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Native Harvest Surveys and Statistics: A Critique of Their Construction and Use

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ABSTRACT. Native harvest statistics are counts, or estimates, of the number of animals by category taken by a specific group of native people during a specific time period. These statistics are significant for basic research in the social and biological sciences, for public policy and for the resolution of environmental conflicts in the North. This paper reviews and assesses two common sources of native harvest data — administrative and monitoring records, and special-purpose studies — and provides an extensive bibliography for the latter. Native harvest data are normally obtained by recall survey rather than direct observation. The existing data base is therefore evaluated in terms of the methodological norms of social surveys, with particular attention to precision and uniformity of survey parameters and interview terminology, sampling procedures, non-response bias and response bias. Despite some lack of methodological rigour, especially regarding parameters, terminology and projection from reported harvests, it is concluded that the existing body of information may be used to recreate an historical statistical series of substantial breadth and depth, useful for both socio-economic and biological research purposes.

Key words: native, Northwest Territories, wildlife, social surveys, methodology

RÉSUMÉ. Les statistiques de récoltes indigènes sont des comptages ou des estimations du nombre d'animaux classés par catégories, récoltés par un groupe d'indigènes particulier, pendant une période donnée. Ces statistiques sont importantes pour la recherche fondamentale en sciences sociales et biologiques, pour l'établissement de politiques publiques et pour la solution des conflits reliés à l'environnement dans le Nord. Cet article fait une revue et une évaluation de deux sources courantes de données sur les récoltes indigènes — les dossiers de l'administration et des organismes de surveillance, et les études spécifiques — et il fournit une bibliographie approfondie pour ces dernières. Les données sur les récoltes indigènes sont normalement obtenues à partir de témoignages sollicités plutôt que d'observations directes. La base de données existantes est donc évaluée en fonction des normes méthodologiques des enquêtes sociales, une attention particulière étant portée à la précision et à l'uniformité des paramètres d'enquête et de la terminologie d'entrevue, aux procédures d'échantillonnage, à la tendance à ne pas répondre, et au parti pris des réponses. En dépit d'un manque de rigueur méthodologique, en particulier en ce qui concerne les paramètres, la terminologie et les projections à partir des récoltes rapportées, on a conclu que l'ensemble des informations existantes peut servir à recréer une série statistique historique d'une ampleur et d'une profondeur considérables, utile pour la recherche socio-économique aussi bien que biologique.

Mots clés: indigène, Territoires du Nord-Ouest, faune, enquêtes sociales, méthodologie

INTRODUCTION

Native people take a substantial part of the total harvest of fish and wildlife north of the settled agricultural areas of North America. Quantitative estimates of their harvests are important for basic research in the social and biological sciences; for making public policy respecting resource management and allocation, economic planning and project assessment; and for impact mitigation and compensation.

Harvest statistics are counts, or estimates, of the quantity of a particular species of fish and wildlife taken in a specific area or by a specific group of people over a period of time. Harvest statistics may thus be presented as totals for either a geographic region or a category of harvesters. In the case of native harvest statistics, these two formats are often used interchangeably (although sometimes incorrectly so), because for many species native people are the sole harvesters and because identifiable groups of native people have normally harvested within well-defined traditional territories.

The term "native harvest survey" seems to have come into common use as a result of the implementation of the James Bay and Northern Quebec Agreement of 1975, involving the Cree and Inuit of northern Quebec and the federal and provincial governments. This agreement called for five-year surveys of the Cree and Inuit harvests, as a basis for setting minimum preferential allocations on a species-by-species basis to these two native groups (James Bay . . . , 1976a,b,c, 1982a,b; hereafter referred to as the JBNQ surveys). Similar surveys have since been conducted in anticipation of the settlement of Inuit claims in the eastern and central Northwest Territories (Donaldson, 1983, 1984; Gamble, 1984; Jingfors, 1984).

These comprehensive and repetitive surveys, covering very large areas, obtain harvest data solely on the basis of harvester recall and have been conducted under a substantial degree of local initiative and control. While there is some variation in both the specific methodology and the reliability of the results of each survey, all meet certain basic standards of uniform and repetitive measurement that enable valid comparison of results over space and time (Usher *et al.*, 1985).

Yet for other parts of the North there are no uniform and reliable systems for obtaining such statistics. There are instead two less satisfactory sources of data. One consists of a number of administrative data sets, which have been collected for several decades in most jurisdictions. Although these provide substantial historical depth and wide geographic coverage, they are of uncertain reliability, chiefly as a result of poor design and low (or unknown) response rates.

The other consists of numerous but fragmentary and isolated estimates of native harvests in the social scientific and biological literature. These date from about 1950 onward and are based on hunter recall, sometimes supplemented by estimates by local non-natives such as traders and game officers, and occasionally by direct observation. However, the purposes of these estimates have varied, and the methods of estimation, although often superior in design and execution to the administrative systems, have been idiosyncratic. As a result, despite the accuracy of

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many of the individual estimates, there are problems in using them for comparative purposes over space and time.

Thus there have been three stages in the collection of native harvest data, which are best conceived of as levels of methodological development rather than a chronological succession, because all three methods of data collection continue to be utilized. Several evaluations of the third stage now exist (James Bay . . . , 1982a,b; Usher *et al.*, 1985), and further consideration of it will be foregone in order to focus on the first two.

What is common to all three methods is that harvest data are normally obtained by means of social surveys, in which people are requested to recall or record their harvests. In large part this is because independent observations of an adequate sample of harvest events are rarely feasible. Typically, native hunters foray repeatedly over large areas in small, mobile parties. Participant observation in hunting and trapping and counts of particular harvested items (e.g., numbers of fish on drying racks) are useful not so much for generating total counts, but rather for verifying or supplementing harvesters' reports.

There are exceptions: for example, where the harvest of prey species or populations such as large marine mammals or migratory waterfowl is highly restricted in space and time. Yet even then, direct observation can only cover the bulk of the catch that actually occurs under these circumstances but not incidental kills at other times and places. In some other cases, like domestic fisheries, a combination of carefully selected sample observations and interviews can provide the basis for generating reliable harvest estimates.

In view of the importance of recall surveys, then, methodological questions about harvest data are necessarily the same as for any social survey: for what purposes, by whom and by what methods were these data collected, how comprehensive was the coverage and how representative are the results? (See, for example, Shipman, 1981.)

Our objective in this article is to answer these questions and to provide a methodological basis for comparing and analyzing apparently disparate data that have hitherto been used only in isolation. There are a number of practical and theoretical reasons for seeking to extend the historical depth and geographical breadth of coverage, which can only be done by making use of the administrative data and occasional surveys already on record. These reasons include the practical objectives already mentioned (especially the allocation and management of fish and wildlife resources), as well as more theoretical issues in both the natural and social sciences. The latter include species population dynamics in relation to harvesting pressure, harvesting strategies in relation to resource abundance or scarcity and the historic effects of variable harvests on the social, economic and cultural life of native northerners. Historical depth is especially important because so often there are substantial long-run variations in both abundance and harvest that recent statistics, even where available, cannot illuminate.

Both the administrative and literature data provide a basis for estimating past levels of native harvests and for obtaining information on current levels. The purpose of this paper is to provide a brief survey of these two types of harvest records, to assess their utility for the aforementioned purposes and to provide a basis for comparing them to the results of the modern comprehensive surveys.

Our data and examples are drawn heavily from the Northwest Territories, because the historical record is the most complete there and because there has been a greater use of native harvest statistics in the N.W.T. than in other North American jurisdictions. We have surveyed the literature (i.e., publicly available "grey literature" as well as published monographs and articles) from all across northern North America in an exploratory rather than exhaustive way, so as to indicate the richness and variety of available sources. Our observations and conclusions are intended to apply broadly.

We review, first, the actual collection and use of native harvest statistics and, secondly, the basic properties of harvest statistics; finally, we identify the key methodological problems associated with harvest surveys and their analysis.

ADMINISTRATIVE AND MONITORING RECORDS

Fish and wildlife agencies have obtained quantitative data on all types of harvests for administrative and monitoring purposes for several decades. With the exception of the fur trade records of the Hudson's Bay Company, these constitute the earliest continuous records available. However, although systems for gathering data relating to native harvests have been in place for some time, the resulting records have generally been kept haphazardly and rarely tabulated or analyzed. They have been used most commonly to provide statistics for agency annual reports or for national economic production (e.g., Statistics Canada, annual). To a lesser extent, these data have also been used to monitor trends in fish and wildlife harvesting and as possible indicators of abundance, but seldom as precise tools for research and management.

