUBSISTENCE ECONOMIES IN ALASKA: PRODUCTIVITY, GEOGRAPHY, AND DEVELOPMENT IMPACTS

ROBERT J. WOLFE and ROBERT J. WALKER

Abstract. This paper describes the productivity and geographic distribution of subsistence harvests in Alaska during the 1980s. Subsistence harvests of a statewide sample of 98 communities are presented, analyzed by size, composition, and locations. The analysis indicates that subsistence harvests of fish, land mammals, marine mammals, and other wild resources are making substantial contributions to the economies of most rural communities in Alaska. Community harvest levels tend to increase in areas away from urban centers, not connected by roads to urban areas, with lower degrees of settlement entry and with lower mean personal incomes. These relationships suggest that certain types of economic development can create conditions which diminish subsistence productivity. Construction of roads and settlement entry into roaded areas produce changes associated with lower subsistence harvests, including increased competition for wild resources, increased habitat alteration, and changing community economic orientations away from mixed, subsistence-market adaptations. By recognizing the substantial contributions subsistence harvests make to the state's regional economies, economic development might be planned in ways which enhance, rather than erode, the state's rural subsistence base.

INTRODUCTION

Noncommercial fishing and hunting figure prominently in the economy and social welfare of many Alaskan communities. Even so, it is a relatively hidden component of Alaska's economy, unmeasured in the state's indices of economic growth or social welfare and neglected in the state's economic development policy. The state has never estimated the amounts of wild fish and game produced and utilized each year in Alaskan communities, though these harvests are of significant economic value. These wild foods and materials, if absent, would have to be replaced by imported substitutes at some economic and social cost. Further, there has been no statewide picture of the geographic areas currently dependent upon wild resource harvests. The relative extent to which regions utilize wild resources as part of their regional economies has been unknown.

Understanding Alaska's "hidden economy" is particularly important during this recent period of rapid economic change due to petroleum exploration and development on Alaska's north slope. During the oil boom from the

middle 1970s to the early 1980s, the state administration followed an economic development policy which stimulated rapid population growth, primarily through in-migration from people outside the state to Alaska's urban centers (Goldsmith et al. 1984; Williams 1985). Using oil revenues, the state created employment in capital construction projects and expanded government services which stimulated in-migration. Alaska became the most rapidly growing state; its population increased 3.6% a year since the middle 1970s, and increased 30% overall from 1980 to 1985. The population boom had ended by 1986 with declining world oil prices and state spending (Alaska Department of Labor 1986).

While the state's economic spending during the oil boom clearly has resulted in short-term economic benefits for many regions, it is possible that the stimulation of rapid growth in the state's population centers (Anchorage, Fairbanks, and Juneau) may have certain negative impacts on the established subsistence sector of the state's economy. By understanding the regional importance of subsistence to Alaska's economy and social welfare, future economic development may be

Robert J. Wolfe and Robert J. Walker, Division of Subsistence, Alaska Department of Fish and Game, P.O. Box 3-2000, Juneau, AK 99802

planned in ways which enhance, rather than erode, the state's subsistence economic base.

This paper describes the productivity and geographic distribution of subsistence harvests in Alaska during the 1980s. The subsistence productivity of a statewide sample of communities is presented, using harvest levels as the measure of productivity. The size, composition, and geographic distribution of harvests are analyzed to explore general statewide relationships of subsistence productivity with roads, settlement entry, and community income. The analysis examines conditions of historic development in Alaska which have enhanced or eroded subsistence productivity in rural areas.

METHODOLOGY

The harvests of fish, land mammals, marine mammals, and other wild resources in 98 communities comprise the data set for this comparative analysis (Fig. 1, Table 1). Harvest levels derive primarily from recent subsistence studies conducted between 1980-1985 by researchers in the Division of Subsistence, Alaska Department of Fish and Game, a relatively new, applied anthropological research unit funded by the state to conduct subsistence studies (Table 1). Additional sources of information include Burch (1985), Fienup-Riordan (1983), Halpin (1985), and Little and Robbins (1984).

Except for four large population centers, harvests were documented in each community through detailed retrospective interviews with harvesters from a sample of households. Harvesters were asked to estimate the quantities of particular species harvested and used by members of that household during the previous 12 month period. Harvests represent a single year's production from a complete seasonal round. Each source should be consulted for details about methodologies employed.

For this analysis, harvests were converted to a common unit for comparison, pounds dressed weight per capita per year, by multiplying the harvests of households within each community by standard factors, converting round to dressed weight, summing across households, and dividing by the total number of household members in the household sample. Although it varies by community and species, in general "dressed weight" is about 70-75% of round weight for fish, 60-65% of round weight for game, and 20-60% of round weight for marine mammals. Dressed weight is the portion of the kill brought into the kitchen for use, including bones for particular species. It represents an estimate of the pounds of usable wild resources harvested by the sampled households during the study year.

Harvests of particular species were combined into four general resource categories. "Fish" contains varieties such as salmon, whitefish, herring, char, halibut, and pike. "Land mammals" comprise species such as moose, caribou, deer, black bear, snowshoe and tundra hare, beaver, and porcupine. "Marine mammals" consist of seal, walrus, and whale. "Other" contains birds, marine invertebrates, and certain plant products such as berries.

Harvests for four large urban population centers (Anchorage, Fairbanks, Juneau, and the Matanuska-Susitna Borough) were developed from statewide harvest data gathered by the Divisions of Game and Sport Fish, Alaska Department of Fish and Game. Urban game harvests are estimated through returned game harvest tickets authorized under general state hunting regulations, corrected for an estimated nonreturn rate and augmented by field biologist estimates from nonreportable hunt areas (Alaska Department of Fish and Game 1985). Urban sport fish harvest estimates derive from a survey mailed to a random statewide sample of anglers (Mills 1984). For this analysis, game and sport fish harvests were disaggregated by urban residency, converted to pounds, and divided by the 1983 urban population (Alaska Department of Labor 1985). No per capita harvest estimates for the "marine mammals" or "other" categories are available for the four urban areas. However, each is considered to be negligible in comparison with game and fish.

Estimates of income levels within communities were drawn from 1982 income tax return summaries (Alaska Department of Revenue 1985). They represent the 1982 mean taxable income per income tax return by community (gross income minus allowable deductions). Ethnic composition of communities was obtained from the 1980 United States census (U.S. Bureau of the Census 1984), unless updated within a particular subsistence harvest study.

Each community is treated as a single unit of analysis. Under this method, the assumption is that the group of 98 communities is a sample of all communities in Alaska. Each community receives equal weighting in analysis, regardless of population size.

The group of communities is a large, but certainly incomplete, sample of all Alaska communities. Collectively, they represent about 29% of the state's population outside the large population centers and 96% of the state's urbanized areas recognized under federal subsistence legislation (Table 2). The geographic areas most seriously underrepresented in the community sample are the Arctic Coast, where relatively complete, reliable harvest data exist for only Gambell, Kaktovik, Kivalina, and Nuiqsut, and portions of the Subarctic

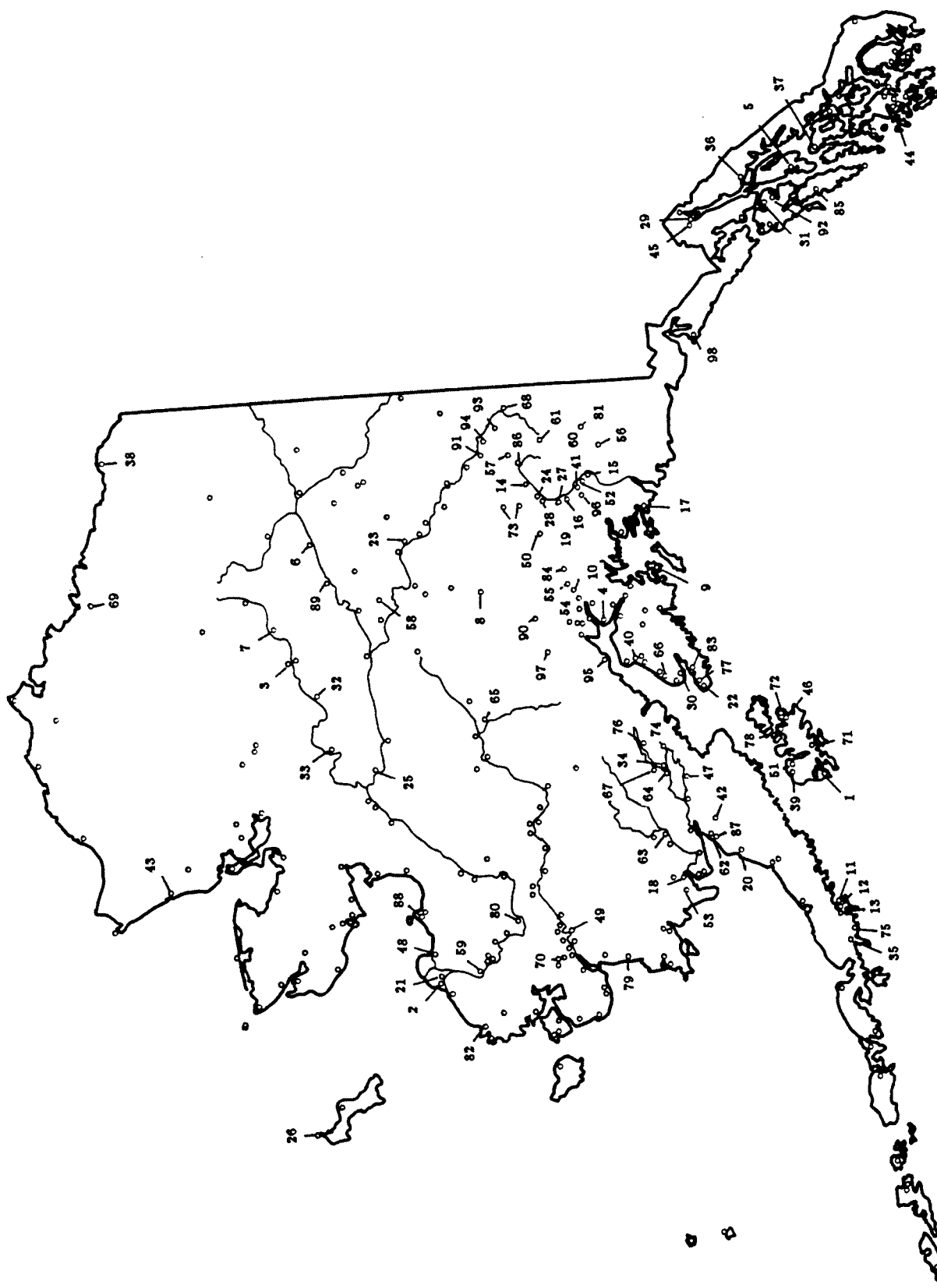


Figure 1. Communities in Alaska. Sampled communities are numbered. (See also Table 3.)

