International Whaling Commission

Aboriginal/Subsistence Whaling (with special reference to the Alaska and Greenland fisheries)

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Preface

This volume contains the Reports and some papers from the Panel Meeting of Experts on Aboriginal/Subsistence Whaling held in Seattle, Washington, USA, from 5 to 9 February 1979. The meeting was called for by the International Whaling Commission in recognition of the fact that in the preceding two years it had become increasingly involved with aboriginal (and in particular, bowhead) whaling. Although it believed that other factors than biology should be considered, it felt it did not possess such expertise. It looked to the Panel Meeting to provide information to help it address this difficult problem. Each of the three panel groups (Wildlife, Nutrition and Cultural Anthropology) met separately and produced their own reports which are published in full. Members of any one panel did not necessarily endorse the reports of the other panels.

Since the meeting, aboriginal/subsistence whaling has continued to be a controversial area of whale management. The final paper in this volume summarises the action taken by the International Whaling Commission from April 1979 to July 1981: the problem remains although progress has been made.

G. P. DONOVAN
Scientific Editor

Cover photograph: Flensing of a 14.75 m (48′5″) female bowhead whale, 24 May 1977, Point Hope, Alaska. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle, WA 98115.*

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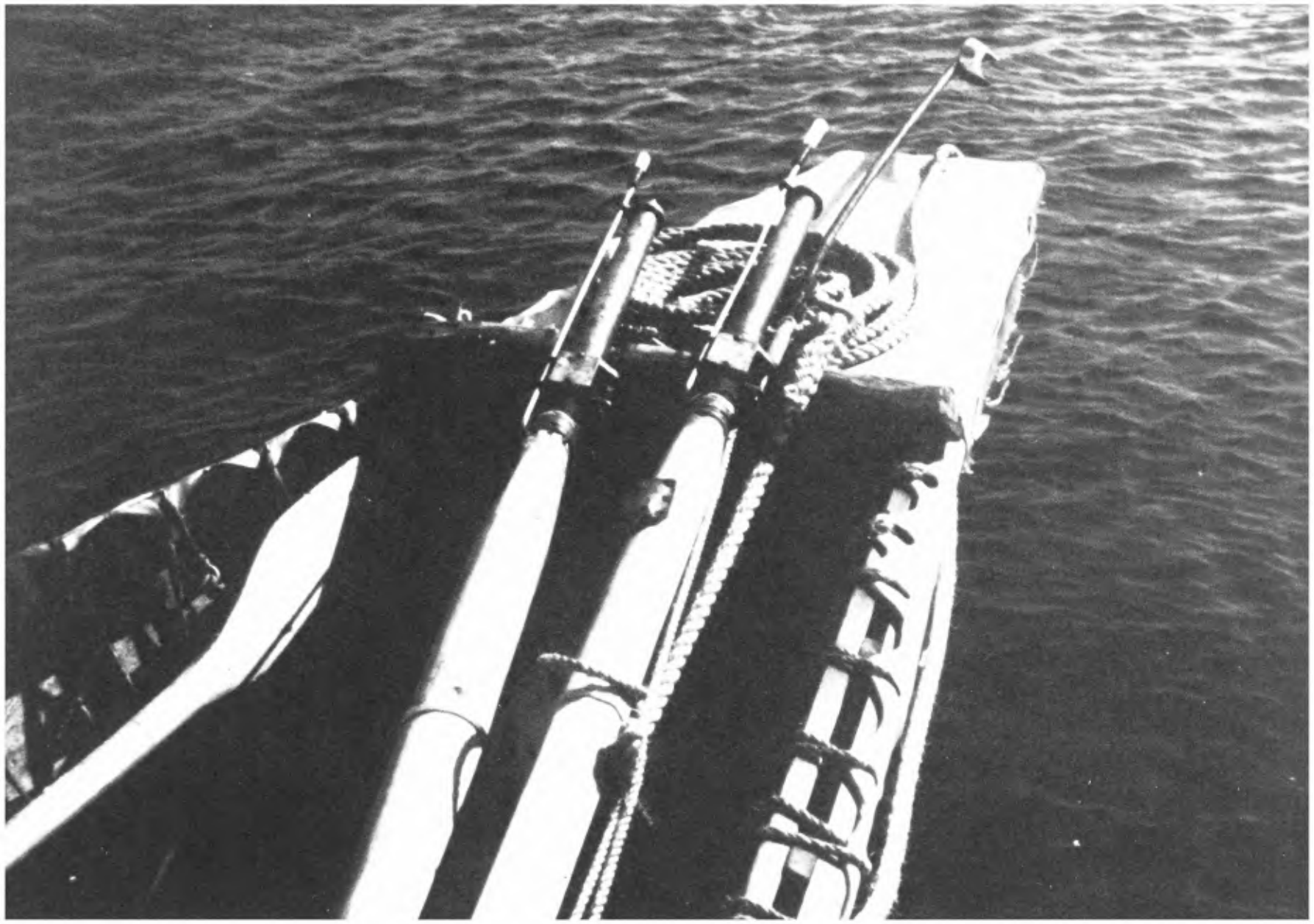

Two darting guns in position in the bow of the skin boat are ready for instance use. One gun has a harpoon attached that is secured to a float by a line about 61 m (200 feet) in length. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

The Bowhead Whale Problem and the International Whaling Commission

Opening comments by Ray Gambell

Secretary to the International Whaling Commission

INTRODUCTION

I would like to welcome you to this International Whaling Commission (IWC) Specialists Meeting on Aboriginal Whaling.

We ask you to provide information to permit us in the IWC to solve the extremely difficult problem created by the harvest of endangered whales by aboriginal people.

To produce an effective means of handling aboriginal whaling in the IWC, it is important that your work this week be as purely scientific as possible. Because many of you are not familiar with the IWC, I would like to cover two areas in my opening comments:

(1) First, I would like to give you a short history of the IWC, focusing on how it has handled aboriginal/subsistence whaling. I will also discuss present and planned activities of the IWC concerning aboriginal/subsistence whaling.

(2) Second, I will outline the specific information we need, and suggest an approach to accomplish the task.

BACKGROUND HISTORY

IWC management policy

The International Convention for the Regulation of Whaling signed in 1946 continued the international prohibition adopted in 1931 on the taking of all right whales, except when the meat and products of such whales would be used exclusively for local consumption by aborigines. This special exemption has allowed the Eskimos of Alaska to take a number of bowhead whales each year; a few bowheads have also been taken by Soviet Aleuts and by Canadian Inuits.

The Alaskan Eskimos have a long history of hunting bowheads so that this enterprise is part of their culture as well as necessary for subsistence. However, the bowheads in the Bering Sea had been severely depleted in numbers by the commercial whaling which took place during the eighteenth and early nineteenth centuries, so that the stock now remaining is very much reduced from its former level. In this respect it is like a number of other whale species and stocks throughout the world which have been overexploited by commercial whaling activity. The depletion of the world's whale resources has led to strong pressures designed to reduce, if not totally end, all whaling activity.

In 1972 the UN Conference on the Human Environment passed a resolution which included as one of its clauses a call for a ten-year moratorium on commercial whaling. This action accelerated the more conservative policies already instituted by the International Whaling Commission (IWC) from 1965. As a result a new management procedure was implemented in 1975 under which the most depleted stocks are given total protection from commercial whaling, and the catches permitted from the more abundant stocks are restricted to less than their natural recruitment rate in order that the numbers may be stabilized at the optimum level for long-term harvesting. The Commission's decisions are governed very largely by the advice received from the Scientific Committee who undertake continual assessments of the various whale stocks throughout the world.

Bowhead catches

The Scientific Committee has expressed concern for a number of years about the trend of catches by the Alaskan Eskimos from the Bering Sea bowhead stock. Since the beginning of this century until 1969 an average of 11 bowheads were landed each year. From 1970 the catch increased significantly and averaged 29 whales each year up to 1977. The increase in catch was apparently associated with caribou take restrictions and an increased availability of cash for whaling activities arising from petroleum exploration employment and settlement of compensation claims relating to land rights.

More damaging than the actual increased number of whales landed was the greatly increased number of whales killed but lost, or struck but lost, of which the majority are thought to die from their wounds. The number lost increased from 10 in 1973 to 79 in 1977, and was associated with a progressive change from using the darting gun to use of the shoulder gun. Bombs from the latter frequently fail to detonate and do not incorporate a fixing line as a standby.

The USSR have overcome high loss rates in their aboriginal fishery by providing a special catcher which replaced the traditional methods of hunting. This applies mainly in the gray whale fishery. The current Alaskan bowhead catch is traditional in the sense that it uses some ancient techniques but has large elements of nineteenth-century whaling technology coupled with twentieth-century skills and mobility. Paradoxically, the more modern elements seem to be the ones causing the current problems.

IWC action, June 1976 and 1977

Presented with this evidence the Scientific Committee at its meeting in June 1976 recommended that assessments of the early population levels, the mortality rates, and the current population status should be carried out. The Commission took note of these recommendations and passed a resolution which recommended Contracting Governments as early as possible to take all feasible steps

to limit the expansion of the fishery and to reduce the loss rate of struck whales.

At its meeting in June 1977 the Scientific Committee was presented with new evidence which suggested that the initial stock size in 1850 was from 11,700 to 18,000 whales, and that the current stock may be between 600 and 2,000 animals. The kill rate was increasing, and the present figure of about 5% of the stock is only allowed for commercial catches from the most abundant populations. There was also concern over potential habitat pollution and destruction by oil exploration and development. The Commission therefore recognized that this is the most endangered of all whale species despite protection from commercial harvesting for 40 years.

The Scientific Committee further commented that the reduction of the bowhead whales to a small fraction of the initial population level poses two interrelated questions about the chances of survival of the species. In the absence of exploitation environmental fluctuations will be expected over time to reduce the population below a critical level where extinction is likely. The smaller the population the higher the risk and the shorter the time to extinction. However, where the population is subjected to exploitation this problem is considerably exacerbated. If a quota is set and at any time some natural disaster reduced the population to any degree, continued application of the quota will result in severe depletion and a correspondingly shorter time to extinction. Accordingly there is a clear scientific case to be made for a moratorium on this species in the hope that it will recover to a somewhat safer level.

The Commission responded to this information by confirming the protection status of the bowhead stock and decided to delete the exemption clause whereby the aboriginal catch had been allowed. Clearly this was a drastic measure but the evidence presented by the scientists indicated that there was a real risk that the expanded slaughter of the bowhead whales, many of which were going to waste, would lead to the extinction of the stock within the foreseeable future. Allowing such a possibility was quite contrary to the Commission's conservation policy and clearly it had to act in what it saw to be a desperate situation.

Tbe USA proposals

At a Special Meeting of the IWC held in December 1977 the USA presented a proposal for a modest take of bowheads in 1978 to satisfy the subsistence and cultural needs of the Alaskan Eskimos in place of the total ban agreed at the June meeting. This catch was associated with a scientific programme and regulatory measures designed to reduce the loss rate.

The Scientific Committee noted that if the annual rate of increase of the bowhead whales is 1%, a figure in line with other baleen whale species, then with no kill the population would rebuild from 1,000 to 10,000 whales in 372 years; an annual kill of 15 whales would lead to extinction. With the annual rate of recruitment of 5% and no kill the time required to rebuild from 1,000 to 10,000 whales is 75 years, but it would take 99 years with a continuing annual kill of 30 whales. Information on the bowhead whale is inadequate to provide any satisfactory guide to management of this population with a non-zero quota. The Scientific Committee emphasized that taking any bowhead whales could adversely affect the stock and continue to prevent its eventual recovery, if in fact such recovery is still possible. The Committee also re-emphasized the serious consequences of a high rate of exploitation on a small stock which may suffer environmental perturbations, and noted the dangers resulting from such events as ice entrapment, in addition to man-made pollution effects.

The Commission could not accept the USA proposals as they stood but eventually agreed to a limited and strictly controlled hunt of up to 12 landed or 18 struck whales. Calves and any accompanying whales were completely protected. Coupled with these controls was a resolution calling upon the Government of the USA to take all necessary steps to minimize the adverse affects on the Bering Sea stock resulting from the aboriginal hunt, urging that measures be taken to preserve the habitat of the whales and looking forward to results of the management and research programmes promised by that Government.

Thus it was at the June 1978 meeting that the USA put forward specific proposals for future action, including a catch limit of the order of 30 whales a year set at the aboriginal subsistence needs, coupled with continued research.

The IWC response

At the June 1978 meeting the Scientific Committee had available the improved population estimates resulting from the substantial USA research programme. This gave an estimate of 2,260 whales off the Alaskan coast. This figure was higher than previous estimates mainly due to a large increase in survey effort, different environmental conditions, and better location of the survey positions. However, the number of calves counted led to an estimate of only 29 calves in this population. There are difficulties of sighting the calves and they may be segregated away from the main bodies of migrating whales so that they are under-represented in this count. Nevertheless, until there is positive evidence on these points the Scientific Committee were concerned that the normal recovery process of the stocks may have been altered and therefore considered that caution was necessary.

There was considerable concern within the Commission about the level of the catch which should be allowed given that the Commission's management policy for whale stocks is becoming more and more cautious to allow for uncertainties of assessment and to ensure that no species is reduced in an unacceptable fashion, particularly when there is a very real risk of extinction. Finally, the Commission adopted a limit for the 1979 hunt of either 18 landed or 27 struck.

Because of the many problems involved in this matter the Commission also agreed that a special working group of the Technical Committee should examine the entire aboriginal whaling problem and develop proposals for a regime for the aboriginal bowhead hunt in Alaska and, if appropriate, a regime or regimes for other aboriginal hunts to be submitted to the Commission for consideration at the 1979 Annual Meeting. The Commission also reaffirmed the resolution previously adopted concerning habitat preservation. Then, at the very end of the meeting, the USA asked for two more bowhead whales to be added to the 1978 catch limits, to be taken during the fall hunt. This too was agreed by the Commission as an act of understanding and sympathy for the particular problems of the peoples concerned.

PURPOSE OF THIS MEETING

The Commission has become increasingly involved with aboriginal whaling in the last two years, and it has recognized that actions concerning aboriginal whaling must take into consideration factors other than the biology of the stocks. The Commission however lacks expertise as to the needs of the aboriginal peoples and has not developed a formal mechanism for weighing these needs with the requirements to assure adequate protection for the stocks of whales. We are looking to you for information which will help the Commission to address this difficult situation. Specifically, the Commission has asked that a Working Group of its Technical Committee propose a possible regime or regimes for the IWC to use in setting limits for aboriginal/subsistence whaling.

You have received copies of letters from Mr M. C. Mercer detailing the means by which these regimes are going to be developed. Mr Mercer is Chairman of the Technical Committee of the IWC. The Technical Committee is the body which receives the reports of the Scientific Committee and which take into consideration all factors in making catch limit recommendations to the Commission.

Your meeting this week will be an information gathering session. We are setting a hard schedule for you. We hope that you will complete work on draft panel reports by Wednesday evening so that each panel can approve its report by Thursday afternoon. To the extent that information provided in panel reports relates to one another, an overview statement addressing these relationships would be prepared on Thursday evening for discussion and approval on Friday morning.

Immediately after this meeting your reports will be transmitted to the Chairman of the Technical Committee and to IWC Commissioners from all member nations. The reports must be distributed quickly because they will be the major documents utilized by the IWC Working Group on aboriginal whaling. This Group which will meet in Washington, D.C., 3–5 April 1979, is composed of several member nations of the IWC and has the responsibility for developing a regime to serve as the Commission's mechanism for setting limits on aboriginal whaling. The Commission has asked for an examination of the entire aboriginal whaling problem, and as a first step that a regime to cover taking of bowhead whales by Alaskan Eskimos should be developed. Other regimes may be recommended, if possible.

The reports of this meeting and the report of the IWC Working Group will be referred to the Scientific Committee of the IWC. This Committee will review these reports at its annual meeting 22 June–3 July 1979 in Cambridge England. At its most recent meeting the Scientific Committee 'urged very strongly' that any scientific evidence arising from your deliberations this week 'be adequately documented and made available to the Scientific Committee for review and study'.

What should you accomplish this week to be of most help to the International Whaling Commission? We need information to enable this Commission to take appropriate action with respect to aboriginal subsistence whaling. We in the Commission have only limited experience in dealing with this type of whaling. This means your contributions will be most valuable.

REVIEW OF PANEL WORK

The questions we believe you should consider are given in Appendices 1–3. In considering these subjects, we would emphasize:

(1) The questions are to be a guide to discussion only.

(2) The panels are not expected to make recommendations for a regime or policy judgements. The IWC Technical Committee Working Group will make the recommendations.

Recognizing that the task before you is great and the time is short, I have a few suggestions which should make your work easier.

The anthropology and nutrition questions contain requests for information on groups of aboriginal whalers including location of these peoples and the level and type of whaling done by them. In order to make sure that the priority of the Commission, i.e. aboriginal whaling for bowheads, receives sufficient attention, it would probably be best initially to consider only the Alaskan Eskimos in the nine whaling villages and other villages with which they share meat. If time permits, the panels could add consideration of other groups. If the panels establish a method of answering the appropriate questions for one group of aborigines, it may be easier to then deal with other groups in a similar fashion.

Questions regarding definitions are also provided for the anthropology and nutritional panels. Because the Commission has proposed that priority be given to the Alaskan Eskimos taking bowhead whales and in light of the suggestion I have just made, there is perhaps less need for the panels to define 'aboriginal peoples'. The IWC clearly recognizes the people of the North Slope as aboriginals. You may decide to place low priority on these questions of definition, or they might seem of great importance. We leave that to you.

Panel 1—Wildlife Science

Information elicited by asking all the questions posed to this panel can be useful to the IWC. As with the other panels, I would suggest that you consider each of the questions relative to the North Slope whaling communities. In other words, evaluate the status of available alternative subsistence species including their ecosystems.

As many of you on the wildlife panel are aware, the IWC will need guidance from you and subsequently from the Scientific Committee as to how to assure the well-being of the Bering Sea stock of bowhead whales. In the event that the other panels conclude that some take of these bowheads is essential, the IWC will need to receive biological advice concerning the impact of different take levels on the population. Therefore, the wildlife panel could consider what biological criteria might be employed where some take is essential.

Panel 2—Nutrition

We need to have as much factual information as possible about the nutritional requirements of the aboriginal people on the North Slope of Alaska. Information on eating patterns is also useful as is information on the likes and dislikes of the people. Information giving:

(1) percentage of the diet fulfilled by whale meat and products;

(2) percentage of the diet fulfilled by subsistence foods;

(3) percentage of the diet fulfilled by cash economy foods; and

(4) additional percentage of the diet that could be fulfilled by better utilization of subsistence foods would be most helpful. Also, questions as to the effects of less than adequate food and the health of the people are of considerable importance.

Although there is no question on it, we would appreciate it if the nutrition panel would consider if there are any objective criteria that could be used to measure nutritional needs and how the people would be affected by a substitution of other animals for whales. Information resulting from questions in section III–Dietary Questions, IV–Nutritional Questions and V–Health Questions will be most helpful to the IWC. Any information available to answer questions V D and E, on health problems resulting from the substitution of other meat or fish products for whale meat and health problems that exist in parts of the population eating normal or abnormal amounts of whale meat would be useful.

Panel 3—Cultural Anthropology

We need factual information as to the role of the bowhead harvest in the cultural activities and cultural identity of the aboriginal people and the relationship of this harvest to their well-being. These relationships should be evaluated in various historical periods as well as now, but the emphasis should be on the present situation. Factual information on the extent to which these villages are subsistence communities is also critical.

Once the information on and evaluation of cultural relationships outlined above has been developed and documented, the IWC would find it most helpful if the panel might propose objective criteria, if any exist, to measure the importance of the hunt to the culture.

In summary, the questions for the anthropology panel which appear most important from the IWC's perspective are:

(1) Those questions which will provide factual information on cultural relationships of the Alaskan Eskimos, III A and IV A. Question III A asks for information on the degree to which whaling in these communities is for subsistence purposes. Question IV A queries as to the place of whaling in various aspects of community life, and in other aspects of the lives of individuals.

(2) Relationships outlined in (1) should be evaluated. This could be done through utilization of information collected under questions such as IV B, V A and III D. Question IV B deals with the level and nature of acculturation. Question V A asks for information on the potential impacts resulting from changes in number of whales harvested or amount of effort; shifts to other whales or other species; increase in whaling technology or entry of more groups into whaling. Question III D inquires about economic well-being within the communities as the people perceive it and in absolute monetary terms.

CONCLUSION

The recommendations of the Scientific Committee concerning whale catches which may be taken are based on the capacity of the whale stocks to sustain those catches on a long-term basis and in accordance with the Commission's management strategy. This has resulted in major reductions in catch levels with resulting hardship for the people employed in the commercial whaling industry. Nonetheless the Commission has felt bound to regulate the industry on the basis of what the whale stocks can sustain and not what the industry would like to remove.

The IWC has as its primary responsibility the conservation of the world's whale stocks, and the orderly development of the whaling industry. The IWC also recognises that subsistence whaling may involve different considerations. It is against this background that the special pleas made by and on behalf of the Eskimos have to be seen, and we ask that you as technical experts in this field provide us with the necessary information to develop a suitable policy.

Appendix 1

WILDLIFE SCIENCE PANEL

Questions

1. What species are taken by aboriginal peoples in the area under consideration? Marine mammals? Terrestrial mammals? Birds? Other marine species? Other terrestrial species? Plants?
2. For each of these species, what is its present status relative to its status before the advent of non-aboriginal peoples into the area? And what are the data for any trend in its population size?
3. What percentage of the present, annual removals from these populations of each species is taken by:
   (a) aboriginals;
   (b) commercial hunters, or other commercial utilization;
   (c) sports hunters?
4. Which populations have been or are affected by human activity resulting in habitat degradation, alteration or destruction? What is the trend for each population so affected?
5. For those species found to be taken in appreciable numbers, how does each relate to the others ecologically: in terms of sympatry, competition, relative position in food web and trophic relations? How many are not closely tied in a common food web?
6. What is the best measure of the interrelationships between the species comprising the majority of the removals from the above populations? Can the effect of trade-offs among the species be measured or estimated at this time?
7. What is the best present estimate of net recruitment rates for each of the species of concern? How does this rate vary relative to absolute population size? To modified population structure? Do historical data, and present biological data, corroborate these estimates?
8. What new harvest regimes might be considered for each of the target species, taking into account:
   (a) their biological parameters, behaviour and peculiarities;
   (b) the past history of exploitation and the response of the population to it, where known;
   (c) the hunting technology used or to be used; and
   (d) their spatial and chronological availability.

Appendix 2

NUTRITIONAL NEEDS PANEL

I. Definitional Questions

A. How should 'aboriginal peoples' be defined in order to assess nutritional needs?
   1. By the composition of the diet?
   2. By characteristic nutritional needs?
   3. By geographical location? For example,
      (a) only Arctic peoples involved in taking cetaceans and other living resources from the ocean,
      (b) all Arctic subsistence-oriented peoples with an emphasis on those taking living resources from the ocean,
      (c) all peoples involved in taking cetaceans for subsistence purposes.
   4. By racial or cultural background?

II. Demographic Questions

A. What distinct groups or communities comprise the target population?
B. How large are these groups now? Do we have information on past trends and future projections?
C. What is the composition of these groups?
   1. By age.
   2. By sex.
D. What are the sources of food for these groups?
   1. Subsistence resources?
   2. Cash economy resources?

III. Dietary Questions

A. What are the major dietary components
   1. of the aboriginal peoples under study?
   2. of distinct subgroups or communities?
B. What percentage of the dietary components of the population and individual subgroups is from
   1. subsistence resources?
   2. whale products alone?
   3. cash economy foods?
C. What changes in aboriginal diets have occurred within the population over the last century?

IV. Nutritional Questions

A. What are the nutritional needs of aboriginal peoples in the Arctic?
   1. vitamins
   2. minerals
   3. protein
   4. carbohydrates
   5. other
B. What are the particular nutritional needs of:
   1. babies,
   2. small children,
   3. teenagers,
   4. adults,
   5. old people?
C. What alternative food sources could fulfil the nutritional needs of the target population? List under:
   1. other subsistence foods
   2. cash economy foods
   3. better utilization of animals taken.

V. Health Questions

A. To what extent do prevailing diets in the target population satisfy nutritional needs? (Same list as in IVA.)
B. To what extent do hunting technologies affect the nutritional value of the landed product?
C. To what extent could alternative food sources fulfill the nutritional needs of the target population? (Same list as in IVA.)
D. What health problems, if any, might result from the substitution for whale products of:
   1. other red meat products (including terrestrial mammals),
   2. seal products particularly,
   3. walrus products particularly,
   4. fish products,
   5. other?
E. What health problems, if any, are characteristic among segments of the target population whose consumption of whale products is:
   1. less than the norm,
   2. equal to the norm,
   3. greater than the norm?

Appendix 3

CULTURAL ANTHROPOLOGY PANEL

I. Definitions

A. *Background.* In the context of the International Whaling Commission (IWC), aboriginal whaling is never precisely defined but the IWC Schedule permits aborigines or a Contracting Government on behalf of aborigines to take gray whales or the Bering Sea stock of bowhead whales 'but only when the meat and products of such whales are to be used exclusively for local consumption by the aborigines'.

At its 30th Meeting, the IWC adopted the following resolution with respect to aboriginal whaling: 'The Technical Committee recommends that the Commission request a Working Group of the Technical Committee examine the entire aboriginal whaling problem and develop proposals for a regime for the aboriginal bowhead hunt in Alaska and, if appropriate, a regime or regimes for other aboriginal hunts to be submitted to the Commission for consideration at the next annual meeting.'

B. *General.* What is the basic working definition of 'aboriginal peoples' which we will use for the purpose of circumscribing aboriginal whaling in polar regions? Is it based on:
1. Race/ethnicity (e.g. Aleuts, Eskimos, Athabaskans)?
2. Technology (e.g. small-scale, low-technology whaling by certain ethnic groups)?
3. Product or end-use (e.g. whaling for subsistence, or cultural artefact production)?

II. Mapping Questions

Under the definitions arrived at in I above, what are:
A. The racial/cultural groups under consideration?
B. The general geographic distribution of these groups?
C. The specific tribes, communities, or other groupings which evidence historical, present, or potential participation in whaling activities?
D. The specific locations of the groups, set out in A (above), including major migratory patterns, including the areas in which the whaling takes place, if that place is different from the group's primary residence area?
E. The level and type of whaling technology used by each of these groups? (With special emphasis on pre-contact aspects of culture, the transition and changes through time.)

III. Economic Questions

For each of the groups described in B and C, what is:
A. The degree to which the whaling is for subsistence purposes, that is, direct consumption or use of the product in its harvested form?
B. The extent of the participation of the group in cash economies, either:
   1. within the group, or within a localized set of economic relationships?
   2. in connection with larger economic systems through sales of whaling products, the purchase of whaling supplies and equipment, and so on?
C. The degree to which the general economy of the group is integrated into larger economic systems through employment, market activities other than those having to do with whaling, government or other assistance, tourism, and so on?
D. The general level of relative economic well-being within the group, both:
   1. in absolute monetary terms, as closely as can be measured?
   2. as perceived by the people in the group, i.e. with respect to their own perception of their economic well-being and their own expectations?

IV. Social, Cultural, and Social/Psychological Questions

A. What is the place of whaling activity in:
   1. the myth, ritual, and general cosmology of the group? (Pre-contact, transition and changes through time.)
   2. the status and role definitions within the group, and between the group and outsiders?
   3. the socialization of children to the group's social and cultural norms?
   4. the maintenance of identity and the quality of self-perception of members of the group?