The Record-Keeping System

The taking of fish and wildlife normally occurs under authority of a licence or permit issued by a fish and wildlife agency. Administrative harvest records are thus conveniently obtained by attaching reporting requirements to these licences. This system works reasonably well for non-native commercial and sport harvests, but less so for native harvests, for two reasons.

One is that native people harvest fish and wildlife almost entirely (except for fur and in some cases fish) for domestic or subsistence purposes. As well, native persons are by law in most jurisdictions the only ones authorized to take fish and wildlife for subsistence purposes. Rarely are there any systems in place designed specifically to track subsistence harvests, and these harvests are largely unaccounted for by systems intended to record commercial and recreational harvests.

The other is that, unlike other citizens, native peoples' entitlement to hunt and fish (at least for domestic use) is not derived from a licence, but rather from their aboriginal rights as recognized by treaties, land claims settlements or other instruments. There is normally no enforceable reporting requirement for aboriginal peoples, and as a result, most jurisdictions have few historical records of native harvests except for commercial ones such as fur and fish. Even in these cases the status of the harvester as native or non-native is not always recorded.

The Northwest Territories, however, has an exceptionally rich record of native harvests, which is in almost every regard superior to that of other northern jurisdictions. The basis and nature of this data set are therefore described in some detail, with only brief observations on the situation elsewhere.

Although the Northwest Territories Act contains exemptions for native harvesters similar to those in other jurisdictions, a nominal reporting requirement has existed for them since 1929 under the Northwest Game Act. The regulations required native

hunters to report annually the numbers they took of specified fur and game species. The N.W.T. Game Ordinance, which replaced the Northwest Game Act in 1949, required all native people to obtain a General Hunting Licence (GHL) at no cost. This licence became the basis for annual affidavit reporting of all game species taken under its authority.

This system has no parallel elsewhere in Canada or in Alaska. The reporting requirements were only nominal, as there was no legal penalty for non-compliance. Yet it appears that most native people assumed they were obliged by the government to report their harvests, and many actually did so. The result has been that, of all North American jurisdictions, the N.W.T. has maintained by far the most complete record of native harvests.

Along with the "kill statistics" compiled from General Hunting Licence returns was a second useful set of data known as the Fur Export Tax returns. A system requiring all persons to obtain a permit to export furs from the N.W.T. was also enacted in 1929. These permits record the number of pelts in each shipment by species and usually by the area in which they are taken (Berger, 1977b, and Usher, 1975, 1977, provide detailed commentaries on the reporting systems in the N.W.T.). These two systems have provided the N.W.T. with an unusually long and reliable data set for both fur and game, although all Canadian jurisdictions have some system in place to record commercial fur harvests.

As well, in the N.W.T. and possibly some other jurisdictions, game officers' annual reports provide useful data. The R.C.M.P. annual reports on game conditions, for example (which were prepared by each detachment from at least the early 1950s to the early 1970s), contain estimates of relative abundance of scarcity of game based on both sightings and local opinion, occasional descriptive accounts of hunting methods, effort and success, as well as quantitative estimates of harvests (by law, in most cases, entirely native) for the district. These estimates were based in part on the fur export and GHL returns, but also include additional information obtained during patrols of outlying camps.

More recently, the establishment of quotas for certain big game and marine mammal species, by which harvests are thus controlled by tags, has provided an additional and more precise source of native harvest statistics, because illicit kills are difficult to conceal or to dispose of commercially in small northern communities.

Administrative data normally reflect the statutory jurisdiction and responsibilities of the agencies that collect them. These have normally been resource management agencies, and thus each data set is limited to a particular group of animals, birds or fish. Although native people harvest a wide range of species, no agency to date has attempted to estimate their entire harvest. Hence distinctive conventions have arisen for estimating native harvests with respect to the following categories of wildlife: migratory birds, fur bearers, big game, large marine mammals, seals and fish.

Where the species or populations cover large areas (and have therefore had a history of federal management involvement), and especially where there has been a national or international, rather than purely local, concern about their status, harvest estimation techniques are better developed. This appears to be true of commercial and recreational harvests as well as of native harvests.

Migratory Birds: The well-developed methods for estimating sport harvests (see below) have not been applied to native harvests. Statistics formerly gathered from GHL holders (in effect, native harvesters) in the N.W.T. were notoriously inaccurate and incomplete. No administrative statistics have been maintained by other jurisdictions.

Fur Bearers: Fur bearer harvests are almost always assumed to be represented by commercial statistics. These statistics, however, record only the sale, circulation or export of pelts, not the numbers of fur bearers actually taken. Elton (1942) commented on this disparity extensively in connection with Hudson's Bay Company trade statistics. Numerous researchers since have estimated the size and regularity of these differences in particular contexts. In some jurisdictions, such as Northwest Territories and Yukon, there are historical records based on licence returns (in effect, recall interviews), as well as on commercial returns. No direct comparisons of recall and commercial records have been published, although some agencies have done internal analyses. During the course of the JBNQ harvest surveys, however, considerable effort was made to compare, and if possible reconcile, the survey results with the commercial records of the Government of Quebec.

Big Game: The rare tabulations of native big game harvests for biological purposes have been based chiefly on the educated guesses of wildlife officers or, in the case of the N.W.T., the Kill Statistics from GHL returns. Counts based on the numbers of tags issued and returned are few, because quotas seldom apply to native harvesters in the North, except for musk-oxen and large marine mammals (see below), and even then they are for the most part relatively recent.

Small Game: Estimates of the native harvest of small game by wildlife agencies are exceedingly rare. The Kill Statistics from GHL returns recorded kills of upland game birds taken in the N.W.T. but made no taxonomic distinctions among grouse or ptarmigan. The statistics gathered for these categories have always been acknowledged to be especially unreliable.

Otherwise, there are no tabulations based on either observations or interviews of such species as rabbits, hares or porcupines for any jurisdiction. Presumably this is because these species are not regarded as scarce, nor do they generate revenue. Yet in some areas small game constitutes a significant proportion of the local diet at certain times.

Large Marine Mammals: In 1972, the Department of Fisheries and Oceans began collecting statistics on native harvests of large marine mammals. Records prior to that time are fragmentary. These harvests are commonly monitored either by direct observations (of landings if not strikings) or by recall interviews at hunting camps. The reliability and comprehensiveness of the current reporting system are greatly enhanced by the fact that the harvests of these species are relatively concentrated in time and space. Fisheries managers consider these counts useful for management purposes but acknowledge two major problems with them. One relates to insufficient standardization of reporting procedures, including the failure to count animals struck and lost. The other is the significant incentive for strategic response bias by hunters, for example, in the case of narwhal, possible non-reporting of untusked animals (e.g., Hunt, 1979, and Fraker, 1980, for Mackenzie Bay beluga, Brodie *et al.*, 1981, for Cumberland Sound beluga and Finley *et al.*, 1980, for North Baffin narwhal).

Seals: There is no systematic recording of native seal harvests. Since the 1960s, the N.W.T. Wildlife Service has kept records of pelt sales, and Hudson's Bay Company records are available for earlier years (Smith, 1975). However the differ-

ence between the numbers of animals struck, the numbers retrieved, the numbers of pelts sold and the number of animals consumed is far greater than for any other fur bearer, and these data are therefore of limited value.

Fish: There is no systematic recording of domestic fish catches in the North. For many years, fisheries managers have considered it unnecessary or infeasible to gather administrative data of this type. The recent introduction in some jurisdictions of "food" or "Indian" fishing licences with reporting requirements has been largely ignored by native harvesters. Only commercial statistics are available.

With the exception of the N.W.T., native harvest statistics in Canada have typically been limited to the commercial take by native peoples from trapping and commercial fishing, based on purchase records, export permits and nominal harvester reporting requirements. Outside of Canada, Greenland has maintained a consistent but partial recording system since the 19th century, chiefly of commerce in wildlife, but also of domestic harvests of the major mammals (Ministeriet for Grønland, 1983). In Alaska, official records are less complete (Buckley, 1954).

The permit-based reporting systems used by fish and wildlife management agencies to track native harvests have generally been developed in-house, for administrative convenience, and have rarely been subject to any critical or peer review. The data have not always been completely or consistently tabulated, nor are they necessarily maintained in a form useful and accessible for research and analysis. In some cases the raw data have been discarded as useless or unintentionally lost in departmental reorganizations and relocations.

