ARCTIC
VOL. 43, NO. 1 (MARCH 1990) P. 35-42

Native Subsistence Fisheries: A Synthesis of Harvest Studies in Canada

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(Received 20 January 1989; accepted in revised form 15 May 1989)

ABSTRACT. Subsistence fisheries, as distinct from commercial and recreational, exist throughout much of the Canadian North and satisfy local needs for fish protein. These fisheries have been investigated quantitatively only since the 1970s. Many of these studies are in the "grey literature"; methods of study and reporting are not standardized, and interpretation of data is often problematic. Nevertheless, some generalizations can be offered from a preliminary survey of harvest study data from 93 communities and from 10 regional studies representing Labrador, Quebec, Ontario, Manitoba, Saskatchewan, British Columbia and the Northwest Territories. The data indicate a wide range of harvest values, clustering at about 60 kg of whole fish per capita per year. If these data are representative, there is a significant subsistence fishery sector important for the local economies of hundreds of communities. Most of these fisheries are not being reported in fishery statistics, nor are they being monitored and assessed.

Key words: subsistence, fisheries, native people, native harvest surveys, resource management policy, co-management, Arctic, Subarctic

RÉSUMÉ. La pêche de subsistance, par opposition à la pêche commerciale ou sportive, existe dans presque tout le Grand Nord canadien et satisfait aux besoins de la population locale en protéines de poisson. Cette pêche n'a été étudiée de façon quantitative que depuis de la «littérature grise»; les méthodes d'étude et de rapport ne sont pas standardisées et l'interprétation des données est souvent problématique. On peut cependant présenter certaines généralisations à partir d'une étude préliminaire des données sur les prises effectuées dans 93 communautés et à partir de 10 études régionales représentant le Labrador, le Québec, l'Ontario, le Manitoba, la Saskatchewan, la Colombie-Britannique et les Territoires du Nord-Ouest. Ces données montrent une grande différence dans les quantités de poisson pêché, quantités qui se situent pour la plupart autour de 60 kg de poisson entier par habitant et par an. Si ces données sont représentatives, il existe un secteur de pêche de subsistance non négligeable et important pour l'économie locale de centaines de communautés, mais on n'en tient pratiquement pas compte dans les statistiques sur la pêche et il n'est ni contrôlé ni évalué.

Mots clés: subsistance, pêche, aborigènes, relevés des prises effectuées par les aborigènes, politique de gestion des ressources, cogestion, arctique, subarctique

Traduit pour le journal par Nésida Loyer.

INTRODUCTION

There is a considerable amount of scattered information about subsistence fisheries, but relatively little of this may be found in the technical literature on fisheries, perhaps partly because the science to deal with such fisheries is not well developed. It is difficult to investigate and quantify subsistence fisheries, defined here as "local, non-commercial fisheries, oriented not primarily for recreation but for the procurement of fish for consumption of the fishers, their families and community" (Berkes, 1988).

Yet studies in Alaska indicate that subsistence fisheries constitute a significantly large, locally important sector (Andrews, 1989; Wolfe and Walker, 1987). Regarding the Canadian North and the mid-North, information remains scattered. There has been one attempt to summarize quantitative information (Berkes, 1983), and a comprehensive review is available on the methodology of native harvest surveys on wildlife and fish (Usher and Wenzel, 1987).

Subsistence fisheries, as defined above, no doubt occur outside the North American North, in areas with non-native populations as well. Indeed, food-oriented local fisheries in parts of the Great Lakes (Stoffle *et al.*, 1983) and the United States Northeast (Belton *et al.*, 1986) have come to the attention of researchers concerned with the unregulated intake of pollutants such as PCBs in fish obtained in these areas. While important topics in their own right, these fisheries, Third World subsistence or artisanal fisheries (Emmerson, 1980) and food fisheries in the Eurasian North have been left outside the scope of this paper.

The task of this paper is to provide an overview of Canadian subsistence fisheries in the North and the mid-North, a survey of the results of quantitative studies of these fisheries, and the context within which subsistence fisheries may be evaluated. The paper also examines the usefulness of this compendium as a basis for analysis and management.

Implications of the new developments and findings in this neglected fishery sector were discussed with the fisheries science community at the Subsistence Fisheries Symposium, American Fisheries Society 1988 Annual Meetings in Toronto and followed up at the 1989 meetings in Anchorage. To a large extent, the subsistence fishery is not being reported in fishery statistics, monitored, assessed or regulated. If there is indeed a significant subsistence fishery sector, this has implications for public policy regarding resource management, allocation, impact assessment and regional economic planning.