(Items 2, 3 and 4 should be differentiated for male and female members of the group.)
B. What is the level and nature of the acculturation of the group to other cultures, norms, and life-styles, including:
   1. the participation of children in non-traditional educational systems?
   2. the degree and distribution of non-native language acquisition?
   3. the incidence of use of non-traditional clothing, construction techniques, and other material items and implements?
   4. the incidence of non-traditional work, recreation, and life-style patterns, i.e. migratory labor, alcohol consumption, male/female relationships, and so on?
C. What is the nature and level of political awareness within the group concerning both their own internal matters and their relationship with outside individuals and structures, i.e. governmental representatives and organizations? What is the historical character of their interaction with these representatives and organizations?
D. What is the nature and incidence of psycho-social and psychological reactions to acculturation and general cultural-contact activity, such as:
   1. delinquency and other juvenile-related problems?
   2. marital and family stress?
   3. individual psychoses, neuroses, and other psychological conditions attributable to changes in economic patterns or cultural configurations?

V. Socio-economic Impact and Policy Analysis Questions

A. For the items in II, III, and IV above, what will be the potential impacts resulting from:
   1. a specific reduction or increase in the number of whales harvested, or in the allowable level of effort in terms of gear or hunting time?
   2. a shift from the hunting of one species of whale to another, or to another type of prey or hunting activity altogether?
   3. an increase in the level of technology available to the group for their whale hunting, processing, or marketing activities?
   4. the entry of more individuals from the group or other groups into whaling?
B. Is a general comment possible on the impact of the items in A on all aboriginal whaling people, or will the matter have to be approached on a case-by-case basis?
C. Assuming a resolution of B, what is the minimum set of indices which could be used to evaluate the impacts of a given management action? Is it possible to evaluate these impacts (i.e. economic, social, cultural, socio-psychological) on a short-term basis? What is a reasonable time frame for proper evaluation?
D. What is the type and specific form of administrative system which would be both effective and acceptable to the IWC, the member nations, and the groups themselves for making policy decisions and implementing management actions?

Report of the Panel Meeting of Experts on Aboriginal/Subsistence Whaling

(Executive summary prepared by the Secretary to the Commission)

A meeting of experts on wildlife science, nutrition and cultural anthropology was called to provide and develop the appropriate data base necessary to assist the IWC Technical Committee in formulating proposals for a regime for the aboriginal bowhead hunt in Alaska, and if appropriate, a regime or regimes for other aboriginal hunts.

The meeting was held from 5 to 9 February at the kind invitation of the government of the USA and was hosted at the University of Washington, Seattle, Washington. The following report indicates the overall conclusions drawn by the meeting and summarizes the pertinent information submitted by the three panels as a result of their deliberations. The three panel reports appear in full, later in the volume.

Overall conclusions

In strictly biological terms, no Bering Sea bowhead whales should be hunted if the population is to have the best prospect for recovery. There are a number of alternative sea mammal and other wildlife resources available to replace the bowhead whale in the lives of the Northwest Alaskan Eskimos. In nutritional terms, assuming replacement with foods of equivalent value, the diet of the Eskimos would not be adversely affected by removing the bowhead whale from the diet. However, this change would certainly have a significant impact on the culture of these whaling communities. Any attempt to introduce regulations or controls should involve the local communities to the fullest extent possible to determine their effects and to achieve full acceptance.

Summary of panel conclusions

The Wildlife Science panel stated that present evidence suggests that the current Bering Sea stock of bowhead whale is a small percentage of its initial size in 1850. Given the small absolute population size, the panel agreed with the IWC Scientific Committee that from a biological point of view the only safe course is to reduce the kill of bowhead whales to zero. No new details of age, size, or other biological composition data were available, and guidelines for research to fill the gaps in knowledge as well as to confirm the population estimates were developed.

If a hunt takes place, additional guidelines to set limits on the removals from the bowhead population were suggested.

Alternative food resources in the area of interest include gray whales, walrus, many seals, an increasing population of polar bears, a reduced but increasing population of caribou, and numerous birds and fish. It was noted that there are seasonal and geographic variations in the distribution and availability of these alternative resources.

The data necessary for management employing single species models were discussed, as it is considered that ecosystem management is beyond the data base and analytical capabilities presently available.

The Nutrition panel reviewed the nutritional requirements of Arctic Eskimos, and concluded that they have no special requirements to distinguish them from non-Eskimo populations. The panel also concluded that the bowhead whale does not provide any food material which cannot be obtained from other sea mammals, so that the bowhead is not uniquely required in the diet. Nutrition problems which occur in Eskimo communities at the present time are largely the result of poorly balanced diets, typified by dental caries and iron-deficiency anemia.

The Cultural Anthropology panel reviewed the place of the bowhead whale in contemporary Eskimo society. The procurement of the whales, distribution of the products and their consumption all have social and cultural components in the various communities. By considering these components in the society structure, relative rankings were scored which demonstrated the great importance of the bowhead whale in these systems.

Cultures are dynamic and resilient, changing in response to the prevailing conditions, but the way in which the changes are introduced affects the final outcome. A natural change in the environment produces a very different reaction to a mandated change imposed from outside. It is therefore very important that the people concerned must be involved in any research and management activities. The exact dimensions of change in a culture caused by policy decisions cannot be predicted in advance of the event.

In the *discussion* by all the participants following the presentation of the three panel reports, it was agreed that:

(1) The definition of subsistence whaling does not prevent the use of modern technology, and there is good reason to recommend improvement in the weapons, powder and bombs currently employed to further reduce the struck but lost rate.

(2) The extent to which the gray whale might replace the bowhead could be further investigated, but it appears that this change would pose technical problems as well as causing the hunt to occur at a different time.

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Point Hope, Alaska. Each whaling crew has a sealskin-covered boat (umiak) and tent. Snowmobiles have largely replaced the dog team for transportation. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

Report of the Wildlife Panel

Bowhead Whaling: Population Status and Alternative Biological Resources

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1. INTRODUCTION

The Wildlife Panel of the Workshop on Aboriginal/Subsistence Whaling met under the auspices of the International Whaling Commission (IWC) at the University of Washington, Seattle, Washington, 5 to 9 February 1979, under the Chairmanship of N. Oritsland and with B. Kemper acting as rapporteur. The Wildlife Panel was composed of the following biologists: H. W. Braham, F. E. Durham, M. A. Fraker, S. J. Harbo, A. Jonsgård F. O. Kapel, J. B. Kemper, V. N. Mineev, E. Mitchell, N. A. Oritsland, E. N. Sabourenkov, I. Stirling, M. F. Tillman.

The Panel was invited on relatively short notice to address the problems laid out in the questions circulated through the IWC Technical Committee (Mercer, 1978). Due to lack of time, the Panel was unable to consider in detail any specific case other than the Bering Sea bowhead stock problem. The Panel felt that this short notice created some problems due to lack of a summary review of the area, previous work and background statistics. Therefore, the present report is offered to the IWC Technical Committee as a collection of ideas and a guide into the literature and problems mentioned, and the Panel believes that before any management decisions on these subjects are made, more documentation of existing published evidence should be compiled and evaluated.

2. THE BOWHEAD SITUATION

2.1. Bowhead, initial population size

Mitchell (1977, MS) reconstructed the catch history using extrapolations from published production statistics, and estimated the initial population size in 1851 as 18,000 bowheads. This estimate is based upon an (extrapolated) cumulative, landed catch of 8,852 in the period 1851–60, corrected, with a minimum loss rate of 0.24, to a kill of 11,647 for this period, further corrected with an estimate of approximately 6,000 for the residual stock in 1861 large enough to have supported subsequent, substantial

removals, a total of approximately 18,000. Bockstoce (1978) more accurately estimated commercial catches from unpublished archival sources (a sample of logbooks) to reconstruct the catch history, and, for example, he (1978, Table 3, Cols. F+G) estimated 5,809 bowheads landed, 8,249 bowheads killed for the period 1851–60 (as contrasted with Mitchell's estimates of 8,852 and 11,647 for this period).

2.2. Bowhead current population

The current estimate of the size of the Western Arctic or Bering Sea population of bowhead whales is 2,264 with a range of 1,783–2,865 (Braham *et al.*, 1979). This estimate, or index of abundance, is the result of three years of counting conducted near the same site off Pt. Barrow, Alaska, by National Marine Fisheries Service (NMFS) biologists. When considering the framework from which to make a determination of population abundance, the following four questions were considered: (1) Is there a migration past the whale 'censusing' camps *before* and *after* the counting period (which is generally mid April to early June); (2) What is the distribution of whales in the offshore leads, at a distance beyond which the counters could see; (3) Is there a late migration in which some animals may never enter into the pack ice, rather than move north with the receding ice in the summer from the Bering to the Chukchi Seas; and (4) Do bowheads move into Soviet waters along the north coast of Chukotka (the Chukotskiy Peninsula) during the spring migration?

Sighting validation studies were conducted during spring of 1978 using aircraft. Concurrent counts from the census camps (2 camps, ½ mile apart) and from the aircraft suggests that: (1) essentially all the whales available to be counted by the census camp observers were counted, (2) both methods (aircraft versus ice camp) were counting the same whales. Verification of these points, although as yet preliminary, comes from angle and distance estimates made from the two methods, and that no whales were observed in any leads (open water) except the nearshore lead where the census camps were located (Braham *et al.*, 1979).

Aerial survey and land camp (Cape Lisburne) activities in the spring of 1978 indicate that the census camps were in place and operating before the first whales arrived at Pt. Barrow. Aerial surveys conducted at the conclusion of the census camps (early June 1978) did not locate any bowhead whales even though surveys were conducted throughout the range of the spring migration south of Pt. Barrow (to St Lawrence Island). A vessel survey conducted from mid June to mid July 1978 also did not detect bowhead whales present in the southern extent of the spring migration. That is, no bowheads were found south of the ice front, which was by this time in the southern Chukchi Sea. A limited aerial survey effort was made in April, May and June 1978 along the north coast of Chukotka; however, no bowheads were detected.

The conclusion, then, is that essentially the entire population of bowhead whales probably migrates past the census camps near Pt. Barrow, Alaska, in the spring, and that the range of the population index is the best abundance estimate using existing data.

2.3. Bowhead, percentage reduction

By any available (minimum) estimate of peak cumulative catch corrected for loss rate (e.g. Mitchell, 1977 MS, 11,647 minimum estimate; Bockstoce, 1978, 8,249 minimum estimate), and the best estimate of current abundance of 2,264 (IWC, 1979a), the Bering Sea stock has been reduced to below 27% of its initial level.

2.4. Bowhead, biological parameters

Estimated values of the biological parameters controlling the population of bowhead whales are virtually unknown. Net recruitment rates into exploitable populations of some large mysticetes are believed to fall between 0.04–0.06. In an iterative model to determine bowhead initial population size, net recruitment rates greater than 0.05 did not allow convergence and, given the catch history, a rate as low as 0.01 was thought unlikely (Breiwick, Mitchell and Chapman, 1978). There is however no available estimate of reproductive rate from counting ovarian corpora scars, or from examining the age structure of the Bering Sea stock. Calves counted by NMFS scientists during the 1978 spring migration at Barrow, Alaska totalled 18 out of 1,601 whales counted (Braham *et al.*, 1979). The 1978 calf counts may be seriously biased downward as only those calves swimming on the shore side of the cow were visible to the counting crew, and only those calves accompanying nearshore animals are sighted. No reliable estimate of recruitment is therefore possible at this time using these data.

In conclusion, the key population parameters (i.e. recruitment, mortality and age structure) are presently not known. Research to be conducted in 1979 will address these issues.

2.5. Bowhead, probable extinction of Spitsbergen stock

Jonsgård (Doc. 5) described four twentieth-century records of five bowhead whales from the Spitsbergen/Barents Sea stock area. This small number of records, especially in view of the presence of approximately 80 Norwegian vessels in the North Atlantic pelagic small whale fishery, led Jonsgård to propose that the Spitsbergen stock is probably extinct and that the modern records represent extra-limital strays from the Bering Sea stock area, and/or the Davis Strait/Hudson Bay stock area.

2.6. Struck and lost problem

Durham (1979) concluded that, because of occasional 'mass' losses of struck bowheads, four out of five whales struck were lost for the period 1961–73. Available data on this problem have been collected by the NMFS since 1973 and summarized by Marquette (1977), Braham *et al.* (1979), Marquette (1979), and Tillman (pers. comm., 1978 autumn hunt):

Year	Landed	Killed and lost	Struck and lost
1973	37	0	10
1974	20	3	28
1975	15	2	26
1976	48	8	35
1977	29	3	79
1978	12	0	6

The U.S. government implemented regulations on this hunt in 1978 which enforced the IWC catch limit of 12 landed or 18 struck, whichever occurred first (later amended to 14 landed or 20 struck).

3. OTHER POTENTIAL BIOLOGICAL RESOURCES

3.1. Status and relative availability

The Panel reviewed other potentially usable biological resources which are tabled below (Table 3.1 A). For various species listed the area in which they occur may differ, and/or the population value given may not be for the entire population, e.g. the polar bear, ringed seal, and cliff nesting birds. The relative availability of these resources is shown in Table 3.1 B.

3.2. Specific resource stock assessments

From the above examples of availability, use patterns and catch statistics, we here comment on some of the important alternative biological resources.

3.2.a. White Whale

Probably all of the white whales passing along the northwestern coast of Alaska and many other available elsewhere in the spring (April–June) migrate to Canadian

Table 3.1 A

Status of Bering Sea/Chukchi Sea, Beaufort Sea populations

	Population size (10^3)			Recent catch (10^3)			
	Initial	Present	Trend	Total	Alaska	USSR	References
Bowhead	18	1.7–2.8	Unknown	0.027[1]	0.027	—	10, 54
Gray Whale	15	15–16	Stable or slight increase	< 0.2	—	0.2	60, 61
White Whale	?	(9.5)	Stable or slight decrease	0.35[1, 2]	0.2	—	64 (see sec. 3.2)
Walrus	200	210–220	Increasing	2.9[1]	1.7[1]	1.2	21, 32, 42
Bearded Seal	?	300	Stable or slight decrease	2.8[1]	1.5	1.3	64
Ringed Seal	?	1,000–1,500	Increasing or stable	13.2	10.5	2.7	64
Largha Seal	?	200–250	Stable or slight increase	6.2	2.8	3.4	64
Ribbon Seal	?	100	Stable or increasing	3.3	0.3	3.0	64
Polar Bear	?	5.7	Increasing	0.3	0.3	—	64
Caribou[3]	> 242	97	Increasing	3.0 (♂)	3.0	—	17, 18
Foxes	?	?	?	?			
Eiders	?	842,000[4]	?	?	8,800[5]		39
Cliff Nesters	?	3,000	?	?			5
White Fish	?	?	?	200 (lb.)	200	—	2, 3, 4, 6, 30, 33, 40, 43, 59
Other Fish	?	?	?	?			3, 6, 30, 33, 40, 43, 60, 66

[1] Does not include unretrieved losses.
[2] Includes Canadian Mackenzie delta catch of 0.15.
[3] Western Arctic herd.
[4] Number of waterfowl, mostly eiders migrating past Pt. Barrow; 13 July–7 Sept. 1970.
[5] Waterfowl harvested, mostly eiders during 13 July–7 Sept. 1970 at Pt. Barrow.

Table 3.1 B

Biological resources present near Alaskan Eskimo whaling villages (approximated from a compilation of the literature). Does not include use factor

Resource	Gambell	Savoonga	Wales	Kivalina	Pt. Hope	Wainwright	Barrow	Nuiqsut	Kaktovik
White Whale	A	P	P	P	A	A	A	P	P
Polar Bears	P	P	P	P	P	A	A	A	A
Walrus	A	A	A	P	P	P	P	O	O
Bearded Seal	A	A	A	A	A	A	A	A	P
Ringed Seal	A	A	A	A	A	A	A	A	A
Ribbon Seal	P	P	P	O	O	O	O	O	O
Largha Seal	P	P	P	P	P	P	P	O	O
Gray Whales	A	A	A	P	A	P	P	O	O
Balaenopterids	P	P	P	O	O	O	O	O	O
Eiders	P	P	P	P	A	A	A	A	P
Cliff Nesting Birds	P	P	P	A	A	O	O	O	O
Caribou	P[1]	P[1]	O	A	A	A	A	A	A[2]
Fish	A	A	A	A	A	A	A	A	A

[1] St Lawrence Island reindeer herd.
[2] Mainland, Porcupine caribou herd.
A = Seasonally abundant.
P = Seasonally present.
O = Unavailable or essentially not part of their range.

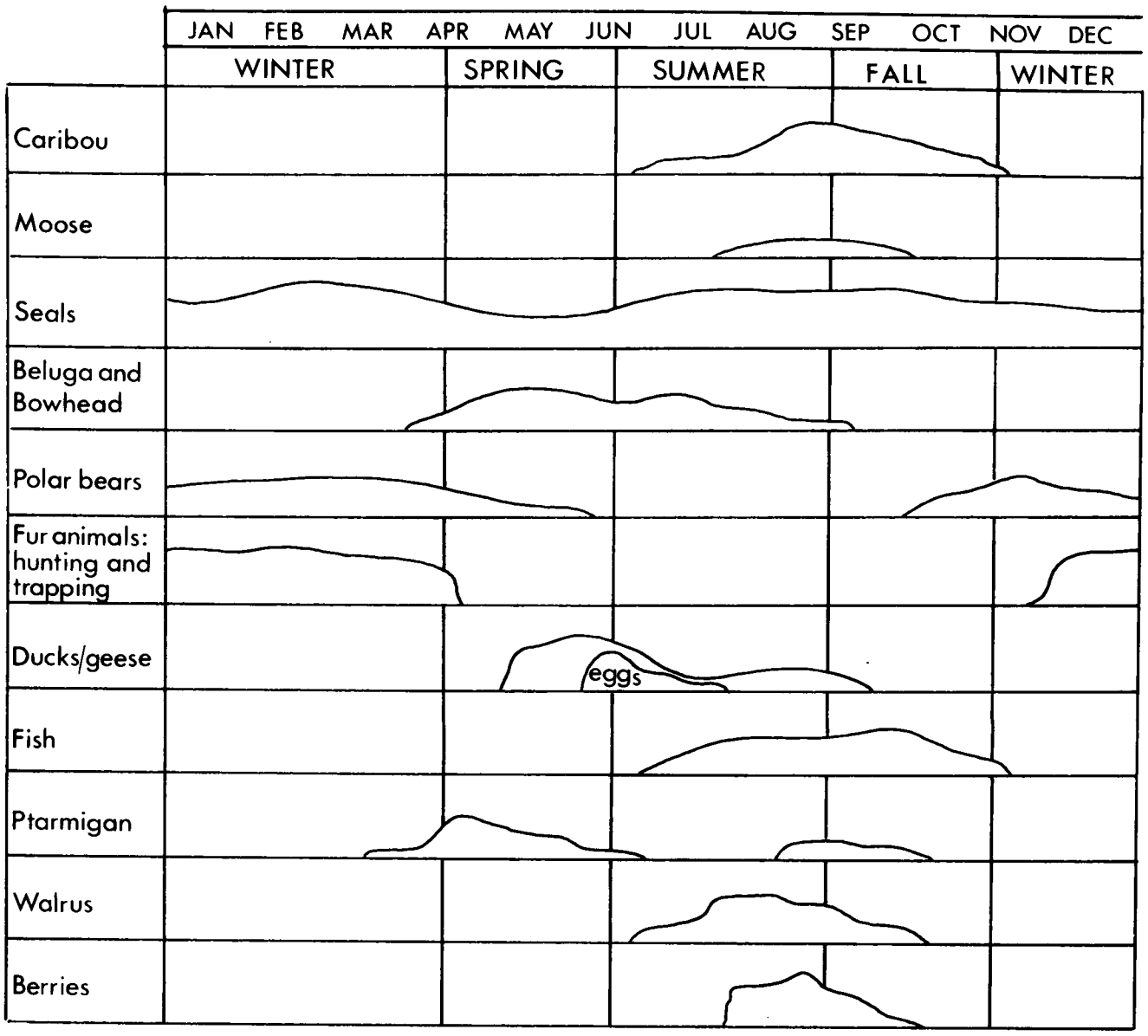

Fig. 3.0. Sample annual biological resource use patterns at Wainwright, Alaska (from U.S. Department of Commerce and Interior, 1978).

waters where they gather in the estuary of the Mackenzie River, mainly during the month of July (Fraker *et al.*, 1978; Fraker, in press). Recent estimates in this region indicate a minimum of approximately 4,000 individuals and a maximum of 6,000 (Fraker *et al.*, 1978).

The abundance of white whales in the Chukotka and Kamchatka regions of the USSR is unknown; the average catch there is about 20–30 taken each year. There is very limited published information on the abundance of white whales in waters off western Alaska; there probably is a minimum of 2,000, but there may be many more. The U.S. Departments of Commerce and Interior (1978) indicate a possible total of 9,500. The 1977 Alaskan harvest was about 215 (plus about 115 lost); the 1978 harvest was 165 (plus about 90 lost) (Doc. 4). The annual landed harvest in recent years in the Mackenzie estuary has averaged about 150, with total removals estimated to be about 225 (Fraker *et al.*, 1978). The total annual removals of white whales from the Canadian western Arctic, Alaska, and Chukotka and Kamchatka regions of the USSR appears to be about 500–600. There is no information on age and sex structure, productivity, or recruitment of the adult populations of white whales in this region. Only the whales in the Mackenzie estuary have been regularly monitored, and there appear to be no changes in numbers there under the current harvest pressure. It is not known whether there is one large interbreeding population in the Bering/Beaufort/Chukchi region or whether there is exchange from year to year between groups occupying the various summering areas in Alaska and Canada.

The panel emphasizes the uncertainty regarding the identity and number of stocks and the estimates of abundance and the absence of data on productivity and other biological parameters of white whales in the area under consideration.

Recent total removal of white whales appears to be approximately 4–5% of the total numbers (500–600 of 9,500) which may be near or possibly in excess of recruitment.

3.2.b. Gray Whale

The IWC reclassified the Eastern Stock of gray whales as a Sustained Management Stock with a catch limit of 178 whales, based upon the average known removals during 1968–77. This entire catch limit for 1979 has been reserved for taking by aborigines or by member governments on behalf of aborigines. The Western Stock of gray whales remained classified as a Protection Stock (IWC, 1979b).

The management of the hunting of gray whales by aboriginal people of the Chukotka and Kamchatka regions of the USSR serves as a parallel example for comparison with the hunting of bowhead whales in Alaska. In the 1930s the number of gray whales was in the low hundreds.[1] Currently the Eastern Stock is estimated at about 15,000–16,000 (Rugh and Braham, in press; Braham, pers. comm.). Through the use of improved hunting technology since 1969, wasteful losses were completely eliminated. Presently, whaling is carried out by a special chartered whale catcher boat in Soviet waters. This approach to the harvest has allowed for the stability of the stock to be maintained. The number of whales necessary to provide the normal animal protein

[1] Based on this population mode, Oshumi (1976) calculated that the lowest level of abundance reached by the Eastern Stock was 4,400.

requirements for the inhabitants of the Chukotka and Kamchatka regions has been arrived at over a relatively long period of time. The catch prior to 1979 was about 200 gray whales, which is not more than 1.5% of the population. The maintenance of the present catch level provides for continued stability of the Eastern Stock of gray whales.

The panel recognizes that gray whales have been taken by Alaskan Eskimo villagers, up to six in 1959, that the northward migration includes coastal Alaska to Pt. Barrow (Maher, 1960), and that this species is thus available to many Alaskan whaling villages (Table 3.1 B.).

3.2.c. Walrus

The walrus harvests in Alaska currently are regulated by means of area quotas. These harvests are not completely utilized for food; complete utilization of the catch would substantially increase the protein resources at several villages, particularly those in the northern Bering Sea. The harvests vary from year to year at all villages, with ice conditions virtually precluding a walrus harvest some years at the villages of Point Hope, Point Lay, Wainwright and Barrow. The greatest percentage of the catch occurs in the Bering Sea during April–June when the majority of the population is available during its northward migration (Fay, 1957; Burns, 1970; Krogman *et al.*, 1978).

3.2.d. Caribou

The Western Arctic caribou herd has declined sharply since 1970. That herd, depending on its movements during the year, is available to residents of the coastal villages of Kivalina, Point Hope, Point Lay, Wainwright, Barrow and Nuiqsut. This herd previously supported harvests of 20,000–30,000 animals, after increasing from very low population levels in the early 1900s (Hemming, 1971; Davis and Valkenburg, 1978). The current harvest is restricted to 3,000 males, with a limit of one caribou per licensed hunter. Many of those hunters are from inland, non-whaling villages.

The Western Arctic herd is currently increasing. Continued low harvests are likely during the next few years, since the responsible regulatory agency has stated that the herd should increase to at least 100,000 adults from its current estimated level of 77,000 adults (Davis, 1979).

4. MINIMUM DATA REQUIREMENTS FOR CONTROLLED HARVEST OF WILDLIFE POPULATIONS

4.1. General outline

The harvest levels for wildlife populations should be based on population characteristics information that satisfies specified minimum requirements. The required data for bowheads, with current knowledge regarding that species is as follows. Population size (2,264), age/sex structure indicative of natural mortality (unknown) and age specific productivity (unknown). Such information/data forms the basis for Leslie matrix population projections which represent the most realistic population models available today.

In the absence of the data needed for matrix population projections, management decisions may be implemented using an exponential growth type of model. The latter model requires less data on age-specific recruitment and mortality rates. If an exponential model is employed, the intrinsic rate of increase of the population should be determined for the bowheads; a cessation of all harvests and accurate population censusing may be necessary for that determination.

However, when an exponential growth model is employed, it must be kept in mind that the rate of increase determined for a population starting at a low level probably is not equal to the rate exhibited by that same population as it attains large population sizes. A weakness of the exponential growth model is the assumption of a stable age distribution; that assumption is unrealistic for any mammalian population released from hunting pressure or environmental perturbations.

Wildlife inventories (i.e., the mapping of animal abundance) for Arctic coasts and marine areas provide valuable information about population ecology. That information is useful for management purposes. However, if the actual areas are disturbed, or if the wildlife populations are directly perturbed by human interference, inventories alone are inadequate for management purposes. In such cases, as well as others, the benefit to management occurs only when such inventory data are combined with mathematical modelling of population dynamics.

It must be recognized that current models on population dynamics do not incorporate trophic relationships in a realistic or satisfactory manner. The inclusion of density dependent factors in population dynamics models represents a grossly over-simplified and pragmatic circumvention of available physiological knowledge and may, if uncritically accepted, counteract necessary investments in physiological wildlife research.

5. ECOSYSTEM CONSIDERATIONS

5.1. Trophic relationships

Modern wildlife management regulations as exemplified by the U.S. Marine Mammal Protection Act tend to incorporate ecosystem considerations beyond our present understanding and the available data base (Eberhardt, 1977). In reality there is a wide gap between our perception that ecosystems exist and our capability to quantitatively describe and predict how ecosystems work.

Trophic relationships within an ecosystem may be illustrated by the construction of food webs (e.g. Figs 5.1A, 5.1B) for the species or groups of animals indicated as potential food resources (Section 3). Such construction has not been attempted by the Wildlife Panel. In addition to illustrating the interdependencies of the species, the food webs may outline the avenues for accumulation of toxic substances.

Assessment of energy or biomass flows in trophic webs and from one trophic level to another has received a great deal of attention in ecology. However, available models on energy flows within an ecosystem are limited (Fig. 5.1C). They only confirm the general experience that less than 10% of the energy available at one trophic level is utilized on the next. The International Biological Programme seems to have demonstrated that developing ecosystem models with satisfactory predictive power is beyond our present analytical capabilities.