It is nonetheless possible in many cases to reconstruct past harvests and to link these data sets to currently generated ones, if the limitations of the original data are properly accounted for. Using appropriate techniques, it is possible not only to design better methods of obtaining native harvest data in future, but also to interpret and evaluate existing data more accurately and reliably.

The Use of Administrative Records

The historical harvest statistics for the N.W.T. have often been used in both biological and economic research during the last 30 years. In some cases researchers have relied on the annual totals by community provided without explanatory text in the summary tables compiled each year by the N.W.T. Wildlife Service. In other cases, they have re-analyzed the original individual permit records or hunter declarations. During the 1960s and early 1970s, these statistics were often used uncritically in economic analyses — for example, in some of the Area Economic Surveys (see below) — and in impact assessments (see, for example, DIAND/MPS, 1973; Gemini North, 1974). Commentaries on the potential for misinterpretation or misuse of these data are found in Berger (1977b) and Usher (1978).

Until recently, administrative data have only occasionally been used for management purposes in the N.W.T. Early examples include the muskrat management program begun in the Mackenzie Delta in the late 1940s, walrus hunting restrictions in the 1950s (Loughrey, 1959) and the establishment of polar bear quotas in 1967, which were set for each community at a percentage of the mean recorded harvest of the three previous years. Commentaries on the limitations of these data for biological management, at least for certain species, are found in Kelsall (1968) and Smith and Taylor (1977). Although wildlife managers have long recognized that catch statistics are in principle an essential management tool, they have had considerable doubts about the reliability for that purpose of the data they have been gathering routinely for decades.

Several problems have been identified in using administrative harvest statistics. First, there is the design of the statistical set, including the absence of reporting requirements for some species, lack of species differentiation (e.g., among geese, ducks, seals and caribou) and in the case of furs the systematic omission of domestically retained or unsaleable pelts from the records. Secondly, there are methodological problems with the collection of the data, including the lack of reporting incentive, inconsistent and frequently unrecorded reporting rates, unreliability of hunter recall over long periods for certain harvests (especially of birds and fish) and the possibility of deliberate misrepresentation of catch.

The net effect of all these difficulties is that official tabulations normally underestimate the volume of the native harvest, in some cases substantially. For some species or areas, the degree to which this is so can be estimated and corrected for; for others it cannot. Even where the potential exists for projecting estimates of total harvests from reported harvests because the sample size is known or can be reliably estimated, this has not been done systematically.

It is generally concluded that official N.W.T. harvest data, in their present form, are useful for reconstructing trends in native harvesting of some species, but the actual quantities must be treated cautiously. Others have reached similar conclusions about native harvest data from other Canadian jurisdictions (e.g., Usher, 1979, for the Yukon, Kelly, 1978, for Saskatchewan, Rogers, 1966, and Usher *et al.*, 1979, for Ontario, Feit, 1975, Weinstein, 1975, and Cree Regional Authority, 1979, for Quebec, and Usher, 1982, for Labrador).

Annual game reports provide a supplementary source of historical data, although they have never been assembled into a single data set (see, however, Smith and Taylor, 1977, on seal harvests). It is especially difficult to compare them over time and place because of idiosyncratic reporting methods. As well, because game officers' obligation to gather statistics is coupled with an obligation to enforce the game laws, full cooperation by harvesters may not always be forthcoming.

Administrative Commercial and Sport Harvest Records

Several systems have been in place to measure the commercial and sport harvests of fish and wildlife in North American jurisdictions. These are of two basic types (not including bag and creel checks, or checkpoint counts, which are primarily enforcement rather than data-gathering techniques).

One is the recording of commercial transactions, based on mandatory recording of sales, purchases or exports. These apply chiefly to fish and to fur-bearers, as described above, and are generally considered to cover virtually all non-native harvests and the bulk of native ones.

The other is the permit-based reporting system, which is normally voluntary and is intended to cover sport or recreational harvests. The standard method of estimating these harvests is to survey a sample of individual permit holders (Filion, 1980), and most jurisdictions conduct recreational harvest surveys of this type (additional reporting requirements often apply to commercial outfitters and guides).

Questionnaire surveys of permit holders are relatively recent

in Canada, and many are no older than the comprehensive native harvest surveys initiated in 1975. The primary example is the National Harvest Survey of waterfowl (Cooch *et al.*, 1978), which began in 1967. It has drawn heavily on the expertise of biometricians and social scientists for its design, interpretation and evaluation, and it has undergone extensive peer review and refinement. There is no comparable system for collecting uniform data at the national level for recreational harvests either of fish (although periodic surveys have been undertaken) or of big game.

The quality of both commercial and recreational harvest estimates varies substantially not only among jurisdictions but also by species. Significant sources of error or bias in them have led to controversy over their interpretation, as has been the case with native harvest statistics. Indeed, Boyd (1977) considered data on waterfowl sport harvesting to be less reliable than the native harvest statistics then being generated by the James Bay and Northern Quebec surveys. Yet, both recreational and commercial statistics have been gathered more consistently and used more extensively for both management and economic purposes than have native harvest statistics.

SPECIAL-PURPOSE STUDIES

What we refer to here as special-purpose studies have been of several types: scholarly social scientific studies, government economic planning reports, social and economic impact assessments, nutritional studies and wildlife status and management studies. Practically all of these date from the post-1945 period, and most since 1960. Although we review these categories separately, some of these studies have served overlapping purposes, and there is much indication of cross-fertilization.

In the years after World War II, there arose, on the one hand, a growing interest in northern research in both the natural and social sciences and, on the other, a growing recognition of both the impending scarcity of certain species (especially caribou) and an economic problem among native people. Reliable estimates of native harvests therefore assumed greater significance for theoretical research as well as in practical questions of resource management and in social and economic planning in the North. There followed an increasing use of native harvest data in support of competing public policy objectives and ideological positions (see Dominique, 1984).

Early investigators of these practical issues (e.g., Buckley, 1962; Cantley, 1950; Jenness, 1964; Kelsall, 1957) had no alternative but to rely on existing administrative records. They did not always do so uncritically, but it became evident that these data were inadequate to meet the tasks of either resource management or economic planning.

Researchers thus began to develop a number of independent methods of obtaining harvest statistics for their specific needs. Most of these methods have been derived from the standard techniques of anthropology and sociology: participant observation, flexible or open-ended interviews and standardized questionnaires. However, as these techniques are based primarily on harvester reporting rather than direct observation, they are in principle refinements and improvements of the basic administrative recording system.

Scholarly Social Science Studies

The intellectual roots of much of the social scientific documentation of native harvests can be traced to the application of the concepts of human ecology or cultural ecology to northern research in such diverse fields as anthropology, human geography, sociology, demography, archaeology and biology (Lantis, 1954). Early research in this tradition focused on the adaptation of northern peoples to their environment and on environmental health. Notable examples include two studies in the late 1940s of the social basis of nutrition and health among the Cree of Attawapiskat (Honigmann, 1961) and Rupert House (Kerr, 1950); Shimkin's (1955) human ecology research at Fort Yukon in the late 1940s; Rogers's (1973) ethnographic study of the Cree of central Quebec in the early 1950s; and the geographical research undertaken by Foote and Williamson (1966) in northwest Alaska in the late 1950s. The last was especially influential on subsequent work in the Canadian North and was as well the prototypical impact assessment of a major project in the Arctic. Each of these pioneering studies attempted to collect and analyze quantitative data on the production and consumption of country food, as well as the sale of furs, in order to understand the native economy.

During the 1960s and '70s, numerous scholarly studies were conducted that described and analyzed the hunting and trapping economies of native northerners. Several provided harvest statistics based on recall interviews with hunters and others, often supplemented by participant observation (e.g., Beaubier, 1970; Berkes, 1977, 1979; Bodden, 1981; Feit, 1978; Freeman, 1969/70, 1975; Haller, 1967, 1978; Jarvenpa, 1980; Knight, 1967; Müller-Wille, 1974; Rogers, 1962, 1973; Rushforth, 1977; Tanner, 1979; Treude, 1977; Usher, 1965, 1971; Williamson, 1964). Most of these authors were trained as anthropologists or geographers, and some had training in wildlife biology as well. Practically all shared a common interest in cultural ecology. Thus their studies tended to bridge the purely economic and the purely biological approaches to the question of harvest statistics. Most of these studies relied primarily on participant observation made possible by extended field residence, but also obtained harvest and/or diet data through recall surveys. In some cases, a sample of harvesters was requested to maintain diary records.