SUBSISTENCE FISHERIES IN CANADA

Historical Development

The first scientific surveys of subsistence fisheries go back at least to the 1940s. Rawson (1947) surveyed the communities around Great Slave Lake and estimated a lake-wide fishery of about 700 t/yr and a per capita consumption of some 75 kg. At the more remote Great Bear Lake, the lake-wide fishery was estimated at 900 t/yr, and the harvest for direct human consumption at 3 t per family per year (Miller, 1947).

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Until the 1970s, information on fish and wildlife harvests — that is, estimates of the quantity of a particular species taken in a specific area or by a specific group of people over a specific period of time (Usher and Wenzel, 1987) — came from three sources: investigations by anthropologists and other field researchers, "area economic surveys" (reviewed by Lotz, 1976) and administrative data sets (reviewed by Usher and Wenzel, 1987).

In the 1970s, comprehensive surveys carried out cooperatively with native organizations, often covering large areas and many communities and obtaining harvest data on the basis of information from the harvesters, became common. The first attempt at such surveys seems to be that of Salisbury *et al.* (1972) in the James Bay area; this study has been superseded by the surveys jointly carried out by the federal and provincial governments, the Inuit of northern Quebec and the Cree of James Bay. Carried out under the James Bay and Northern Quebec Agreement of 1975, these JBNQ Native Harvest Research surveys (henceforth NHR) have been the basis of many similar surveys elsewhere (NHR, 1982a,b).

Treatment of the Data

This compilation of quantitative estimates of subsistence fisheries should be taken as a "preliminary synthesis" because it is no doubt incomplete and only a first approximation in summarizing a vast "grey literature" (Usher and Wenzel, 1987). In compiling and standardizing the data, the following guidelines were used.

The data were summarized in the simplest, least interpreted form possible, in kg per capita per year of round (whole) weight units. The total community harvest (not food weight or consumed weight) was taken, from which commercial catches (if any) and harvest specifically identified as dog food (if any) were subtracted. The community harvest figure was then divided by the number representing the total resident (not total registered) native population (including children) to give a per capita figure.

In cases in which the harvesters included non-native people, the population figure as supplied by the investigator was used (e.g., Labrador, Usher, 1982). In cases in which the results were given in units other than "whole weights," the investigators' own conversion factors were used to back-calculate whole weights. Or else data were converted by using the relationship "edible weight = 0.70 whole weight." In instances in which the author supplied data on fish numbers (and not weights), mean fish weights were taken from NHR (1982a) and NHR (1982b), which provide data from across the Canadian North, not only from James Bay and northern (arctic) Quebec.

Data sources used in Figure 1 were limited to studies in which there was at least a recognizable methodology for collecting information. Sources that included information only in passing and those in which data collection details — year, community name, population size — could not be confirmed were left out of the compilation. However, no attempt was made to evaluate each of the accepted sources critically; this has been done by Usher and Wenzel (1987).

Since the studies in this paper do not follow a consistent methodology, the data from each region or community are not strictly comparable. This is an unavoidable shortcoming of a synthesis of such a field of study, and this qualification should be kept in mind when interpreting the overall results. However, at least one set of results (Chisasibi, James Bay) from a questionnaire and diary-based harvesting study have been extensively field-tested and confirmed (Berkes, 1983).

Regional Studies

Table 1 provides a summary of regional fish harvest studies across Canada. The Labrador study included Inuit people as well as "settlers," non-native people who share a native lifestyle. The northern Quebec study was summarized using the more conservative data (year 1978) from this five-year investigation; the final summary report was not available at the time of writing. The James Bay data were available as a five-year average (NHR, 1982b), but the 1974-75 data were used here as the most representative year because there were development-related perturbations after that date (Berkes, 1982).

The Huron-Georgian Bay study covered the Robinson-Huron Treaty region. Much of this harvest came from one large reserve on Manitoulin Island, Wikwemikong, which controlled the fishing area of the east coast of the island and which also carried out commercial fishing. The Manitoba figure was a province-wide rough estimate. The population figure of 35 000 refers to the whole province; the population of northern native communities was given as 31 500 (Green and Derksen, 1984).