Thus a 'system' approach to the management of whales, seals, etc. (Laws, 1977) may not be a feasible

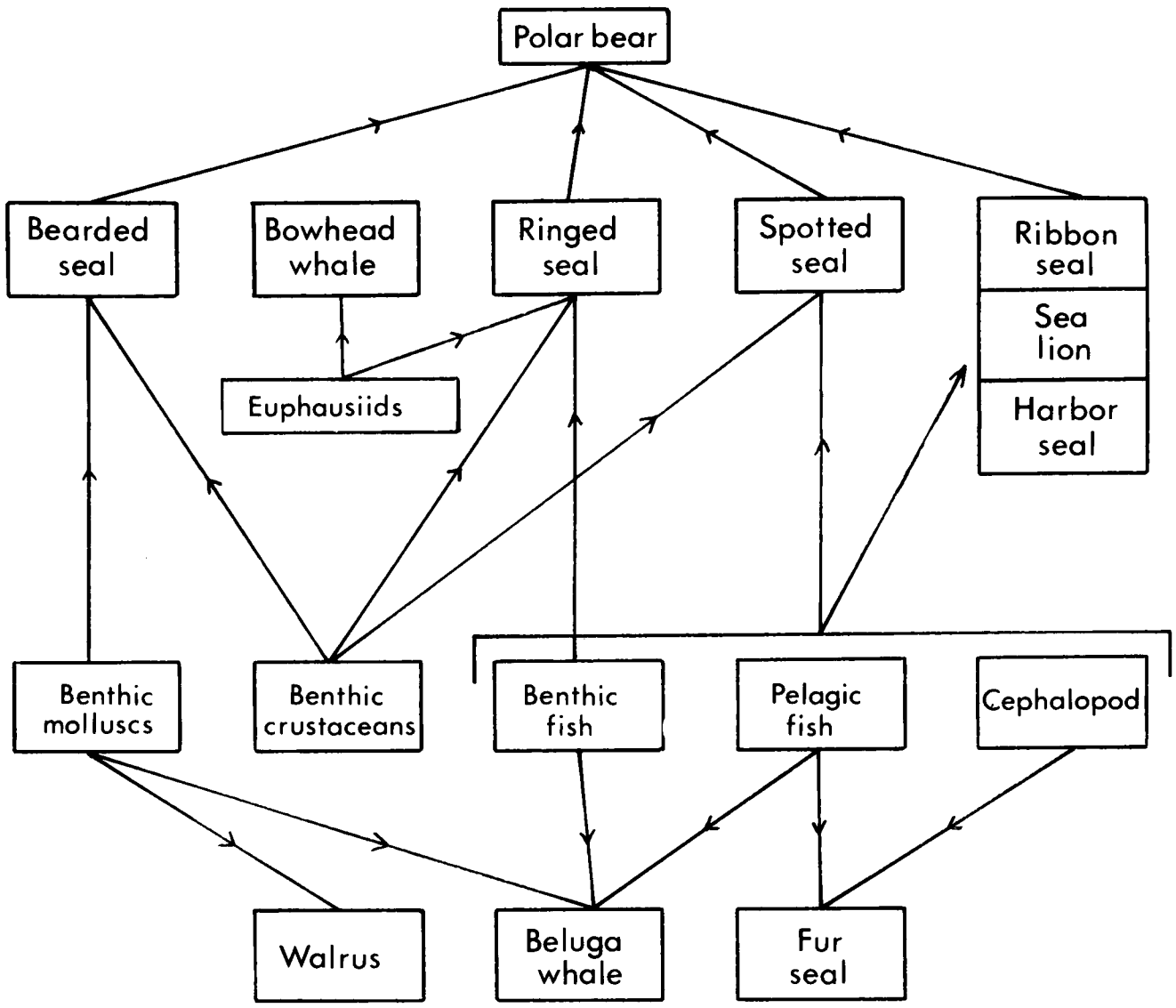

Fig. 5.1A. Marine mammal food relationships in the Bering and Chukchi Seas (from U.S. Department of Commerce and Interior, 1978).

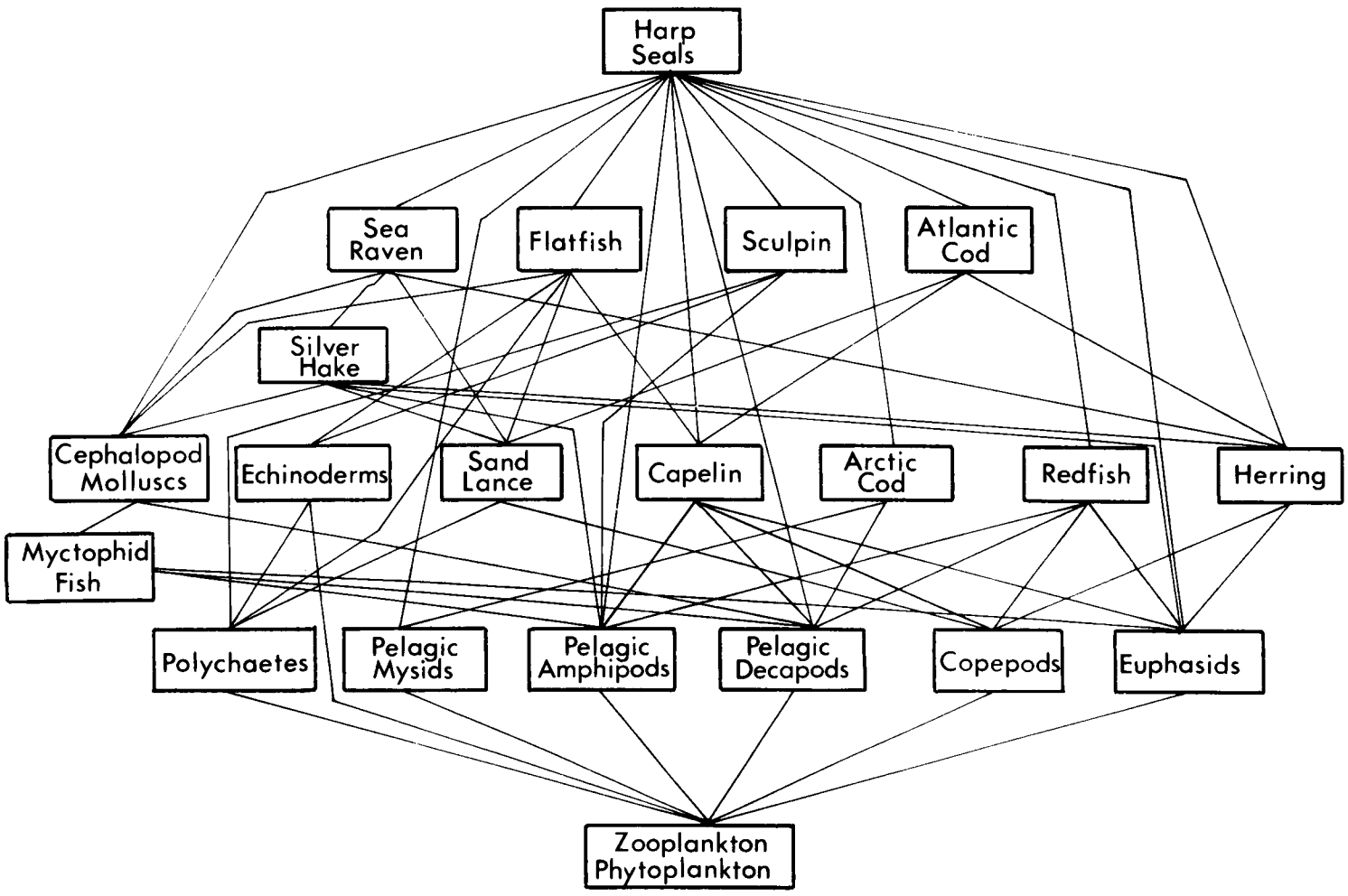

Fig. 5.1B. Sample food web (from Lavigne *et al.*, 1976).

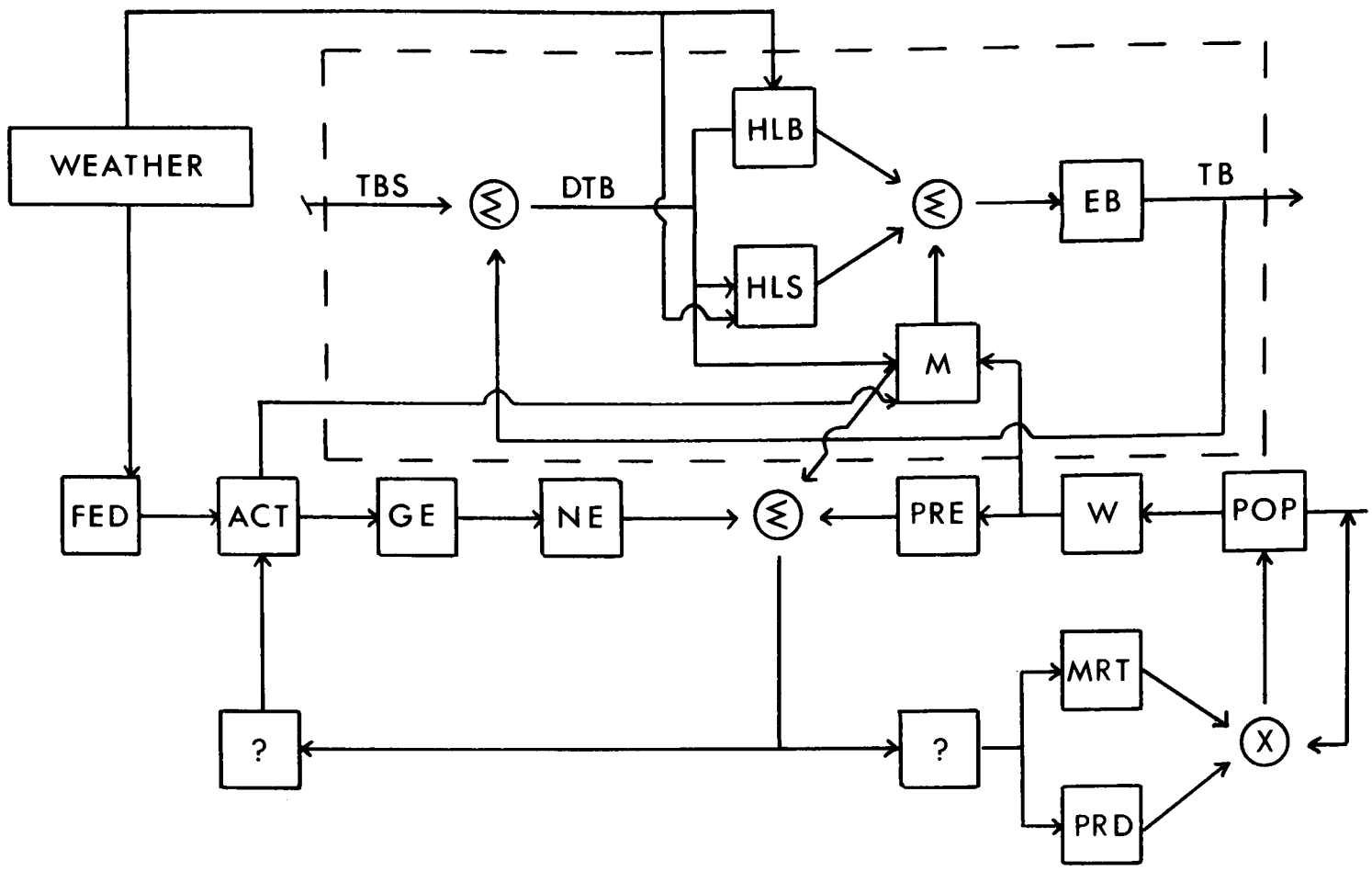

Fig. 5.1C. Coupling of a heat balance model (enclosed with broken line) into a model of population energetics. The population size (POP) is determined by mortality (MRT) and productivity (PRD) factors by means of a Leslie matrix multiplication (Poole, 1974). Also from the population is generated a distribution of body weights (W) forming the basis for estimates of energy required for production (PRE) and maintenance/metabolism (M). The energy requirements are compared with net energy (NE) made available through digestive processes from the gross ingested energy (GE) (Kleiber, 1961). The balance between available and required energy may act as feed back elements for a quantitatively not known regulation of the mortality and productivity factors. Such an energy balance may also have an effect on the activity/behavior (ACT) of the animals. In principle a direct relationship between activity and deep body temperature can be expected although it is not indicated in the figure. Changing weather conditions act as disturbing elements both via heat balance and via effects on the food supply (FED) of the population. [From Oritsland (1978 MS). Some applications of thermal values of fur samples in expressions for *in vivo* heat balance. University of Oslo.]

alternative to the present management based on single population models (Lavigne *et al.*, 1976).

5.1.a. Concern for alternative resources

The panel noted that a cessation or reduction of the subsistence take of bowheads could result in an increased harvest of other biological resources. The Wildlife Panel is concerned about the well-being of those alternative resources and believes that their status should be adequately studied.

5.1.b. Concern for potential competition for food

The panel noted evidence for potential competition for food between ringed seals and bowhead whales (Lowry *et al.*, 1978). The possibility that this competition may have affected the recovery of the bowhead population was discussed. The panel noted that further research defining the trophic relationships of these two species as well as other competing species would be useful.

5.2. Secondary effects of man

This section addresses the indirect effects of man's activities on bowhead (*Balaena mysticetus*), white (*Delphinapterus leucas*) and gray (*Eschrichtius robustus*) whales of the Beaufort, Chukchi, and Bering Seas which are believed by the panel to be important in the context of aboriginal/subsistence whaling. Typical Arctic marine developments, as currently are under way in Canada and Greenland, are discussed briefly, as are developments in Mexico (which may affect gray whales). This discussion is not intended to be exhaustive. It is only intended to illustrate certain general types of human activities which may affect whales.

Offshore oil and gas exploration is currently being carried out in the Canadian Beaufort Sea where offshore construction of artificial islands began in 1972 and drilling from drillships began in 1976. Concern has been expressed for safety of the marine environment in the Canadian Beaufort following uncontrolled water flows from 3 to 12 offshore wells drilled to date.

In the U.S. zone gravel island exploration drilling at Duck Island and Reindeer Island near Prudhoe Bay, Alaska, in shallow water are planned for the winter of 1979. Exploratory activities are to be completed by April before bowheads enter the Beaufort Sea.

5.2.a. Oil and gas exploration

The direct effects of shooting seismic tests both with dynamite and with airguns has not been tested on large marine mammals. Observations on fish suggest that death or shock will occur near dynamite charges exploded in the water column. The recommended strategy (in Canada) has been to conduct such activities using airguns with adjustable shot pressure only in areas and at times when marine mammals will not be present.

Resident seals may be difficult to avoid but it is believed that they avoid the areas during seismic tests. In the Beaufort Sea it should be possible to schedule seismic activities so as to avoid the main bowhead and beluga whale migration periods and periods of use of other critical areas (e.g. feeding grounds). If seismic tests are to be shot in the main migration corridor (currently undefined for the fall period) surveys should be

conducted to make sure the area is clear of whales. The sound (particularly low-frequency sound) of shots would carry a long distance underwater.

5.2.b. Drilling activities

Two platforms for drilling are likely to be used in the area under question: drillships and artificial islands.

Neither mode poses serious problems provided that a subsea blowout does not occur. Drillships may add the unknown facet of subsequent noises from the drill pipe which may or may not mask bowhead acoustic signals or highly disturb bowhead whales. Since Arctic drilling from ships is relatively new, there are not, to our knowledge, observations available to suggest whether odontocetes or baleen whales will avoid or be otherwise affected.

Drilling from artificial islands does not pose the same acoustical problem but the activity necessary to build the island probably causes white whales to avoid the immediate area during construction; they do not appear to be disturbed by the presence of islands once they are built (Ford, 1977; Fraker, 1977a, b; Fraker *et al.*, 1978).

The introduction of drilling muds, some of which may be toxic, has been cited as a problem in some areas but is generally not believed to be a problem in offshore areas (Falk and Lawrence, 1973). The dilution factor is large and companies have been encouraged and regulated to use less toxic substances in their regular drilling muds.

A major threat to bowhead whale food resources from offshore petroleum drilling may be subsea or surface blowouts. Most of the information regarding subsea blowouts and their effect on the environment is based upon theoretical calculations which estimate the droplet size upon release from the wellhead on the ocean floor. If the well is in deep water (200 ft.) and the droplet size is small a slick is not likely to develop on the surface (Milne and Smiley, 1976). The effect of widely dispersed oil droplets in the water column is unknown. Some studies are currently being conducted under the Eastern Arctic Marine Environmental Studies (EAMES) in Canada and Alaska Outer Continental Shelf Environmental Assessment Program (OCSEAP) in the USA to describe the effects on phytoplankton and zooplankton. Studies of the biodegradation of oil have been started in both the Gulf of Alaska and the Baffin Bay/Davis Strait regions.

There are no accurate predictions of the long-term effects or for the necessary recovery time of the Arctic marine ecosystem following oil contamination from a blowout or spill from a ship (tanker).

5.2.c. Oil spills from vessels and subsea pipelines

A major tanker spill, either from a tanker or a large supply ship, would result in a large surface slick which could foul beaches, oil animals directly, and be incorporated into the food chain and the sea ice. Surface oil in restricted lands could affect significant components of highly migratory whale populations such as the bowhead, gray, and white whale. It is not known whether bowhead or any other whales have the ability to detect surface oil and thereby avoid it; similarly the influence of oil contact on skin, eyes, blowholes, etc., is not known. Seals and sea otters have been tested and found to be affected to varying extents (Geraci and Smith, 1976).

The break of a subsea pipeline might introduce significant amounts of crude oil into the marine environment. The effects would be a combination of those envisioned for a subsea blowout and surface spill. If the break occurred under continuous sea ice the oil would not be easily detectable and would be incorporated into the brine channels of the ice in the spring.

For all Arctic oil spills the cleanup effectiveness may only be 5–15% under the most ideal conditions. If sea ice is present the cleanup effectiveness is close to zero. Under these situations, dispersants may be the only way of preventing the direct oiling of birds and marine mammals. The dispersants may also adversely affect the marine ecosystem.

5.2.d. Mining

Construction of heavy metal mines near sea coasts could pose a serious threat to local marine food chains. In Greenland, the Black Angel lead–zinc mine which deposits its tailing directly into the sea has resulted in a rapid rise of heavy metals in the water column and marine organisms. The Fiord involved is now heavily polluted which has resulted in the death of most organisms (Recipient Undergelse, 1976) and there is some evidence that the situation is spreading to the adjacent Fiord.

The Nanisivik mine (Baffin Island, Canada), also a lead–zinc mine, is depositing its tailings into a lake which overflows into the sea. Background levels of lead, zinc, calcium, and mercury were high in local organisms, including narwhal, before the mine developed. Some evidence suggests that biomagnification had occurred for Cd in the food chain and levels are very high in narwhal brain tissue (Kemper, pers. comm.). Since resident seals, char and narwhal are used for human food, the monitoring programs must precede and parallel such developments.

5.2.e. Marine traffic

There are direct detailed observations of the reactions of white whales to boat traffic and a limited number of such observations of bowheads (Ford, 1977; Fraker, 1977a, b, 1978; Fraker *et al.*, 1978). The following is modified from Fraker (1977b) (with respect to white whales).

There are two mechanisms by which boat traffic may affect whale movements:

1. Underwater noise may disturb the whales to an extent that they are repelled from the barge route.
2. An acoustic barrier may result from small bubbles of air forced into suspension in the water in the wakes of boats.

The direct reactions of white whales (odontocetes) to nearby boat traffic which have been seen probably have been caused by underwater noise.[1] The response of the whales in these situations has been to swim rapidly away from the vessels. However, an effect of barge traffic appears to persist even when there are no barges within audible range of the white whales which at maximum was 3,300 m for the vessels recorded by Ford (1977), although the maximum observed reaction distance was 1.5 miles (2,400 m) (Fraker, 1977b). While sounds are quickly dissipated in water, vessels leave in their wakes small bubbles of air which may remain for several hours. Such

[1] It is important to recognize that echolocation has been demonstrated only in toothed whales (odontocetes) and that both echolocation and social acoustic signals in this group are composed of relatively high frequency sounds. Echolocation has never been demonstrated for any baleen whale (mysticete) and social acoustic signals are composed of relatively low frequency sounds. These differences are probably major factors in the potential for acoustic disturbance from various industrial activities.

bubbles may be suspended in water to a depth of several metres. Stuntz *et al.* (1977) reported that bubbles from the wakes of tuna boats appear to create such a temporary barrier to the movement of porpoises in the Pacific Ocean. An improved understanding of the mechanisms by which barge traffic affects whales is important since it could form the basis for more effective mitigative measures. Power-boat traffic from non-industrial activities (e.g. local fishermen) may also potentially affect whales adversely.

There are very few observations of bowhead whales close to vessels (Fraker, 1977b; 1978). These generally indicate no apparent reaction until vessels are within approximately 150–400 m. There is general concern about the effects on bowheads of large amounts of low frequency sound emanating from offshore activities. More data are required on the reactions of bowheads to disturbance from marine traffic (and other sources).

5.2.f. Gray whale situation

There are current concerns about the well-being of the (California) gray whale, which is important to native inhabitants of the Chukotka and Kamchatka region of the USSR. Brownell (1977) identified two possible serious threats to the calving and breeding grounds in Mexico:

(*a*) present and future industrial development in and around the calving lagoons which may result in the loss of critical habitat;

(*b*) the repeated harassment of whales in their calving lagoons, which may deleteriously affect mother–young relationships and reproductive success.

Ivashin and Mineev (Doc. 8) summarized the concern about effects to (California) gray whales as follows:

'In the literature in recent years there have appeared statements about the possible effects of increasing amounts of marine traffic in the area of gray whale breeding, about pollution of the water of (calving) lagoons by the waste from industrial plants, and related to the effects of these insults, the possibily increasing mortality to newborn and older calves. As a result, it is important and timely to implement measures to maintain normal conditions (in the lagoons) for breeding gray whales.... Undertaking such protective measures would promote the maintenance of the gray whale stock at a high level.'

5.2.g. Conclusion

All of these secondary effects of man may affect the bowhead population, its prey, and other marine biological resources; and the panel concludes that increased attention should be paid to the protection and maintenance of marine habitats.

6. SOME GUIDELINES FOR THE MANAGEMENT OF THE BERING SEA STOCK OF WHALES

We conclude that:

1. Present evidence suggest that the current Bering Sea stock of the bowhead whale is a small percentage of its initial size (in 1850). Given the small absolute population size, this panel agrees with the IWC Scientific Committee recommendation '... that from a biological point of view, the only safe course is to reduce the kill of bowhead whales from the Bering Sea to zero' (IWC, 1979c).

2. Management should provide for the identification and maintenance of critical habitats (e.g. breeding, calving, nursing, feeding grounds) and migration routes throughout the geographic range of the Bering Sea stock of bowhead whales.

3. If, in spite of the biologically safe course of reducing the kill to zero, a harvest is taken, the management objective, under any circumstance, must allow the Bering Sea population to increase annually:

(a) total annual removals (catch plus 'struck and lost') should be less than the estimated net recruitment based on the best available direct counts of the population (and of calves) with an adjustment for juvenile mortality;

(b) the harvest regime should include a safety factor to accommodate any irregular catastrophic mortality in the population that can be detected or estimated (e.g. ice entrapment, disease, etc.);

(c) in the event of a harvest, an appropriate research program must be undertaken to:

(i) monitor trends in abundance of the entire population through direct animal counts utilizing procedures that will provide comparable results between years;

(ii) provide annual direct measurement of the size composition of the population throughout its range, if possible;

(iii) undertake sampling of the entire landed catch including both ovaries, both ear plugs (and other appropriate specimens for age determination), and other appropriate samples and data.

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Shoulder guns used by Alaskan Eskimos during hunt for bowhead whales. The bomb has been removed from one gun to show its size. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

Report of the Nutrition Panel

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1. INTRODUCTION

This report was prepared by the Nutrition Panel of the 'Meeting of Experts on Aboriginal/Subsistence Whaling of the Technical Committee of the International Whaling Commission' convened in Seattle, Washington, by invitation of the US National Marine Fisheries Service. The Panel comprised H. H. Draper, F. A. Milan, W. Osborn and O. Schaefer.

Ray Gambell, Secretary to the International Whaling Commission, charged us at the Plenary Session with the task of 'providing information to permit us in the International Whaling Commission to solve the extremely difficult problem created by the harvest of endangered whales by aboriginal people' and requested that we provide as much factual information as possible about the nutritional requirements of the aboriginal people (Eskimos) on the North Slope of Alaska.

This Panel was guided in its deliberations by a questionnaire prepared by M. C. Mercer, Chairman of the Technical Committee of the IWC which requested specific information about the diet, nutrition and health status of Arctic Eskimos. This Report presents a consensus of the results of our discussions over a four-day period. It should be pointed out that we all have had rather extensive practical experience over a number of years in Arctic areas investigating the subjects discussed in addition to a good theoretical knowledge of nutrition, human health and biology.

2. NUTRITIONAL REQUIREMENTS OF ARCTIC ESKIMOS

The Arctic Eskimo native diet is remarkable for its extraordinarily narrow nutritional base. In contrast to the four or more food groups that constitute the cornerstones of diet recommendations for populations consuming a mixed diet, the Arctic Eskimo historically depended for his nutritional needs on the nutrients provided by only one food group: meat, fish and eggs. In subarctic regions, the diet base was expanded to include significant amounts of plant foods, but it was still devoid of cereals and dairy foods.

These dietary constraints imposed unusual requirements for metabolic adaptation which are not required of omnivores or vegetarians. Chief among these was the need to synthesize from dietary protein most of the glucose required for energy metabolism. This need arose from the very low carbohydrate content of the native regimen. The low carbohydrate, high fat diet also led to an unusual dependence upon ketone bodies, formed by the metabolism of fat, as a partial substitute for glucose as a metabolic fuel. There was a further necessity to dispose of extraordinary amounts of urea produced as a waste product of the conversion of protein to glucose.

The question has arisen whether these dietary constraints, acting over many centuries, have given rise to unique nutritional requirements. Although this question has not been answered with specific reference to every essential nutrient, it is apparent that the basic nutrient requirements of Eskimos are similar to those of non-Eskimos. A good quality diet of Western foods is capable of sustaining nutritional health in nearly all Eskimos. Conversely, subjects habituated to the mixed diet can adapt successfully to the carnivorous Eskimo diet, provided it is prepared and consumed in the traditional manner.

Nevertheless, some Eskimos have difficulty in utilizing certain food items in the modern diet. This difficulty pertains mainly to some forms of carbohydrate. A limited capacity to digest lactose restricts the intake of dairy foods (an important source of calcium and some vitamins in the mixed diet) by Eskimo adults and older children. In this respect, however, Eskimos resemble most other populations which lack a history of dairying, including all populations of Mongoloid origin as well as those of Negroid origin. Estimates of the prevalence of lactose intolerance are markedly influenced by the method of testing. The standard 50 g lactose load (equivalent to 1 litre of milk) produces adverse symptoms in about 70% adults and teenage children. In contrast, after a 10g load (equivalent to 1 cup of milk) a large majority of subjects (about 90%) are asymptomatic. The general recommendation that US adults consume 2 cups of milk or their equivalent in other dairy foods per day can be met by most Eskimos provided this quantity is not taken at one

time. It will be difficult, however, for women to consume the additional amounts of dairy products recommended during pregnancy and lactation, and therefore, calcium supplementation during this period is indicated. The problem of calcium supply in the Eskimo diet has been accentuated by the decline of bone chewing, which provided the calcium necessary to counterbalance the high intake of phosphorus from the meat diet.