A unifying interest for most of these studies was the relationship between human social groups and their resource base; consequently, the relationship of harvesting practices and levels to resource abundance and availability were central research concerns. The objective of these authors in generating quantitative data on hunter success was to correlate this information with data on social organization, culture change, employment and cash income and hunter effort and productivity and not necessarily to contribute to some larger harvest data set. Consequently, the actual methods of data collection and interpretation remained somewhat idiosyncratic and were rarely specified in detail. Most authors appear to have regarded textbook survey and sampling methods as not only unnecessary, but also of doubtful utility in a cross-cultural setting.

Government Planning Studies

In the late 1950s, the Canadian government (Department of Northern Affairs and National Resources) began a series of Area Economic Surveys, which during the ensuing decade covered the entire N.W.T., northern Yukon and arctic Quebec (Lotz, 1976). The purpose of these surveys was to document the contemporary economic situation of the native people and to recommend measures to improve it. Many of these studies carried forward methods of analyzing native economic activity

developed by Foote and Williamson (both of whom also participated in some of them) and provided the first comprehensive documentation of native harvest levels across much of the North (see especially Abrahamson, 1963; Abrahamson *et al.*, 1964; Bissett, 1968a,b; Brack, 1962; Brack and McIntosh, 1963; Foote, 1967; Haller *et al.*, 1968; Usher, 1966). Besides examining existing government statistics, these studies obtained data through participant observation and recall interviews with individuals and households. The survey methods, though innovative, were *ad hoc* and were modified chiefly on the basis of previous experience rather than examination of the social scientific literature.

Similar studies have been undertaken recently in Alaska by the Subsistence Division (established in 1978) of the Alaska Department of Fish and Game. Like the Area Economic Surveys, these studies are intended as one-time surveys to establish the general levels of subsistence resource use in any particular locale, rather than as repetitive annual surveys. They are intended to provide data for resolving particular resource issues, such as allocation and habitat protection, rather than for species-specific management. Harvest data are thus generated as part of a broad description of the social and economic patterns of community harvesting. Most studies include hunter recall surveys using questionnaires or guided interviews, sometimes aided by harvest calendars (e.g., Behnke, 1982; Burch, 1985; Foster, 1982; Sherrod, 1982; Thomas, 1982; Wolfe, 1981; Wolfe *et al.*, 1984). These methods are, however, discussed and evaluated with more rigour than was the case with the Area Economic Surveys.

Socio-Economic Impact Assessments and Claims Statements

A range of "megaprojects," especially for hydro-electric power in northern Quebec and a gas pipeline in the Mackenzie Valley, proposed in the early 1970s generated a new interest in native harvest statistics. The chief issues that arose as a consequence of these developments were their broad impact on native harvesting and how to value native harvests and harvesting for the purpose of cost-benefit analysis and possible compensation. The starting point for these questions was necessarily volume: the quantity of food that native people were actually harvesting from their lands and waters. (The problem of converting that volume into value, dollar equivalent or otherwise, has become a significant public policy issue, but it is not the direct concern of this paper.)

The initiative for these evaluations came largely from native organizations, which were responsible for responding to these proposed developments on behalf of their constituents. Accordingly, these organizations, sometimes with the cooperation and support of governments, commissioned studies of the possible effects of these developments (impact assessments) in which the quantification of native harvests was a central research focus (in some cases documentation of the interest of the sponsoring group in certain lands and resources in preparing statements of claim thereto was also a concern). Examples include Dimitrov and Weinstein, 1984 (Yukon); Brody, 1981 (B.C.); Ballantyne *et al.*, 1976 (Saskatchewan); Usher *et al.*, 1979 (Ontario); Elberg *et al.*, 1972, Weinstein, 1976 (Quebec); and Wetzel *et al.*, 1980 (Newfoundland).

In documenting native harvests, most of these reports do two things: first, they explain why the official records drastically underestimate total harvests and, second, they estimate actual harvests on the basis of one-time recall surveys of hunters. Most reports also provide estimates of total food production by weight. As well, native organizations also commissioned critiques of the estimates of country food significance submitted by project proponents to regulatory hearings (e.g., Kelly, 1977, 1978; Shindelka, 1978).

These reports were commissioned to demonstrate the full extent of native harvesting and use of fish and wildlife, but as they were intended for use in adversarial proceedings such as public inquiries, negotiations and court cases, the authors had to ensure that their findings could be validated. As well, those commissioned to do the research were often those who had already undertaken scholarly work of the type outlined in the previous section. Where these reports or submissions based on similar evidence were actually used in such proceedings, for example in Quebec (Kanatewat *et al.* v. Hydro-Quebec, the James Bay and Northern Quebec Agreement), Saskatchewan (the Churchill River Board of Inquiry — see its Report, 1978), and the N.W.T. (the Mackenzie Valley Pipeline Inquiry — see Berger, 1977a,b), their native harvest data were generally accepted. These reports often incorporated previous scholarly research results of their authors or led to subsequent scholarly publication of the commissioned results.

One consequence of these events has been that both industry and government have become less willing to rely on conventional wildlife agency statistics as the sole basis for estimating native harvests. For example, the federal government commissioned impact assessments in Old Crow in 1973 in connection with the proposed gas pipeline (Stager, 1974), in Baker Lake in 1977 in connection with mineral exploration in the region (Interdisciplinary Systems, 1978), and (in cooperation with the Newfoundland government) in Lake Melville in connection with winter ice-breaking (Boles *et al.*, 1983). All of these studies employed hunter recall surveys.

The Polar Gas Project commissioned several studies involving hunter recall surveys in advance of submitting an application for pipeline construction in the central Arctic (Kemp *et al.*, 1977; McEachern, 1978; Stager, 1977). Major oil companies operating in the Eastern Arctic also sponsored hunter recall surveys (Finley and Miller, 1980; Resolute Bay Hunters . . . , 1983). The reports by McEachern and by Finley and Miller are particularly noteworthy for their careful attention to methodology.

In some of these impact and claims studies, harvest data are linked to native land use patterns, thus drawing on a related set of data generated by the various land use and occupancy projects undertaken by native organizations in the 1970s (e.g., Freeman, 1976; Brice-Bennett, 1977). However, rarely is there any precise or detailed correlation of quantitative harvests with specific areas.

Impact and claims studies both influenced and were influenced by the methodological development of the JBNQ harvest survey program, and especially the phase I recall surveys undertaken in 1975. These surveys were designed to obtain harvest data for the two (and for some species the three) preceding years from a one-third sample of harvesters in order to provide interim data for the implementation of the JBNQ agreement and as a basis for the four-year continuing survey to begin the following year. The JBNQ surveys were designed on the basis of an analysis of much of the earlier work cited in this paper and of Weinstein's (1976) work at Fort George, which was intended in part as a prototype (see James Bay . . . , 1976a, for a detailed account of the methodology).

Like most of the special-purpose studies already noted, the JBNQ surveys were innovative documentations of the levels of native harvesting and country food consumption, but their primary objective was not wildlife management. The data may be useful to wildlife managers as indicators of some otherwise unobserved problem involving the human use of wildlife, but not as a basis for active management intervention.

Nutrition Studies

Some medical and nutritional studies in the North have provided information on native harvests by documenting what people actually eat. Such studies are designed to estimate the consumption of country food by individuals, and thus their intake of caloric energy or specified nutrients and their exposure to toxic substances. Recall interviews are employed to determine what individuals have consumed over a specified period of time. This period may vary from 24 hours to a year, but the most thorough studies have involved the daily recording of consumption by a sample of households over several weeks or months (e.g., Ballantyne *et al.*, 1976; Barbeau *et al.*, 1976; Honigmann, 1961; Kemp, 1971; Mackey, 1984a,b; Spady *et al.*, 1982; Usher *et al.*, 1979; Waldram, 1985; Woolcott, 1974). It should be emphasized, however, that consumption and production (or harvest) are not equivalent. It may be possible nonetheless to infer harvest levels of at least some species from consumption data, which thus provide a useful cross-check for harvest survey results.

Biological and Wildlife Management Studies

Estimates of native harvests independent of official recording systems have been made by wildlife management agencies or independent biologists since the 1950s. As in the case of the administrative recording systems, distinctive methods have been developed for different types of wildlife. These have tended to combine the methods of recall survey and direct observation.

Migratory Birds: Estimates of native waterfowl harvests have been made sporadically in Alaska (e.g., Klein, 1966; Thompson and Person, 1963; see also the review by Loranger, 1985), the Western Arctic (Barry and Carpenter, n.d.) and Alberta (Macauley and Boag, 1974). More frequent estimates have been made on the James Bay coasts of Ontario and Quebec. Work done by or in cooperation with the Ontario Ministry of Natural Resources or its predecessors includes Hanson and Currie, 1957; Hanson and Gagnon, 1964; and Prevett *et al.*, 1983. A review of the James Bay estimates is found in Curtis (1973).