The Saskatchewan estimate was based on harvests of licenseholders and their families (pop. 1923) projected to the entire province (total native population at the time, 71 047). The subsistence harvest is no doubt distributed beyond the immediate families of license holders and likely shared by the

TABLE 1. A summary of regional studies of native subsistence fisheries in Canada (see text for explanatory notes)

Region	Year	Fish harvest (kg)	Population	Per capita (kg/year)	Reference
Labrador	1979	170 909	2 068	83	Usher (1982)
Northern Quebec (Inuit)	1978	233 000	3 981	59	NHR (1982a)
James Bay area, Quebec	1974-75	320 000	6 267	51	NHR (1982b)
Huron-Georgian Bay, Ontario	1982	306 818	4 967	62	Armstrong (1983)
Manitoba	1975	1 700 000	35 000	50	Green and Derksen (1984)
Saskatchewan	1985	284 076	1 923 (sample)	148	Murray and Clouthier (1986)
		1 850 000	71 047 (tot. pop.)	26	
British Columbia	1980	2 270 000	43 000	53	Pearse (1982)
Mackenzie Valley, N.W.T.	1972	374 954	7 485	50	Bissett (1974)
Baffin Region, N.W.T.	1982	370 000	6 889	54	Donaldson (1984)
Keewatin Region, N.W.T.	1981-82	161 079	3 769	43	Gamble (1984)

TABLE 2. Per capita harvests by community; harvest figures were standardized as outlined in the section on data treatment

	Population (year)	Harvest (kg/capita/yr)	Reference
1. Inukjuak, Quebec	687 (1978)	118	NHR (1982a)
2. Akulivik	221	168	"
3. Sugluk	410	62	"
4. Wakeham Bay	304	72	"
5. Koartuk	150	34	"
6. Payne Bay	272	144	"
7. Aupaluk	56	191	"
8. Leaf Bay	105	286	"
9. Kuujjuak	902	64	"
10. George River	355	175	"
11. Great Whale River (Inuit)	466	26	"
12. Fort George (Inuit)	49	48	"
13. Fort George (Cree)	1525 (1974/75)	62	NHR (1982b)
14. Great Whale (Cree)	352	22	"
15. Paint Hills	628	34	"
16. Eastmain	306	26	"
17. Rupert House	910	10	"
18. Mistassini	1725	62	"
19. Waswanipi	719	94	"
20. Dokis, Ontario	153 (1982)	90	Armstrong (1983)
21. Henvey Inlet	23	19	"
22. French River	84	27	"
23. Magnetawan	40	12	"
24. Mississauga	178	58	"
25. Nipissing	354	81	"
26. Parry Island	176	29	"
27. Serpent River	145	17	"
28. Shawanaga	69	42	"
29. Sheguiandah	73	49	"
30. Sheshegwaning	82	10	"
31. Spanish River	644	16	"
32. Sucker Creek	175	30	"
33. Thessalon	19	9	"
34. West Bay	518	20	"
35. Whitefish Lake	170	22	"
36. Whitefish River	233	30	"
37. Wikwemikong	1829	209	"
38. Pukatawagan, Manitoba	1025	53	Green and Derksen (1984)
39. South Indian Lake	669	34	"
40. Nelson House	1360	17	"
41. Brochet	994	17	"
42. Little Grand Rapids	518	51	"
43. Pauingassi	194	50	"
44. St. Therese	933	51	"
45. Garden Hill	1280	33	"
46. Wasagamach	417	51	"
47. Red Sucker	281	33	"
48. Oxford House	828	51	"
49. Gods Lake	1018	54	"
50. Shamattawa	425	31	"
51. Granville Lake	121	31	"
52. Cross Lake	2174	52	"
53. Arctic Bay, N.W.T.	345 (1982)	58 (1984)	Donaldson
54. Broughton Island	367	125	"
55. Cape Dorset	737	68	"
56. Clyde River	434	49	"
57. Frobisher Bay	1470	11	"
58. Grise Fiord	99	37	"
59. Hall Beach	339	67	"
60. Igloolik	716	73	"
61. Lake Harbour	214	54	"
62. Nanisivik	110	20	"
63. Pangnirtung	789	53	"
64. Pond Inlet	663	50	"
65. Resolute Bay	144	8	"
66. Sanikiluaq	364	74	"
67. Outpost camps	126	148	"
68. Baker Lake, N.W.T.	992 (1981-82)	41	Gamble (1984)
69. Chesterfield Inlet	204	8	"
70. Coral Harbour	376	44	"
71. Eskimo Point	1005	19	"
72. Rankin Inlet	653	62	"
73. Repulse Bay	338	33	"
74. Whale Cove	201	156	"
75. Aklavik	677 (1973)	66	Jessop *et al.* (1974)
76. Arctic Red River	96 (1973)	613	"
77. Lac La Martre	160 (1972)	401	Bond (1973)
78. Resolute/Kuvinaluk	179 (1976)	45	Kemp *et al.* (1977)
79. Old Crow, Yukon	142 (1973)	96	Stager (1974)
80. Fort Good Hope, N.W.T.	500 (1982)	125	Fort Good Hope Band Council (unpubl.)
81. Lake of the Woods, Ont.	1667 (1980-82)	33	Usher (1987)
82. Teslin, Yukon	187 (1984)	81	Duerden (1986)
83. Old Crow, Yukon	165 (1983-84)	15	Murphy (1986)
84. Ross River, Yukon	243 (1982)	83	Dimitrov and Weinstein (1984)
85. Nain, Labrador	890 (1979)	68	Usher (1982)
86. Hopedale	420	72	"
87. Makkovik	320	87	"
88. Postville	183	135	"
89. Rigolet	255	107	"
90. Black Lake, Sask.	675 (1985)	74	B. Smith, pers. comm. from data of Murray and and Clouthier (1986)
91. Buffalo River	429	54	"
92. Patuanak	643	33	"
93. Turner Lake	413	65	"
94. Pinehouse, Sask.	671 (1983-84)	109	Northern Village of Pinehouse (1987)
95. Sanikiluaq, N.W.T.	435 (1985)	86	Quigley and McBride (1987)
96. Makkovik, Labrador	333 (1980-81)	29	Mackey and Orr (1987)