Arctic Eskimos appear to be uniquely susceptible to a racial-ethnic form of primary sucrase deficiency which is related to the absence of sucrose in their traditional diet. Although the incidence of this deficiency is low, for those affected it places severe constraints on the choice of foods from the modern diet. Sucrase deficiency appears to be a problem mainly of the northern Arctic. In the subarctic, berries containing sucrose are a significant item in the traditional diet. The highest incidence of sucrase deficiency has been recorded in Wainwright where it affects 2–3% of the population. The occurrence is distinctly familial and, unlike lactase deficiency, it is present in an acute form from birth.

The nutritional requirements of humans exposed to a cold environment have received considerable study. There appears to be no significant effect on nutrient requirements in subjects who are adequately clothed. When this is not the case, shivering thermogenesis and an increased basal metabolic rate raise the requirement for energy and some vitamins required for energy metabolism. Provided the diet is of good quality, the increased need for both vitamins and energy is met by an increase in food intake. The requirement for protein is not increased unless both fat and carbohydrate are limiting, in which case protein is used for energy.

Vigorous physical activity, such as that still engaged in by some Eskimos, likewise entails an increased requirement for energy and certain micronutrients which function in energy metabolism. Despite a widespread impression to the contrary, exercise does not increase the requirement for protein, provided sufficient calories are available from other sources. The basic need is for additional food.

It can be concluded therefore that the dietary standards which have been formulated under the auspices of various national governments are applicable to the Eskimos as well as the non-Eskimo segments of the population. For example, the conclusion of the Food and Nutrition Board of the US National Academy of Sciences that 56 grams of protein per day is an adequate intake for healthy adult US males extends to Alaskan Eskimo males, despite the fact that their traditional diet provided several times this amount of protein. Although local foods contribute a disproportionate amount of protein to the Eskimo diet, there is little reason for concern that a diminution of their intake entails a risk of protein deficiency. The acidic nature and high phosphorus content of the meat diet have been implicated in an unusually rapid rate of aging bone loss in Eskimos. On the other hand, the efficient absorption of iron from diets containing meat is a factor in the prevention of iron-deficiency anemia, which has become more prevalent with the decline of the nature food culture.

Just as the high protein content of the native diet has had no apparent effect on their requirements for protein, neither has their diet created a dependence on high fat or low carbohydrate intake. The nutritional health of Eskimos is dependent upon an adequate intake of essential nutrients and not on any intake of specific foods. The fact remains, however, that the decline of the native food culture has been accompanied by an increased incidence of undernutrition with respect to certain vitamins and minerals, and the appearance of those nutrition-related diseases which are characteristic of industrialized societies. In addition, in any proposal for diet modification, it must be recognized that emotional and cultural values are attached to certain foods by every human population, and these values should be considered in arriving at any decision which may jeopardize the availability of these items in the food supply.

3. A HISTORICAL REVIEW OF NUTRITIONAL AND DIETARY STUDIES UNDERTAKEN ON ARCTIC ESKIMOS

August Krogh [the Nobel prizewinner in Physiology and Medicine from Denmark in 1920] and his wife Marie (1913), studied the diet and metabolism of East Greenland Eskimos at the turn of the century and from the results, declared them to be 'the most exquisitely carnivorous people on earth' who consumed, on an average, 280 g of protein per day. This figure for protein consumption was some four times greater than that considered necessary at that time, for it was reckoned that daily requirements were approximately 1 g of protein per kilo of body weight. Today, that protein amount consumed by those Greenlandic Eskimos is considered as five times the daily requirement.

In the early 1950s Sinclair (1953) undertook an investigation of the diet of Eskimos at Iglulik and Coral Harbor in the Canadian Arctic and found the diet to be made of 45% protein, 46% fat, and 7% carbohydrate, indicating a predominantly native diet.

Previous to 1956, dietary studies of Alaskan Eskimos were limited to a series of investigations undertaken at Gambell and Anaktuvbuk Pass by Rodahl (1954) from the US Air Force's Arctic Aeromedical Laboratory in Fairbanks, and Heller (1947) at Unalakleet, White Mountain, and Selawik.

The 'Alaskan Dietary Survey' was undertaken by C. Heller and E. Scott (1956–61) of the US Public Health Service's Arctic Health Research Center over the period 1956–61. The purpose of the 'Survey' was fourfold: (1) to determine present food habits of Alaskan Eskimos and Indians, (2) to estimate the degree of their dependence on local foods, (3) to estimate the adequacy of the diet, and (4) to predict medical or public health problems which might arise from an inadequate diet. Over 5,000 food intake records of 3 to 7 days each for both sexes and all age levels were collected at eleven Alaskan villages. Nutritional analyses of native food stuffs were undertaken at the laboratory.

According to the authors, 'the most outstanding characteristic of these diets was the wide range in the mean daily intakes of all of the major nutrients—from extremely low to extremely high—a clear indication that family and village food supplies fluctuate enormously throughout the year'. It was found that the diets were made up of a combination of imported, that is, Western-type store-purchased food, and locally available foods. When compared to the recommended dietary standards of the National Research Council (NRC, 1958), the Alaskan diets were found high in protein and niacin. Compared to NRC standards 75% of diets were low in Kcal, calcium and ascorbic acid, 66% were low in

vitamin A, 25% were low in riboflavin and 33% of all diets for adolescents and lactating women were considered low in iron.

Northern Eskimo communities surveyed were Point Hope, Noatak, Shishmaref and Shungnak. Since Point Hope was the only whaling community surveyed, information about energy consumption and nutrient intakes in that community is presented in Table 1.

Table 1

Alaskan dietary survey, Point Hope (1956–61)

	Daily averages		
	Total	Local	Imported
Kcal	2,122	641	1,349
Protein (g)	120.4	81	29.8
Fat (g)	93.8	34.0	57.7
CHO (g)	212.7	1.1	200.7
Calcium (mg)	652	41	532
Iron (mg)	37.8	27.9	7.5
Vitamin A (i.u.)	6,197	3,928	1,055
Thiamine (mg)	1.698	0.409	0.808
Riboflavin (mg)	3.030	1.559	0.862
Ascorbic acid (mg)	13	1	4*

* School lunch program 7 mg.

This information shows that this population derived 70% of its nutritional energy from imported, Western-type foods and 30% from local food resources. Local foods included wild fowl, fish, caribou, seals, polar bears, baleen whales and belugas. Importantly, local food resources provided most of the protein, iron, vitamin A and riboflavin.

In 1958, the Interdepartmental Committee on Nutrition for National Defense (ICNND, 1959) undertook an investigation to appraise the health and nutritional status of Alaskan Eskimos.

Clinical examinations, biochemical assessments of nutritional status and dietary records were obtained from a sample of 713 men of the Alaska National Guard present at the annual Spring encampment in Anchorage. Since the guardsmen came from 55 different villages, the same information was obtained on the diet and nutrition of those men and on women and children in villages represented. One village investigated was Point Hope.

Clinically, the men in the Guard were described as 'active, rugged, deeply tanned and well-conditioned'. The most serious medical problems observed were the high prevalence of infectious diseases, especially tuberculosis, the frequency of corneal scarring, and the generally poor teeth. Important negative findings were the lack of inanition, anemia or cardiovascular disease, or of specific signs of deficiency of B vitamins or protein. Clinical examinations in the village revealed no evidence of nutritional disease.

The Committee concluded that specific nutritional deficiencies were not a health problem at that time. However, dental disease related to the increased consumption of sugars was rampant and increasing. Despite the fact that the average daily calorific intakes of men in the villages were considerably below the NRC recommendations, there was no evidence of under-nutrition. The statistically derived standard deviations for the average daily calorific intakes were equal to about one-half of the average values showing wide fluctuations in the daily calorific consumption.

The amount of food consumed at Point Hope and its nutrient content is shown in Table 2.

Table 2

Average daily nutrient intake at Point Hope (1956–58)

Number of men	11
Kcal	2,075
Protein (g)	158.9
Fat (g)	73.4
CHO (g)	196.7
Calcium (mg)	632
Phosphorus (mg)	1,177
Fe (mg)	12.2
Vitamin A (i.u.)	2,065
Thiamine (mg)	1.92
Riboflavin (mg)	2.40
Niacin (mg)	13.3
Vitamin C (mg)	19

In January 1969, Sauberlich, Goad, Herman, Milan and Jamison (1972) undertook a biochemical assessment of the nutritional status of Wainwright Eskimos. A total of 129 persons (23 men, 14 women and 92 children) in a population of 308 were examined and blood and urines were collected. Based on ICNND values for the classification of hemoglobin and hematocrit data, iron deficiency anemia was the most significant nutritional problem of the children. It was suggested that this anemia might be related to the nutritional and social practices of these people contributing to a nutritional neglect of the pre-school child. School children received a school lunch plus a supplement of 4000 i.u. of vitamin A and 400 USP of vitamin D on school days. It was concluded that, except for anemia in the younger children and marginal intakes of vitamin B6, the population was in a generally acceptable nutritional state.

In an attempt to determine the percentage of nutrients obtained from outside the village, the village store's annual inventory was examined. These foods included: evaporated milk (24,000 cans), sugar (11,200 lb), flour (31,500 lb), rolled oats (3,240 lb), corn meal (2,200 lb), crackers (8,700 lb), rice (2,300 lb), fats (5,200 lb), and soda pop (14,400 12-oz cans). Calculations by Milan (1979) showed that these foods provided approximately 57%–60% of the village's annual calorific requirements. Refined sugar consumption averaged out to be 36 lb/person/year. By including the sugar in soda pop and candy bars, which interestingly did not turn up on the inventory, sugar consumption is probably twice the calculated value.

Dietary studies were undertaken at Wainwright and Point Hope during 1971–72 as part of the multi-disciplinary investigations of Eskimo human biology under the auspices of the International Biological Program. Bell and Heller (1978) collected 3–4 day dietary records and they calculated the intake of 11 nutrients. It was found that 54% of the children at Wainwright and 58% at Point Hope, and 65% of adults at Wainwright and 59% at Point Hope consumed less calories than the recommended dietary allowances of the NRC. Since there was no evidence of undernutrition from the clinical studies (Colbert, Mann and Hursh, 1978) it can be assumed that the calorific intakes were under-reported. Approximately 34% of calories in Wainwright and 18%

at Point Hope were obtained from native foods. Adults at Wainwright and Point Hope obtained 75% and 57% respectively of protein from native foods. Children, however, especially at Point Hope, obtained most of their calories from the store showing their preference and, perhaps, parental neglect. All carbohydrates and approximately one-half of all fats were derived from store-purchased foods.

Table 3

Nutrient intake from native foods (%) (Bell and Heller, 1978)

Subjects	No.	Calories	Protein	Fat	Carbo-hydrates	Ca
Wainwright						
1971						
Males	9	42.6	79.4	47.7	0.5	27.5
Females	7	52.2	83.3	62.7	0	29.7
Children	16	23.2	55.6	30.0	0.05	6.4
1972						
Males	17	33.0	68.1	44.7	0.5	24.4
Females	15	45.5	73.2	60.3	0.9	18.6
Children	21	25.3	55.6	42.0	0.7	18.1
Average	85	34.1	66.0	45.8	0.5	19.2
Point Hope						
Males	16	23.9	62.0	25.9	0.5	10.3
Females	16	19.8	51.8	22.3	0	11.4
Children	12	8.1	22.0	12.5	0	2.5
Average	44	18.1	47.4	20.9	0.2	8.6

The nutritional status of these two village populations with respect to the biochemical parameters measured was generally satisfactory except for a pervasive incidence of low hemoglobins and hematocrits.

Draper (1978), based on the information from these studies, concluded that the changes in the nutritional status of Alaskan Eskimos over the past 25 years were the result of acculturation, the availability of Western-type foods in local stores and government 'give away' food programs.

Draper (1977) further wrote: 'The modern Eskimo has for the first time the opportunity to make significant food choices. Presented with an array of exotic new foods which he is not equipped by personal experience or education to evaluate, he tends to choose badly. In general, the items he selects are below the average quality of the US mixed diet. His nutritional status is deteriorating in terms of both under- and over-nutrition, in direct relation to the proportion of processed foods in his total diet. In the subarctic, where the dietary acculturation is extensive, the Eskimo has the full complement of diet-related diseases that are characteristic of other segments of the US population of low socio-economic status: obesity, cardiovascular disease, hypertension, and tooth decay.'

In summary, then, a review of the dietary and nutritional studies undertaken on Arctic Alaskan Eskimos clearly reveals the changes that have occurred over the last twenty-five years. The major change has been a shift from complete dependence on local food resources to only partial dependence, with a major proportion of food now eaten being Western-type foods purchased at local stores. Accordingly, protein intakes have been reduced and carbohydrates have markedly increased over this period. These dietary changes over time have probably contributed to the secular trend increase in adolescent growth over the last decade (Jamison, 1978) and a lowering of the age at menarche (Milan, 1978).

4. HEALTH EFFECTS OF NUTRITIONAL LIFE-STYLE CHANGES OVER TIME ON ARCTIC ESKIMOS

a. Alaska

The ICNND study (1958–61) in Alaska was the largest study of the nutritional status of the Alaskan native in terms of number of Eskimo villages. That study indicated the diet of northern villagers was superior nutritionally to that of southern Eskimo villagers. This was largely due to the more frequent and larger amounts of subsistence protein foods used, particularly sea mammals. It was found that the increasing use of store foods was having adverse effects upon the nutritional value of all diets.

The easier accessibility to subsistence protein foods in the north, coupled with the larger quantities available, influenced the superior quality of the northern Eskimo diet.

At the time this study was carried out, the leading health problems of the Alaskan native were tuberculosis, respiratory diseases and gastro-intestinal diseases unrelated to nutrition. Infants and young children were especially affected by the latter two disorders. Infant mortality rates were roughly six times the US National average, and deaths from tuberculosis were of the same magnitude. Over 50% of hospital admissions of Alaskan natives were individuals under 6 years of age.

Severe dental caries was common from weaning onwards, leading dentists in the Indian Health Service (IHS) to state that baby teeth were 'bombed out' soon after eruption. The widespread change from breast to bottle feeding and the change from hard-teething foods (dried fish, dried meat, pilot bread) to soft-teething foods (soda crackers, cookies, and sweets) were considered to have been major contributing factors to early dental caries.

In 1960 a major campaign to educate Alaskan natives on the nutritional value of subsistence food was begun by the IHS and the Bureau of Indian Affairs (BIA) in Alaska. This continued until 1966. Eskimo-designed posters of the 'Alaska Basic 5 Good Groups' combining native and store foods were widely distributed. Teaching manuals for nutrition education relating to this poster were developed. School teachers, village health aides, Public Health nurses, hospital staffs and community leaders were given in-service training with the purpose of their utilizing this training both during work and informally. Posters of the nutritional values of individual native foods were made and used in these in-service sessions, along with posters of the values of store foods of comparable value and store foods of poor nutritional values.

Simultaneously, the IHS, ADPH and AHRC stepped up screening, treatment, and preventive health education vis-à-vis tuberculosis, respiratory diseases, gastro-intestinal diseases, and dental caries. Post-neonatal deaths and repeated admissions to hospitals for respiratory diseases, tuberculosis, and gastro-intestinal diseases dropped sharply over a 10-year period, especially in the under-6 years age group.

At the present time (IHS FY 77) the leading causes of death among Alaskan natives are accidents, diseases of the heart, malignant neoplasms, suicides and homicides, and cirrhosis of the liver. Chief chronic illnesses/conditions treated on an out-patient basis presently related to nutrition are dental caries (ages 6–18), obesity (all ages), iron-deficiency anemia (women of child-bearing age,

adults over 65 years, and children from birth through 6 years). Adult-onset diabetes is gradually increasing, but of low incidence compared with American Indian populations in the 'lower 48'. Documented data on nutritional deficiency diseases of Alaskan natives discharged from hospitals during 1974–78 show iron-deficiency anemia as the only disease of any significance in terms of incidence.

The type A School Lunch Program began in Alaska in 1960 for all BIA schools. It provides $\frac{1}{3}$ of the child's daily nutritional needs. Some schools also provide breakfast. Federal food programs begun in Alaska since 1965 which may have had some impact, both positive and negative, on the nutrition of Arctic Alaskan natives include:

1. *Food Stamp Program*—initially not well accepted due to stringent regulations which are now being eased.

2. *Headstart Program* for ages 3–5 years—$\frac{1}{4}$ to $\frac{1}{3}$ of the child's daily nutritional needs are provided. This program may operate five days a week during the school year.

3. *Supplementary Food Program for Women, Infants and Children* (WIC)—operates only in three North Slope villages (Barrow, Wainwright and Nuiqsut). It provides total daily nutritional needs in protein, calcium, iron, and vitamins A and C year-round to pregnant and lactating women and children from birth through 5 years. Began 1973. Nutrition education is provided to all participants. See Appendix 1 for examples of hand-outs from the program.

4. *Meals for the Elderly*—provides $\frac{1}{3}$ daily nutritional needs for adults over 60 years. This program operates five days weekly, year-round in Kotzebue village only.

Twenty-four-hour food recalls of some participants of these programs indicate improvement in the diets of some program participants and their families. Some carry-over after leaving the program, in terms of food purchased, is reported by store-keepers.

The extent of the use of store foods as compared with subsistence foods varies from family to family, village to village, and season to season. It has been the policy of IHS to serve meals in hospitals which cater to nutritious food preferences of patients. The use of native (subsistence) protein foods in IHS hospitals in Alaska has declined since 1967 due to sanitation problems and game laws, availability, and changing staff. However, diet instructions for out-patients and patients being discharged are planned around the food preferences of the patient, which frequently include native foods. Nutritional standards set for IHS hospital diets since 1970 have been in excess of RDA dietary allowances in some nutrients.

It is the position of the IHS that consideration of Alaskan native food preferences in diet counselling and nutrition education is highly essential to the health and well-being of the Alaskan native. This position differs in no way from that of health agencies anywhere else in the world where the purpose of diet counselling and nutrition education is to effect behavioral change within the constraints of custom, economy and availability.

State and local agencies currently providing nutrition education concerning native foods are the North Slope Borough School District, the University of Alaska, Cooperative Extension Service, the Alaska Departments of Education and of Health and Welfare.

b. Canada

The changes in Eskimo nutritional life-styles differed in rapidity and intensity in different parts of the Canadian Arctic over time. Comparisons of nutritional and general health parameters of different population groups found at different stages of acculturation, and the changes observed in the same population before and after the advent of drastic changes in their nutrition and life-styles, have enabled an assessment of the impacts of these changes in the Canadian Arctic.

Although no detailed biochemical assessments are available from earlier times dealing with Eskimos living exclusively or almost exclusively on traditional diets, general descriptions by explorers and reports from medical personnel describe them generally as 'strong, robust and full-blooded' except when affected by newly introduced epidemics of acute or chronic infections.

Of particular interest in this respect are the reports by Rabinowitch (1936) from McGill University, who, in the mid 1930s, participated in the eastern Arctic patrol and examined a fair number of Eskimo children and adults in the northeastern and southeastern Canadian Arctic. Rabinowitch stresses that Eskimos examined at the larger trading posts—Chesterfield and Port Burwell—were pale, whereas many of the natives of the northeastern Arctic, living almost exclusively off sea-mammals looked plethoric and quite a few of these had frequent nose-bleeds, which he attributed to their excess erythemia, also reflected in their mean hemoglobin of 145% of norm. Markedly lower levels of hemoglobin and some cases of overt iron deficiency were found at Ungava Bay (Arctic Quebec). These Eskimos had already at that time switched to substantial amounts of store foods.

Sellers *et al.* (1959) found in the late 1950s that iron-deficiency anemia was becoming a problem in children of the Keewatin district (central Arctic). There, the population who had traditionally subsisted entirely on caribou and fish were suffering a drastic decline of the caribou herds in the 1940s and 1950s. They had endured a number of local famines and were living to a large proportion on store foods, i.e. mainly flour at that time.

Schaefer (1964) and Conway and Schaefer (1969) investigated anemia in the eastern Arctic and found mean hemoglobin levels 1–2 gms higher in the northeastern cf. southeastern Arctic, differences being most significant in children and women of childbearing age. Iron deficiency anemia was found prevalent in the settlements of Arctic Quebec and settlements at or near DEW-line sites where a major proportion of the diet was derived from store food, and was conspicuously absent in hunting camp populations further north.

It should be noted here that starting in 1964/65 a massive school and house-building program had been launched in the central and northeastern Arctic gathering most of the population from almost all remaining hunting camps into larger settlements around trading posts and schools giving wage employment or welfare to most former hunters, thus giving them cash to buy store food.

In Alaska, Scott and Heller (1964) found also more iron-deficiency anemia in southwest Alaska Eskimos living more on fish and store food than in those from the Alaskan North Slope who still used some sea mammals at that time.

It may also be of interest in this context that Schaefer

found in April 1978, 12 of 24 Eskimo mine employees in Namisivik, N.W.T., below the 5th percentile of normal hemoglobin values for sex and age compared with one of their white co-workers who ate the same meals in the central dining hall. When examined in April 1976, only 2 of 17 Eskimo employees fell below the 5th percentile. In 1971, during construction, the Eskimo workers took only one meal per day at the dining hall, while eating most of their meals at home in Arctic Bay, consisting often of caribou and seal meat.

This observation based on relatively small numbers requires follow-up and confirmation in a larger group of people. It fits, however, frequently reported impressions of northern health workers that Eskimos appear particularly prone to develop typical iron-deficiency anemia even when consuming diets with, by our standards, sufficient iron content, and that Eskimo children and adults treated for iron-deficiency anemia tend to respond slower than normally to oral iron preparations.

While requiring further elaboration and confirmation, these preliminary observations suggest that Eskimos traditionally oversupplied with iron (we found in native food samples collected in 1976 in Arctic Bay, e.g. iron content of caribou meat was more than twice that of beef muscle and seal muscle contained more than six times, seal liver 15–20 times as much iron as beef muscle and beef liver did) may have adapted intestinal iron absorption to this state of over-supply and that they may therefore be more prone to develop iron-deficiency anemia when changing to our diets containing only marginal amounts of iron.

Iron-deficiency anemia, particularly in growing children and women of child-bearing age, whose increased iron requirements make them more vulnerable, is the health effect best documented and most clearly related to nutritional change observed in the native population in northern regions. It may also be one to which formerly sea mammal consuming natives may be particularly vulnerable. There are others such as dental caries generally recognized to be connected with increased sugar consumption and decreased bone chewing activity.

A number of diseases prevalent in Western civilization, such as obesity, gall-bladder disease, diabetes mellitus, hypertension and arterio-sclerotic diseases of the heart and peripheral circulation are found in increasing incidence in those Eskimo populations who have given up their traditional nutrition habits as evidenced by comparing findings in recent surveys of general and nutritional health in urbanized Eskimos living in Inuvik and Eskimos of northern Baffin Island who only 10 years ago moved from hunting camps into settlements and still derive at least 50% of their food intake from native sources (see appended paper by Schaefer, Timmermans, Eaton and Matthews).

It should be stressed, however, that these 'civilization diseases' such as obesity, diabetes, gall-bladder disease, hypertension, hyperlipidemia and atheromatosis of the coronaries and other arteries cannot so exclusively or even predominantly be linked to nutritional change. Their etiology is obviously more complex and changes in physical activity and life-style may be equally important factors in their pathogenesis.

Considering above quoted evidence, there is little doubt that preservation of traditional nutrition habits and life-style, and that includes in particular consumption of meat and organs from sea mammals, is highly desirable for Eskimos in order to safeguard their health.

In regard to the specific issue—bowhead whaling—the panel lacked personal acquaintance with the conditions prevailing at present for the population groups directly concerned, the Eskimos of north and northwestern Alaska. Bowhead whaling was part of the traditional pursuits of Canadian western Arctic and to a much lesser degree also eastern Arctic Eskimos, but ceased to be of any practical importance to them more than a generation ago.

The presence of a number of Eskimo families on Holman Island and Sach's Harbor on the eastern rim of the Beaufort Sea who moved there with the American whalers around the turn of the century, and their successful change from a predominant reliance on whaling to sealing and fox-trapping for subsistence without untoward health consequences points, however, to a valid alternative to whaling at least as far as nutritive needs are concerned.

We do not know of any particular nutrient found in the large bowhead whales not supplied by seals or the smaller white whales (beluga) or narwhals. Seals, furthermore, must be regarded at present as the most underutilized and, in recent years of high seal skin prices, most often wasted meat resources of northern Canada and probably also of Alaska.

Indeed, we have good reason to believe that systematic exploitation, distribution and consumption of the vast resources of *Phoca hispida*, common jar seal, could satisfy all protein requirements of most North West Territories (and likely also Alaskan) Eskimos and perhaps even a majority of the remaining population in the North West Territories Fisheries and Game management of the North West Territories could find no evidence for depletion of seal herds in the Canadian Arctic in times when due to introduction of seal-netting catches multiplied compared to those in terms of traditional subsistence hunting.

5. NUTRITIONAL VALUE OF THE WHALE AND OTHER LOCAL RESOURCES TO ARCTIC ESKIMOS

In arriving at a policy decision regarding aboriginal whaling, it is important to consider the contribution of the whale catch to the food economy of the population affected. This contribution obviously is highly variable, depending upon the number of whales taken, their size, the proportion eaten and the availability of other foods.

The following is an estimate of the calorific contribution of the edible portion of a typical bowhead whale. It is based on the average length of whales taken by Alaskan Eskimos during the period 1973–77, and on the assumption that the weight to length relationship is similar to that determined for the related Pacific right whale. Estimates of percentage yields of various tissues and organs also are based on data for the right whale. Figures for the proportions of each carcass component consumed, as well as their protein and fat content, have been taken from information on the bowhead. The assistance of M. F. Tillman in locating sources of information is gratefully acknowledged.

Estimated length of bowhead whales

Reference: Marquette, W. M. 1977. The 1976 catch of bowhead whales (*Balaena mysticetus*) by Alaskan

Eskimos, with a review of the fishery, 1973–76, and a biological summary of the species. *Northwest and Alaska Fisheries Center Processed Report*. 80 pp.

Year	Average length (m)	
	Spring hunt	Autumn hunt
1973	8.63	—
1974	10.53	9.55
1975	9.79	—
1976	9.58	14.87
1977	9.60	10.67

Weighted average for all years, both hunts: 10.16 m (33.33 ft.).

Estimated weight of bowhead whales

Reference: Lockyer, C. 1976. Body weights of some species of large whales. *J. Cons. CIEM* 36(3): 259–73.

$$W = 0.0132L^{3.06}$$

where W = weight in metric tons, L = length in metres

for $L = 10.16$ m, $W = 15.91$ metric tons (15,910 kg).

Estimated body composition

Reference: Omura, H., Ohsumi, S., Nemoto, T., Nasu, K. and Kasuya, T. 1969. Black right whales in the North Pacific. *Sci. Rep. Whales Res. Inst.*, Tokyo 21: 1–78.

Meat	31.3%
Blubber	39.8%
Bone	12.8%
Viscera	13.9%
Blood and fluids	2.6%
	100.0%

Estimated portions consumed

Reference: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *A Special Report to the International Whaling Commission: Bowhead Whales*. 1978. 63 pp. and appendices.

Meat	100%
Blubber (as muktuk)	15%
Bone	—
Viscera	100%
Blood and fluids	0

Estimated energy content of portions eaten (Kcal)

Reference: Heller, C. A. and Scott, E. M. 1967. *The Alaska Dietary Survey 1956–1961*. U.S. Department of Health, Education and Welfare. Publication 999-AH-2. 19. 281 pp.

Percentage of total energy utilized for food:

$$\frac{16.82 \text{ Kcal} \times 10^6 \times 100}{63.66 \text{ Kcal} \times 10^6} = 26.4\%.$$

The fact that apparently only 26.4% of the blubber (which consists almost entirely of fat) is used for food means that nearly three-quarters of the calories derived from the whale kill are lost to nutritional use.