TABLE 1. SAMPLED COMMUNITIES BY REGION AND SOURCE.

Alaska Peninsula

Chignik Bay	Morris 1985b
Chignik Lagoon	Morris 1985b
Chignik Lake	Morris 1985b
Egegik	Morris 1985b
Ivanof Bay	Morris 1985b
King Salmon	Morris 1985a
Naknek	Morris 1985a
Perryville	Morris 1985b
South Naknek	Morris 1985a

Copper Basin

Cantwell	Stratton and Georgette 1984
Chickaloon	Stratton and Georgette 1984
Chistochina	Stratton and Georgette 1984
Chitina	Stratton and Georgette 1984
Copper Center	Stratton and Georgette 1984
E. Glenn Hwy.	Stratton and Georgette 1984
Gakona	Stratton and Georgette 1984
Glennallen	Stratton and Georgette 1984
Gulkana	Stratton and Georgette 1984
Kenny Lake	Stratton and Georgette 1984
Lake Louise	Stratton and Georgette 1984
Lower Tonsina	Stratton and Georgette 1984
Matsu Glacier	Stratton and Georgette 1984
McCarthy	Stratton and Georgette 1984
Mentasta	Stratton and Georgette 1984
Nabesna Road	Stratton and Georgette 1984
N. Wrangell Mts.	Stratton and Georgette 1984
Paxson-Sourdough	Stratton and Georgette 1984
Sheep Mt.	Stratton and Georgette 1984
Slana	Stratton and Georgette 1984
S. Wrangell Mts.	Stratton and Georgette 1984
Upper Tonsina	Stratton and Georgette 1984

Kenai Peninsula

English Bay	Stanek 1985
Homer	Reed 1985
Kenai	Reed 1985
Ninilchik	Reed 1985
Port Graham	Stanek 1985
Seldovia	Reed 1985

Kodiak Island

Akhiok	Kodiak Area Native Association 1983
Karluk	Kodiak Area Native Association 1983
Kodiak City	Kodiak Area Native Association 1983
Larsen Bay	Kodiak Area Native Association 1983
Old Harbor	Kodiak Area Native Association 1983
Ouzinkie	Kodiak Area Native Association 1983
Port Lions	Kodiak Area Native Association 1983

North Slope

Kaktovik	Pedersen 1987
Nuiqsut	Pedersen 1987

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Interior, especially the Kuskokwim River and lower-middle Yukon River areas. The statistical comparisons that follow should be considered an exploratory picture of statewide subsistence harvests because of these data gaps.

In statistical analysis, stepwise regression was performed on the data set with SPSS/PC (Norusis 1984). PIN (the probability of F-to-enter) was set at 0.05; POUT (the probability of F-to-remove) was set at 0.1. Tolerance was set at 0.01. Indicator variables (Neter and Wasserman 1974) were used to allow certain qualitative variables to enter the regression model (geographic region). A qualitative variable with *n* categories was transformed into *n*-1 indicator variables where the indicator variable had a value of 0 to 1. Contour maps of harvests were generated using SURFACE II (Sampson 1978). This program calculates for each possible X-Y coordinate (grid node) a weighted average of the projected slopes of the five nearest data points. Smooth contour lines are generated with the estimated height and slope of the grid node.

FINDINGS

Harvesting of fish, land mammals, marine mammals, and other wild resources occurs in Alaskan communities at substantially different levels, as indicated by the harvests of the 98 sampled communities (Fig. 2, Table 3). As shown in Figure 2 and Table 3, total annual per capita harvests vary tremendously between communities, from a low of 10 lbs (urban Anchorage), to a high of 1498 lbs (Hughes, a community on the Koyukuk River), with a median harvest of 252 lbs (Slana, a community in the Copper Basin region).

Subsistence harvests are making substantial contributions to the welfare of many rural Alaskan communities. This is seen by comparing harvest levels with the average per capita purchases of meat, fish, and poultry in the western United States as a whole. About 222 lbs

TABLE 1 (Continued).

<i>Northwest Arctic</i>	
Gambell	Little and Robbins 1984
Kivalina	Burch 1985
<i>North Cook Inlet</i>	
Tyonek	Fall, Foster, and Stanek 1984
Yentna	Fall, Foster, and Stanek 1983
<i>Prince William Sound</i>	
Chenega Bay	Stratton and Chisum 1986
Cordova	Stratton 1987
<i>Southeast</i>	
Angoon	George 1985
Haines	Mills, George, Kookesh, and Sumida 1984
Hoonah	Schroeder 1987
Take	Firman 1987
Klukwan	Mills, George, Kookesh, and Sumida 1984
Klawock	Ellanna and Sherrod 1987
Sitka	Gmelch and Gmelch 1984
Tenakee Springs	Leghorn and Kookesh 1986
Yakutat	Mills and Firman 1986
<i>Southwest</i>	
Dillingham	Fall, Schichnes, Chythlook, and Walker 1986
Iliamna	Morris 1986
Kokhanok	Morris 1986
Manokotak	Schichnes 1987
Newhalen	Morris 1986
New Stuyahok	Wolfe et al. 1984
Nondalton	Behnke 1982
Pedro Bay	Morris 1986
Port Alsworth	Morris 1986
<i>Upper Tanana</i>	
Northway	Haynes 1984
Tanacross	Haynes 1984
Tetlin	Halpin 1985
Tok	Haynes 1984
<i>Urban</i>	
Anchorage	ADFG 1985; Mills 1984
Fairbanks	ADFG 1985; Mills 1984
Juneau	ADFG 1985; Mills 1984
Matsu Borough	ADFG 1985; Mills 1984
Talkeetna	Fall and Foster 1987
<i>Western</i>	
Alakanuk	Wolfe 1981
Emmonak	Wolfe 1981
Kotlik	Wolfe 1981
Kwethluk	Coffing 1987

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of meat, fish, and poultry are purchased (and brought into the family kitchen) for each person each year in the western states, depicted as the upper horizontal line in Figure 2 (U.S. Department of Agriculture 1983). On average, about 1370 lbs of all foods are consumed per person per year in the United States (U.S. Department of Commerce 1984). Thus, the wild resource harvests in 46% of the sampled Alaskan communities are at levels matching or exceeding the western U.S. average of meat, fish, and poultry use. The wild resource harvests in 84% of the sampled Alaska communities are at levels which are at least half or greater than this western United States standard. The federal government recommends that American families on a "low cost food plan" purchase at least 163 lbs per capita of meat, fish, and poultry each year, represented by the lower line in Figure 2 (University of Alaska 1984). Of the sampled Alaskan communities, 69% are harvesting wild food resources at levels exceeding this recommended federal standard for meat, fish, and poultry use.

Clearly, a large proportion of communities in the statewide sample are harvesting wild resources at high levels relative to these national averages. Subsistence harvests are making major economic contributions to the welfare of Alaskan residents in the 1980s.

HARVESTS BY ECOLOGICAL ZONE

Subsistence harvests of communities are grouped into five general ecological zones (Fig. 3, Table 4), which were also historic culture areas: Arctic-Subarctic Coast (Inupiaq-Yup'ik), Aleutian-Pacific Coast (Aleut-Sugpiaq), Subarctic Interior (Athapaskan), Northwest Coast (Tlingit-Haida), and Other (contemporary urban population centers). The Arctic-Subarctic Coast displays the greatest subsistence harvest of the five ecological zones (610 lbs per capita), due primarily to relatively greater harvests of

TABLE 1 (Continued).

<i>Western</i>	
Mt. Village	Wolfe 1981
Nunapitchuk	Andrews 1985
Quinhagak	Wolfe et al. 1984
Russian Mission	Pete 1985
Scammon Bay	Fienup-Riordan 1983
Stebbins	Wolfe 1981
<i>Yukon-Koyukuk</i>	
Allakaket-Alatna	Marcotte and Haynes 1984
Beaver	Sumida and Alexander 1987
Bettles-Evansville	Marcotte and Haynes 1984
Galena	Marcotte 1987
Hughes	Marcotte and Haynes 1984
Huslia	Marcotte 1986
Minto	Andrews 1985
Nikolai	Stokes 1984
Stevens Village	Sumida 1986

fish and marine mammals. Next in total output are the Aleutian-Pacific Coast (378 lbs) and Subarctic Interior (377 lbs). The land mammal harvests of the Subarctic Interior are not substantially different from the Arctic-Subarctic Coast land mammal harvests. The Northwest Coast is fourth (212 lbs). Historically rich in fish, the Northwest Coast currently displays lower subsistence fish harvests than the other ecological zones. Finally, the lowest harvests (48 lbs) are displayed by communities in densely populated areas, treated separately for this comparison.

Fishing output is greater than hunting in all ecological zones, comprising 57-68% of the total subsistence output (Table 4). Hunting of land and marine mammals contribute from 25-34% of subsistence outputs. These proportions tend to support Lee's (1968:41-48) hypothesis linking resource composition to latitude: fishing predominates in the foraging economies of cold temperate latitudes (40-59°) while hunting provides about 20-35% of resources harvested for foragers at all latitudes. Communities in this contemporary Alaska sample lie above 55° north latitude. However, Lee's hypothesis that hunting predominates above 60° latitude is in need of refinement. Of the 60 sampled Alaska communities above 60° north latitude, in only 17 does hunting outstrip fishing in productivity. In general, it may be stated that fishing predominates in most Alaska communities above 60° latitude, except the extreme Arctic Coastal sea mammal-caribou hunting communities.