portion of the native population (27 457) living in central and northern parts of the province. If so, the per capita harvest may be more like 50 kg, obtained by dividing the harvest in these parts (1 312 479 kg) by the local population. Data from one northern and three central zone communities with good statistical coverage indicate a mean of 56 kg and a range of 33-74 kg (B. Smith, pers. comm. 1988).

The British Columbia figure is based, not on harvesting surveys, but on federal government statistics on the coastal fishery, mainly on salmon (Pearse, 1982). The report indicated that some 25 000 people benefited from this harvest (Pearse, 1982). But because of extensive food-sharing networks so common among native peoples, E. Pinkerton (pers. comm. 1987), who has done work with native fisheries,

estimated that about three-quarters of the total native population of 57 000 may be consuming it; Table 1 follows Pinkerton's estimate. In a more recent publication, Pearse (1988) has updated his B.C. native fishery estimate to 3062 t/yr, but no details were given.

The Mackenzie Valley study was one of the earlier surveys, and harvests by community were difficult to ascertain from the results. Together with the Keewatin Region survey (in which more complete data were available for 1981-82 than for 1982-83) and the Baffin Region survey (a multi-year study for which the final report was not available at the time of writing), the Northwest Territories (N.W.T.) surveys add up to a subsistence harvest of 906 t/yr. There have also been N.W.T.-wide estimates of 1136 t (Science Advisory Board, 1980) and 1300 tons (Pearse, 1988), but no details of calculations were given. The N.W.T. estimates will be updated by means of the Government of N.W.T., Renewable Resources Department survey, Federal Department of Fisheries and Oceans surveys and the Inuvialuit harvest study, all of which were in progress at the time of writing.

Harvests by Community

Regional studies are useful in providing information over large areas, but averaging several communities masks the differences among them. Table 2 provides community-by-community information on subsistence fish harvests, converted to common units. The table includes all available community data from the regional studies referred to in Table 1, plus a number of studies based on one or a small number of communities, for a total of 96 entries. The table excludes a number of older studies in cases in which more recent data exist. Three communities, however, are entered twice where two different studies are available, both relatively recent. The total number of communities represented is 93.