Estimated equivalents in terms of human energy requirements

Basis 2,500 Kcal/day required for a man of moderate physical activity

Used portion $\frac{16.82 \times 10^6 \text{ Kcal}}{2{,}500 \times 365 \text{ days}}$

= 18 man years energy equivalent (m.y.e.e.)

Unused portion $\frac{46.84 \times 10^6 \text{ Kcal}}{2{,}500 \times 365 \text{ days}} = 51$ m.y.e.e.

Used and unused portions = 69 m.y.e.e.

Estimates of subsistence harvest

1. Reference: Patterson, A. *Subsistence harvests in five native regions*. Joint Federal-State Hand Use Planning Commission for Alaska, Anchorage. 1974. (For the period 1969–73.)

	Point Hope		Wainwright		Barrow	
	N	lb.	*N*	lb.	*N*	lb.
Caribou	750	112,500	1,500	225,000	3,500	525,000
Bowhead	8	216,000	2	54,000	15	405,000
Hair Seal	2,060	164,800	350	28,000	1,000	80,000
Bearded Seal	180	72,000	50	20,000	150	60,000
Walrus	Unknown		50	47,250	33	31,185
Fish	—	40,000	Unknown		—	61,550

2. Reference: Foote, D. C. and Williamson, H. A. A Human Geographical Study. Pp. 1041–1107. *In:* N. Wilimovsky and J. N. Wolfe (Eds). *Environment of the Lake Thompson Region, Alaska*. U.S. Atomic Energy Commission, Washington, D.C. 1966. (For the period June 1960–May 1961.)

	Point Hope	
	N	lb.
Hair Seal	1,847	267,815
Bowhead	2	130,000
Bearded Seal	281	114,975
Caribou	287	111,300
Walrus	10	10,000
Fish	—	22,300

	Nutrient content (1%)			Nutrient content (kg), 15,910 kg whale			Energy content (Kcal × 10^6)
	Fat	Protein	CHO	Fat	Protein	CHO	
Meat	2.6	26	0	129	1,294	0	6.34
Blubber	96.5	0.4	0	917	4	—	8.27
Viscera				1 Kcal/g (est.)			2.21
Total used portion (basis 15% consumed)							16.82
Unused portion (85% of blubber)	5,382 kg blubber			5,194	22	—	46.84
Total energy (used and unused)							63.66

Some values for the composition of local and non-local meats

	Water %	Protein %	Fat %	Iron mg/100 g	Vitamin A i.u./100 g
Beluga meat[1]	72.5	26.5	0.5	25.9	340
Seal meat	67.4	28.4	3.2	19.6	—
Whale meat (bowhead)	70.9	26.2	2.6	14.1	330
Seal meat[2]	68.5	29.6	0.4	—	—
Caribou meat	70.8	26.6	1.2	—	trace
Walrus meat	59.9	26.5	11.6	—	—
Seal meat[3]	69.6	25.1	4.6	14.0	—
Caribou meat	74.0	22.0	2.9	4.2	—
Sirloin steak[4] (boneless raw)	53.7	16.4	28.0	2.5	—
Chicken (stewed)	60.4	30.0	8.8	1.5	—

[1] Heller, C. A. and Scott, E. M. 1967. *The Alaska Dietary Survey.*
[2] ICNND. 1959. *An Appraisal of the Health and Nutritional Status of the Eskimo.*
[3] Hoppner, K. *et al.* 1978. *J. Amer. Diet Assoc.* 73: 257–61.
[4] USDA Handbook No. 456. 1977. *Nutritive Value of American Foods.*

6. SUMMARY AND CONCLUSIONS

The review of presently available information shows the Arctic Eskimos have no unusual nutritional requirements as a result of their long-time occupancy of the Arctic environment. Their nutritional needs can be met by either local subsistence foods or Western-type foods if appropriate food choices are made. Any risk to the survival of the bowhead whale which may be posed by the continuance of aboriginal whaling cannot be justified on nutritional grounds.

Notwithstanding, the nutritional status of Arctic Eskimos has declined with the erosion of the native food culture. Examples are the evidence of anemia in Eskimo women and children, rampant dental disease and an increase in cardiovascular disorders. The withdrawal of the whale from the Eskimo diet will contribute to this decline unless appropriate and comparable subsistence or Western-type foods are substituted. Bowhead whales are not unique in their nutritional contents. The seal, beluga and walrus are equal to the bowhead whale in nutritional value. Four hundred and thirty phocid seals are the calorific equivalents of one bowhead whale and could be considered as local resource alternatives.

It is recommended that dietary and nutritional monitoring of Arctic Eskimos be continued, that research be undertaken on the Eskimo anemias and that attempts be made to improve their nutritional education programs.

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Bowhead whales captured by Alaskan Eskimos are pulled up on shorefast ice by means of block and tackle for butchering. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

Appendix

General and Nutritional Health in two Eskimo Populations at Different Stages of Acculturation[1]

O. Schaefer, J. F. W. Timmermans, R. D. P. Eaton and A. R. Matthews

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ABSTRACT

Detailed nutritional health and occupational histories, clinical and laboratory examinations were obtained of 644 perseons, mostly (503) Eskimos from: (1) A small Eastern Arctic settlement (Arctic Bay) still heavily dependent on traditional food resources and hunting activities. (2) An urbanized center in the Western Arctic (Inuvik) with little resource to traditional food and lifestyle during the last generation.

In children, inverse relations of duration of breastfeeding to morbidity rates of diarrhea, recurrent respiratory infections and otitis media were found.

Anemia was also more prevalent in bottlefed infants and aggressive iron supplementation during the first three months of life was associated in a number of bottlefed children in Arctic Bay with intractable diarrhea.

Breastfed infants walked 2.75 months earlier than bottlefed children in Arctic Bay. Eskimo children were heavy for height, cf. North American norms, and this was found more marked in Arctic Bay than Inuvik, where evidence for secular growth-acceleration including advancement of menarche were greater than in Arctic Bay.

In adults differences were greatest and most significant in regard to skinfolds, serum cholesteral levels and prevalence of gallbladder disease. Skinfolds were double and triple in Inuvik women and men 20–49 years old respectively and rates of persons with serum cholesterol in the 'High risk' range three times and those afflicted with proven gallbladder disease tenfold higher in Inuvik cf. Arctic Bay. The largest skinfolds were found in heavy beer-drinkers.

There was also a positive association of alcohol abuse and peptic ulcer disease. 40% of native men in Inuvik had a history of alcoholism leading to serious physical, legal or social consequences. Worst affected were middle-aged natives of both sexes in Inuvik with few of their families remaining intact.

Hypertension was found in only one old woman in Arctic Bay, but in several men and women in Inuvik. Means of systolic and diastolic B.P. were similar in Eskimos, Indians and Whites in Inuvik and showed moderate rises with aging typical for our society in contrast to Arctic Bay Eskimos. Aortic Indices, measuring elongation and widening of the aortic arch were found significantly greater in Inuvik native men over 40 years of age.

Dental caries and loss of teeth due to extractions were very prevalent in middle-aged natives in Inuvik, while in Arctic Bay adults were less but children much more affected, reflecting earlier diet and dental care changes in the West.

Vitamin and mineral analyses in both settlements were somewhat better than those found 1972 by Nutrition Canada in Indians and Eskimos. Children under 10, however, in Arctic Bay tended to show low Vitamin A levels while elderly Eskimos in Inuvik had low Vitamin C levels.

Serum protein levels were high in both settlements. Some cases of iron deficiency anemia were seen in children and women of childbearing age in both settlements, but in general levels were slightly better in Arctic Bay than Inuvik.

[1] Editor's note: a slightly revised version of the paper presented at the meeting has been published in the *Canadian Journal of Public Health* Volume 71 (November/December 1980) pages 397–405, and so only the original abstract has been published here.

76H3, Point Hope, Alaska. A 13.21 m (43'4") female has just been pulled up on ice and a second whale is ready to be pulled up next to it. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

Report of the Cultural Anthropology Panel

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SUMMARY STATEMENT

This Report analyses the role of subsistence hunting for bowhead whales in the contemporary culture, society and economy of north Alaskan Eskimos. Its fundamental conclusions include the following.

(1) The complex of whaling and associated activities is perhaps the most important single element in the culture and society of north Alaskan whale hunting communities. It provides a focus for the ordering of social integration, political leadership, ceremonial activity, traditional education, personality values, and Eskimo identity.

(2) Whaling has retained its unique importance in these communities, despite cultural change during the modern era. Technological shifts or replacements have not altered the intrinsic nature, purpose, meaning, and social-cultural role of subsistence whaling.

(3) Expansion of whaling activity in recent years has occurred for a number of reasons, including revitalized interest in traditional culture among younger Eskimos. A quota system regulating the number of whales taken has been successfully introduced and seems to permit stabilization of harvests despite an increase in the number of crews engaged in whaling.

(4) From a cultural standpoint, whales are not replaceable by alternative resource species. The position of whaling as a pivotal, cultural activity and the extremely high valuation placed on bowhead whale products as food makes such replacement impossible.

(5) Compilation of biological data and formulation of management policies regarding bowhead whales should be undertaken with the direct and formal participation of Eskimo whalers from north Alaskan communities. Input from this source is essential to assure accuracy of information and to maximize compliance with management plans.

PANEL MEMBERS

John Bockstoce (USA), Milton Freeman (Canada), William S. Laughlin (USA), Richard K. Nelson (USA), Michael Orbach (USA), Robert Petersen (Denmark), J. Garth Taylor (Canada), Rosita Worl (USA); assisted by Wendy Anendale (University of Washington, Seattle).

INTRODUCTION

The cultural panel interpreted its charge as the development of a report discussing the role of subsistence hunting for bowhead whales in contemporary Alaskan Eskimo culture, society, and economy. As social scientists, we recognize that no science is value free, especially where it addresses problems related to public policy. In this task, our value position is as follows: the management of aboriginal subsistence whaling involves principles of the participation by all concerned parties in decision-making that affects them or their environment, the maintenance of social units whose economy is based on direct consumption and use of renewable natural resources, and the continuation and strengthening of activities integral to Eskimo cultural identity. Any aboriginal subsistence whaling management regime based on these principles can only be developed with the participation of members of the Eskimo whaling community in order to provide the proper information and perspective on Eskimo culture, to promote the welfare of Eskimo communities, and to support the conservation and best use of the whale stocks.

We have not fully addressed the problem of subsistence whaling in areas outside Alaska. Given the particular expertise of our panel, the constraints of time and the available data base for north Alaska, we have restricted ourselves to focused consideration of bowhead whaling in north Alaskan Eskimo society in the very recent past. Therefore, we considered the whaling practices of other Arctic/subarctic indigenous peoples only where they illuminated our defined problem. Similarly, we directed only minor attention to the long archaeological and historical dimensions of the whaling tradition in north Alaskan native society.

As a panel, we could not review thoroughly all the literature available on the subject we were to address. However, we are confident that our panel contained some of the most informed current non-native authorities on the sociology of Alaskan whaling, including researchers who have spent extended periods as participant-observers in the whale hunt. No major written sources of information were unknown to us collectively. We append a brief bibliography of the most important background documents.

Hunting, especially the hunting of preferred animal species, has long been central to the total well-being of the Alaskan Eskimos. This idea is an important and recurrent theme in our report. Indeed, anthropologists regard hunting as the master behavior pattern of the human species. It is the regime under which our species evolved and migrated to all different areas of the world, including America. Hunting is a way of life, a pattern for living, and not merely a subsistence technique. Hunting places a premium upon inventiveness and problem solving. It also imposes real penalties for failure including death, starvation, and extinction. As a way of life hunting has contributed as much to advancing our one human species as to holding it together within the confines of a single variable species.

Hunting is obviously an instrumental system in the real sense that something gets done, and several ordered behaviors are performed with a crucial result. The technological aspects—the spears, harpoons, clubs, boats, and other objects suitable for museum display—are essentially meaningless apart from the context in which they are used. These objects alone do not represent a suitable place to begin analysis of hunting as a physical or cultural activity. Childhood training, preparation, scanning, pursuit, killing, retrieval, and distribution are all steps in an organized sequence that involves all members of a community and pervades their religious concepts as well as their social behavior (for an extended discussion, see Laughlin, 1968).

Marine mammal hunting using kayaks and *umiaqs*,[1] successfully practiced by Eskimos and Aleuts for some thousands of years, is the most skilled form of hunting. It requires more training beginning in childhood, more articulated knowledge of animal behavior, marine conditions, and technology, and more team organization of hunting crews than any other form of hunting.

The pre-eminent ethnographer of Eskimo culture, Birket-Smith, writes of the large whales:

> There is on the whole no animal...whose hunting is so hedged by strict taboo, magic formulas, and the use of amulets. And considering the size of the animal, and the dangers attached to the hunt, this is not surprising...The extensive distribution of some parts of the cult and the nature of their elaborations indicate great historical and cultural force back of the cult, as well as the emotional force of individual encounters with the powers of nature (quoted from Lantis, 1938).

Members of our panel who are familiar with life in contemporary Alaskan whaling villages affirm that this cultural force is very much alive today. These opinions have recently been expressed by a north Alaskan Eskimo spokesman.

> [The whale] is the center of our life and culture. We are the People of the Whale. The taking and sharing of the whale is our Eucharist and Passover. The whaling festival is our Easter and Christmas, the Arctic celebration of the mysteries of life (Hopson, 1978–79).

WHALING IN NORTH ALASKA

Historical background

Pre-1970

Although Alaskan natives have hunted whales for as many as 8,000 years, it was not until about 1,000 years ago that the inhabitants of the Bering Strait region and northwestern Alaska developed intensive whale hunting practices that allowed a regular and reliable whale catch. This development probably arose from a constellation of factors including a diffusion of technological advances in sea hunting equipment, ice patterns that forced the whales close to shore, control by a captain over his crew, cooperation between crews, and most important—a sufficiently large population to allow several crews to hunt together (Bockstoce, 1973; 1976; 1979). From this prehistoric base, whaling quickly became the most important hunting practice and the focal point of the peoples' year from the Bering Strait region to Point Barrow. Beyond this core area, whaling was also carried on, possibly with less intensity, in Anadyr Gulf and at various times on the shores of the eastern Beaufort Sea and Amundsen Gulf.

From this genesis, whale hunting continued to evolve over the succeeding millennium in response to changing factors in the environment. But the most wrenching change took place in 1848, when the first commercial

[1] Eskimo usage and spelling of certain words and phrases are used throughout this report. In some cases, the spellings may differ from those appearing in other publications.

whaleship reached Bering Strait and discovered the vast numbers of bowhead whales in those waters. Following that discovery, the pelagic whalers began systematically to reduce the bowhead population and over the next 60 years made more than 2,600 cruises, probably killing more than 20,000 bowheads (Bockstoce, 1978).

Nevertheless, the Eskimos and commercial whalemen did not come into significant contact until after 1870. Contact occurred because the Eskimos wanted to obtain darting guns and bomb-lance shoulder guns, devices useful for hastening the whale's death and retrieval. It is important to note that the Eskimos' adoption of this manufactured equipment does not differ qualitatively from their adoption of new whaling apparatus nearly 1,000 years earlier. In both cases, these technological changes arose from a rational decision on their part to use a more effective means of ensuring their continued food supply. Such changes should be seen as a natural evolutionary development; in this decade, the use of walkie-talkies, skidoos, and outboard motors is a similar innovative response.

However, by the late 1880s important changes began to overtake the Eskimo whalers. Commercial shore-based whaling stations were established on the Alaska coast in response to the rising price of baleen and the declining pelagic catch. These shore stations thoroughly changed the character but not the technique of Eskimo whaling; the stations, which could send out as many as 20 crews each in the spring, hired large numbers of Eskimos, paid them for their labor, and required only that the baleen be retained by the company. Natives from all over the northern interior drifted to the coast to become commercial hunters, and before long, the number of crews had increased by two or three times above the aboriginal level. The number of whales taken increased at first, but despite the increase in hunting effort the numbers soon declined, for the bowheads had been severely reduced. Scarcity drove the price of baleen higher and ultimately caused the collapse of the industry in 1908, when spring steel was introduced as a cheaper substitute for corset stays.

The industry's collapse ushered in the return to whaling as a subsistence activity. With bowheads commercially valueless, the number of crews fell almost to the aboriginal level, and for 50 years, the number of crews operating in Alaska was fairly constant. From 1920 to 1970, these crews were based continuously in five communities (Barrow, Wainwright, Point Hope, Wales and Gambell) and for less than the full-time span at four others (Savoonga, Point Lay, Kivalina and Kaktovik). Whaling camps were sometimes as much as 100 miles from the base village, depending on a particular season's ice conditions and the availability of open water.

Post-1970

Since about 1970, some aspects of Eskimo whaling have been affected by technological changes but overall the technology for pursuing whales has changed very little in the past 50 to 75 years. Hand-paddled skin boats are still predominantly used for pursuit during spring whaling, and whales are struck with the same weapons that were introduced before the turn of the century.

Engine-powered boats have been used for fall whaling at Barrow for about 50 years, and their use continues not only at Barrow, but also at Nuiqsut and Kaktovik. Engines are not used for pursuit of whales in the spring, but they are sometimes employed for pulling a killed animal back to the ice, hastening the process and reducing the chance of spoilage during a long tow (towing may take up to 48 hours). Using power equipment to haul fall-killed whales onto a beach has a similar effect, and reduces an otherwise enormous output of hand labor.

Other technological changes have included using small two-way radios, important safety devices for the widely scattered crews. Radios may also help reduce the struck and lost problem by allowing communication between pursuing boats. Snow machines have added substantially to the convenience and safety of whaling, and have permitted much more effective transportation of meat and *maktak* to distant villages.

Some Eskimos have tried using aluminum boats in the spring hunt, but they are poorly regarded by most Eskimo whalers becuase they are noisy and may frighten off the animals. It is not clear whether local whaling organizations will rule against their use. The only other technological innovation in whaling itself is the plastic float, now often substituted for the traditional sealskin *pok*.

While these changes have affected the comfort and safety of whaling activities, there is little evidence that they increase the number of whales that are struck. Moreover, such improvements may have improved the chances that struck whales are retrieved and fully used.

Alaskan Eskimo whaling today

Background

After 150 years of contact with western influences, the north Alaskan Eskimos still exist as a distinct cultural enclave within the larger society of Alaska and the United States. Outward signs of Westernization include modern goods and services, institutions, houses, and a monetary economy. Although the aboriginal culture has changed with the integration of western cultural elements, it persists as a characteristically Eskimo society.

The gradual introduction of western institutions allowed the Eskimos, who always maintained the numerical majority within their aboriginal setting, to accommodate change without destroying the fundamental nature of Eskimo culture. The northern region is remote and isolated with no stable market economy. Economic development throughout the historical period has been characteristically described in terms of boom-bust cycles. Periods of commercial whaling, gold rush, fur trapping, and military construction attracted non-Eskimos, but when the development activity declined, the temporary migrants left. Cultural contact occurred primarily between the Eskimo and a few non-Eskimos who remained with their western institutions. In the present period, the petroleum development in the Arctic Slope is generally restricted to enclave settlements. Direct contact between the petroleum workers and the permanent population is minimal.

Although jurisdiction over Alaska has been assumed by federal and state agencies, the Eskimos continue to enjoy relatively unrestrained access to their land and sea environments. The tenacity of Eskimo cultural survival has been attributed to their continued relationship with their environment and the persistence of family and community organization. The Eskimos participate to varying degrees in a monetary economy, but they remain heavily dependent and emotionally attached to their environment and its natural resources.

The following description of whaling activities is based on the North Slope Inupiat pattern (Worl, 1978a, b, c). The overall characteristics of this pattern apply to all Alaskan Eskimo whaling communities, but significant variations do occur. In particular, the Bering Strait–St Lawrence Island area cannot be described here because of limitations in data and the panel's lack of first-hand experience in that region. There is a clear need for current information on whaling in these communities as background for informed policy and regulation.

Whaling activities

While the spring whaling season may last six weeks and the fall season less than a month, activities associated with the whaling complex continue throughout the year. Primarily during the months of June and July, but also in October and November and occasionally through the winter, hunters seek bearded seal or walrus for skins to cover the *umiaq*. The skins are prepared in a specialized process and stored for later use. In early March or April, the women sew the skins together with caribou sinew. The skins are then tied to the *umiaq* frame and left outside to freeze.

Many other tasks are completed before whaling actually begins. Following strict customs, the men construct, expand, renovate and clean ice cellars dug into the permafrost. During March, the crews construct or repair and meticulously clean all whaling equipment. In the northern communities, crew members also survey the ice pack to map out and construct trails to selected camp areas. Wedging out a trail through several miles of sea ice is arduous, and expert knowledge of the sea-ice environment is imperative. The captain must check the surface of the ice for cracks and flaws to ensure the safety of his crew. If dangerous changes occur in the ice, the crew must move their camps. The Eskimo whaler must be able to understand and predict the movement of the sea ice, which is affected by both wind and sea currents.

In setting up camps, crew members are assigned different tasks. Lookouts are posted, and many tedious hours are spent patiently watching for the bowhead whale. When whales are not running, the whalers may hunt seal or waterfowl. In some camps, the captain may also lecture on the sharing policies. He diagrams the whale in the snow and outlines the vital areas where the whale can be wounded. The captain may drill the crew on proper procedure for steering and throwing floats after striking a whale. He may also discuss the importance of observing currents and bubbles generated by the whale to determine its movements.

Once a whale is struck, word spreads quickly through the camps and the community. Several crews rush to assist the successful whalers in towing the whale to the ice or beach. In some communities, a crew member is dispatched to the village to raise the captain's flag over his house. Offices, schools, and homes empty as people rush to assist the crews in pulling the whale onto the ice or the shore, butchering it and transporting the meat and *maktak* to the community. All who assist are given fresh *maktak*.

Rules for sectioning the whale and patterns for sharing and distributing the whale vary from community to community, but they are well defined and strictly followed. Sharing begins with an initial distribution on the ice and a series of traditional feasts throughout the year, including the captains' feast in June (*nalukataq*) and at Thanksgiving and Christmas.

After each successful whaling season, the community joins together for a celebration, *nalukataq*, that lasts for several days. Perhaps the most important ceremonial occasion observed by the north Alaskan Eskimos, *nalukataq* brings together people from all surrounding communities for a formalized thanksgiving that includes feasts of traditional dishes (especially the most valued parts of the whale), Eskimo dances, and the famous blanket toss. This celebration is a powerful reaffirmation of Eskimo values and identity. Perhaps more than any single event, it epitomizes the continuity of customary patterns into the modern era.

Another traditional observance, the Slush Ice Feast, is also retained in at least two north Alaskan villages. This feast involves a formalized distribution of *maktak* taken from the small of the bowhead (just before the flukes), contributed by a captain who has taken at least one whale. This fall ceremonial is practiced at Point Hope and according to reports, has been recently revived at Wainwright (Worl, 1978: p. 24).

Social relationships

The local family is the basic unit of production from which the whaling crew is drawn. However, membership in any one crew is not rigidly defined and a member of a local family may switch from one crew to another.

The optimum number of crews for equitable distribution of one whale appears to be eight. Analysis of Point Hope's butchering and sharing indicate that the first through seventh crews receive the prime cuts. The eight and ninth crew to assist have the least favorable portion of the whale. Relationships between the crews are formalized through the captain's voluntary organizations.

The village and family groups also function as socioeconomic units. Whaling, governed by patterns of cooperation and an elaborate, structured system of sharing and distribution, integrates the community as a functional unit. The sharing and distribution of the whale to other communities and families strengthens ties with those distant communities and families.

The total labor force actively and continuously engaged in the spring whaling season in only three of the northern communities can involve more than 500 people. Each crew usually requires eight men who man the *umiaq*, one or more women who run the camp, young boys who begin apprenticeship at age 9–10, older women who prepare and sew the skins for the *umiaq*, and at least 60 people who pull the whale up onto the ice or beach and butcher it. This number may be even greater since as many as 20 men may be considered members of one crew, but only participate periodically during the season. Usually the entire community assists when a whale is taken.

Economics

The interdependence of the monetary system and the subsistence economy is exemplified in the whaling complex. While the aboriginal system was independent of the market economy, the contemporary whaling system depends on cash income for purchasing equipment. The present Eskimo economy has been described as 'dual' or 'mixed'. Analytically, the economic systems can be held distinct, but in the Eskimo experience, the two economic systems are closely interrelated.

The whaling complex involves the cooperative interaction of three groups: (1) subsistence harvesters, those who actively engage in subsistence activities throughout the year to support the whaling enterprise; (2) subsistence recipients, those specified persons, such as the elderly, who receive goods through various sharing mechanisms; and (3) financial sponsors, those who donate cash or supplies to the whaling venture. Individuals often combine the functions of these roles, or in some cases alternate roles.

The initial investment in the whaling enterprise may range to well over $10,000. The following list shows the necessary major equipment, supplies, and services and their estimated costs in 1978:

	$
umiaq	600.00
bearded seal/walrus skins $50 × 6	300.00
skin sewing for *umiaq*	300.00
shoulder gun @ 2 each	650.00
darting gun	350.00
bombs (shoulder gun, 10 @ $32 each; darting gun 10 @$27.50 each)	595.00
harpoon	50.00
block and tackle	1,000.00
skin (or plastic) floats (2 @ $58.00 each)	116.00
rope, 25 fathoms	150.00
outboard motor, 25 h.p.	960.00
snow machine	2,000.00
sled	250.00
tent frame	200.00
camp equipment	200.00
gas, food, cigarettes	1,500.00
feasts	1,000.00
citizen band radio	140.00
	$10,361.00

The above list includes the minimum equipment and costs. Usually two to three sleds and snow machines, and two guns and harpoons per crew are required. Costs vary between villages, and skin sewing for the *umiaq* may range up to $550.00. Specialized clothing, such as the white parkas and fur-lined boots and parkas, are also essential in the Arctic climate. Whaling captains who catch whales must sponsor a series of feasts. The major pieces of whaling equipment are usually inherited, but the *umiaq* skins, skin sewing, bombs, gas, food, and cigarettes are annual recurring costs. In some villages, crew members are paid a $25.00 retainer fee for the whaling season just as they were paid in the past with skins or other subsistence goods.

Cash to support whaling is derived through a variety of patterns. The whaler may alternate between subsistence activities and wage jobs. The captain or crew members may receive financial support from relatives, spouse, in-laws, or hunting partners. A common pattern is for the wife to seek employment or sell her handicrafts while the husband devotes the greater part of this time to subsistence activities. Another pattern is to have one member of the family do wage work while another hunts. Family members often alternate between these two occupations. This plural economic adaption is exceedingly important because its flexibility allows people to engage in a variety of occupational pursuits as they see fit, and as fits their limited occupational environment.

The whaling complex also generates limited cash income. The primary income is obtained from the sale of arts and craft products made from whale bone, baleen, and the *bulla tympanica*. However, this is not extensive since there are only a limited number who carve or etch the bone, or weave the baleen. The amount any one individual can obtain is limited by the share he receives. The baleen is divided among the crews according to prescribed rules of the community. If all the whale bone and baleen were used for arts and craft products, a single whale could bring up to several thousand dollars. However, community members never receive this amount, and what they do receive is not realized immediately because the whale bone is usable only after it is cleaned. The natural process of cleaning whale bone takes several years.

Political institutions

Many researchers (for example, Spencer, 1959) refer to the traditional institutions that helped to establish and maintain the internal cooperation and external independence of Eskimo societies. Several traditional forms persist into the contemporary period, for example, the whaling captains' associations and the *qargi* (men's meeting house).

In Barrow, the Association of Whaling Captains is a modern version of a traditional organization which evolved from the aboriginal *qargi*. In Point Hope, two of the six original *qargi*, Qagmaqtuuq and Unnasiqsiqaaq, remain. Membership in the *qargi* is composed of interrelated kin. The centralized organizations are the governing bodies that review old regulations and adopt new rules as necessary relating to the harvest and distribution of the whale. The captains discuss any problems from the previous season and distribute a list of each captain's property marks placed on whaling equipment to identify the owner of a landed whale.