HARVESTS BY REGION

Figure 4 provides a breakdown of subsistence harvests by geographic region. It shows that the lowest fish and game harvests (30 lbs per capita) occur in the urban areas of Anchorage, Fairbanks, Juneau, and the Matanuska-Susitna Borough (which borders Anchorage). Next in order of magnitude are the Kenai Peninsula (96 lbs), Copper Basin (149 lbs), Southeast Region (212 lbs), Upper Tanana River (218 lbs), Prince William Sound (256 lbs), Northern Cook Inlet (265 lbs), Alaska Peninsula (290 lbs), North Slope (364 lbs), Kodiak Island (426 lbs), Southwest Region (626 lbs), Western Region (732 lbs), Yukon-Koyukuk Region (839 lbs), and Northwest Arctic Region (1067 lbs).

The spatial relationships of the regional harvests are depicted as three maps in Figures 5-7.

Harvest levels are shown as topographic contours with intervals of 50 or 100 lbs per capita. The contours were generated by a mathematical algorithm averaging the harvest outputs of the five nearest communities at any geographic locus.

In Figure 5, three areas show total harvests lower than the 100 lbs contour: Cook Inlet (Anchorage, Matanuska-Susitna Borough, eastern Kenai Peninsula), Fairbanks, and Juneau. Farther away from these urban low points, subsistence harvests tend to increase rapidly. Crossing west over the Alaska Range from Anchorage finds communities harvesting between the 600-800 lbs contours. Similarly, moving west from Fairbanks, subsistence harvests increase precipitously near the Yukon River. The highest peaks in total output are along the Koyukuk River and in the extreme northern Bering Sea coastal reaches. Westward along the Pacific Coast, subsistence harvests increase more gradually across Kodiak Island, reaching the 300-500 lbs levels in the Aleutian-Bristol Bay regions. Figures 6 and 7 provide the same geographic distributions for fish and land mammal harvests separately.

In general, these maps indicate that subsistence productivity increases as one moves away from the urban population centers. This generalization is supported by Figure 8, which shows a positive correlation between subsistence output and distance from an urban center ($r=.55$, .000 sig.).

TABLE 2. SAMPLE SIZE BY REGION.

Region	1984 Population	Number	Sampled Communities	
			Population	Percent
Kenai Peninsula-				
N. Cook Inlet	38,285	8	10,985	28.7
Interior	37,471	13	3,044	8.1
Southeast	37,148	9	11,593	31.2
Arctic	18,939	4	1,235	6.5
Western	16,631	10	4,411	26.5
Kodiak Island	12,381	7	12,381	100.0
Alaska Peninsula-				
Aleutian Islands	9,389	9	1,595	17.0
Copper Basin-Prince				
William Sound	8,730	24	5,325	61.0
Southwest	5,171	9	3,291	63.6
Subtotal	184,145	93	53,860	29.2
Anchorage	243,829	1	243,829	100.0
Fairbanks	41,509	1	41,509	100.0
Matanuska-				
Susitna Borough	29,836	2	29,836	100.0
Juneau Borough	23,729	1	23,729	100.0
Subtotal	338,903	5	338,903	100.0
Total	523,048	98	392,763	75.1

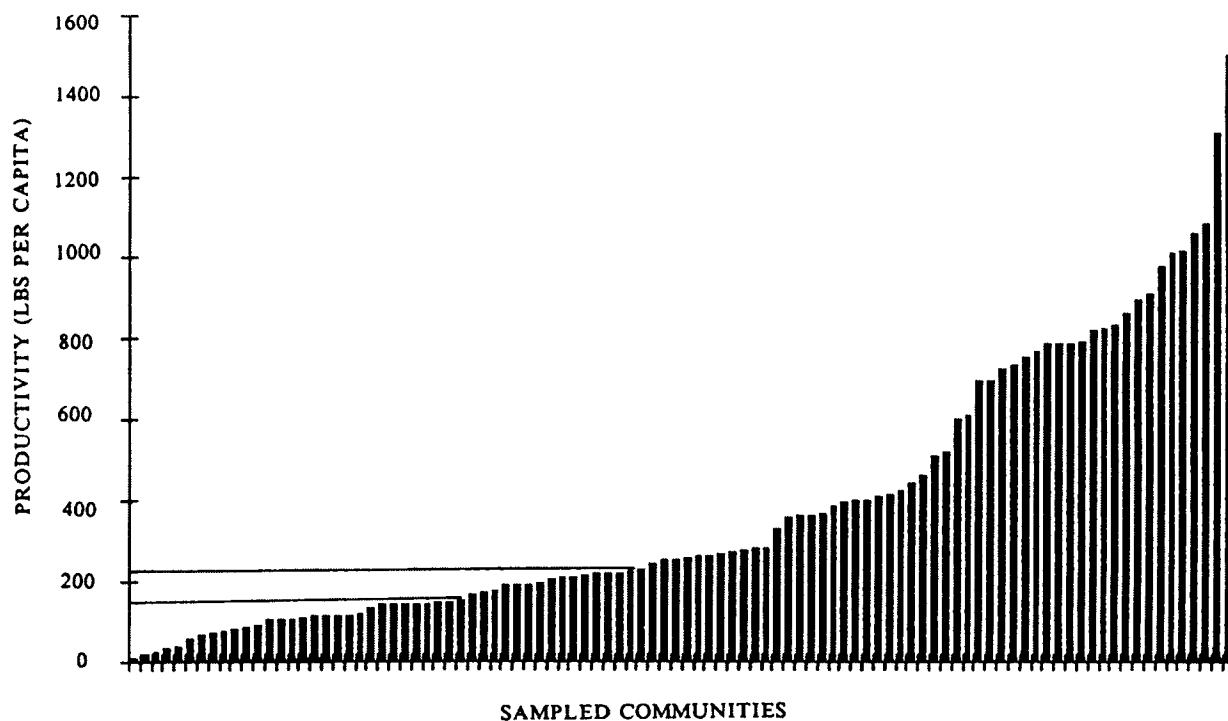


Figure 2. Resource Harvests by Community. Upper and lower lines indicate U.S. mean and recommended use of purchased meat, fish, and poultry.

TABLE 3. RESOURCE HARVESTS BY COMMUNITY (POUNDS PER CAPITA).

COMMUNITY	TOTAL	FISH	LAND MAMMAL	MARINE MAMMAL	OTHER
1 Akhiok	518	253	74	145	46
2 Alakanuk	733	480	71	129	53
3 Allakaket-Alatna	909	734	143	0	32
4 Anchorage	10	5	5	0	0
5 Angoon	216	120	58	17	21
6 Beaver	723	496	176	0	52
7 Bettles-Evansville	260	107	143	0	10
8 Cantwell	130	31	95	0	4
9 Chenega	361	88	73	140	60
10 Chickaloon	213	79	119	0	17
11 Chignik Bay	196	167	14	5	10
12 Chignik Lagoon	229	145	59	3	22
13 Chignik Lake	282	162	109	3	8
14 Chistochina	115	52	49	0	14
15 Chitina	190	124	53	0	13
16 Copper Center	113	94	15	0	6
17 Cordova	151	95	40	1	15
18 Dillingham	242	159	66	3	14
19 East Glenn Highway	144	81	53	0	10
20 Egegik	385	109	246	0	30
21 Emmonak	612	429	57	94	32
22 English Bay	147	129	1	8	9
23 Fairbanks	22	8	14	0	0
24 Gakona	192	132	54	0	6
25 Galena	787	606	170	0	10
26 Gambell	1309	254	0	838	217
27 Glennallen	71	38	30	0	3
28 Gulkana	114	71	39	0	6
29 Haines	114	72	30	1	11
30 Homer	103	50	28	0	25
31 Hoonah	209	86	57	21	44
32 Hughes	1498	1239	229	0	30
33 Huslia	1082	645	397	0	40
34 Iliamna	416	362	33	22	19
35 Ivanof Bay	445	290	96	21	38
36 Juneau	34	21	13	0	0
37 Kake	217	115	27	26	49
38 Kaktovik	328	61	189	57	21
39 Karluk	835	643	92	83	17
40 Kenai	38	25	6	0	7
41 Kenny Lake	78	34	38	0	5
42 King Salmon	220	118	102	0	0
43 Kivalina	824	211	318	290	5
44 Klawock	223	126	36	14	47
45 Klukwan	174	151	14	2	7
46 Kodiak City	143	102	21	3	17
47 Kokhanok	697	606	68	0	22
48 Kotlik	510	296	71	105	40
49 Kwethluk	792	671	59	8	54

(continued)

TABLE 3 (continued).

COMMUNITY	TOTAL	FISH	LAND MAMMAL	MARINE MAMMAL	OTHER
50 Lake Louise	172	88	58	0	26
51 Larsen Bay	400	224	76	56	44
52 Lower Tonsina	120	83	29	0	8
53 Manokotak	411	236	95	50	30
54 Matsu	17	5	12	0	0
55 Matsu Glacier	104	34	60	0	10
56 McCarthy Road	140	60	73	0	8
57 Mentasta Lake	109	25	69	0	15
58 Minto	1015	860	122	0	33
59 Mountain Village	822	648	130	23	18
60 N. Wrangell Mts.	208	73	135	0	2
61 Nabesna Road	280	143	129	0	6
62 Naknek	188	121	66	1	0
63 New Stuyahok	896	538	322	0	36
64 Newhalen	767	707	40	6	15
65 Nikolai	785	391	353	0	41
66 Ninilchik	87	59	9	0	19
67 Nondalton	976	771	190	0	14
68 Northway	275	118	132	0	25
69 Nuiqsuit	400	177	169	33	20
70 Nunapitchuk	697	562	41	11	82
71 Old Harbor	464	274	84	74	32
72 Ouzinkie	358	211	68	29	50
73 Paxson-Sourdough	164	49	108	0	8
74 Pedro Bay	865	790	54	0	21
75 Perryville	396	276	85	18	17
76 Port Alsworth	361	251	97	0	13
77 Port Graham	145	112	1	22	10
78 Port Lions	262	176	42	7	37
79 Quinhagak	756	491	113	128	24
80 Russian Mission	599	503	96	0	0
81 S. Wrangell Mts.	203	57	136	0	10
82 Scammon Bay	787	583	38	98	68
83 Seldovia	54	30	8	0	16
84 Sheep Mountain	73	45	26	0	3
85 Sitka	141	106	26	0	9
86 Slana	252	123	116	0	13
87 South Naknek	268	101	167	0	0
88 Stebbins	1012	622	17	322	51
89 Stevens Village	1058	943	94	0	21
90 Talkeetna	66	49	11	0	6
91 Tanacross	86	37	36	0	13
92 Tenakee Springs	250	113	65	4	68
93 Tetlin	424	322	76	0	26
94 Tok	144	64	69	0	11
95 Tyonek	272	201	57	3	11
96 Upper Tonsina	102	59	37	0	6
97 Upper Yentna	257	99	151	1	6
98 Yakutat	369	212	52	24	81