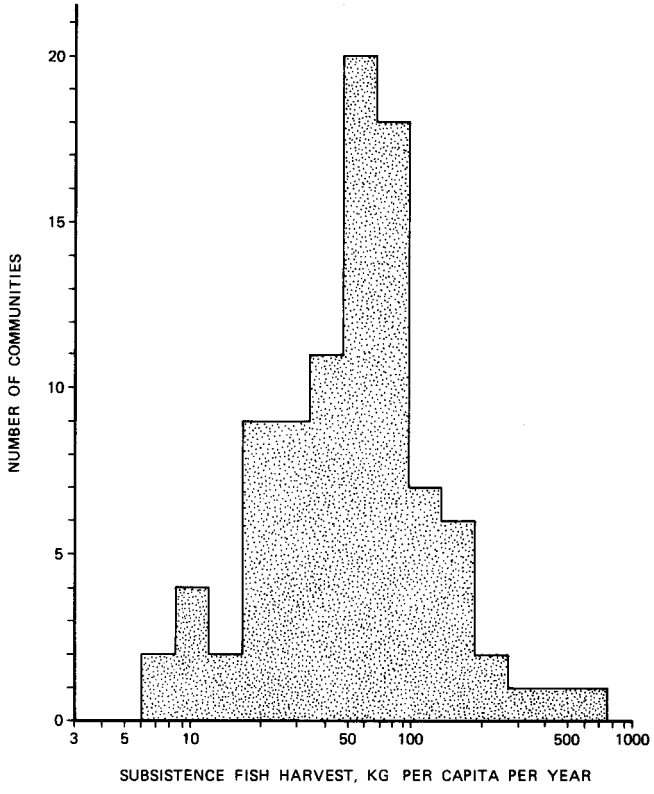

FIG. 1. Subsistence fish harvests (kg whole weights per capita per year) in 93 communities across the Canadian North and mid-North. For details and references, see Table 2.

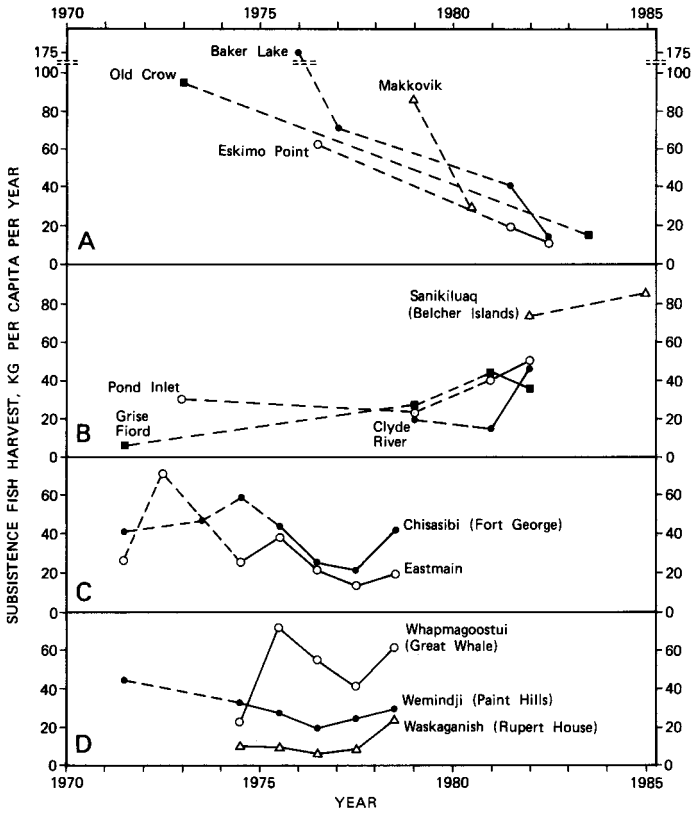

FIG. 2. Time trends in subsistence fish harvests. Solid lines indicate consecutive year coverage with standardized methodology. Sources — A: Stager (1977); Interdisciplinary Systems (1978); Gamble (1984); Stager (1974); Murphy (1986); McEachern (1978); Usher (1982); Mackey and Orr (1987). B: Riewe (1977); Finley and Miller (1980); Donaldson (1984); Quigley and McBride (1987). C and D: Salisbury *et al.* (1972); Weinstein (1976); NHR (1982b).

Figure 1 displays these data on 93 communities. Regarding the 3 communities entered twice in Table 2, those indicated as numbers 83, 87 and 95 were left out by random selection. The presentation of results poses a problem because of wide variation. Since the range of values is about two orders of magnitude (from a low of about 6 to a high of 600 kg per capita per year), a log scale is used. Two-thirds of the values fall in the interval 25–110 kg. The two highest bars represent 41% of all of the values and fall between 43 and 91 kg. Given the nature of the data, the direct comparison of figures from different studies would not be prudent, and exacting statistical analysis of Figure 1 would not be appropriate. A figure of 60 kg per capita per year will be taken as a "working mean."