The whaling captains, who are recognized as the traditional political elite, are respected throughout the community.

Conclusion

The bowhead whale complex is the foundation of Eskimo culture and society. The cooperative hunting activities throughout the year and the communal patterns of sharing the whale integrates the society as a cohesive unit. Continued limitations on hunting of the bowhead whale, together with severe restrictions on other subsistence activities, such as caribou hunting, threaten the survival of Eskimo culture and the organization of their society.

There is an extensive and growing literature indicating that the most rapidly modernizing Eskimo societies are subject to an increasing measure of social and psychological stress at both the individual and community level. Such social and cultural dislocations are believed to underlie the increasing violence, drug and alcohol dependence, family breakdown, and frighteningly high suicide rates (for example, Lantis, 1968; Chance, 1968; Schaefer and Metayer, 1976). Alaskan Eskimos (and indeed Eskimos elsewhere—see, for example, Brody, 1975) still regard life in the smaller native communities, allowing access to land-based resources, as the most rewarding life-style. In these circumstances, hunting of the most highly valued animals is held to be basic to this preferred mode of living. Indeed, the continued appropriate acquisition and consumption of these resources

constitutes the most meaningful and socially sustaining celebration of life in north Alaskan Eskimo communities.

The significance of whaling in Eskimo culture

Cultural continuity

The Eskimos are by tradition the most hunting-oriented of all human groups, because their environment provides very few non-animal resources. Throughout their 4,000–5,000 year existence, they have sustained themselves by harvesting the wild resources of the land and sea, following a lifeway that entails the most direct interactions between hunter and environment. It is difficult for outsiders to comprehend the intimacy of these interactions because their relationship to the natural world is so different. The Eskimos' language, folklore, world view, ethics, education, and epistemology have all grown directly from the land, sea, atmosphere, and animals that surround them. Thus, Eskimo culture is a manifestation in human terms of the environment that has been its sustaining foundation.

Despite an era of change which has strongly affected Arctic peoples, frame houses, store-bought foods, and part-time employment have not altered the fundamental premises on which Eskimo culture is based. The people are still very much a part of their environment; they still view themselves as hunters above all else and they still find ultimate meaning of life close to the land. Derived from this background, Eskimo values emphasize hunting as the highest form of human achievement. Individuals tend to equate participation in the hunt with their validity as men and as *Inupiat* ('real people'). The measure of a man is often predicted on his success or skill in subsistence pursuits, and for women a similar measure derives in part from abilities in working with the products of these pursuits.

It is true that north Alaskan Eskimo life still focuses on the land and the hunt, and it is equally true that the pivot point of this life is whaling. Nothing dominates the ethos and orientation of these people like whaling. It is the greatest source of prestige for men, the coming-of-age activity for boys, the matrix for a broad network of social and economic interrelationships that help to unite the villages and define regions, and the culmination of a highly evolved body of hunting knowledge and skills.

While western peoples have learned to harvest whales through large-scale technology, Eskimos have based their whaling on the progressive refinement of knowledge. Probably no species of whale is as well known by a human group as the bowhead whale is known by the Eskimos. Each expert hunter spends a lifetime studying whales, combines his experience with the transmitted knowledge of preceding generations, and passes it on to the younger men who join whaling crews each spring. Young Eskimos aspire to become proficient whalers in the tradition of their elders, at least as much today as 10 or 15 years ago. Thus, we can anticipate that the tradition and its supporting value system will continue as a central element of north Alaskan Eskimo life into the foreseeable future.

In large measure, this continuity of interest in whaling derives from two elements in north Alaskan Eskimo culture. First, whaling is fundamental to the entire social and cultural fabric of the communities in which it is practiced. Second, there is the powerful concern for food, which a whale provides not only in the greatest quantity, but also in the most esteemed quality.

Personal identity and social integration

Many north Alaskan Eskimos consider themselves 'whaler men' above anything else. Whaling is a prime source of their identity, symbolic of their status as hunters in a society where hunting is the supreme concern. Leadership in these communities derives in large measure from the *umailiq*, the whale boat owners and crew captains. Each whaling village has a small number of these leaders, who achieve their position through success in the hunt and a demonstrated ability to make intelligent decisions in all aspects of their lives. But if he is not a successful whale boat captain, a man cannot be an *umailiq*.

Thus, political leadership and prestige in these communities is bound to the annual whale hunt. Further, the network of social relationships and interdependencies centers in no small measure on the complex of whaling activities. Each year for several months the entire community devotes its collective efforts to the single goal of hunting whales, distributing the catch, and conducting the required ceremonial activities. The entire social system is arranged into the cooperative segments of crews and those who support them. It is nearly impossible for anyone to avoid involvement at some level, if indeed a person was not inclined to participate.

Whaling therefore serves an important integrative function both within the communities where it takes place, and between these and other communities. This integration is especially significant during the present period of culture change, when generations are divided and continuity is threatened. Each year the adults and the young join together for this single purpose, working in close, prolonged contact, carrying out the most important activity derived from their traditional lifeway. Here, above all else, knowledge, values, and perspectives derived from Eskimo culture are transmitted from one generation to the next. Whaling has become a matrix for cultural survival.

Recent shifts in acculturative trends have influenced this pattern. Until about 10 years ago, young Eskimos were taken from their home villages to high schools located in distant parts of Alaska or outside the state. This absence from home during a critical period of life, coupled with a declining interest in transmitting cultural traditions led to lack of interest in subsistence pursuits among the younger age groups.

But in the past 10 years this trend has been reversed. Local high schools have been established so that children can remain in their villages. Similar to concerns among native North Americans elsewhere, interest in native traditions has grown dramatically. As a result, far more young people are now participating in subsistence activities. This pattern is most strongly manifested in the whale hunt, which attracts large numbers of young apprentices. Thus, more knowledge of the traditional whaling complex is being passed along than of any other ongoing customary practice.

In the midst of this general 'revitalization' of Eskimo culture, outside pressure upon subsistence in general and whaling in particular has grown. This combination of a growing interest and an outside threat to the focus of that interest has almost certainly intensified the commitment to the tradition of whale hunting in north Alaska. In effect, whaling has become a symbol of the Eskimos' desire to perpetuate key elements of their lifeway.

Whaling integrates contemporary Eskimo society in other very important ways as well. If one or more whales are taken, an elaborate system comes into play for distributing the meat, *maktak*, and other rewards of the harvest. Specific rules, which vary from one community to another, govern the division and subsequent sharing of each whale. In the end, the products of the hunt are distributed throughout the community so that everyone benefits from the success of a few. In this way, mutual interdependence and cooperation are strongly reinforced within the society. At the same time, those individuals whose skill and persistence resulted in taking the whale are rewarded with the highest prestige that can be achieved in Eskimo society.

The tradition of Eskimo whaling in Arctic Alaska is thus far more than an important economic activity, though it is surely that as well. Whaling is a focal point of Eskimo culture in which values are expressed and actualized, individual achievement is fulfilled, and social integration is manifested to its highest degree. This perspective should facilitate non-natives' understanding of the deep commitment that north Alaskan Eskimos have demonstrated for perpetuating this activity.

Cultural aspects of native diet

Modern village economies in north Alaska are based on a mix of indigenous and imported resources. The ratios of each vary considerably from one community to another, from year to year, and from season to season. Even within specific communities there is wide variation among families, ranging from strict traditionalists to those with a more progressive orientation. However, one generalization does apply with fair universality: resources from the land and sea continue to be regarded as the economic and cultural mainstay, and imported foods are considered to be far less significant.

Regardless of the proportions of native and imported foods, the north Alaskan Eskimos place an extremely high cultural value on their customary diet. Most people express a conviction that meals are incomplete without native food, and emphasize that they cannot remain strong, healthy, and satisfied when they rely on imported foods. Lack of subsistence foods is perceived as one of the greatest hardships encountered in living away from the village. To compensate, Eskimos usually attempt to carry a supply with them when they travel outside their home region. Their high regard for native food is reflected in the term used to designate it—*niqipiaq*—which means real or genuine food.

The most common elements of the diet, especially whale and caribou, are valued far above all others. These staples are not only considered the easiest foods to live with, but are also the most difficult to live without. The Eskimo diet is quite narrowly circumscribed (from an outsider's perspective) and it differs greatly from that familiar to non-Eskimos. Some of the most esteemed and regularly eaten foods, such as raw meat and fermented sea mammal oil, are not usually considered edible by outsiders. These choices do not reflect indiscriminate eating habits, however, for in fact the Eskimos have very specific taste preferences and follow rather elaborate traditional recipes in preparing various foods. In many ways, their consciousness is pervaded by a concern for food, and important cultural themes center around obtaining those foods which are most valued, sharing them among fellow villagers, and providing the most esteemed native dishes for guests.

There is almost universal agreement among Alaskan Eskimos that one cannot live on 'white man food' alone. Such a feeling may be difficult for an outsider to understand, since this latter diet is completely satisfying to a person raised with it. But it becomes comprehensible when the situation is reversed and the outsider is restricted to an exclusive diet of Eskimo foods. Then no amount of eating will satisfy an endless craving, whether that craving is physiologically or psychologically derived. Regardless of nutritional considerations, the Eskimos' sense of health and well-being is closely tied to traditional elements in their diet.

In a society which focuses its attention so closely on food, the most valued delicacy of all comes from the bowhead whale. The delicacy is *maktak*, whale skin with a layer of blubber attached. It is eaten both raw and cooked, and each whale provides it in very large quantity. For the whaling villages, a year without *maktak* is a year without the full measure of life. And the collective definition of success in these communities depends in no small way on its having fresh *maktak*, sour meat, flipper, and the other esteemed whale foods. Whaling is therefore not only the most highly regarded form of hunting, it is the source of foods that are defined as essential within their cultural context.

Recent changes in Eskimo whaling activity

The level of whaling activity in North Slope villages has increased significantly over the past 10–15 years. This increase has occurred in two ways. First, whaling has been reinstated by three communities where it formerly took place but had lapsed for a period of time. And second, the number of crews participating in the hunt has grown in communities with a continuous history of whaling.

Several identifiable causes for this increase are the following.

(1) *Economic factors.* Growth in the number of whaling crews coincided with a period of economic expansion on the North Slope, suggesting that increased access to cash allowed more individuals to finance whaling crews. However, there were two previous periods of quite dramatic growth in access to cash income (the fur trade era and the period of DEW-line construction) when no significant increase in the number of whaling crews occurred (supportive unpublished data from Bockstoce). Thus, while economic factors may be involved, other non-economic factors appear to be of equal or greater significance.

(2) *Ecological factors.* Over the past 10 years, a major decline in the western Arctic caribou herd has forced Eskimo hunters to focus more attention on other resources. The increased effort to take whales is almost certainly related in part to this change in the natural environment.

As others have often reported, the Eskimos are convinced that bowhead whales have increased over the past 15 years. Thus, in their view, expansion of the whaling effort relates to improving chances for success in the hunt. Certainly the numbers of whales taken by most or all villages has increased. The hunters perceive this increase as supporting their belief that the resource is growing, although they have recently supported the need for some restriction on the harvest.

(3) *Identity factors.* We have mentioned elsewhere that increased interest in whaling is related to a revitalized concern for native traditions over the past 15 years. This revitalization has affected the younger people most strongly, and has focused on the importance of subsistence activities as a way of expressing commitment to a particular and meaningful cultural identity. Among the north Alaskan Eskimos, whaling in particular has been the focus of this cultural movement. In addition, events perceived as threats to continued whaling have probably intensified the movement's strength.

(4) *Changes in whaling custom.* Recent changes in practices that make whaling more comfortable have probably increased the attraction of whaling for younger people. For example, traditional practices that led to isolation and physical hardship have been relaxed. Frequent snow machine trips to the villages are now possible, whereas in the past they were discouraged by custom and by the slowness of dog team travel.

At the same time, however, this less intensive approach to whaling has probably diminished its overall effectiveness. Whales are perhaps more likely to pass in the leads without being detected or successfully pursued, because crew discipline and attentiveness have relaxed. This pattern varies between communities, however, because some are more strict and traditional than others.

(5) *Migration.* The re-establishment of whaling in at least two communities (Nuiqsut and Kaktovik) was influenced strongly or caused entirely by the in-migration of whalers from Barrow. Of course, the other factors listed above may have been involved as well.

(6) *Regulatory factors.* Increased whaling activities and whale harvests have resulted in another change—the introduction of a regulatory structure from outside the whaling communities. While this change was not achieved without some difficulties, it was eventually implemented successfully. It is worth noting here that Eskimo whale hunters have complied completely with the regulations and quotas established by the U.S. Federal Government. They have voluntarily reported all strikes of whales, including those subsequently lost. And they have fully utilized all whales taken, without permitting any usable parts to be wasted (this information from the 1978 Special Report to the International Whaling Commission).

This successful establishment of a regulatory structure ensures that the number of whales removed from the population is not governed by the number of whaling crews. Therefore, growth in the whaling effort need not result in an increased harvest. And with more crews participating in the hunt, the struck and lost figure should be reduced. The result is an increased efficiency without (in the presence of regulation) an increased removal of animals.

Cultural change

All cultures change and have done so throughout the course of human history. Indeed, we might say that every human being who has ever lived has witnessed and been part of the dynamic process of cultural change during his or her own lifetime. Change in itself is not a threatening process.

Two aspects of change are important: first, how members of a changing society perceive the circumstances surrounding a change, and second, how antecedent circumstances may affect the adaptive competence of the changing society. Maintaining the integrity of the social and cultural system is crucial, for the continuing ability of the group to cope with inevitable future changes will depend on this system.

When faced with change, a social group is generally concerned about the long-term perpetuation of their culture as they define it, and, at a more proximate level, with maintaining or increasing individual collective wellbeing of the group members.

Thus, the introduction of a new technology, a new religious code, or new economic modes need not cause stress to a social or cultural system, if the adoption of the new behaviors and ideas can be rationalized to conform with existing behavioral and belief systems or to offer the promise of increased future well-being.

The Alaskan case

To make these general statements more specific, we can ask why the introduction of the rifle to north Alaskan native society did not disrupt and weaken that society and culture, despite the profound changes it caused. These changes included, for example, encouraging greatly individualized hunting practices, causing new dependencies and a concomitant lack of self-sufficiency, and losing a whole battery of technological skills associated with stone tools. Yet despite these widespread and profound changes, the culture remained undeniably Eskimo. The reason, quite simply, is that a culture is not defined by a catalogue of traits such that fewer 'traditional' traits means a significant loss of the essence of what that culture really is. The essentials of 'Eskimoness', for example, are defined and continually redefined by the members of that group, and their perceptions are changing in response to continuous environmental change. No one would suggest that the early twentieth-century American farmer, who replaced his horses with a tractor, or substituted electric lamps for oil lamps became any less American for making the change. The same is true whether or not the innovations were American, European, or Japanese in origin.

Furthermore, we must remember that cultures are dynamic systems allowing the members of the group to reassign meaning and value from one behavior to another so as to preserve the functional nature of the total cultural-social system. Thus, the way people hunted following the introduction of rifles was different from earlier times, but hunting as a vitally important institution did not thereby lose its significance. The values that underlie hunting and the associated institutions that depend upon the continuance of hunting provide the cultural and social matrix within which hunting derives its value, its centrality, and its longevity in Eskimo society. The core values of the society that underlie and in turn are sustained by hunting give meaning and vitality to a whole array of interdependent social institutions, such as sharing and cooperative association. These social institutions clearly sustain the sense of community and hence the adaptive capability of the local population. For these reasons, new ways of hunting following on the introduction of rifles have not compromised the 'Eskimoness' of the changing society; the culture is not embarrassed because compensatory shifts in value weightings accommodate the new reality. For example, a greater stress on sharing the products of the hunt, or on a rise in the social value of collective activities in the

non-hunting spheres of life, may have compensated for more individualized hunting following introduction of the rifle.

Problems associated with cultural change

It would be wrong to assume that all behavior is functional, that all changes which must occur can be absorbed without ill effect or social stress. What is suggested is the fact that local groups do have ways of handling change. Their continued presence attests to the effectiveness of these methods. But the manner in which the change presents itself has a considerable influence upon the nature of the outcome.

In the case of the rifle, we can assume that nothing greater than social pressure from members of an individual's own society or an individual's sense of 'self advancement' prompted the initial adoption of the new technology. Thus, an underlying cardinal value of this society—namely the continued exercise of individual autonomy—was not threatened by this innovative behavior. The greater yield of food produced did not unbalance the economic system, for this system emphasizes the *distribution*, rather than the mere accumulation, of surplus. Finally, we must stress the voluntaristic rather than coercive nature of the adoptive process: the individual elects to make a change, it is not required or imposed involuntarily. This idea is certainly more relevant to the eventual social outcome than the fact that the innovation was the product of a foreign culture.

Recapitulation

(1) Cultures are dynamic and change continually;
(2) Despite continued change, the members of a cultural group usually have little difficulty in identifying with their culture in its evolving form;
(3) Loss or substitution of cultural elements does not necessarily lessen the viability of a given culture, providing the 'core elements' (as defined by the members of the group) remain substantially as the group requires them be;
(4) The members of the cultural group ordinarily employ substitution (shift of values from one element to another) as a means of ensuring cultural continuity in the face of inevitable change;
(5) The manner in which change is introduced can seriously affect the ability of the group to respond appropriately; and
(6) The most threatening situation occurs when an introduced change profoundly affects a number of social institutions and values that the society holds to be 'core elements' of their culture.

POLICY ISSUES

We wish to emphasize our earlier observation that human inventiveness frequently results in highly unpredictable behavioral responses to environmental change. Nevertheless, our knowledge and experience in relation to the specific problem we are addressing here does allow us to make some policy-relevant observations.

Alternatives to bowhead whaling

It is very difficult to predict accurately the economic, cultural, and psychological impact if the Eskimos' access to bowhead whales should be severely curtailed. We have demonstrated throughout this report that whaling is a fundamental element of north Alaskan Eskimo culture, and thus the effects of such a change would be very significant indeed. We will not attempt to analyze probable long or short range impacts of a curtailed harvest, but will deal specifically with the idea that economic or cultural replacements for bowhead whale hunting may exist.

At the present time, bowhead whales occupy a position of great importance in the economies of northern whaling communities. This position results in part from the decline of caribou populations over the past 5 to 10 years. Whaling activities have almost certainly increased as a compensatory response (other activities, notably fishing, have also increased). Factors such as greater access to cash income and revitalization of interest in traditional culture have further contributed to growing emphasis on whaling.

In view of this economic reality, severe reduction of whale hunting would have serious consequences for the village people. From a purely nutritional standpoint, villagers would not have difficulty surviving. Certainly, they would turn to greater use of imported foods, with some nutritional loss, but they would not starve. And within a strictly subsistence context, efforts to increase harvests of seals, walrus, or fish in the continued absence of abundant caribou could help compensate for the loss of whale products.

But it is equally important to understand that such alternative resources would not *replace* bowhead whales. Whales are much more than food for the north Alaskan Eskimos. From this perspective, nothing can compensate for the absence of bowhead whale meat, *maktak*, and other whale products; and certainly no activity can replace whaling as a focal subsistence tradition among these Eskimos.

In the Eskimo ranking of food preferences, bowhead whales stand above all other resources. Only caribou meat is at all comparable, and it should be considered a parallel resource, not a potential replacement. Seals and walrus rank very low as possible staple foods; never in recent times have they filled more than a subsidiary role in the diet. Beluga is highly valued as food, but can be obtained only in small quantities. Gray whale is similarly limited in availability, because this species arrives too late for effective hunting and is considered quite dangerous. In addition, the gray whale is not preferred food. From the Eskimos' perspective, therefore, bowhead whale products (especially the *maktak*) are not qualitatively replaceable.

Because whales provide more food, we conclude that whaling activities themselves cannot be replaced. A simple discussion of whales as food would miss the fundamental fact that whaling is a pivotal element in north Alaskan Eskimo culture. Earlier sections have emphasized the involvement of total communities in whaling, the social and psychological rewards dependent upon this activity, and the integrative functions that whaling serves in the contemporary Eskimo communities.

Should the complex of whaling activities be removed from these communities, their fundamental structure and value system would be altered dramatically. The impact would be intensified by the present situation in which whale hunting is a symbolic medium for expressing collective identity in the face of change. Whaling, more

than any other activity, fundamentally underlies the total lifeway of these communities, and so its loss would have very serious consequences.

In this context, we should also understand the difference between failure of a whale hunt and elimination of the hunt altogether. Failure to take any whales has occurred numerous times in the past, but in these cases the entire whale hunt and its associated activities were still carried out (except for the *nalukataq* feast). Although the ultimate goal was not fulfilled and the people experienced a sense of loss, they nevertheless realized the cultural and social benefits of undertaking the hunt; very importantly, they were able to affirm, in this modern world, their fundamental and distinctive identity as Eskimos. North Alaskan Eskimos of all ages place extremely heavy emphasis on ethnic identity, and have apparently done so since the early contact period. If no hunt takes place at all, the community experiences not only the loss of a resource, but also the loss of their most important traditional activity and all that is associated with it. Therefore, carrying out a complete but unsuccessful bowhead whale hunt is not at all comparable to eliminating the hunt altogether. We feel that this difference is of considerable importance and that it should be given careful consideration.

Ecological considerations

The cultural panel wishes to comment from a social science perspective on matters of ecological concern that may be addressed by other panels.

Population

We recognize that the native societies in Alaska have increased in size greatly over the past few decades. Thus, even if the fertility of these populations drops over the next few years (which seems quite likely), in the absence of significant emigration from the region (which also seems likely), considerable population growth will continue until at least A.D. 2010. This inescapable demographic conclusion has led a number of observers to conclude that by now, or shortly hereafter, the 'carrying capacity' of the land has been or will be exceeded with disastrous effects upon major food species and the human population. Our working group rejects these projected outcomes as inexorable and inevitable conclusions, and seriously questions the appropriateness of applying the concept of carrying capacity to many human ecological problems.

Carrying capacity

The utility of this concept, widely used in various renewable resource management schemes, has been seriously questioned in respect to human ecological problems (for example, see Street, 1969; Vayda and McCay, 1965). Calculating carrying capacity requires that we know the metabolic demand of a given population, and that we also know the environmental productivity necessary to meet that demand. Our concern as social scientists relates only to the demand side of the equation, for we believe, in practical terms, that it is unknowable.

In a purely scientific sense one can perhaps calculate the nutritional and food energy demand of a given population. However, a great deal of variation exists based upon peoples' preference for certain types of food. In our own society, if we harvested dogs, cats, squirrels, and song birds, the 'carrying capacity' (in respect to calorific or even high quality protein content) of the environment would rise, but we do not consider these appropriate means of meeting our metabolic requirements. To the social scientist, 'wants' are quite different from 'needs'.

In the Arctic, people exercise choice, defining certain foods as acceptable. These preferences vary both from place to place, and from time to time in any one place. Thus, beluga meat might be relished in the western Canadian Eskimo communities and avoided as food in most eastern Canadian Eskimo communities, and the same polarity exist for bearded seal meat in northwestern Alaska compared with the eastern Canadian Arctic. Within a given community, some people will not eat polar bear, musk ox, seagulls, sculpins, polar cod, or any number of other foods that others at the same locality will find quite acceptable. Some individuals change their minds as they grow older, or as more preferred foods become more or less available.

There are two other complications that should be mentioned briefly. First, human beings harvest the energy/nutrient supplies of their environment by means of technology; thus, one can only compute a carry capacity in relation to a stated technology. For example, if the harvesting range of a hunter is x miles using a dog team in winter, it may be $4x$ miles using a skidoo one year later. But a change in occupation status may limit the time an individual can spend in travelling in connection with the hunt, so that he may not be able to realize the greater harvesting potential that the new technology provides. Further complication may be introduced by the negative impact of the new technology on the resource being harvested. For example, approaching a seal with a motor may be more difficult than with a dog team. Hunters and hunting equipment show great variation in hunting effectiveness (Freeman, 1969–70).

Second, the local 'need' for seals, for whales, for berries, or sea gull eggs cannot be equated with the need for energy, protein, vitamin C, iron, or whatever other nutritional elements these food items coincidentally contain.

Maktak provides more than nutritional and energy requirements, and what it provides can only be supplied by a particular type of whale. *Maktak* from the preferred species fulfills a large array of needs on which the society places great value. Acquisition, distribution, and consumption all have meaning, all have a cognized purpose, and all play their part in maintaining the overall system and hence the continued ability of the members of the society to fulfill themselves. How do we measure this demand on the environment? We have no available qualification, no calculus for cultural need, psychological well-being, social facilitation, or social cost. But to make matters even worse, this system is no more static than food preferences or the technological aspects of the problem. The cultural demand for scarce resources, potentially in 'limiting supply', continues to be met as the valued resource diminishes in absolute quantity. The highly structured division of the ringed seals in central Canadian Arctic winter camps (Dams, 1972) or the feasts where only part of a particular animal is ceremonially distributed and consumed (VanStone, 1962) provide examples. In such cases consumption of the product contributes far more than energy and nutrients to the

participants. Thus despite their importance, these values can only be expressed qualitatively and cannot be used in defining carrying capacity.

Diversity

We are concerned that simplistic analysis of the ecological problems faced by an expanding human population with a diminishing (or at least non-increasing) food supply might produce misleading conclusions. The main characteristic of man–land relationships among traditional hunting peoples appears to be the adoption of ecological strategies that allow the population to exercise consideration flexibility in meeting their needs, making selective choices about which resources to use and employing a wide range of techniques. Such subsistence strategies are clearly adaptive because they cushion the population against fluctuation in environmental production, they prevent socially disruptive competitive interactions and they enhance ecosystemic stability through structural diversity (e.g., see Freeman, 1971; and Table 1). The complexity of human adaptive response clearly defies simple analytic approaches developed for non-human ecological problems. We are very concerned about the negative consequences of simplifying social and economic institutions, for it appears that diversity is an important factor in the long-term adaptive success of human populations.

Eskimo involvement in management

Eskimo involvement in research and management is necessary for several reasons. First, documented research results are not available in many areas, and the Eskimos are often the possessors of exclusive knowledge. Because of physical distance and terrain, sea characteristics and climatic conditions, the availability of financial resources and facilities, and other factors affecting research in Alaska, both natural and social scientific data on bowhead whaling by Eskimos is difficult to collect. For centuries, the Eskimos have lived in the areas where the whaling is performed, and participated in the hunt, making them primary sources of research information relating to whale behavior, and the place of whaling in their contemporary culture and economy, and so on. This knowledge can best be realized if Eskimos are involved in research and data gathering. They should be included on panels of behavioral experts in ecology, demography, ethnology, culture history, archaeology, population growth and history, nutrition, hunting, material and intellectual culture, health, biology, economics, and linguistics. Eskimo expertise in the field of biology is often overlooked by wildlife managers, despite the large literature attesting to the importance and accuracy of this particular data source (for example, see Nelson, 1969, with respect to Alaskan Eskimo knowledge of sea-ice environment and marine mammal behavior; Laughlin, 1961 and Anderson *et al.*, 1977 for information on native knowledge of anatomy).

Second, Eskimo participation in management greatly enhances the potential success of the management regime. Such participation helps assure that the management regime will be biologically and socially sound because it includes local knowledge, perceptions and preferences. Eskimos possess first-hand experience concerning the impact and consequences of management policies on Eskimo life and economy. Their participation also will increase the chance for acceptance and compliance by affected communities. As Kapel and Petersen pointed out in their report on subsistence hunting in Greenland prepared for the Seattle conference,[1]

> Game regulations passed by the local authorities seem to be regarded as relevant for the practising hunters, at least they seem to be more conscientiously obeyed than government notes and international agreement(s) at central authority level(s) (Kapel and Petersen, 1979: 43).