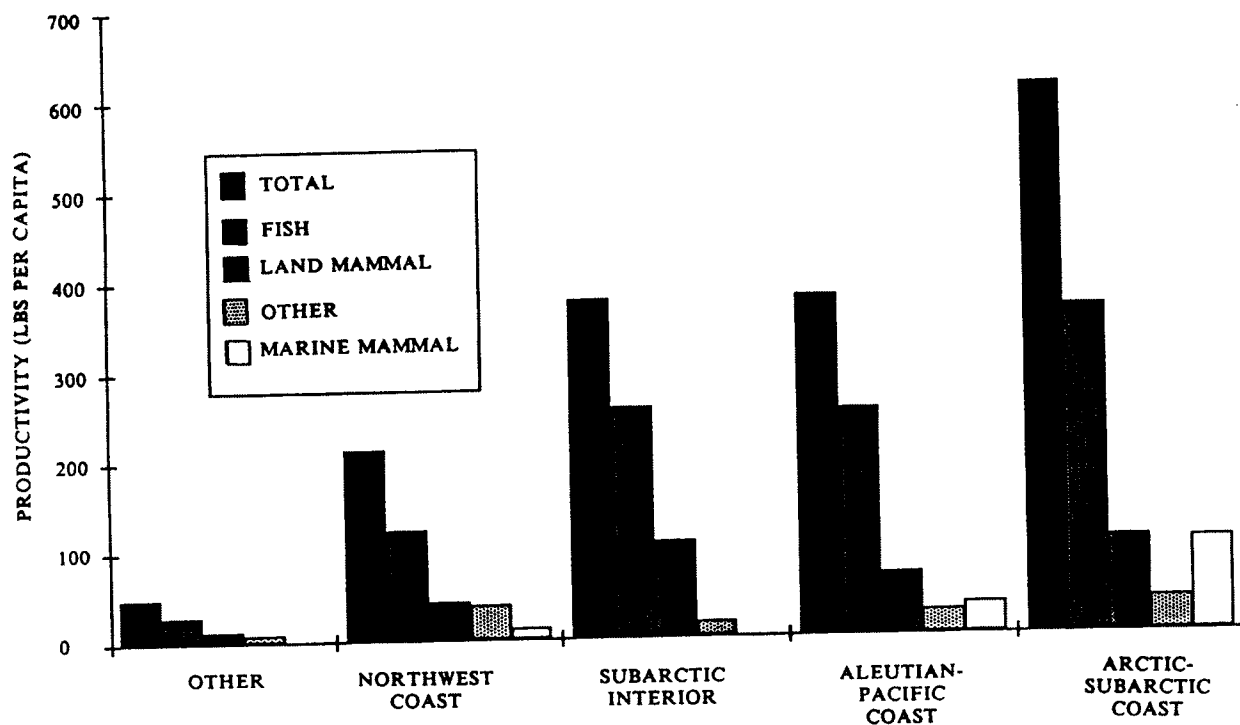


Figure 3. Resource Harvests by Ecological Zone (Culture Area).

TABLE 4. RESOURCE HARVEST BY ECOLOGICAL ZONE (POUNDS PER CAPITA).

Ecological Zone (Culture Area)	N	Fish	Land Mammals	Marine Mammals	Other	Total
Arctic-Subarctic Coast (Inupiaq-Yup'ik)	21	363 (59.5)	106 (17.4)	104 (17.0)	37 (6.1)	610
Aleutian-Pacific Coast (Aleut-Sugpiaq)	19	251 (66.4)	68 (18.0)	33 (8.7)	26 (6.9)	378
Subarctic Interior (Athabaskan)	40	256 (67.9)	105 (27.9)	<1 (0.0)	15 (4.0)	377
Northwest Coast (Tlingit-Haida)	9	122 (57.5)	41 (19.3)	12 (5.7)	37 (17.5)	212
Other*	9	28 (58.3)	12 (25.0)	0 (0.0)	8 (16.7)	48

*"Other" includes current urbanized areas (Anchorage, Fairbanks, Juneau, Matanuska-Susitna Borough) and Southern Cook Inlet (Kenai, Ninilchik, Homer, Seldovia).

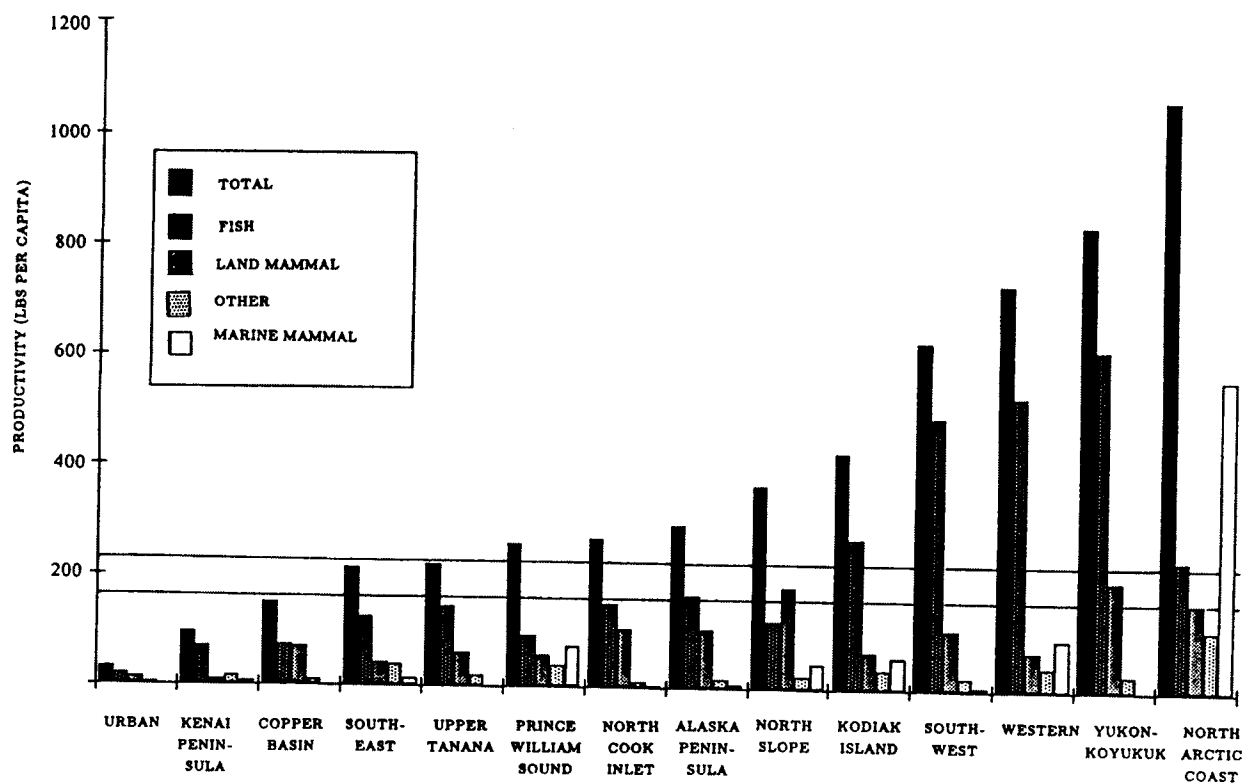


Figure 4. Resource Harvests by Region. Upper and lower lines indicate U.S. mean and recommended use of purchased meat, fish, and poultry.

ROADS

In addition to distance, at least three other factors seem to be associated with the geographic distribution of subsistence productivity: roads, degree of settlement entry, and community income. The presence of roads is significantly associated with reduced subsistence productivity. Harvests of communities along the road network or marine highway system are 69% less than harvests by communities off the road network (171 lbs compared with 559 lbs per capita; Table 5). These lower harvests appear in Figure 5 as the area peripheral to Anchorage and Fairbanks in the 100-199 lbs contour range (the Copper River Basin, Upper Tanana River, Railbelt, and western Kenai Peninsula), and the area around Juneau in the 100-299 lbs contour range.

SETTLEMENT ENTRY

Another factor associated with reduced levels of productivity is degree of settlement entry by non-Natives in a community (Fig. 9). Statistically, as the percentage of non-Natives increases in a community's population, overall subsistence productivity decreases.

The relationship is exceptionally strong ($r = .66$, .000 sig.).

INCOME

An inverse relationship also exists between a community's average personal income level and subsistence productivity ($r = -.57$, .000 sig.; Fig. 10). Higher mean income levels are associated with lower subsistence productivity at the community level. In addition, income levels are positively associated with settlement entry ($r = .62$, .000 sig.), so, statistically, a community's non-Native population and mean income increase together.

PRODUCTIVITY MODEL

A mathematical model accounting for the variation in the sampled communities' total subsistence outputs can be created using the factors of settlement entry, geographic region, and community income (Table 6). Degree of settlement entry accounts for most variation in community harvest levels. As a statistical association, a community's resource harvests decrease by 2.2 lbs per capita for every percent increase in non-Native

TABLE 5. RESOURCE HARVESTS BY ROAD STATUS (POUNDS PER CAPITA).

Road Status	N	Fish	Land Mammals	Marine Mammals	Other	Total
Not Road Connected	55	365	113	51	30	559
Road Connected	38	101	51	2	17	171
Urban	5	18	11	*	1	30

*No data, probably <1.