Two methods have been used to estimate native waterfowl kills. In one, observers have gone out with native hunters and recorded the number of birds coming within range, hunter effort, gear and success. From these data they have calculated rates of kill per hour, per day, per shot, and so on. In the other, researchers have conducted recall interviews with hunters to ascertain the numbers of birds shot during the season.

The problem with the first method is that the proportion of relevant events that can actually be observed is normally small and may not be representative. The problem with the second is that although a large sample of relevant events is reported, there may be some doubt about the reliability of these reports. We found no case in the literature where both methods were used simultaneously. However Curtis (1973) projects total kills from data obtained by both methods from different places and times in the James Bay area. Although not intended as a direct comparison of the two methods, the results in fact are not dissimilar.

Since 1980, the U.S. Fish and Wildlife Service has conducted systematic annual surveys of native hunters in the Yukon-Kuskokwim Delta to ascertain subsistence harvest levels of migratory waterfowl. Copp (n.d.) provides a detailed critique and analysis of these surveys.

Mammals: Direct observations of trappers' or hunters' catches are rare in the literature and, in any event, constitute such a small sample of relevant events as to be unreliable for generalization. Inuit seal harvests are an exception. There is a substantial literature based on hunter recall interviews and direct observations of hunts, similar to that described for migratory birds. The difference is that these data have been collected and published mostly by social scientists (e.g., Haller *et al.*, 1968; Foote, 1967; Riewe and Amsden, 1979; Usher, 1971; Wenzel, 1980) rather than biologists (with the notable exception of McLaren, 1958).

Fish: Numerous estimates have been made from time to time for specific communities or areas (see summaries by Corkum and McCart, 1981, for the Mackenzie Delta and adjacent Beaufort Sea coast and DIAND/MPS, 1973, for the Mackenzie Valley). Many of the Area Economic Surveys attempted to estimate domestic fish catches as well. These occasional data are derived chiefly from recall interviews with fishermen and are sometimes supplemented by observational data.

Both methods are beset with special problems, however, when applied to fisheries. People catch fish in such quantities and often over such an extended period of time that they cannot readily recall numbers, even assuming counts were made at the time. Observational data can rarely be generalized because they normally account for a small proportion of seasonal or annual catches that occur at many locations on numerous occasions.

Fisheries managers may also require information on length, weight and age from an adequate sample of an entire catch. These data cannot be reliably obtained through recall. Nor, unless the fishery is a relatively intensive one, is knowledge of gear size alone an adequate basis for inferring these data, and in any event native people often use a wide variety of gear to fish throughout the year. Consequently, direct observation of a sample of the catch is required.

Few biological studies of domestic fisheries in the North have attempted to account for all of these problems. Bond (1973) used a questionnaire in combination with some weighted averages (presumably based on observation) to make an annual estimate of total domestic consumption at Lac la Martre. The Department of Fisheries and Oceans has recently examined domestic fishing in the Mackenzie Delta, using a combination of survey questionnaire and direct observation, but the results are yet unpublished (V. Gillman, Fisheries and Oceans, Winnipeg, pers. comm. 1984).

Assessing the Literature

Several key points emerge from this brief review of the history and literature of the measurement of native harvests in the North. First, the studies to date have had quite diverse objectives, including commercial accounting or administrative record keeping; wildlife management (and usually the management of a single species or group of species, such as caribou or waterfowl); socio-economic analysis and planning; and the balance between human populations and animal resources. For

example, some of the Area Economic Surveys and the scholarly studies have attempted to calculate the theoretical harvest requirements of specified human populations, as well as their actual harvests, and to compare both of these with the sustainable yield of local wildlife populations (see also Science Advisory Board of the N.W.T., 1980).

Except for the administrative records, such as fur exports and licence returns, previous studies have been restricted in time, space and coverage. Normally they provide data for a single year and for a single community or region. As well, some have been concerned with particular species and therefore have not attempted to determine the total take of all harvested species. These limitations add to the difficulty of making direct comparisons among study results.

Secondly, the parameters of the harvest statistics are not uniform and often are not specified. We address this problem at length in the following section.

Thirdly, hunter recall surveys have proven to be a necessary method, and in many cases the only possible method, of obtaining native harvest data; hence, the normal methodological considerations associated with any social survey must be taken into account. Yet, despite nearly three decades of occasional special-purpose recall surveys, these methodological problems remain largely unrecognized, let alone resolved. Even within the major categories of harvest surveys — biological and social scientific — no uniform methodologies or protocols for obtaining and presenting harvest data have been developed.

Why this has been so deserves comment. Biologists, like social scientists, have relied mainly on hunter recall surveys to obtain native harvest data. These surveys are in principle no different from any other kind of social survey. Even though the resulting data may be of primary use to wildlife scientists and management agencies, the data themselves are social in nature: they are reports by human beings about their own activities and their consequences. There seems to have been inadequate recognition on the part of biologists that harvest surveys are not biological but social in nature and consequently require the application of social scientific techniques for their conduct and interpretation.

While social scientists commonly deal with interview data, biologists are unfamiliar and perhaps even uncomfortable with them, because these data do not appear to be "hard," in the way that observational data are assumed to be. As well, some wildlife managers, especially those with enforcement responsibilities, may feel that it is simply inappropriate to rely on the unsubstantiated testimony of people, some of whom may be violating the regulations. A few, regrettably, may simply dismiss the possibility that native people have useful information to provide.

Yet, many social scientists who have conducted these surveys have also failed to give adequate recognition to established social scientific methodology. Indeed, it seems fair to say that the techniques for social surveys now frequently used by North American wildlife management agencies (Filion, 1980) have had virtually no impact on the estimation of native harvests. The reasons include: (1) lack of familiarity with these techniques on the part of northern researchers, whether they have had biological or social scientific training (most of the social scientists have been anthropologists or cultural geographers, who tend to have less training in social survey techniques than sociologists); (2) the problem of cross-cultural adaptation of these techniques so that they can be applied validly in native communities; (3) the relatively small populations of native harvesting communities, which makes a census, as opposed to a sampling, approach attractive and feasible; (4) the assumption, usually unstated, that the survey population is relatively homogeneous and harvest success is normally distributed among its members; (5) the fact that the native harvest, unlike most recreational ones, is not necessarily restricted to a short season, and this compounds the recall problem.

Yet, by no means all fish and wildlife agencies take adequate account of these considerations in gathering recreational harvest data either.

In the following sections, we will outline the essential parameters of harvest statistics and the basic survey methods for obtaining these statistics. The contribution of existing administrative and literature records to a valid historical data set may then be evaluated in terms of these criteria.

CHARACTERISTICS OF HARVEST DATA

Harvest data are normally arrayed to show the number of animals, by category, taken by a specific group of people or in a specific area over a period of time. A historical data set provides these numbers for successive time periods. A "harvest statistic" (N) is the sum of a number of individual recollections or observations of harvest events.

It follows from our opening definition of native harvest statistics that five parameters must be specified for any set of harvest data. Considering the various objectives of harvest data collection, and especially the somewhat divergent needs of wildlife management and socio-economic analysis, it is to be expected that these parameters may be defined differently in each case. The literature reviewed suggests that most researchers have done this implicitly, but without specifying how they did so. This is a major source of difficulty in using these data for comparative purposes.

The basic parameters for any set of native harvest statistics are: (1) harvests, (2) categories, (3) time, (4) area and (5) harvesters.

Harvests

Harvests may refer to:

(1) Kill, or the number of individuals removed from a population by harvesting activity, i.e., how many were killed by or subsequently died as a consequence of shooting, trapping, snaring, netting, harpooning or other consequences of harvester activity. This figure includes animals struck and lost as well as those actually retrieved by the harvester. This is the quantity normally of interest to resource managers and biologists.

(2) Consumption, or the number of animals (or parts thereof) actually utilized for human purposes, i.e., for domestic food (including dog food), clothing, bedding or other uses or for commercial sale as food, raw fur or inputs to other products, such as handicrafts. This is the quantity normally of interest to economic planners and to social scientists who want to estimate the economic significance of wildlife harvesting. It is also the quantity of interest to the nutritionist or epidemiologist, who is concerned with the dietary basis of health or with exposure to toxic substances through ingestion.