Finally, participation by Eskimos is a most efficient means of disseminating information concerning the management regime.

> A conscious attitude (towards) the need (for) game protection seems to be the best way (to avoid) violation of the game regulation, and so, game regulations at local authority level(s) offers an extra advantage, namely the public participation in the hunting policy (Kapel and Petersen, 1979: 43).

> Game regulation as principles seems to be better the more consciously these principles are known by (the) people, and in this connection game regulation on local authority level(s) seems to be the best solution in the long run (Kapel and Petersen, 1979: 43).

The need for Eskimo participation in all decision-making which affects them or their environments, and the

[1] The following quotations and page references refer to the original manuscript presented to the Meeting. A revised version of this paper is included in this volume.

Table 1

Aleutian exploitation of environmental resources (Laughlin and Harper, 1979)

Habitats keyed to population cohorts (Increasing mobility from top to bottom)								
Inland	Lakes and streams	Beach	Village	Reef	Bay	Offshore islands	Cliffs	Open sea
+	+	+	Old infirm females	+	+	–	–	–
–	+	+	Old infirm males	+	+	–	–	–
(+)	–	(+)	Pregnant women	(+)	(+)	–	–	–
+	+	+	Children	+	+	(+)	(+)	–
+	(+)	+	Young to middle-aged females	+	+	+	+	+
(+)	+	+	Young to middle-aged males	+	+	+	+	+

Beginning with the kinds of people, their use of habitats is indicated by a plus sign. Parentheses indicate qualified use or special limitations. This chart provides no indication of the different methods of using the same area nor the different resources procured. Thus, old men hand-line fish the bay from boats; old women fish from the shore. Men collect driftwood suitable for boat frame manufacture; women collect driftwood suitable only for fuel.

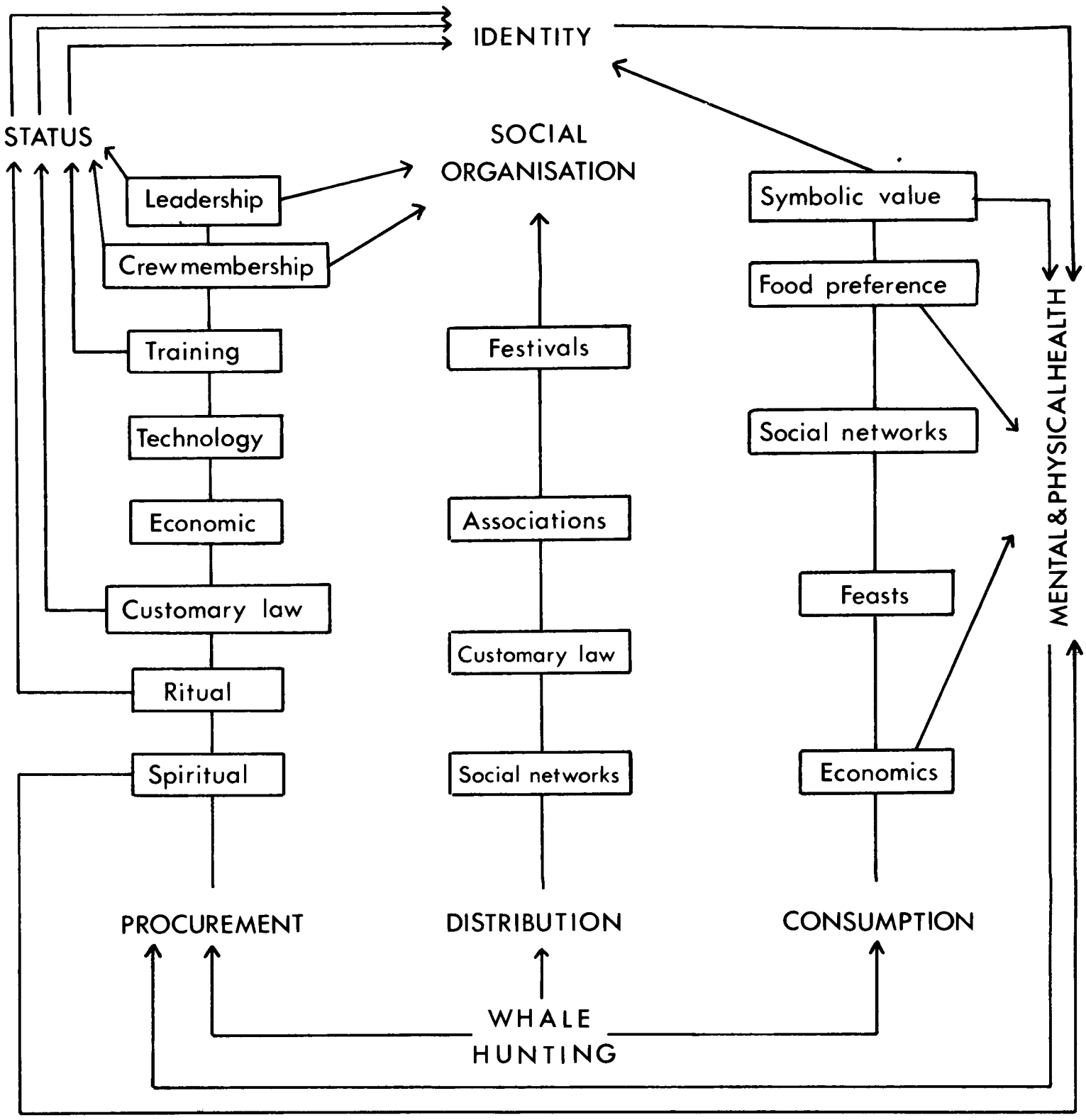

Figure 1. The basic importance of whale hunting in north Alaskan Society.

importance of natural resources, particularly whales, for subsistence is evident throughout the international Eskimo community. The Inuit Circumpolar Conference held in Barrow, Alaska in June 1977, resolved that there shall be prepared a charter including the following issues:

A. The safeguard and protection of the resources of the Inuit homeland;

B. The preservation, retention and further development of Inuit language and culture in all their aspects;

C. That the Inuit be adequately consulted and take part in any and all discussions affecting their homeland which may have potential significant impact;

D. The development of proper and adequate game management systems for their homeland; and

E. The development of a meaningful Arctic policy (Barrow Resolution 77-01).

As a result of the Inuit Circumpolar Conference in Barrow, several resolutions have been adopted. These resolutions are appended to our report (Appendix II).

Some concluding remarks

The information summarized in Figure 1 indicates very briefly the more important elements involved in the social-cultural system based upon whale hunting. We want to stress that other systemic interrelationships could be drawn to represent seal hunting, beluga hunting, caribou hunting, and so on. But in each case, the cultural loading would be less, for no species carries the social, symbolic, ritual, economic, or identity-contributing value comparable to the bowhead whale. Thus, hunting of beluga or seals, for example, involves a simplified technology, a less important place in the local economy, less identification with crew or voluntary associations, and no involvement with festival ceremonialism.

All these factors have an impact on an individual's sense of identity, for if the systemic integrity of an individual's society is weak, that individual feels less secure. The social pathology associated with such threatened native societies has been documented elsewhere, and the serious difficulties associated with personal and societal rehabilitation suggests the wisdom of

Table 2

Relative social and cultural significance of marine mammals in contemporary north Alaskan whaling communities

	Bowhead	Walrus	Ringed and bearded seals	Beluga
Economic	4	1	1	1
Law	5	3	3	4
Skill/knowledge/training	5	4	5	4
Technology	5	4	3	4
Ritual	5	3	2	1
Ceremonial	5	1	1	1
Spiritual	5	3	1	1
Crew membership	5	2	2	2
Associations	5	1	1	1
Festival	5	1	1	1
Social networks	5	3	2	2
Feasts	5	1	1	1
Symbolic	5	2	1	3
Food preference	5	2	1	3
Leadership	5	2	2	2
Scores	74	33	27	31

Scale

Weak (or not at all) 1 2 3 4 5 Strong

contribution to/involvement in each activity

thinking in terms of preventive action if such breakdowns seem likely to occur.

In this case, preventive action would include meaningful cooperative interaction with members of the whaling communities concerning future management actions. Not to institute such actions would be widely perceived in these whaling societies as a lack of concern for the whale, an inference that would certainly undermine the foundations of any society having such a cultural, psychological, social and health investment in this resource.

To emphasize the importance of bowhead whales in the north Alaskan Eskimo social and cultural systems, the various behavioral, institutional, and psychological traits identified as important in Figure 1 have been assigned a score on an arbitrary scale of one to five. Thus, Table 2 indicates the relative weighting of each of 15 categories with respect to bowhead whale hunting, walrus hunting, seal hunting, and beluga hunting.

We want to emphasize two points in regard to Table 2. First, panel members arrived at the scores through a consensus, but the scores are no more than the well-considered opinions of knowledgeable non-members of the society in question. Secondly, the scores reflect our best assessment of current situation; we want to stress that the data do not allow the generation of predictive statements.

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Appendix I

For the purposes of our panel discussion, subsistence use of whale products was defined as:

(1) The personal consumption of whale products for food, fuel, shelter, clothing, tools, or transportation by participants in the whale harvest.

(2) The barter, trade, or sharing of whale products in their harvested form with relatives of the participants in the harvest, with others in the local community or with persons in locations other than the local community with whom local residents share familial, social, cultural, or economic ties. A generalized currency is involved in this barter and trace, but the predominant portion of the products from each whale are ordinarily directly consumed or utilized in their harvested form within the local community.

(3) The making and selling of handicraft articles from whale products, when the whale is harvested for the purposes defined in (1) and (2) above.

Appendix II

RESOLUTIONS ADOPTED AT THE INUIT CIRCUMPOLAR CONFERENCE, BARROW, JUNE 1979

A Resolution calling upon the International Whaling Commission to defend Inuit rights to hunt the whale (Resolution 77-15)

WHEREAS, the Inuit have hunted the whale for thousands of years, and the relationship between the Inuit and the whale has become a necessary part of the Arctic ecological system, and

WHEREAS, there are those who do not understand the relationship between the Inuit and the whale, and are working to stop Inuit whaling as a means of preserving whale species being destroyed by commercial whaling, and

WHEREAS, whaling is a necessary part of Inuit cultural identity and social organization, and is in no way similar to commercial whaling;

NOW THEREFORE, BE IT RESOLVED that the delegates assembled at the first Inuit Circumpolar Conference call upon the United States and Canadian delegates to attend the forthcoming meeting of the International Whaling Commission in Australia to defend the Inuits' aboriginal right to hunt the whale in the Arctic.

A Resolution urging the wise and full use of subsistence resources (Resolution 77-16)

WHEREAS, game stocks upon which the Inuit depend for their physical and cultural survival are limited, and are under heavy pressure wherever Arctic natural resources are being developed; and

WHEREAS, these pressures will result in attempts to limit or eliminate subsistence hunting in the Arctic unless special care is taken, and

WHEREAS, it is traditional behavior for game biologists and other to justify hunting limitations by pointing to wasteful hunting practices through modern hunting equipment and transportation, and

WHEREAS, stories of waste of game and other poor hunting practices make the political defense of subsistence more difficult by reducing public confidence in the ability of the Inuit to manage fish and game;

NOW, THEREFORE, BE IT RESOLVED that the delegates assembled at the first ICC call upon Inuit to behave as hunters and in no way that will create scandal and endanger our subsistence hunting rights, and to conserve our game as we would conserve our homeland, and protect the future generations of our people.

A Resolution concerning environmental policy (Resolution 77-06)

WHEREAS, the regions of the Inuit homeland are made up of numerous fragile ecosystems and environments, and

WHEREAS, the nations within the circumpolar region presently lack adequate environmental policies and legislations to protect these regions, and

WHEREAS, the Inuit have not been permitted full participation in the various decision-making processes, both in private and public sectors, affecting these regions;

THEREFORE, BE IT RESOLVED that each nation in which the Inuit live is vigorously urged to adopt by convention a common set of rules with respect to offshore and onshore Arctic resource development, and that the Inuit community has right to participate in this rule-making;

BE IT FURTHER RESOLVED that the rules for Arctic resource development will specifically provide for an Inuit-controlled technology assessment program; and

BE IT FURTHER RESOLVED the rules of Arctic resource development will specifically provide for the determination of safe technology; Arctic population policy; and locally controlled wildlife management.

Two large bowhead whales captured by Alaskan Eskimos have been pulled up on the shorefast ice for flensing. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

Subsistence Hunting – the Greenland Case

F. O. Kapel[1] and R. Petersen[2]

INTRODUCTION

The taking of large baleen whales as well as smaller cetaceans has for centuries been part of the hunting pattern which was the basis for existence in Greenland. This hunting pattern also included exploitation of other marine organisms (primarily seals) and some terrestrial animals. It is therefore necessary to consider whale catching in Greenland in relation to the exploitation of other living resources.

Originally, all hunting was carried out by means of 'primitive' tools, although some of these were highly adapted to the various types of hunting and for using available raw materials (Fabricius, 1810; 1818; Holtved, 1962). As a result of the contact with foreign peoples, a modification of the original hunting methods took place during the eighteenth and nineteenth centuries, e.g. the introduction of firearms, but in general methods remained unchanged up to the beginning of this century. The development of a modern fishery in the southwestern part of Greenland during the most recent decades has had some influence in the hunting districts, but on the whole hunting has kept its character as a technically simple, locally orientated occupation.

Hunting in Greenland has always, with few exceptions, been carried out by the indigenous people who are primarily of Eskimoic – or Inuit – origin, although during a period of some hundreds of years a certain degree of mixing with European peoples has taken place. The presently used term for the indigenous people is 'Greenlanders' or (more recently re-introduced) 'Inuit'.

The purpose of the hunting was, of course, to provide the basis for existence. Because of seasonal and long-term fluctuations in the availability of the prey animals, it was necessary to have means of smoothing out the differences between periods of high and low hunting yields. This was partly done by a food conservation and storing system and partly by multispecies exploitation. It is important to stress that domestic hunting can normally be adapted to seasonal differences without expensive technological innovations, and that hunting in Greenland still does not support an industry, which would call for feasibility considerations and thereby may require increased hunting.

For the major part of the Greenlandic population, fishing is today more important than hunting, and the export of fishing products plays a different role in the economy to that of hunting products. Fishing needs a large degree of modernization and investment in industrial plants and efficient vessels. The feasibility demands of fish processing industries tend to create stable or even increasing exploitation of fish resources. The Greenlandic fishermen and the fish processing industries are sensitive to changes in market conditions outside Greenland, and are very much dependent on international agreements on quotas etc., but are also vulnerable to small changes in the environment. The protection of renewable resources is therefore an important objective for fisheries policy in Greenland.

Present-day hunting in Greenland is, of course, also influenced by technical innovation and economic considerations. Technical improvements and needs have ensured that a monetary income is now necessary even in the hunting districts. Another reason is that the previous system of mutual exchange of hunting products does not work in all cases; some households must pay in money, as they have no hunting products to give in return. Although hunting is also an important supplementary occupation in the fishing districts, there is a permanent demand for hunting products in these areas. Food products from the hunt are still valued highly in all parts of Greenland, and constitute an important contribution to nutritional requirements. There is practically no export of this type of hunting product from Greenland.

In order to evaluate the importance of present day hunting in Greenland, it is necessary to consider many factors, e.g. the status of living resources, occupational and demographical patterns, nutritional needs, social and economical conditions. The present paper intends to give some background information for discussion of these matters and of the concept of 'subsistence hunting'.

OCCUPATIONAL REGIONS

Historical review

Originally, hunting was the most common occupation in Greenland – the sole basis of survival. The relative importance of the various prey species varied with time and season and to some degree from locality to locality along the vast coastline. Similarly, habitation changed with variations in hunting conditions.

During the eighteenth and nineteenth centuries this nomadic way of life was gradually transformed into a more permanent system with a couple of hundred small settlements and a few larger ones, although seasonal movements still took place. A wide variety of prey species were utilized, mainly seals (especially ringed and harp seals) but also whales, sea birds, caribou and others, which were of seasonal or regional importance. This multispecies hunting pattern showed minor regional

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variations, but the general pattern was the same in all parts of Greenland, and was maintained until the beginning of the present century.

A change in this pattern appeared at the turn of the century and increasingly in the 1920s and 1930s. The seal hunt decreased drastically, especially in southwest Greenland, causing severe problems for the population in this part of the country. At the same time cod was found to occur in the Davis Strait in significant numbers, and these factors formed the background for an attempt to introduce a new pattern of occupation and trade. A transition to fishing was planned, and to a great extent carried out in southwest Greenland during the 1930s and 1940s, and evolved rapidly after 1950.

No similar developments took place in northwest and east Greenland, although some effect of the changes occurring in the southern part of the country could be traced also in these regions.

As a result, Greenland can at present be divided into several regions, which are rather different from each other in respect to current and potential occupational possibilities. A survey of these regions has previously been given in various publications (e.g. Kapel, 1975d) but is repeated below with special reference to the relative importance of whale hunting within each region.

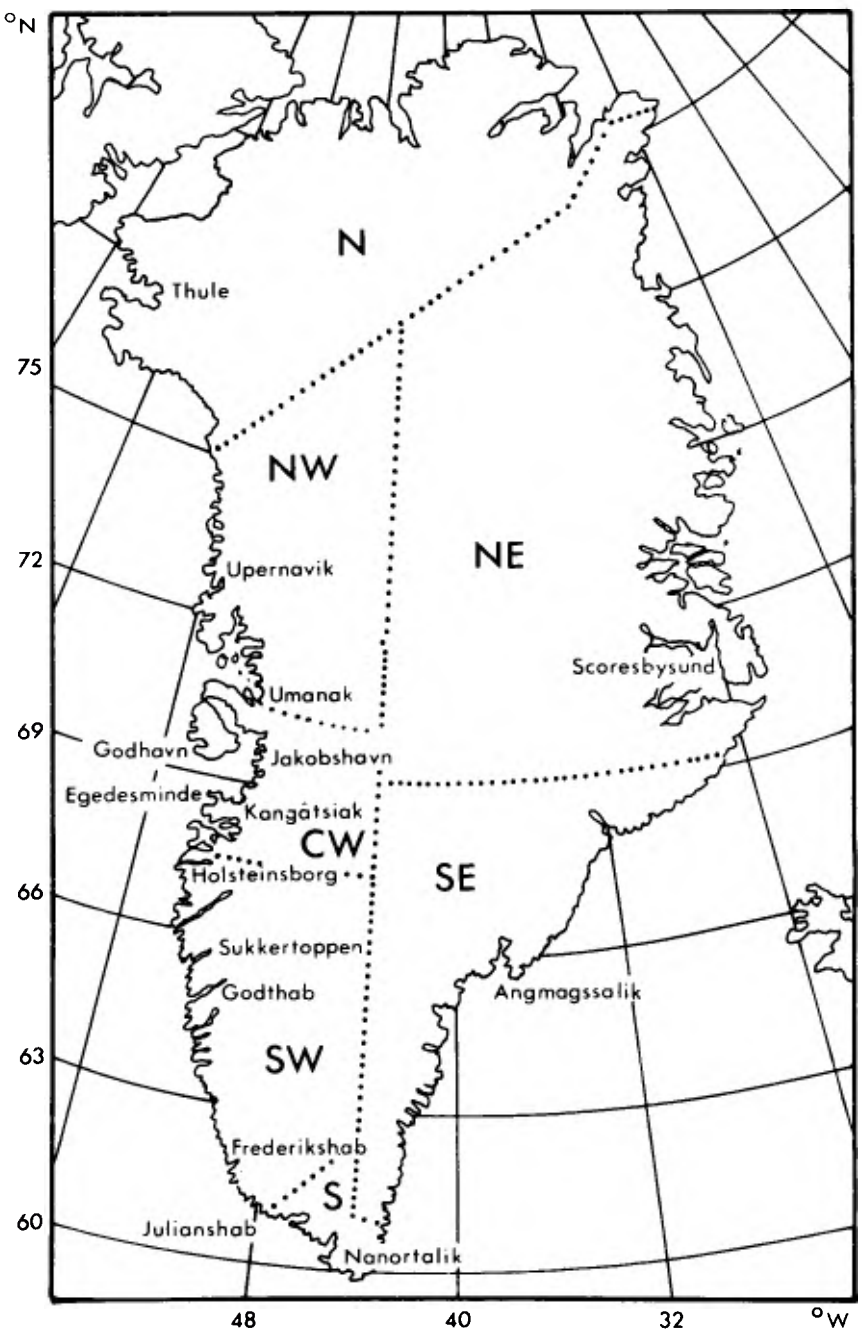

Fig. 1. Greenland, showing the main districts.

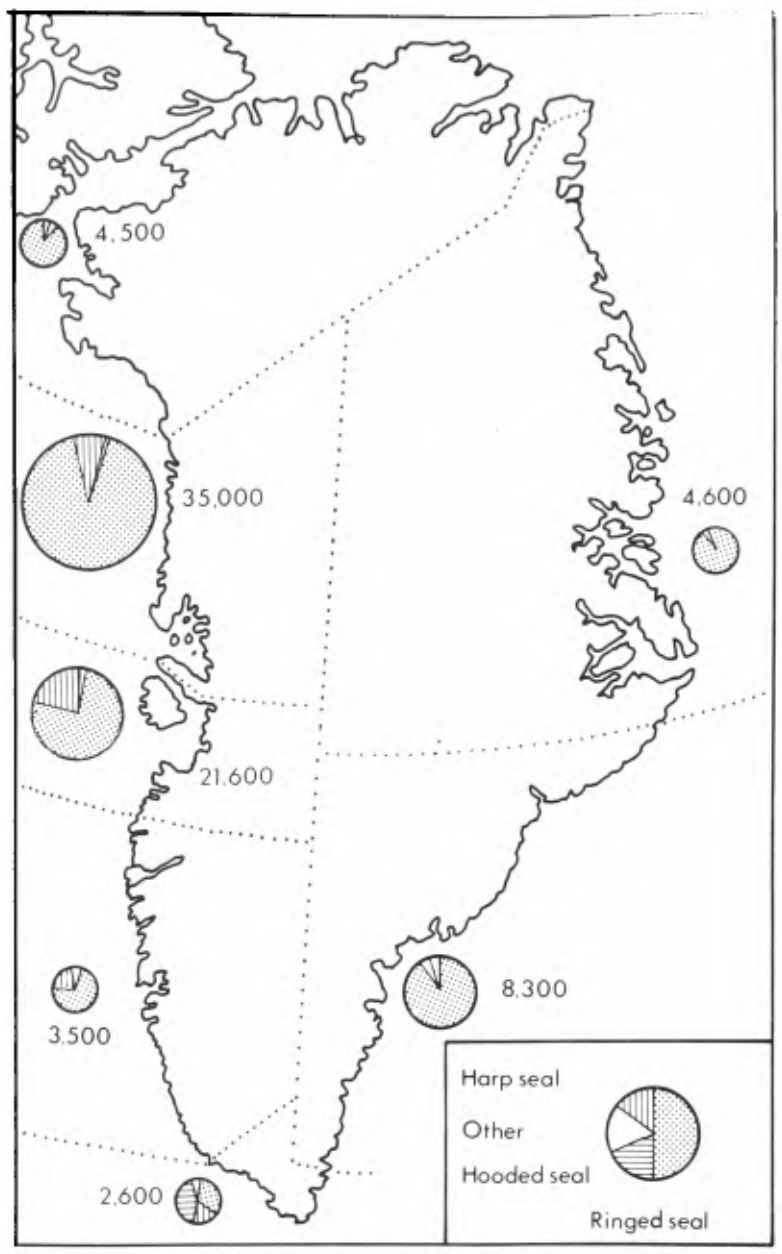

Fig. 2. Mean annual catch of seals in Greenland, 1964–66; total 80,000.

Present regions (Figs 1–2)

North Greenland (N; Thule district)

Hunting is the only basis for existence. The ringed seal is the most important species by number, but the bearded seal and walrus are also of great importance. Harp and hooded seals are only caught in small numbers. The catch of narwhals and to some degree also belugas is extremely important in the summer months. The polar bear is more important here than in any other part of Greenland. The catch of sea birds, and in particular the little auk, plays an important role locally, while the catch of the Arctic fox is often significant.

North East Greenland (NE; Scoresbysund district)

Hunting is the only basis for existence. The ringed seal is by far the most important species. The polar bear and muskox are of some importance, in addition to narwhals and belugas.

South East Greenland (SE; Angmagssalik district)

Hunting is the dominant occupation. The ringed seal is the most important species, but the hooded seal is also caught in significant numbers in the summer. In addition, some bearded seals, harp seals, polar bears, Arctic foxes, narwhals and belugas are caught. There is a small cod fishery at one settlement.

Plate 1. In Spring in northern Greenland, the hunting of ringed seals hauled out on the ice is very important, using a dog sledge and a white shooting shelter. Kuvdlorssuaq, Upernavik district, May 1976. (Photo, F. Larsen)

North West Greenland (NW; Upernavik and Umanak districts)

Hunting is the dominant occupation, in the town of Umanak and at some settlements supported by an increasing fishery, especially for Greenland halibut, wolf-fish (*Anarhichas*), and Greenland shark. The ringed seal is the most important species during winter and spring, whereas the harp and hooded seals are of importance in summer and autumn. The catch of belugas and narwhals plays a significant role in the autumn, less so in the spring. The minke whale is an important meat source during the summer, especially in the Umanak district, and the same is true of bird hunting, especially for the thick-billed murre and eiders.

Central West Greenland (CW; Disko Bay and adjacent areas)

Fishing, especially for deepwater prawn and Greenland halibut, is the most important occupation in the towns of this region, but hunting is an important supplement for the population of the towns, and is of basic importance for subsistence in the smaller settlements, especially in winter. Ringed and harp seals are the most important species, although hooded seals and walrus play a minor role. Belugas and narwhals are of great importance in winter and spring, particularly in years of 'savssat' (mass-occurrence in holes in the ice). The catch of minke whales and occasionally fin whales, is locally of great importance in the summer, when bird hunting is also an important supplement to the diet.

South West Greenland (SW; Holsteinsborg to Frederikshåb districts)

The most important occupation is fishing, especially for cod and deepwater prawn, but for other species as well. The fishery is carried out as a coastal fishery by rather small vessels, as well as an offshore trawler fishery on the banks of the Davis Strait. The catch of minke whales and occasionally of humpback and fin whales is a significant supplement to the nutrition of the local population. The catch of smaller cetaceans (harbour porpoise, beluga etc.) and seals (ringed, harp and hooded seal) plays a similar but less important role. Bird hunting contributes much to the local nutrition, especially in the autumn. Caribou hunting is very important in winter and late summer.

South Greenland (S; Narssaq, Julianehåb and Nanortalik districts)

In the end of the fiords, sheep farming is the important occupation for a scattered population. In the archipelago at the mouths of the fiord system, fishing is the dominant occupation, supplemented in the spring and early summer by a significant catch of seals, especially hooded seal. A small number of polar bears is regularly taken. Bird hunting is of local importance, catches of whales and smaller cetaceans occur sporadically.

To summarise, the living resources of the sea constitute the predominant basis for existence for the Greenlanders. In the true hunting districts (regions N, NE, SE and NW) the catch of marine mammals is still the only important occupation. At present about 20% of the population lives in these regions. In addition, hunting makes a considerable contribution to the nutritional requirements in the fishing districts (regions CW, SW and S). It is a valid statement, that between one fourth and one fifth of the Greenland population is totally dependent on hunting for bare subsistence, and that the products from the hunt play a very important nutritional role for the remainder.