TABLE 6. MULTIPLE REGRESSION SUMMARY TABLE, TOTAL HARVEST AS DEPENDENT VARIABLE.

Step	MultR	Rsqr	AdjRsqr	F(Eqn)	SigF	RsqrCh	FCh	SigCh	Variable	BetaIn	Correl
1	.6578	.4327	.4268	73.236	.000	.4327	73.236	.000	In: NATIVE	.6578	.6578
2	.7529	.5668	.5577	62.157	.000	.1341	29.406	.000	In: YUKKOY	.3720	.4760
3	.7904	.6248	.6128	52.170	.000	.0579	14.513	.000	In: ARCSUB	.2684	.3689
4	.8120	.6594	.6447	45.006	.000	.0346	9.448	.003	In: NWARCTIC	.1939	.3051
5	.8341	.6957	.6792	42.068	.000	.0363	10.986	.001	In: SOUTHWST	.1969	.2394
6	.8736	.7632	.7476	48.874	.000	.0675	25.922	.000	In: WESTERN	.3934	.3645
7	.8721	.7606	.7476	58.447	.000	-.0026	1.001	.320	Out: ARCSUB		.3689
8	.8785	.7718	.7568	51.309	.000	.0113	4.500	.037	In: KODIAK	.1127	.0376
9	.8843	.7821	.7651	46.137	.000	.0102	4.218	.043	In: INCOME	-.1315	-.5654

Variables in the Equation

Variable	B	SE B	95% Confdnce	Intrvl B
NATIVE	2.21870	.60326	1.02023	3.41717
YUKKOY	534.07653	57.93623	418.97609	649.17696
NWARCTIC	722.17911	117.00442	489.72942	954.62881
SOUTHWST	333.27396	59.43629	215.19340	451.35452
WESTERN	387.29198	60.85671	266.38951	508.19445
KODIAK	136.88080	65.71762	6.32127	267.44033
INCOME	-8.44460E-03	4.11186E-03	-.01661	-2.75680E-04
(Constant)	218.98732	81.47461	57.12379	380.85064

Variable	Beta	Correl	Part Cor	Partial	Tolerance	T	Sig T
NATIVE	.25361	.65783	.18099	.36147	.50926	3.678	.0004
YUKKOY	.49906	.47604	.45363	.69689	.82622	9.218	.0000
NWARCTIC	.31521	.30510	.30373	.54535	.92848	6.172	.0000
SOUTHWST	.29712	.23945	.27593	.50882	.86247	5.607	.0000
WESTERN	.36190	.36448	.31317	.55709	.74882	6.364	.0000
KODIAK	.10882	.03765	.10250	.21445	.88710	2.083	.0401
INCOME	-.13147	-.10106	-.10106	-.21158	.59090	-2.054	.0429
(Constant)						2.688	.0086

population. Five regional variables are next in a step-wise insertion procedure: Yukon-Koyukuk Region (add 534 lbs), Northwest Arctic Region (add 722 lbs), Southwest Arctic Region (add 333 lbs), Western Region (add 387 lbs), and Kodiak Island Region (add 137 lbs). Income levels are inserted next: a community's resource harvest decreases by 8.4 lbs for every \$1000 increase in a community's mean taxable income per income tax return. A constant is added at 219 lbs. This regression model has a multiple correlation coefficient of .88 and accounts for 78% of observed variation in community harvests with a standard error of the regression estimate of 158 lbs. Figure 11 presents the actual harvests of the 98 sampled communities and the predicted harvests based on the predictive model in order to illustrate its performance with observed data points.

DISCUSSION

ALASKA'S MIXED SUBSISTENCE-MARKET ECONOMY

The statewide survey indicates that subsistence harvests are a prominent part of the economy and social welfare of most rural Alaska regions. Subsistence productivity is substantial in most areas except in the four large urban population centers of Anchorage, Fairbanks, Juneau, and the Matanuska-Susitna Borough. In the 1980s, 82 of the 98 sampled communities were harvesting wild resources at levels half or greater than the mean per capita use of meat, fish, and poultry in the United States. In many regions, subsistence harvest levels were two to four times the U.S. average use of meat, fish, and poultry.

Fishing and hunting for subsistence provides a reliable economic base for many rural regions (cf. Behnke 1982; Wolfe et al. 1984). This type of regional economy has been termed a "mixed, subsistence-market economy" (Wolfe 1984; Wolfe et al. 1984), and occurs in the Canadian North as well as Alaska (Asch 1983; Feit 1983; Usher 1981). In Alaska's rural mixed economies, fishing and hunting are central activities in the community, conducted by domestic family groups with efficient, small-scale technologies (such as fishwheels, gill nets, motorized skiffs, and snowmobiles). Subsistence activities, while often highly productive, are not oriented toward sale or accumulated profit as is commercial market production. Rather, they are directed toward meeting the self-limiting needs of families and small communities.

In Alaska's mixed economies, a family's subsistence production is augmented and

supported by cash employment of family members. Depending upon the region, employment commonly is in commercial fishing, commercial trapping, public sector wage employment (such as in schools and local government), services, and capital construction projects. The money generated in the commercial-wage sector of the economy enables families to capitalize in the subsistence sector. The combination of subsistence and commercial-wage activities provides the economic basis for the way of life so highly valued in rural communities. Case studies of Alaska's mixed economy are presented in Behnke (1982), Fall et al. (1984), Marcotte and Haynes (1984), Mills et al. (1984), Morris (1985a), Stratton and Georgette (1984), Wolfe (1981, 1984), and Wolfe et al. (1984).

The substantial harvest levels and widespread geographic distribution of wild resource harvests help explain why "subsistence" is currently an important social and political issue in Alaska. In rural communities there is a great desire to maintain this part of a region's economy in the face of new economic changes primarily developing from the urban population centers.

SUBSISTENCE AND ECONOMIC DEVELOPMENT

The subsistence component of Alaska's economy currently receives uneven recognition in state legislation and policy regarding land and resource development. A state "subsistence law" passed in 1978 and amended in 1986 recognizes subsistence uses of fish and game as having priority over commercial and sport uses of fish and game, should restrictions on harvests be necessary to preserve fish stocks and game populations (AS 16.05). The state's fish and game management system has been in the process of implementing this new law in fishing and hunting regulation.

In contrast, subsistence uses have an ambiguous status in regard to other uses of public lands. Subsistence is not recognized as a separate type of land use in state land planning classifications of the state's Department of Natural Resources, charged with managing state lands. While a variety of land uses are recognized (agriculture, coal, forest, geothermal, grazing, heritage resources, material, mineral, oil and gas, public recreation, reserved, resource management, settlement, transportation corridor, water resources, and wildlife habitat), subsistence fishing and hunting for food is not. Consequently, ongoing subsistence uses receive no protection in legislation or regulation in the development of state lands. As the state creates plans for the future use and development of state land holdings to "provide for balanced use, development, and conservation of those resources for the maximum benefit of

the people of Alaska...[and to] identify primary uses" (Alaska Administrative Code 55.010), there is no requirement for these new uses to be assessed for their impacts on ongoing subsistence activities.

Unlike state lands, subsistence fishing and hunting are recognized as uses on federal lands in Alaska by the recent Alaska National Interest Lands Conservation Act of 1980 (P.L. 96-487). Subsistence opportunities must be provided for in the management of most national parks, national fish and wildlife refuges, and national forests. Also, new development on federal lands must be assessed for their impacts on subsistence uses.

The recognition in law of subsistence as a valid economic land use is relatively recent on federal lands and has not yet occurred on state lands. Previously, subsistence generally had not been considered in the economic development of Alaska's resources under Russian and American administrations. The current geographic distribution of subsistence harvests reflects those historic land use policies.

Historically, two major sources of impacts on subsistence productivity have been road building and settlement entry by non-Natives along roads and marine highway networks. Settling roaded areas appears to diminish the subsistence productivity of an area over time. The communities with the lowest subsistence harvests in the 1980s occur along the roaded, settled areas surrounding Anchorage and Fairbanks (Figure 5). These areas were the historic territories of Ahtna, Dena'ina, and Upper Tanana groups. In recent decades, roads into these areas have triggered several developments. Roads have increased competition for wild resources between rural and urban residents. Urban-based hunters and fishers utilize roads for access to rural areas for fishing and hunting, directly competing with rural communities and lowering their subsistence harvests. As an example of the level of competition, of 3097 moose hunters counted by the state fish and game department in 1983 in the Copper Basin (a traditional Ahtna region connected by roads to Anchorage since 1927), only 13% were local rural residents of the basin. Of 7540 salmon dip net and fishwheel permits, only 5.3% were held by local rural residents (Fall 1985). The increased competition for wild resources by outsiders has led to more restrictive regulations for fishing and hunting (seasons, bag limits, and methods) which have lowered subsistence harvests. The new state subsistence law was passed in part to rectify these types of disruptions of subsistence harvests caused by uncontrolled competition.

In addition to competition, state land disposal programs which turn public lands over to private ownership typically occur

along the road networks. Land disposal programs stimulate settlement entry by outside immigrants who transplant sociocultural and market-oriented economic systems which are not directed toward fishing and hunting for local consumption. New non-Native settlers do not have the same value orientations toward hunting and fishing as do Alaska Natives, and choose to consume wild resources at lower levels. Concurrently, the development of private land holdings commonly create changes in the natural environment that reduce wild resource populations. Income levels increase in communities along roads with the changing economic system, providing the means for importing food products. However, incomes typically are not distributed equally among social classes in rural Alaska areas, so that many indigenous rural residents face both low monetary incomes and newly depressed subsistence harvests.

These types of changes have been accelerated in the past decade by the rapid state population growth stimulated by state spending of oil revenues from Prudhoe Bay, as outlined above (Alaska Department of Labor 1986; Williams 1985). The accelerated population growth has elevated subsistence to a more central issue in state development policy: will new growth that benefits the urban economy create conditions which erode subsistence productivity in the rest of the state? From the perspective of rural communities, it is shortsighted to strengthen the state's economy in the large population centers at the expense of the subsistence component of the state's rural economy. The best economic and social policy would seek to recognize subsistence as a major sector of the state's rural economy, and seek paths of regional development compatible with high, sustainable wild resource extraction.