For several communities, a number of harvest estimates are available over a period of time. Figure 2 shows the time trends for a selection of 13 communities. Figure 2A depicts four communities with apparent trends of sharp decline; the reasons for this decline are unclear. Figure 2B shows a different collection of four communities with an apparently increasing trend of per capita subsistence fish harvests. Solid (as opposed to broken) lines were used only in cases in which a community was surveyed using standardized methodology over consecutive years.

The most consistent set of time-series data comes from James Bay area harvest studies. Leaving out the two communities most seriously affected by high mercury values in fish over the study period, Figure 2C and D show time trends for five Cree communities. The year-to-year variation seen in these graphs provides some indication of the risks involved in generalizing from only one year of surveys for any one community.

Extensive field studies reported elsewhere (e.g., Berkes, 1979) showed that the year-to-year variations in Chisasibi (Fort George) were not due to fluctuation in the supply of fish, but to changes in employment opportunities and the availability of other wildlife used as food. This was the case also for some other communities. For example, the low value for Great Whale in 1974-75 coincided with the community housing project, which kept many hunters-fishers in the village during that year. Once the project was over, per capita fish harvests showed a 3.5-fold increase in 1975-76.

Fish harvests in the James Bay Cree communities tend to average about one-quarter of the total subsistence food harvest (NHR, 1982b). Fish are considered a "back-up" food source, and there is evidence that the fish harvest fluctuates in a way that compensates for the availability of other, preferred wild food, which varies from year to year (e.g., geese) or shows periodic cycles (e.g., small game) (Weinstein, 1976; Berkes, 1979).

Because of the relatively reliable and abundant nature of the resource, many native groups across the North regard fish as a staple. The subsistence fishery is often the most persistent segment of the traditional wildlife-based native economy. Thus, even in areas such as the Huron-Georgian Bay region, where opportunities for hunting are very limited, fishing continues to provide relatively high returns. Native fishermen, by virtue of detailed local knowledge of fish populations and their life history, are able to harvest the fish at times when the return per unit of fishing effort is particularly high. This may be seen in Table 3, which shows that the native subsistence fishery, compared to non-native angling, was 21 times more productive per person-day of effort. When only angling was considered, native fishermen still obtained more than four times as much fish per unit of effort. High levels of harvests over short periods in native subsistence fisheries have also been observed by Berkes (1977) in James Bay and by Busiahn (1989) in Wisconsin and may be a general characteristic of these fisheries.

TABLE 3. Comparison of the fishing success of native fisheries and non-native recreational fisheries in the Robinson-Huron Treaty area of Ontario (data from Armstrong, 1983)

	Total catch (10^6 kg)	Total effort (10^6 person-days)	Catch per unit of effort (kg/person-days)
Non-native, angling	1.675	2.637	0.6
Native, angling only	0.045	0.017	2.6
Native, all methods	0.489	0.027	18.1
Native, all methods excluding commercial catch	0.307	0.024	12.8

DISCUSSION

Native harvest surveys utilize social science methodology and depend on information from the harvesters. In this regard, subsistence survey results are not fundamentally different from statistics on commercial and recreational fishing. But they do differ from commercial fishery surveys in one important way: subsistence harvesters cannot be forced to report their harvests, accurately or otherwise; they have to be willing to cooperate.

As well, there are other potential problems in native harvest surveys, including lack of standardization of survey methodology; "strategic bias," whereby harvesters may deliberately provide inaccurate information; and "recall failure," whereby harvesters may simply be unable to report what was caught during the previous year.

In their review of data collection and imputation methodologies, Usher and Wenzel (1987) concluded that the lack of standardization did not detract from the reliability of any one individual study. "Strategic bias" probably existed but was not systematic. "Recall failure," the authors concluded, was not a problem for most species — except for fish. The special problems in the quantification of subsistence fisheries have been dealt with by Berkes (1983), with the general conclusion that the harvest values reported in the questionnaires are probably conservative estimates.