(3) Production (in the economic rather than the biological sense), or the number of animals struck (or shot, trapped, netted, snared, as appropriate) and retrieved. Unless the survey is suitably specialized (and often this is not feasible for the

primary purpose at hand), struck and retrieved is both the quantity that harvesters commonly assume is being asked and the quantity they are most likely to be willing and able to recall. This is true whether the survey is in the form of government records or special-purpose studies and whether it is conducted by biologists or social scientists.

Thus, while resource managers want to know kill and economic analysts want to know consumption, harvest surveys almost invariably yield neither figure, but rather an approximation of production. In most cases this number is closer to the number of animals utilized than the number killed, for once an animal has been retrieved, it is almost invariably used in some way. Exceptions would include animals cached but for some reason not subsequently brought home, trapped fur bearers whose pelts are later judged unsaleable or unusable and meat that is spoiled or lost between retrieval and consumption.

Struck and retrieved is thus the most practical definition of harvest. Yet rarely is any of this acknowledged, let alone specified, in the literature. In some studies the terms kill, production and consumption are used interchangeably as though they meant the same thing. Sometimes there is no way of interpreting whether the statistics presented refer to kill, production or consumption, either because this information is not specified or because the methodology is sufficiently ambiguous that respondents themselves might not have interpreted the question or responded to it consistently.

Categories

Harvest statistics are normally compiled by species or genus. Resource managers and biologists want species-specific, population-specific and sometimes even age- and sex-specific data. They may, however, only want it for the particular species they are managing or studying. Economists, planners and social scientists, on the other hand, may be satisfied with such general categories as "caribou" or "geese" but require quantities for each of the entire range of harvested species, which they may then wish to convert to units of weight or nutrition. Harvest data gathered for one purpose may be of only restricted value for the other.

Time

Both administrative and special-purpose harvest data have been commonly recorded on an annual basis. The actual time period may, however, be a calendar year, a year of administrative convention, such as the licence year (which in the N.W.T. begins on 1 July) or the fiscal year, a year adjusted to local convention based on the seasonal round or simply the year prior to the survey date. Occasionally data are presented by season or month. If these do not cover a full year, however, straight-line projection of annual estimates from them is usually inappropriate because of the great seasonal variation of most harvests.

Area

Any harvest statistic must refer to some geographic area. What this area is will depend both on the purpose at hand and what is feasible to obtain records for. Resource managers interested in the harvesting pressure on a particular population want harvest statistics that relate to the normal range of that population over an annual or life cycle or some specified part thereof, such as wintering, calving or spawning. Economists and social scientists want harvest data that relate to human populations, which means either by jurisdiction (e.g., Labrador or N.W.T.) or the normal harvesting area of a particular community or group of people (e.g., of the people of Pond Inlet, or Fort Norman, or historically of a particular family group or band). Most of the data in the government records and in the literature are organized by such areal units as police detachments, regional administrative zones, fur trade regions and traditional community harvesting areas, although sometimes one must infer this from the nature of the records, because it is not always stated. Data are rarely organized by game management zones, herd ranges or natural bioregions.

Harvesters

In many parts of the North, native people are the sole legal harvesters of many or most species of fish and wildlife. Thus for many purposes, areally defined harvest statistics may be assumed to represent the native harvest, or conversely, the harvest of an identifiable group of native people may represent the total harvest in a defined area. This convenient interchangeability does not always apply, however, and it is necessary to ascertain the identity of the harvesting population or to define it according to certain criteria.

The definition of a native person (or harvester) is sometimes problematic. In Canada, there are the definitions commonly used for public administration, such as status and non-status Indians, Metis and Inuit. Persons in some of these categories are recognized as having aboriginal hunting, fishing and trapping rights, and this may affect their status as licence-holders in any permit-based reporting system. There are also community definitions (which are rarely articulated in print) and individual self-identification. These do not always coincide with legal or administrative definitions. In Alaska, where aboriginal rights are said to have been extinguished, native people are largely, but not entirely, subsumed under the category of subsistence users. How then does one identify native harvesters?

In practice, the literature reviewed here has defined native harvesters as the native residents of small communities, which is in fact where most native northerners live. No native harvest surveys have been undertaken in Canada in such centres as Yellowknife or Whitehorse, where native people are a minority, in some cases not easily identified and certainly not easily surveyed as a separate category of persons. However, a recent survey of subsistence harvests in a similar sized community in Alaska (Sitka, population 7803), based on a random, unstratified sample, is reported in Gmelch and Gmelch (1985). It seems reasonable to assume that as inter-community migration and mobility increase, the identification of particular groups of natives with traditionally defined areas will become less straightforward.

There is an additional problem when dealing with allocation issues that is not only to identify native harvesters but also to categorize what they do. In the view of many resource management agencies, native harvesting does not fit comfortably into the conventional tripartite division of commercial, recreational and domestic harvesting. In practice, native people may obtain their harvests by the gear and methods typical of each and engage in the harvest and make use of its products for each of these purposes.

For example, Indians in northwestern Ontario commonly obtain fish by commercial netting, domestic netting (using different mesh sizes for each) and angling in the course of

commercial fishing, guiding sport fishermen (in both cases keeping the rejects for domestic consumption) and in fishing for their own use. Out of their total catch, they may sell some on commercial markets, exchange some within their community and among kin (in some cases for money or money's worth) and retain some for household consumption (Hough, Stansbury + Michalski Ltd., 1982; Usher *et al.*, 1979). While this may be an extreme example of the complexity of native harvesting, it occurs to some extent and with particular variations in all native communities and for a wide range of species.

SURVEY METHODS

To reconstruct and evaluate historical harvest statistics of any type, it is necessary to determine: (1) the accuracy of the data, e.g., whether those providing the data tended to or were likely to bias their individual reports, intentionally or unintentionally, and if so, in what direction and to what extent; (2) the completeness of the data, e.g., what proportion of the population actually reported, or what proportion of the harvesting events was reported; and (3) the representativeness of the data, e.g., whether those who reported were typical members of the population with respect to their harvesting and reporting characteristics.

If all three characteristics of the data set are known, it is possible to estimate, by projection, the total harvest within precisely specified confidence limits. In practice, it is seldom possible to be so precise about the data set, but the use of a common set of conventions will nonetheless yield a reliable evaluation of its validity.

It follows from the above that the harvest, N, can be presented as a statistic in two ways. In the first, it is the sum of all of the individual reports,

$$NR = n_1 + n_2 \ldots n_i \qquad (1)$$

where NR = reported harvest; n = individual harvest report; i = harvesters reporting (or harvest reports).

In the second, it is the estimate of the total harvest,

$$NT = NR\ (j/i) \qquad (2)$$

where NT = total harvest; j = all harvesters (or all harvest events).

The normal objective of harvest surveys is to estimate NT from NR, and in practice equation (2) normally includes weighting factors to account for the biases noted above.

Sampling Methods

Virtually every study or system has attempted comprehensive coverage of all harvesters, although few have achieved it. This is true of the Kill Statistics from GHL returns (response rate varied substantially from place to place and from year to year, where it was indicated at all), the Area Economic Surveys (high response rate) and the scholarly and the impact studies (high response rate in most cases). Although many of these studies indicate the response rate, rarely do they indicate precisely how estimates of total community harvests were derived from reported totals. There is insufficient recognition that a very large sample is still a sample nonetheless and that in the case of an incomplete census it is never a random sample.

In practice, whether the response rate has been high or low, the studies reviewed have relied on fortuitous samples. Respondents are those in town during the research period and at home when the interviewer arrived. Further, whether for the official statistical records or the results of special purpose surveys, harvester reporting has been voluntary. Rarely, if ever, are there penalties for failing to report harvests to wildlife officers or for failing to participate in surveys whether publicly or privately undertaken.

Non-Response Bias

The question thus arises as to whether those who chose not to participate in the survey might in some important way differ from those who did — for example, that they were the top harvesters, or that they did not harvest at all. This possibility of non-response bias receives virtually no attention in the literature. Instead, reported results are commonly projected to total estimates, on the assumption that a representative sample was obtained. If, however, a disproportionate number of the top harvesters was excluded for whatever reason, then proportional projection, even from a sample of 70-80%, could produce misleading results.

In practice, field researchers familiar with the communities they are working in have a good subjective assessment of whether non-response bias may be affecting their results. While in mass social surveys, the behaviour of non-respondents is unknown, that is seldom true in small northern communities, where researchers almost certainly know something about the people they did not interview, as well as about those they did. This knowledge is not always communicated to the reader, however. The problem of non-response bias, although theoretically valid, is more apparent than real in the literature reviewed, because virtually all of it deals with small communities. It is of greater significance in interpreting government records, however, because the proportion of non-reporting harvesters is usually higher and their characteristics are not known.