Economic development which takes subsistence into consideration might help to alleviate the potential problems identified above. The maintenance of current levels of subsistence productivity might be identified as a goal of state development policy. Conditions which foster continued high productivity then might be considered, such as containing external competition for local resources, placing reasonable limits on settlement entry, and stimulating the local market sector in ways compatible with the subsistence sector (cf. Wolfe 1984). Performance of the subsistence and commercial-wage sectors might be monitored in tandem, recognizing that for many communities, a healthy regional economy is dependent upon mutually supportive sectors.

In summary, though documentation of Alaska's mixed, subsistence-market economy is just beginning, this preliminary survey

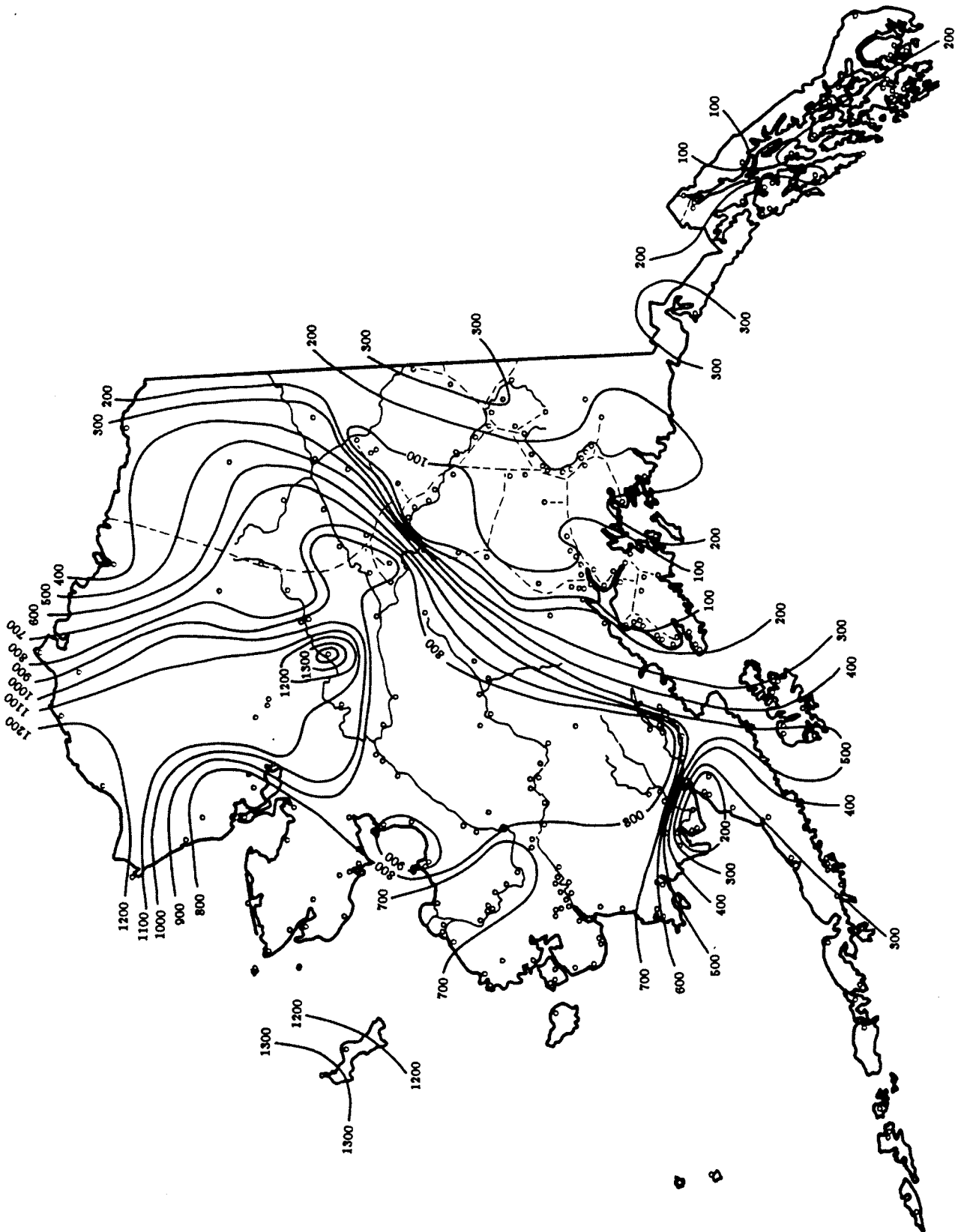


Figure 5. Geographic Distribution of Total Subsistence Harvests in Alaska (Lbs per Capita), Represented at 100 Lbs Intervals. Dotted lines indicate road and marine highway system.

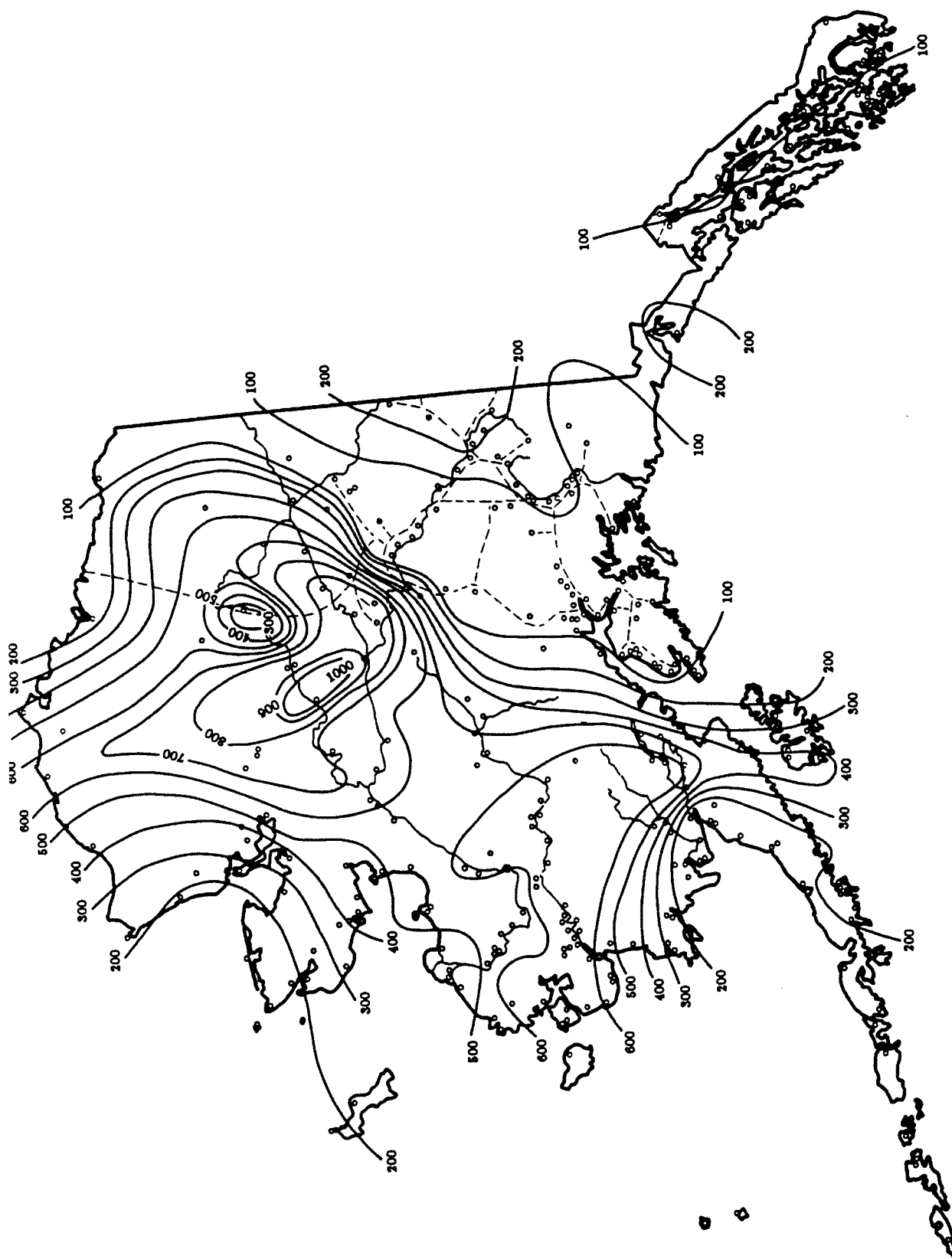


Figure 6. Geographic Distribution of Subsistence Fish Harvests in Alaska (Lbs per Capita), Represented at 100 Lbs Intervals. Dotted lines indicate road and marine highway system.