Harvest study results were corroborated in the field for one of the surveyed communities, Chisasibi. The subsistence fishery was studied in the field by means of spot checks and participant observation techniques. Twelve family groups were monitored over several years. The overall average harvests of these groups, which were considered to be representative of the community, was 60 kg per capita per year over the period 1975-81 (Berkes, 1983). Note that this is higher than all but one year of the community survey results, as shown in Figure 2.

Other field studies based on observations of family groups confirm that substantial amounts of fish may be harvested. Jarvenpa (1980) reported a per capita consumption level of 112 kg for a group of 26 Chipewyan people at Patuanak, Saskatchewan, in 1971-72. L. Johnson (pers. comm. 1988) observed that a family group of Inuit, averaging 10 adults and children, fairly consistently harvested about 1000 arctic charr (*Salvelinus alpinus*) per year over the years 1974-88 at Nauyuk Lake, Kent Peninsula, near Parry Bay, N.W.T. At 2.5 kg per fish, this group was estimated to harvest about 250 kg per person per year.

The actual harvests of fish may be higher than those reported here, especially considering that some fish are also used as bait in trapping (e.g., species of suckers in the James Bay area) and that in some communities much fish may be used as dog food. Murphy (1986) estimated that three-quarters of the fish harvest was used as dog food in Old Crow in 1984, virtually the same proportion as reported by Stager (1974). However, in most northern Canadian communities, this proportion is likely to be much lower because the use of dogs in transportation has declined in the 1960s and 1970s.

Subsistence fisheries provide Canadian native harvesters with some 60 kg of fish, or a potential edible weight of some 42 kg per person per year. This is six times higher than the average Canadian fish consumption of 7 kg. In Alaska, the harvest figure and the discrepancy between subsistence fishermen and the general United States population is even more striking. Over the period 1980-85, Alaska Department of Fish

and Game, Division of Subsistence, surveyed 98 communities, including about a one-third sample of the rural population of some 185 000. The overall average harvest was 104 kg dressed weight (or 140 kg whole weight) per person per year (Wolfe and Walker, 1987). This is more than twice as high as the Canadian native harvest averages summarized here. Alaska subsistence harvesters were estimated to consume 18 times more fish than the general public in the United States (Wolfe and Walker, 1987).

The higher average harvest figures in Alaska require some explanation. An intuitive ecological explanation is that the resource base may be more biologically productive on the Alaska coast than in much of the waters harvested by Canadian native groups. There is, however, an alternative explanation. Analysis of the Alaska data shows that fish almost always make up half of the total subsistence harvest, and in some regions closer to two-thirds (Wolfe and Walker, 1987). By contrast, the contribution of fish to the overall subsistence harvests in Canada is typically one-quarter to one-half in regions such as James Bay and northern Quebec (e.g., NHR, 1982b).

Estimating the Size of the Subsistence Fishery Sector

The subsistence sector is a large fishery — but how large? Bodaly (1986) provided a Canada-wide estimate by assuming an annual consumption value of 35 kg (equivalent of a harvest value of 50 kg). If 50 000–150 000 native people out of a total of some 400 000 native people, including Metis, participate in subsistence fisheries, this would give a Canada-wide annual harvest total of 2500–7500 t. To put it in perspective, the subsistence fishery, according to these assumptions, would be on the order of one-tenth the size of the inland commercial fishery of Canada, which is 40 000–50 000 t/yr in most years.

The actual magnitude of the subsistence sector is likely to be greater than this, simply on the basis of existing harvest surveys. The regional summaries in Table 1, incomplete as they are, add up to about 180 000 people and 7750 t/yr. These totals are already at the upper limit of the Canada-wide subsistence fishery estimate based on Bodaly's (1986) assumptions.

Another estimate of the total "native fisheries" is provided by Pearse (1988), based on personal communication from government fishery managers. These approximations, most of them indicated by the author to be "very rough estimates," add up to 9298 t (British Columbia, 3062 t; Alberta, 700 t; Saskatchewan, 2050 t; Manitoba, 1000 t; Ontario, 842 t; Quebec, 216 t; Maritime provinces and Labrador, 108 t; Yukon, 20 t; N.W.T., 1300 t).

Some of these harvest values (e.g., Quebec, Ontario, Yukon) are obvious underestimates. To appreciate the extent to which subsistence fisheries in areas such as Alberta have been underestimated for the lack of data, suffice to point out that Saskatchewan Fisheries Branch increased their estimate of the size of their subsistence fishery by an entire order of magnitude upon the completion of a detailed study of this sector (Murray and Clouthier, 1986).