As a rule, then, sampling and non-response bias is not a major concern in in-depth surveys of small and relatively homogeneous communities, so long as researchers are aware of the problem and communicate to readers how they dealt with it. On the other hand, mass repetitive surveys that cover small communities superficially or cover larger communities must use statistically valid sampling strategies in order to project total harvests from reported ones.

Response Bias

Response bias arises from the fact that in any social survey there may be a difference between the true answer to a question and the respondent's answer to it. The causes of response bias in recreational hunting surveys have been reviewed by Filion (1980:448-453) and include: (1) poor questionnaire design (for example, leading questions, unclearly or ambiguously worded and thus misleading questions, excessive burden on the respondent due to length or complexity of questionnaire); (2) recall failure (inability to remember the facts); (3) bias introduced by the interviewer (he or she may inspire discomfort or mistrust in the respondent or may unwittingly elicit a response intended to please); and (4) strategizing (respondents may wish to assert an interest and therefore claim to have hunted when they did not, thus exaggerating their catch, or they may wish to conceal something and therefore deny or under-report their catch).

The solutions to these problems include: (1) clarifying, simplifying or otherwise improving the questionnaire; (2) improving reporting frequency, requesting the respondent in advance to record certain events for later recall and providing the respondent with recording aids; (3) selecting and training

interviewers to recognize, minimize and be able to assess the bias introduced by personal contact (or avoid it by using a mailed questionnaire); and (4) creating a situation in which the respondents have no systematic motivation to misrepresent their harvests for strategic reasons.

To what extent do these causes of response bias also exist for native harvest surveys, and what have been the means of eliminating them or correcting for them?

Interview Design and Format: Most of the studies reviewed did not use standardized questionnaires, but instead relied on informal interviews. Especially where the objective was species-specific data, the interview was limited to a few simple questions such as: how many (of species x) did you get (since time y)? Where the enumeration of harvest was part of a larger objective, standardized questionnaires have sometimes been used, but the harvest section itself remained fairly simple.

Recognizing that much of the literature reviewed was the product of individuals with substantial field experience and/or academic training, we assume that reasonable care was taken to avoid misleading or ambiguous questions, especially in a cross-cultural situation. Yet unless the questionnaire or interview format is not only standardized but also communicated in the published results, there is much room for ambiguous interpretation. The problem of definition has already been noted. There is as well the problem of consistent reporting so as to avoid double counting or omissions, for example, where several individuals hunt together in a party. Who killed an animal may not be the same person who brought it home or who eventually consumed it. Knowledge of these cultural rules is, of course, as important for interpreting observational data as it is for interpreting survey data. Yet explicit discussion of the interview or questionnaire format or of data aggregation is rare. McEachern (1978) and Wetzel *et al.* (1980) are among the very few examples in the literature reviewed where the actual questionnaire is appended to the report and the methodology described. We found no such examples that predate the James Bay and Northern Quebec research.

These considerations are especially important if the questionnaire is to be administered in a native language, either directly or in translation, or if the respondent is not especially fluent in English. Few of the authors cited are, to our knowledge, fluent in any native language, and rarely is it indicated that the interviews were conducted in languages other than English.

The question of excessive burden, leading to item non-response or less accurate overall response, has not been specifically analyzed with respect to any single native harvest survey questionnaire, although Filion (1981) has examined this problem with respect to waterfowl sport harvest surveys. In our experience, the perception of excessive burden by native respondents results not only from the length of complexity of the questionnaire itself, but also from the prevailing view of research in the community at the time. Hostility toward research and scientists will result in low receptivity to even a simple interview, regardless of content. However, of the literature reviewed, no one has reported excessive burden leading to poor response. Perhaps this is because none of the surveys combined excessive questionnaire or interview length (e.g., more than 20-30 minutes) with repeated administration. Either they are long and administered only once, or if repeated at intervals, they are short.

Recall Failure: Native northerners, like most other people, have long memories and accurate recall of the things that are important to them. The reliability of Inuit recall of historic events over living memory has been favourably assessed by Arima (1976), and Krech (1978) cited a case of detailed recall by Dene informants of situations decades afterward, which he was subsequently able to corroborate very closely on the basis of independent quantitative records.

Native people have traditionally relied on oral transmission of knowledge and information, which many observers believe results in a much greater emphasis on accurate recall and recounting of events or knowledge than in a culture in which there are alternatives to memory, such as writing, for ensuring the continuity of knowledge. Nelson (1969:374-75), in his study of north Alaskan Inuit hunters, states that they rely on each other's empirical knowledge unquestioningly, this being the source of the common fund of knowledge with respect to harvesting. It is generally considered that individuals who reported to the various land use and occupancy studies in the Canadian North during the 1970s took special care to relate their land use activities accurately and completely.

These findings do not mean, however, that recall failure is not a problem for harvest surveys. First, harvest surveys are not necessarily analogous to the example of the land use and occupancy interviews cited above. Those interviews (which were of a directed but informal nature rather than a survey questionnaire) were seen as a once-and-for-all statement on matters of great cultural and historic importance. They constituted, for many respondents, the occasion to relate an important story: not only their autobiography but the manner in which they as individuals put their heritage into practice. In traditional native cultures, great value is placed on stories and their accurate transmission. The recall of a simple series of numbers, even though relating to as important a subject as harvesting, is probably not considered by many to be in the category of a "story," and hence less importance may be attached to a full and accurate recounting.

Secondly, practically all of the studies cited are retrospective and ask the harvester to recall, on the single occasion of the interview itself, the number of each species he or she took over a specified time period (usually the preceding year). Success in doing so requires, first, that the numbers were actually committed to memory at the time and, secondly, that they remained accurately fixed in memory during the intervening period. The occurrence of recall failure in native harvest surveys is due chiefly to the failure of harvesters in the ordinary course of events to count their harvest of a certain species, and thus to have any number to remember. Once a quantity has been tabulated and committed to memory, the ability to recall it is generally satisfactory.

There are several reasons why native harvesters have not normally committed the numbers of animals taken to memory. One is that in most cases, the precise quantity of animals taken is not a useful datum for the future success of either the harvester himself or other members of the group. General observations of abundance or scarcity or precise observations of animal behaviour or environmental conditions are much more important. It is the factors that affect success or failure, rather than the quantitative measurement of success or failure itself, that have traditionally been considered important. Success or failure was adequately measured simply as enough or not enough. Another reason is that some species are taken in such quantity and in such a routine fashion over extended periods of time.

On the other hand, the calculation and memorization of quantities is likely to occur where the harvest is rare or occurs

under exceptional circumstances, where it has special ceremonial significance or where it is sold commercially. For example, the senior author, during research on trapping on Banks Island, N.W.T., found that trappers' verbal recollections of the numbers of foxes taken as long as 30 years before generally corresponded closely with their reports to game officers within a few months of the trapping season, as recorded in the N.W.T. licence returns (Usher, 1971).

As well, where quotas or possession limits exist for certain species, the likelihood of hunter tabulation and recall is increased. Finally, women, who are much more involved in butchering and preparation of animals, may be more likely to recall quantities, but we have not seen this hypothesis put forward or tested in the literature, nor have any harvest surveys been designed especially to make use of womens' knowledge.

Where scientists have commented favourably on the recall of native people, however, it has usually been in the context of a situation in which substantial trust has been established, and this is more likely to be the case with extended participant observation research rather than with survey research, where personal contact is very limited.

Aids to Recall: In a very few cases in the literature, recording aids have been used with mixed success to enhance recall. During the early 1960s, the N.W.T. Wildlife Service gave out diaries to General Hunting Licence holders, with spaces to record their take of the major species by month. The senior author found that at Sachs Harbour, almost all of the trappers maintained these diaries diligently, whereas at Coppermine and Holman, very few did so (Abrahamson *et al.*, 1964; Usher, 1965, 1966, 1971). The practice was discontinued in the late 1960s, and in any event, the Wildlife Service used the diaries only for annual tabulations and rarely, if ever, made use of the monthly data. Otherwise the use of continuous recording aids is mostly limited to those studies interested in nutrition or in detailed household budgets, as well as harvests (e.g., Ballantyne *et al.*, 1976; Kemp, 1971; Mackey, 1984a,b).