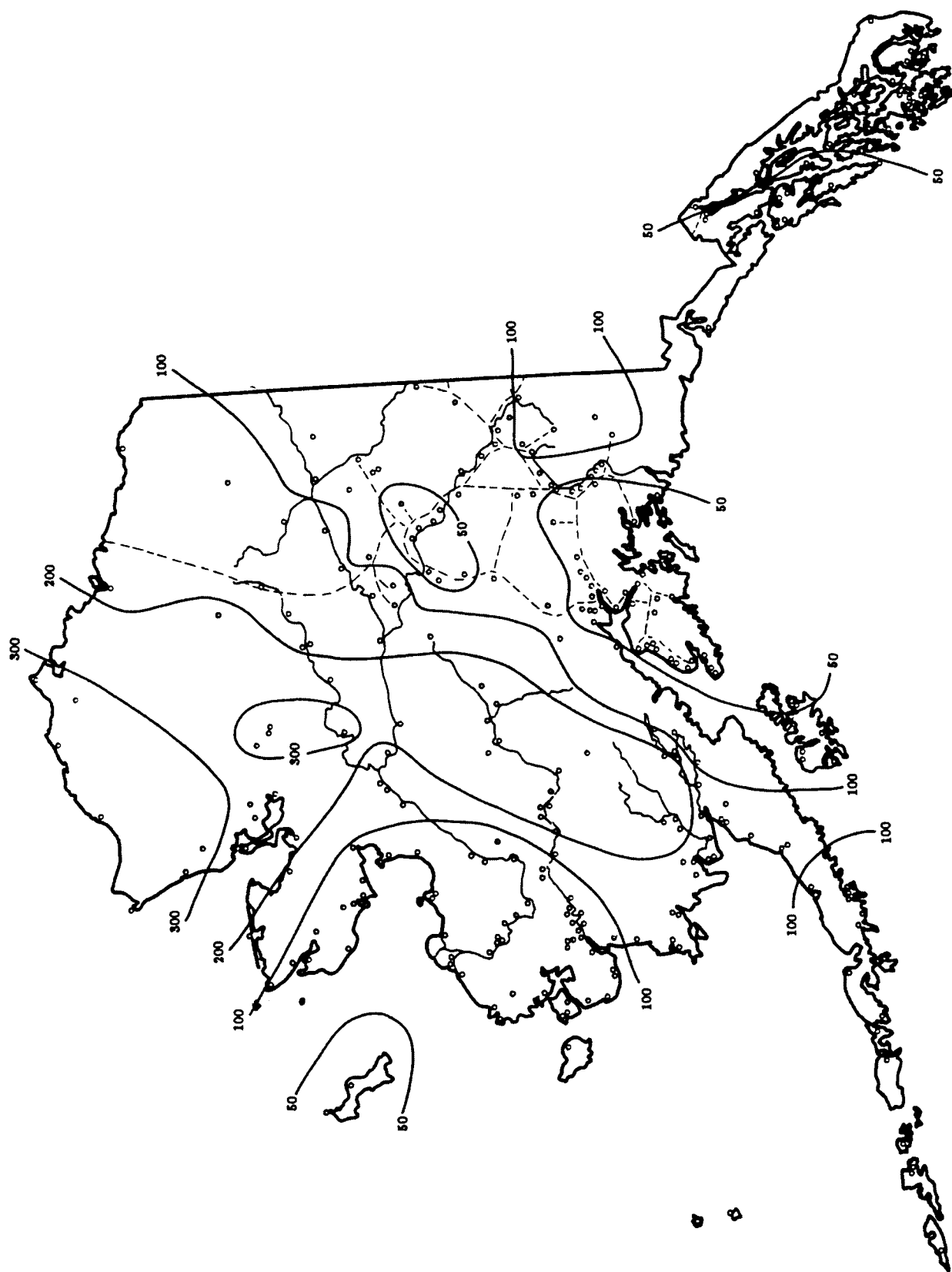


Figure 7. Geographic Distribution of Land Mammal Harvests in Alaska (Lbs per Capita), Represented at 60 Lbs Intervals. Dotted lines indicate road and marine highway system.

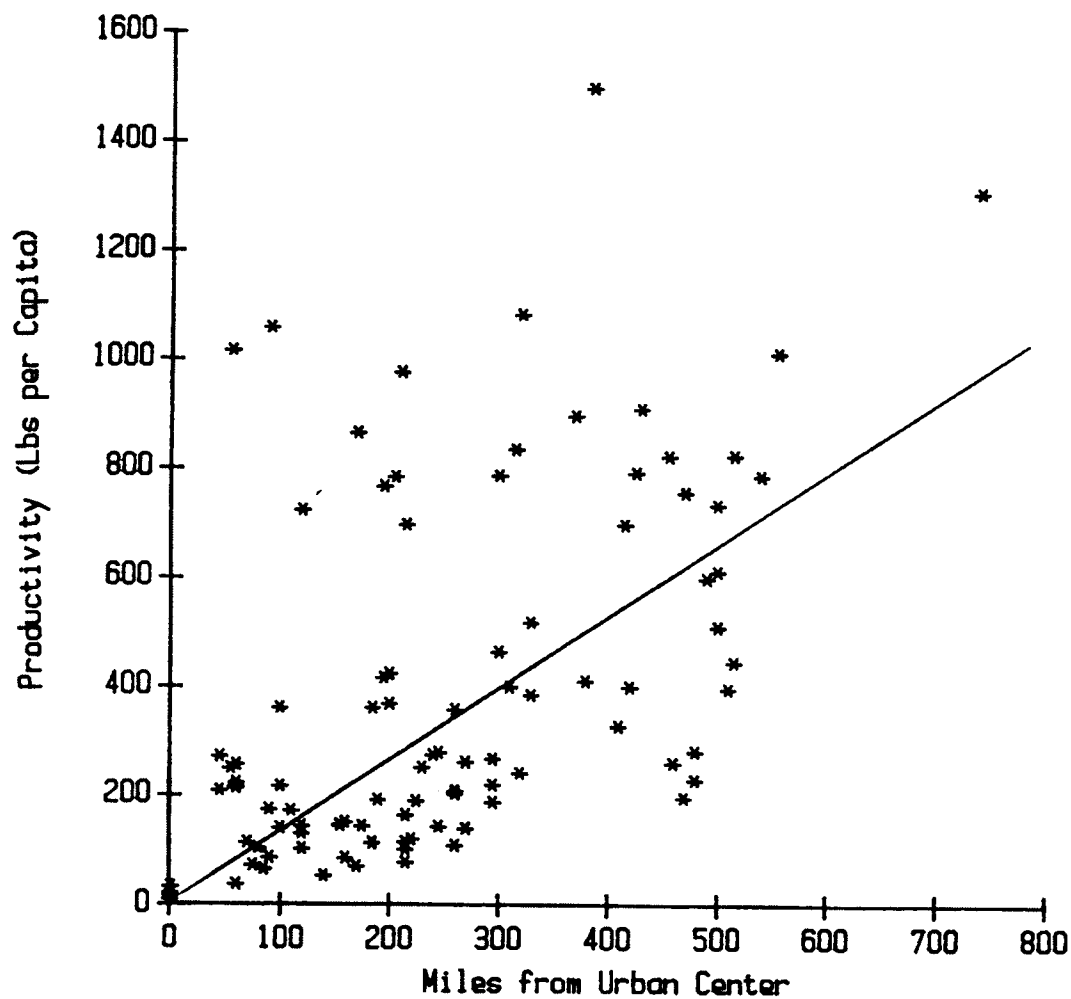


Figure 8. Subsistence Harvests (Lbs per Capita) by Distance of Community from Urban Population Center (Miles; $r=.548$, $r^2=.301$, $\text{sig}=.000$).

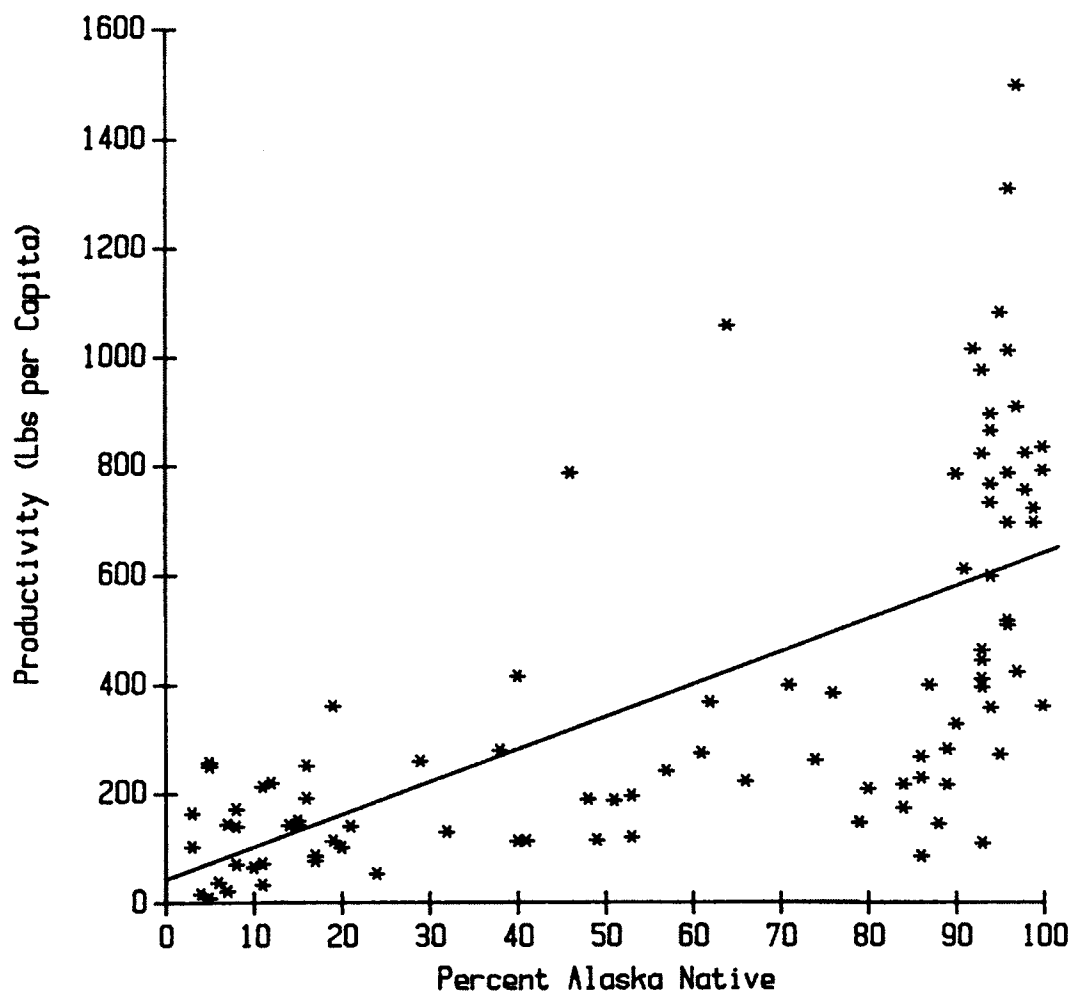


Figure 9. Subsistence Harvests (Lbs per Capita) by Degree of Settlement Entry (% Alaska Natives in Community; $r=.658$, $r^2=.433$, $\text{sig}=.000$).