Considering such recent findings and the fact that much greater numbers of people than hitherto suspected seem to be participating in subsistence fisheries, it may be reasonable to hazard a guess that Table 1 covers only about one-half of the Canada-wide subsistence sector. If so, some 300 000 northern rural people, including non-status Indians, Metis (as in Pinehouse, Saskatchewan, Table 2), and non-native people (as in Usher, 1982), may be harvesting on the order of 15 000 t of fish per year. If so, the subsistence sector may be closer to one-third of the Canadian inland fishery sector, rather than one-tenth.

Policy Implications

The data summarized here indicate that subsistence fisheries are both quantitatively significant and geographically extensive. Such fisheries are found over wide regions of the Canadian North and mid-North, and not only in a few areas. They are important for local traditional economies and culture (Keith *et al.*, 1987; Tough, 1984).

As compared to commercial fisheries, the subsistence sector is a different kind of fishery and thus requires a different kind of management. First, since subsistence fisheries are spread over a very large area, the applicability of the usual fisheries science to this sector, with stock-by-stock assessment, is a problem. Second, even if harvest quotas and other regulations could be formulated, the enforcement of such government regulations over scattered areas would be impossible, or nearly so.

A number of innovative approaches have been suggested for subsistence fisheries management, and some have already been incorporated in government policy. These include: a) the use of local knowledge, b) the decentralization and sharing of resource management decision-making responsibility, and c) the establishment of clear priorities regarding the allocation of the resource among the subsistence, commercial and recreational fishery sectors.

Regarding local knowledge, extensive traditional knowledge obviously exists on distributions and life cycles of fish, simply because such knowledge is essential to productive fishing and was, at one time, essential to survival. As recommended by the November 1985 workshop of the Department of Fisheries and Oceans, the integration of native peoples' knowledge and scientific knowledge appears to be a useful and important resource management approach (Keith *et al.*, 1987). But to carry out such integration appears to be a challenge that requires closer cooperation between scientist/managers and local harvesters than has been possible in the past.

The sharing of responsibility for resource management, or co-management, is an approach examined by, among others, the Canadian Arctic Marine Conservation Strategy (Department of Fisheries and Oceans, 1987). The Strategy recommends the sharing of decision-making powers among government, native people and other stakeholders (Strategy, item 3.2.1), and provides for the recognition of cultural as well as economic benefits through the sustainable use and development of renewable resources (Strategy, item 3.3.2).

Regarding allocation priorities, policy recommendations to give subsistence fisheries precedence over commercial or sport fisheries go back at least to a 1972 Federal-Northwest Territorial task force report (Keith *et al.*, 1987). The policy issue is an important one because the commercialization of subsistence fisheries in the past has adversely affected local subsistence economies and led to non-sustainable resource use patterns, not only in the Northwest Territories

(Keith *et al.*, 1987), but also in other parts of the Canadian North and mid-North, for example, in Manitoba (Tough, 1984).

In conclusion, subsistence fisheries have been virtually ignored for a long time partly because there was little published information regarding their extent and significance. Material reviewed here supports the contention that "aboriginal harvesting is not an incidental cultural remnant from the past, but a critical economic activity" (Keith *et al.*, 1987) that continues to be important.

There is evidence from parts of the North that native subsistence users of living resources are capable of sharing management responsibility towards the sustainable use of these resources (Drolet *et al.*, 1987). Government, however, retains the ultimate jurisdiction for resource conservation. Wherever feasible, the revitalization of community-level self-management, subject to principles of conservation, has the potential to become the cornerstone of an innovative policy for subsistence fisheries management.

ACKNOWLEDGEMENTS

I am thankful to B. Smith, E. Pinkerton, R.A. Bodaly, L. Johnson and S. Murphy for their help and information. Many colleagues involved in James Bay area studies have inspired my interest in subsistence harvests and harvesters; they include M. Breton, L. Brooke, C. Drolet, H. Feit, I. Juniper, W. Kemp, A. Reed and M. Weinstein. I appreciate the lively interest and feedback from many at the American Fisheries Society Annual Meeting, September 1988, Toronto, and at the Freshwater Institute, DFO, Winnipeg, where preliminary versions of this paper were presented. This work has been supported by the Social Sciences and Humanities Research Council of Canada (SSHRC).

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