Other aids to recall include designing multiple-choice rather than open-ended questionnaires and breaking down harvesting activity into components from which an annual or seasonal total can be reconstructed. The few examples of these techniques have, not surprisingly, been applied to those species which, for reasons already noted, people typically have the most difficulty quantifying: fish and small game. McEachern (1978), for example, used multiple-choice or categorized questions to ascertain fish catches. Usher *et al.* (1979) disaggregated the fishery by gear and season, obtaining recall data for each item, in order to reconstruct total annual catches.

Interviewer-Induced Bias: All of the harvest data, whether obtained in the form of licence or permit returns or through special-purpose surveys, have been based on personal interviews administered by police constables, game wardens, government field officers or trained social scientists. In no case has a self-administered, mail-in or drop-off questionnaire been used (except in Greenland — Haller, 1978), because of the certain expectation in earlier years of almost complete non-response to self-administered questionnaires, to say nothing of the infrequency of mail service. Even today, however, despite higher rates of literacy, greater familiarity with survey research and better communications, no self-administered questionnaire survey of any kind in the small, largely native communities has been reported in the literature. Consequently interviewer-induced bias is necessarily a consideration in harvest surveys to date, whether outsiders or local people do the actual interviewing and regardless of their training. Given the nature of the data, however, it is difficult to dissociate this bias from the more important source, namely, strategic response.

Strategic Bias: The possibility that native harvesters might bias their responses to harvest surveys for strategic reasons has long been recognized. The earliest discussions of this bias and how to overcome it appeared in the 1960s in the literature on migratory birds (see, for example, Klein, 1966:320-21; Barry and Carpenter, n.d.:2).

Prior to the mid-1970s, the chief reason for strategic bias in native harvest surveys was the fear of individual prosecution for violation of game laws or, more rarely, with respect to commercial harvests the fear of income investigation for tax or social welfare purposes. The fear of prosecution in most parts of the North, however, was limited to migratory birds. Another concern was the possibility that even where individual prosecutions were not an issue, the collective results of a harvest survey could lead to the imposition of quotas. This may have been the case in certain parts of the N.W.T. mainland with respect to barren-ground caribou.

In our experience, these biases were likely to exist whether the interviewer was a biologist or a social scientist and could only be dispelled, if at all, through a lengthy establishment of trust. The influence of strategic bias up to that time, then, was most likely to have been to produce an underestimate of the harvests of certain, but by no means all, species. The reasons for strategic bias have increased in recent years to include not only the regulation of harvesting, but also income tax, social welfare programs and harvesting support programs (Usher *et al.*, 1985), and it is therefore more important than ever that those who collect and use native harvest statistics account for it. At the same time, however, it must be recognized that there are no straightforward technical solutions to the problem of strategic bias (see, for example, Copp, n.d.:1-5), as there are for other sources of bias in social surveys. What is essential is to recognize its existence and effects and for public agencies, at least, to try to minimize it through appropriate public policy measures.

CONCLUSIONS

Despite the general tendency to ignore methodological questions in the native harvest literature, the actual results of most of the studies reviewed appear to be more reliable than most sets of administrative harvest data, for the following reasons:

(1) Although the results are sometimes difficult to compare directly from one study to another, the lack of standardization does not detract from the reliability of any individual study.

(2) For the most part, the statistics refer to production (struck and retrieved) rather than kill or consumption, regardless of the terminology used in the study.

(3) The problems entailed by a fortuitous rather than a random sample are largely overcome where the sample size is very large and where the characteristics of the unsampled population are not entirely unknown. Most of the studies reviewed achieved over 80% coverage, and in many cases special efforts were made to contact the most active hunters.

(4) Most researchers have had sufficient sensitivity to the problems of interview design and procedure in cross-cultural situations to minimize, or at least be able to account for, those sources of bias.

(5) Recall failure is not a problem for most species, and

especially those that constitute the bulk of the harvest, except for fish.

(6) Strategic bias is not systematic but is rather restricted to certain species and can be readily ascertained at the outset. For the most part, however, a consensus emerges from these studies that native harvesters, once they chose to cooperate with a survey, made the effort to record their harvests accurately but on balance underestimated slightly due to cautious interpretation of the questions and a concern, based on their cultural values, to avoid exaggeration.

(7) Most researchers have had substantial field experience and consequently have had a good subjective or intuitive sense of the quality of the information they obtained.

(8) In many studies, the reliability of interview data is considered against other evidence, such as spot counts, participant observation, personal accounts and estimates by other knowledgeable individuals.

(9) When the results of a wide variety of surveys are compared, the total harvests per capita tend to fall within a limited range and the variations are more or less readily explained. This is a purely inferential verification, however.

Many of the administrative data sets are also a valuable source of harvest statistics. The frequent and valid criticisms of these data sets, however, apply chiefly to their uncritical use, rather than to their potential. In the case of the N.W.T. statistics especially, reporting rates are often known or can be estimated from existing archival data, with the result that it is possible for many key species at least to make valid projections of total harvests from reported ones. To date, however, attempts to compile comprehensive historical data sets from administrative data (Usher, 1975, 1977) have not explored this possibility.

As a result of both the comprehensiveness (if not the accuracy) of the N.W.T. statistical record and the number and quality of special-purpose harvest surveys and estimates in the literature, there is a more complete record of native harvests of fur, fish and game in northern Canada for recent decades than exists for any other hunting societies in the world. Unfortunately this fact is seldom recognized. Too often, biologists and social scientists fail to make themselves fully aware of each other's work, let alone make good use of it. Too often, both resource managers and socio-economic planners make uncritical use of poor quality or out-of-date statistics, when better ones (with more satisfactory methodological accounts) are readily available. Indeed, too often both set out to gather new statistics with *ad hoc* methods, in ignorance of a substantial body of experience and literature.

This is especially a problem in compiling historical summaries. In the absence of generally recognized conventions for doing so, a variety of data sets, with or without methodological explanation or even reference to each other, creep into the record and are then seemingly randomly selected by users for reproduction in the literature.

Yet to some extent this woeful situation is the result of the inadequacies of the existing record to which we have drawn attention, such as:

(1) Objectives and purposes have varied over time, and there is rarely any clear recognition of the implications of the study objectives for the design of the study and the interpretation of the results. In particular, wildlife management and socio-economic analysis objectives are not easily reconciled (although it is by no means impossible to do so).

(2) In many cases, especially the scholarly social scientific studies, harvest statistics are a by-product rather than the central focus of the research. They were generated as a means of testing certain relationships between human groups and the environment. Consequently, the estimation of total harvests for an entire harvesting population or geographic area has been less important than accurate recording of the harvests of particular individuals or social groups. However, even where harvest statistics are the primary intent of a study (which is especially the case with the impact assessments and the biological studies), the methodology tends to be developed on an *ad hoc* and often internal basis, with little reference to the literature and without benefit of external peer review.

(3) Coverage is discontinuous in space and time and rarely includes all harvested species. Consequently, it is often difficult to generalize from any particular study to a large region or to the North as a whole.

(4) Terminology and definitions have not been standardized.

(5) Although there is a trend over time to a more precise interview protocol, there has been no systematic or collective effort on the part of researchers to standardize procedures and methods.

(6) Sampling techniques and their implications have barely been acknowledged as an issue, let alone been standardized.

Yet the demand for native harvest surveys has grown and now includes active management intervention, the allocation of wildlife resources among competing users and the value of harvests with respect to possible compensation requirements for loss or reduction. These demands have transformed native harvest studies from a solely scholarly concern to one having immediate and significant practical applications. They must, however, be capable of withstanding the scrutiny of both external peer review and of adversarial proceedings. Crude methodologies, which provided useful "guesstimates" in years past, are simply not adequate to meet these new demands.

In the one case — James Bay and Northern Quebec — where a large development project led directly to a negotiated claims settlement, the question of native harvest levels was resolved by formally institutionalizing a system for obtaining the required data. Thus began the generation of surveys now commonly referred to as "native harvest surveys." Since 1975, a substantial part of the Canadian North has been covered by these comprehensive and repetitive surveys, and more are envisaged by both governments and native organizations as a consequence of further claims settlements in the Canadian North. These surveys have for the most part consciously attempted to overcome the problems enumerated in this article, albeit with mixed success (James Bay . . . , 1976a,b, 1982a; Usher *et al.*, 1985).

These surveys are costly, though, and most are expected to run only for a few years. There will, however, be a continuing need for less expensive and elaborate surveys, both on a regular basis for management and planning purposes and occasionally for specific problems and user requirements. Both the permit-based statistics routinely gathered by fish and wildlife agencies and the occasional special-purpose studies will thus continue to be important sources of native harvest data. Consequently, the methodological questions identified in this article should be addressed by both those who gather native harvest statistics and those who use them.

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