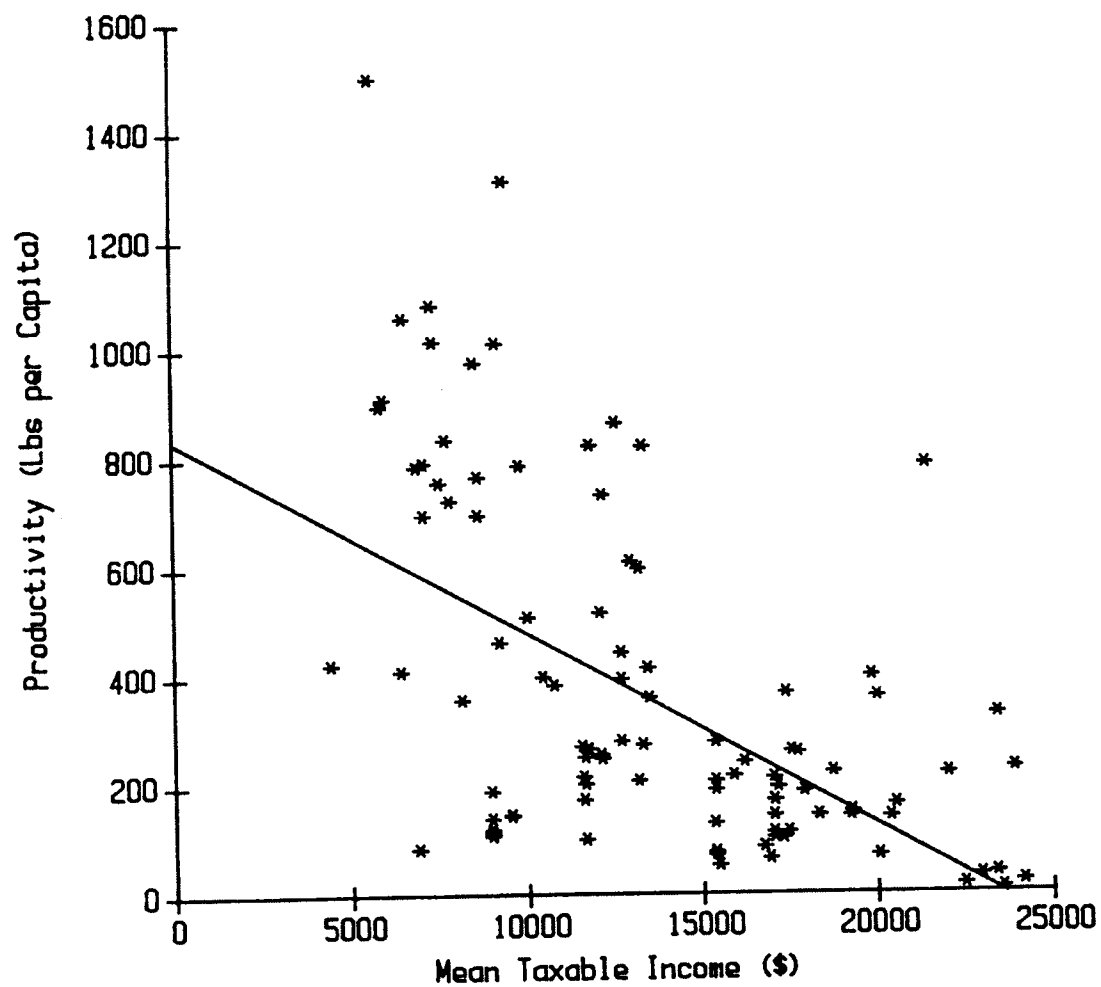


Figure 10. Subsistence Harvests (Lbs per Capita) by Community Mean Personal Income (Dollars; $r = -.565$, $r^2 = .320$, $\text{sig.} = .000$).

FIGURE 11. PERFORMANCE OF THE REGRESSION MODEL: OBSERVED AND
PREDICTED HARVESTS WITH STANDARD ERROR BY COMMUNITY

Case #	VILLAGE	-3.0	0.0	3.0	OUTPUT	*PRED
		O:.....:O				
1	Akhiok	.	*	.	518	466.5821
2	Alakanuk	.	*	.	733	711.8550
3	Allakaket-Alatna	.	*	.	909	917.5424
4	Anchorage	.	*	.	10	30.8727
5	Angoon	.	*	.	216	318.4518
6	Beaver	.	*	.	723	906.3741
7	Bettles-Evans.	.*	.	.	260	667.5820
8	Cantwell	.	*	.	130	160.2343
9	Chenega	.	*	.	361	326.8212
10	Chickaloon	.	*	.	213	99.3112
11	Chignik Bay	.	*	.	196	191.5338
12	Chignik Lagoon	.	*	.	229	207.6569
13	Chignik Lake	.	*	.	282	309.3063
14	Chistochina	.	*	.	115	251.8794
15	Chitina	.	*	.	190	249.6607
16	Copper Center	.	*	.	113	163.6534
17	Cordova	.	*	.	151	89.3208
18	Dillingham	.*	.	.	242	541.8147
19	East Glenn Hwy	.	*	.	144	90.4364
20	Egegik	.	*	.	385	296.5755
21	Emmonak	.	*	.	612	698.6121
22	English Bay	.	*	.	147	313.7452
23	Fairbanks	.	*	.	22	30.3446
24	Gakona	.	*	.	192	124.6170
25	Galena	.	*	.	787	673.8437
26	Gambell	.	*	*	1309	1074.3768
27	Glennallen	.	*	.	71	67.3889
28	Gulkana	.	*	.	114	234.1298
29	Haines	.	*	.	114	113.6745
30	Homer	.	*	.	103	79.5940
31	Hoonah	.	*	.	209	285.2509
32	Hughes	.	.	*	1498	920.2531
33	Huslia	.	.	*	1082	901.7216
34	Iliamna	.	*	.	416	527.4040
35	Ivanof Bay	.	.	*	445	318.1811
36	Juneau	.	*	.	34	49.4374
37	Kake	.	*	.	217	271.0719
38	Kaktovik	.	.	*	328	220.7118
39	Karluk	.	.	*	835	512.4274
40	Kenai	.	*	.	38	34.6536
41	Kenny Lake	.	*	.	78	126.8357
42	King Salmon	.	.	*	220	59.5602
43	Kivalina	.	*	.	824	1058.6232
44	Klawock	.	*	.	223	207.0766
45	Klukwan	.	*	.	174	307.3583
46	Kodiak City	.	*	.	143	224.2953
47	Kokhanok	.	*	.	897	892.2611
48	Kotlik	.	*	.	510	734.5327
49	Kwethluk	.	*	.	792	768.0488
Case #	VILLAGE	O:.....:O			OUTPUT	*PRED
		-3.0	0.0	3.0		

Figure 11. Performance of the Regression Model:

FIG. 11 (CONT.). PERFORMANCE OF THE REGRESSION MODEL: OBSERVED AND
PREDICTED HARVESTS WITH STANDARD ERROR BY COMMUNITY

Case # VILLAGE	-3.0	0.0	3.0	OUTPUT	*PRED
	O:.....:O				
50 Lake Louise	.	*	.	172	92.6551
51 Larsen Bay	.	*	.	400	425.1242
52 Lower Tonsina	.	*	.	120	260.7542
53 Manokotak	.	*	.	411	704.2592
54 Matsu	.	*	.	17	37.9515
55 Matsu Glacier	.	*	.	104	74.9055
56 McCarthy Road	.	*	.	140	180.9128
57 Mentasta Lake	.	*	.	109	349.5021
58 Minto	.	*	.	1015	894.5873
59 Mountain Village	.	*	.	822	699.7814
60 N. Wrangell Mts.	.	*	.	208	89.1178
61 Nabesna Road	.	*	.	280	173.4283
62 Naknek	.	*	.	188	180.8136
63 New Stuyahok	.	.	*	896	711.1477
64 Newhalen	.	.	*	787	687.8237
65 Nikolai	.	*	.	785	894.3522
66 Ninilchik	.	*	.	87	115.1230
67 Nondalton	.	.	*	976	686.3144
68 Northway	*	.	.	275	776.0574
69 Nuiqsuit	.	.	*	400	244.2536
70 Nunapitchuk	.	*	.	697	765.9484
71 Old Harbor	.	*	.	464	484.2296
72 Ouzinkie	.	*	.	358	495.5431
73 Paxson-Sourdough	.	.	*	164	52.2082
74 Pedro Bay	.	.	*	865	654.6365
75 Perryville	.	*	.	396	318.1611
76 Port Alsworth	.	*	.	361	425.3387
77 Port Graham	.	*	.	145	333.7134
78 Port Lions	.	*	.	262	371.7983
79 Quinhagak	.	*	.	756	759.9803
80 Russian Mission	.	*	.	599	703.2246
81 S. Wrangell Mts.	.	.	*	203	120.6499
82 Scammon Bay	.	*	.	787	736.2892
83 Seldovia	.	*	.	54	141.5981
84 Sheep Mountain	.	*	.	73	113.5235
85 Sitka	.	.	*	141	93.3777
86 Slana	.	*	.	252	156.1491
87 South Naknek	.	*	.	268	310.5966
88 Stebbins	.	.	*	1012	741.7275
89 Stevens Village	.	.	*	1058	839.7081
90 Talkeetna	.	*	.	66	98.2156
91 Tanacross	.	*	.	86	351.5445
92 Tenakee Springs	.	.	*	250	127.6562
93 Tetlin	.	.	*	424	396.6816
94 Tok	.	*	.	144	97.4445
95 Tyonek	.	*	.	272	332.1862
96 Upper Tonsina	.	*	.	102	165.0239
97 Upper Yentna	.	.	*	257	127.8927
98 Yakutat	.	.	*	369	209.5936
Case # VILLAGE	O:.....:O			OUTPUT	*PRED
	-3.0	0.0	3.0		

Observed and Predicted Harvests with Standard Error by Community.

suggests that subsistence fishing and hunting are making substantial contributions to the economic and social welfare of large portions of the state. Many regions are heavily dependent upon fish and wildlife harvests. By understanding the role of subsistence in Alaska's regional economies, development may be planned in ways to enhance this important economic base.

Acknowledgements. The authors would like to thank the researchers whose studies supply the data base for this comparative analysis. The high quality of social science work currently underway in Alaska makes these kinds of comparative analyses possible. In addition, the authors thank the residents of the Alaskan communities mentioned in the report. It is through their cooperative spirit and assistance to researchers that an understanding of subsistence as a way of life in Alaska can be developed.

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