LIVING RESOURCES AND THE LEVEL OF EXPLOITATION

For some of the living resources, a fair amount of knowledge has been gathered and presented on their past and present occurrence in Greenland, while for others very little is known with respect to their occurrence and the status of the stocks in relation to the level of exploitation. A short review is given below for the more important species, with special emphasis on marine mammals.

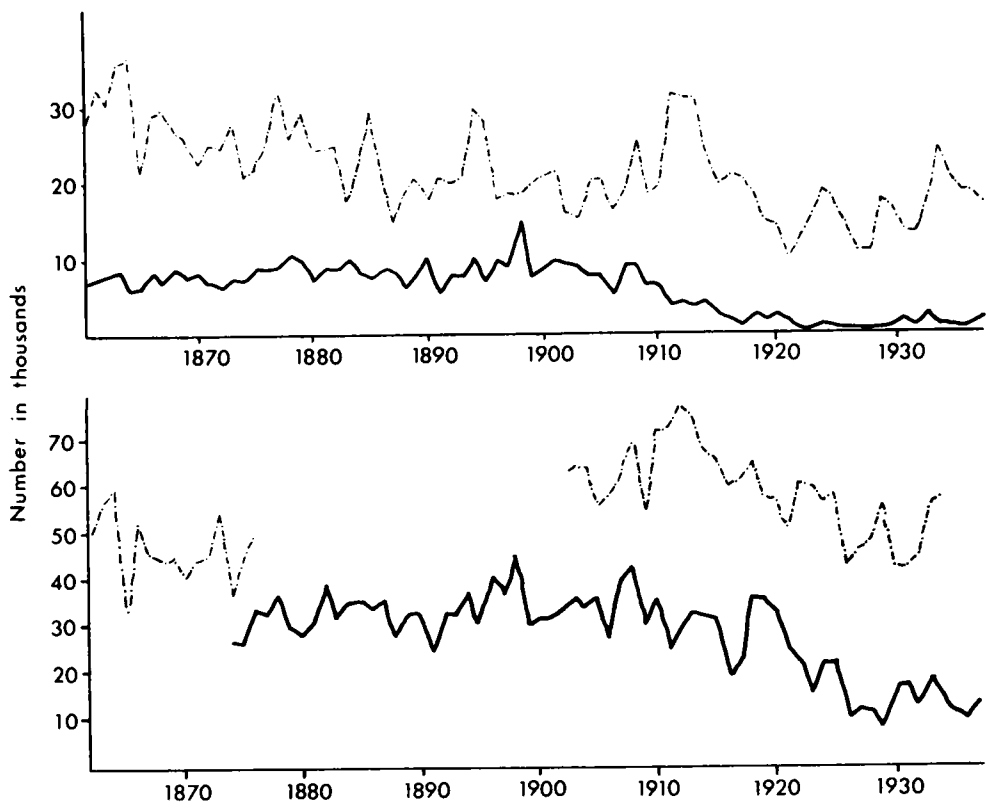

Fig. 3. Upper: purchase of seal skins by the Royal Greenland Trade Department, Lower: number of seals caught in Greenland, 1862–1937. Solid line: S and SW Greenland; broken line: CW and NW Greenland.

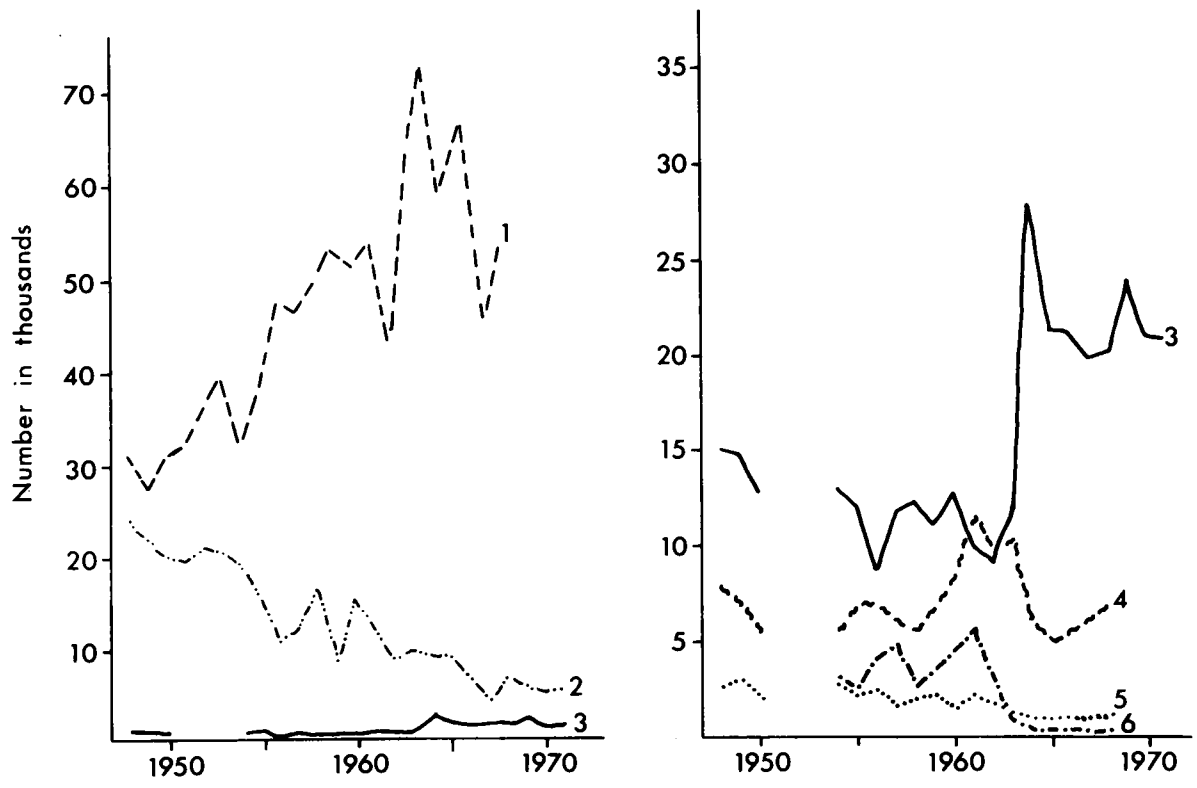

Fig. 4. Number of seals caught in Greenland, 1948–71, 1: ringed seals; 2: harp seals; 3: hooded seals; 4: bearded seals; 5: harbour seals; 6: walruses.

Marine mammals: Pinnipeds (Figs 3–4)

Ringed seal (Pusa hispida)

An accurate assessment of past and present population sizes of this species had not yet been possible, but it is beyond doubt that its availability is subject to fluctuations, which first and foremost are determined by climatic conditions. From a rather low level in the beginning of the present century, the population apparently increased during the 1950s and 1960s and remains at a high level at present. It is not clear whether the ringed seals of Greenland belong to one single or (more likely) several separate stocks, and it is possible that some exchange takes place with northeast Canadian stocks. The total 'Greenland population' is probably of the magnitude of two million animals with an annual pup production of some hundred thousands.

The catch of ringed seal varies between one year and the next, but has during the last decades been of the magnitude of 50,000–70,000 animals per year with an increasing trend. The major part of this catch is very young animals ($\frac{1}{2}$–$1\frac{1}{2}$ year old), and very few mature animals are taken. Part of the explanation for this fact is that the hunting activities are concentrated among the skerries and the outer parts of the fiords, and that very limited hunting takes place in the bottom of the fiord system, where the more important breeding localities are situated.

Although a precise assessment is not possible on the basis of the available knowledge, it is considered reasonable to state that the stocks of ringed seal in Greenland are not threatened by hunting, and are unlikely to become so as long as the present hunting pattern is maintained. There remain in Greenland

sufficient large and remote areas to serve as refuges for the breeding population, and these areas are to some degree the object of deliberate conservation measures.

It is, further, likely that ringed seals breeding in the offshore drift ice of Baffin Bay make a significant contribution to the population exploited along the coast of West Greenland.

Plate 2. In Spring, ringed seals are often flensed on the ice, immediately after capture. Kraulshavn, Upernavik district, May 1975. (Photo, F. Kapel)

Harp seal (Pagophilus groenlandicus)

The stocks of harp seal in the Northwest Atlantic are well known, particularly as a result of Norwegian and Canadian investigations. The stock of importance for Greenland breeds around Newfoundland and the current population is estimated to be of the magnitude of $1\frac{1}{4}$–$1\frac{1}{2}$ million animals with a tendency of slow increase and an annual pup production of 300,000–400,000 (ICNAF, 1979). The stock was, however, previously considerably larger (probably at least 5 million animals), most recently in the 1940s and 1950s. The decline up to the beginning of the 1970s may to some extent be explained by climatic factors, but is considered mainly to be the result of overexploitation in the breeding areas around Newfoundland. Because of this a significant reduction in the allowable catch was introduced in that area in 1971.

The catch in the breeding areas is now of the magnitude 150,000, of which the greater part (80%) are newborn pups, 'white-coats'. The catch in Greenland is at present 5,000–10,000 harp seals per year of which 50–80% are young of the year (3–9 months old) (Kapel, 1975a; 1977a; Kapel and Geisler, 1979). Previously, e.g. in the 1940s, the Greenland catch was much higher, probably 20,000–30,000 per year, and this species was at that time extremely important for subsistence, particularly in the central and southern parts of West Greenland (Kapel, 1978b). Because of the opportunistic character of the Greenland catch it will never become a threat to the stock of harp seal.

Hooded seal (Cystophora cristata)

The stocks of hooded seal are also rather well investigated by Norwegian and Canadian scientists, although some uncertainty remains with respect to stock boundaries and migration paths. It is, however, beyond doubt that the animals occurring in Greenland originate from breeding areas in Newfoundland and in the Davis Strait. These stocks are estimated to be approximately 100,000–120,000 animals with an annual pup production of 25,000–30,000 (ICNAF, 1979). The stock of hooded seals at Jan Mayen is estimated to be approximately double the size of the western stocks, but it is apparently of very little importance to the catch in Greenland. All stocks were probably much larger at the turn of the century, thereafter decreasing until the beginning of the 1960s. At that time an end was put to the the catch in the moulting areas in the Denmark Strait, and quota regulations have now been established in the breeding areas (TAC's:

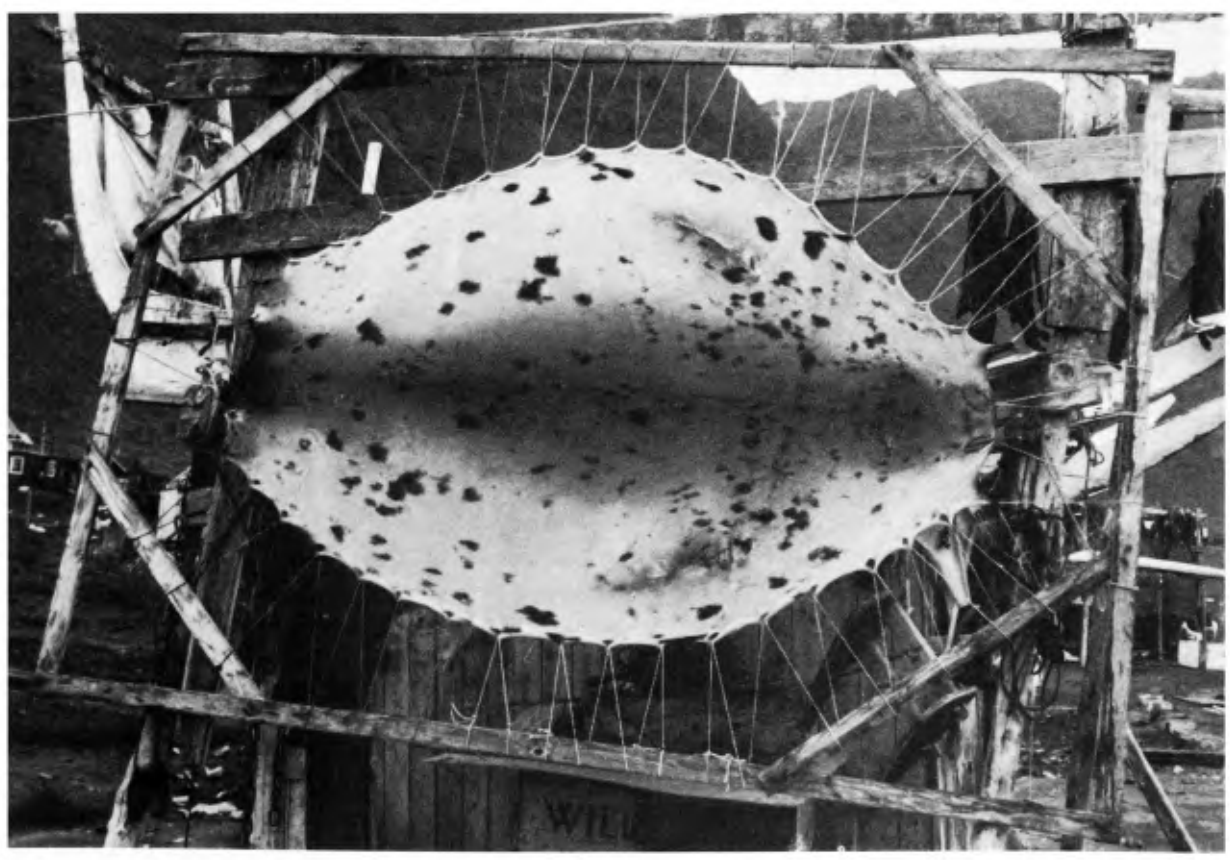

Plate 3. The skin of a young harp seal on a stretching frame, Igdlorssuit, Umanaq district, September 1979. (Photo, F. Kapel)

15,000 animals at Newfoundland, 30,000 at Jan Mayen). The stocks of hooded seal seem at present to be increasing in both areas.

The catch in Greenland was at a high level at the turn of the century (probably 10,000–15,000 animals per year), but decreased to ca. 1;000 per year around 1960. During the following years the catch increased again up to a level of ca. 3,000 per year (Kapel, 1978b). The composition of catches differs from that of the harp seal in that very few young of the year are taken in Greenland; 2–5 year old immatures dominate the catch, and males are in excess of females (Kapel, 1972; 1974; 1975b; 1980a). As in the case of the harp seal, the Greenland catch has little influence on the status of the stocks compared to the catch in the breeding areas.

Plate 4. Male hooded seal in the moulting area, in the drift ice of the Denmark Strait, East Greenland, June 1970. (Photo, F. Kapel)

Bearded seal (Erignathus barbatus)

The catch of this species in Greenland amounts to 500–1,000 animals per year without any clear trend (Kapel, 1975d). This could indicate a stable population of at least 25,000–50,000 animals, but nothing is known with certainty on the actual size of the population, or its relationship to stocks in other areas.

Walrus (Odobenus rosmarus)

The walruses of North East Greenland probably belong to the same stock as those occurring around Spitzbergen and in the Barents Sea. Of an estimated total of a few thousands (FAO, 1979) only a small fraction occurs in the uninhabited areas of North East Greenland, which are now a National Park. The present status of this herd is not known, but only one or two stragglers are caught occasionally near the settlements farther south at the east coast of Greenland.

Walruses occurring in West Greenland are assumed to have some connection with those of Northeast Canada, but it is not clear whether they belong to one or more stocks, and to what extent exchange takes place between walruses in Greenland and in Canada. The magnitude of the total population in these areas is estimated to be 10,000 animals (FAO, 1979).

Walruses occurred previously in rather large numbers in the Egedesminde-Holsteinsborg area (CW-SW Border area), and were subject to significant hunting at the beginning of this century. Today they are not common in nearshore areas; less than 50 animals per year are taken in West Greenland south of the Melville Bay (60°–75° N).

In the Thule district (76°–79° N), however, the catch of walrus is still very important, and in this area 100–200 animals are taken per year.

Harbour seal (Phoca vitulina)

This species breeds in the fiords of South West Greenland in low numbers, probably a few thousand. At present the catch amounts to less than 100 animals per year, half as much as before 1950 (Kapel, 1975d). The decrease may be due to climatic factors.

Cetaceans (Figs 5–7, 18)

Beluga (Delphinapterus leucas)

The beluga is now common along the coast of West Greenland, especially north of the Arctic circle, and was previously common in South West Greenland. Apparent-

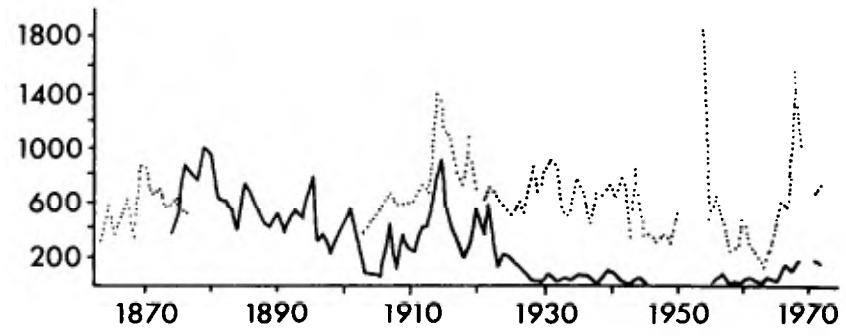

Fig. 5. The Greenlander's catch of narwhals and belugas. Solid line: SW Greenland; dotted line: NW Greenland.

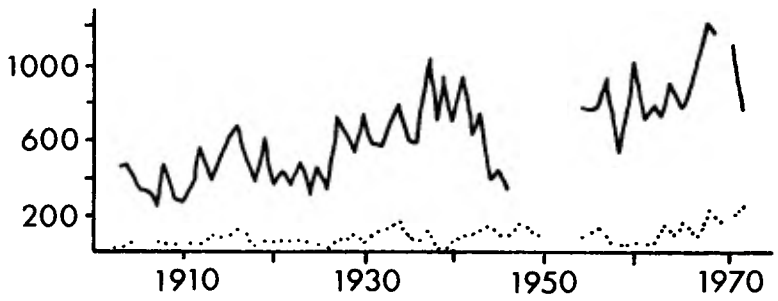

Fig. 6. The Greenlander's catch of *Phocoena phocoena*. Solid line: SW Greenland; dotted line: NW Greenland.

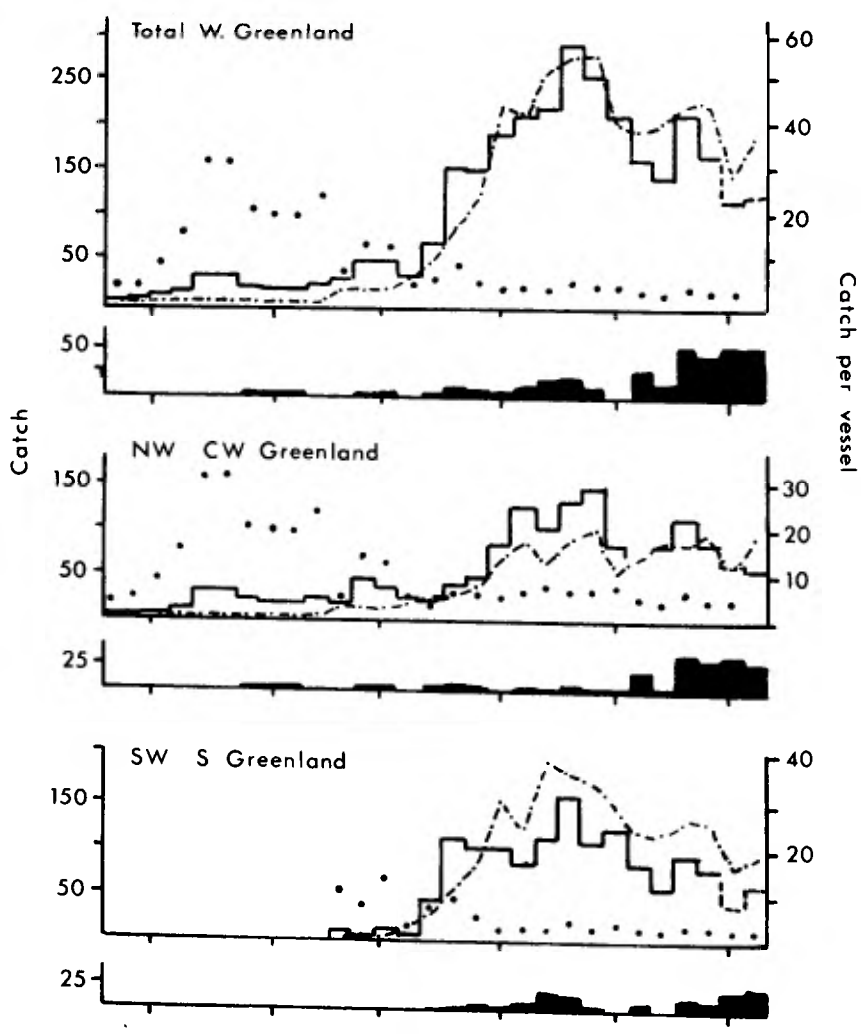

Fig. 7. The catch of minke whales in West Greenland, 1948–76. □: no. caught by vessels; —·—·—: no. of vessels; ·: catch per vessel; ■: non-vessel catch.

ly, the animals migrate northwards in spring to summering areas in the Melville Bay and Thule district and southwards in autumn where they winter in Disko Bay or farther south (Kapel, 1977b).

Little is known about the size of the population or its possible relationship to the stocks in northeast Canada except that it has been able to sustain a catch in Greenland of the magnitude 500–1,000 animals per year, greatly varying from one year to the next but with an increasing trend over the most recent decades. In the last century and the first part of this one the catch was larger in southwestern Greenland than it is at present (300–600 compared to 100–200 per year), but in the central and northern districts the catch has remained at about the same level (400–800 animals per year).

Narwhal (Monodon monoceros)

The narwhal has a similar distribution and migration pattern to the beluga, although it is rarely seen as far south as that species, and it is more abundant farther north. There is a similar uncertainty with respect to population size and possible connections with northeast Canadian stocks.

The catch of narwhal in West Greenland south of the Melville Bay amounts to 100–500 animals per year, to which should be added 100–300 animals caught in the Thule district, and less than 100 in East Greenland (Kapel, 1977b).

Harbour porpoise (Phocoena phocoena)

The harbour porpoise is common in southwestern Greenland, where the opportunistic catch in the first half of the present century amounted to 500–1,000 animals per year, showing an increasing trend. For a short period in the late 1960s and early 1970s the catch was somewhat higher (1,000–1,500), to which should be added a by-catch of non-Greenlandic salmon vessels, probably of the same magnitude (Lear & Christensen, 1975; Christensen & Lear, 1977). The non-Greenlandic catch has now ceased, and the Greenlandic catch for the most recent years has again been at the level 500–1,000 animals per year (Kapel, 1977b; IWC, 1978b; IWC, 1979c).

The size of the population and its boundaries with other stocks are not known.

Other smaller cetaceans

A few other species of small and middlesized cetaceans are more or less frequently seen in Greenland waters, but none of these are subject to regular hunting (Kapel, 1975c).

Minke whale (Balaenoptera acutorostrata)

The minke whale occurs off West Greenland as far north as the Upernavik district, and is common in late summer at least up to Svartenhuk (72° N). In South West Greenland it is apparently most abundant in spring and autumn, which indicates that at least part of the population carries out a north-south migration during the summer season. The Greenland population is considered a separate stock, but its actual size and relationship with the East Canadian and East Greenland-Iceland stocks remains uncertain (IWC, 1976).

Exploitation of minke whales in West Greenland began in 1948, when the first fishing vessel equipped with a harpoon cannon made this type of hunting possible, but remained at a low level during the following decade (average 18 animals per season).

During the 1960s the total catch increased from ca. 50 to 200–300 animals per year, because an increasing number of fishing vessels were equipped with a harpoon cannon and participated on an opportunistic basis in the taking of minke whales. In 1968 Norwegian small-type whaling vessels extended their operations to the Davis Strait, and in the following years they caught an average of *ca.* 175 animals per year – on the top of the Greenlanders' catch of *ca.* 225 minke whales annually during the same period (Kapel, 1977c; 1978a). Some concern was expressed about this recent development of exploitation, and a preventative quota was recommended separately for this stock for the season 1977, and similar

Plate 5. Narwhal captured by Kayak hunters (based on a motorboat, see Plate 10) being flensed at Tugtuligssuaq, Melville Bugt, northwest Greenland, July 1976. (Photo J. Christiansen)

Plate 6. Small fishing vessel equipped with harpoon cannon towing a minke whale to shore for flensing, Godthab, July 1956. (Photo, E. Smidt)

quotas were set for the following seasons (IWC, 1977; 1978a; 1979a; 1980; 1981a). Following these recommendations the Norwegian catch in the Davis Strait was reduced to 75 minke whales per year. The Greenlandic catch in the years 1977–1979 was 160–250 or near the average of the immediately preceding years (IWC, 1979c; 1981c).

Fin whale (Balaenoptera physalus)

Fin whales occur during the summer months in West Greenland waters as far north as the Umanak district (71° N), and some animals remain in the southern areas (SW) during the autumn. They seem to spend the winter and spring farther south in the North Atlantic, but their relationship with stocks in other areas is not fully understood (IWC, 1979b).

Fin whales were not exploited in the Davis Strait until Norwegian pelagic fleets caught them (and other species) in rather large numbers in the 1920s and 1930s (Jonsgard, 1955; 1966). Partly with the declared purpose to provide the Greenlanders with meat, a Danish catcher boat took small catches (average 20–25 per year) in the periods 1924–39 and 1946–58 (Kapel, 1979). After these operations were brought to an end, fin whales have only occasionally been caught by some of the Greenlandic fishing vessels equipped with harpoon cannons (0–13 annually).

Humpback whale (Megaptera novaeangliae)

The humpback whale is a regular summer visitor in the near-shore waters of South West Greenland, and may reach as far north as the Disko Bay region. These animals are probably part of the stock breeding in the Caribbean Sea (IWC, 1981b, p. 136). This stock is considered heavily reduced by overexploitation from whaling expeditions in the early twentieth century, and commercial whaling on this species was prohibited in 1955 (in the North Atlantic). There is some evidence that the species is becoming more common in Central West Greenland (Kapel, 1979).

There was an old tradition of catching humpbacks in Greenland (Fabricius, 1809), which with minor modifications was continued until 1923 (Winge, 1902; Anon., 1944), when it was replaced by modern whaling using a catcher-boat run by the Danish authorities as mentioned in the previous section (Kapel, 1979). When the species was protected by the IWC in 1955, an exception was introduced that the Greenlanders were allowed to take up to 10 humpbacks per year from small vessels. In the years 1958–72 very few were taken (0–5), but during the most recent years the average catch has been 9 animals per year. The justification of the Greenland exception was questioned at the 1977 meeting of the IWC (IWC, 1978d). The problem is further complicated by increasing incidents of net entanglements of humpback whales at Newfoundland (Perkins and Beamish, 1979).

Other large whales

During the periods of catcher-boat activity a few blue whales (*Balaenoptera musculus*), sei whales (*B. borealis*) and sperm whales (*Physeter catodon*) were taken, but none of these species have been of importance for the Greenlanders' hunting (Kapel, 1979).

It should, however, be mentioned that this was the case with the bowhead (*Balaena mysticetus*), which was common in Baffin Bay until the first part of the nineteenth century. Although climatic changes may have had an adverse effect on the stock of bowheads in the Baffin Bay area (Vibe, 1967), this decline was predominantly due to overexploitation by European whalers in the seventeenth, eighteenth and in the beginning of the nineteenth centuries. As a result of this the ancient Greenlandic hunt of bowheads from skin-covered boats lost its importance in the eighteenth or at the beginning of the nineteenth century, and during this century only one or two animals have been caught. The species was rarely seen during the first half of the twentieth century although it has been sighted more regularly in Central West Greenland in recent years (IWC, 1981c).

Other mammals

Polar bear (Ursus maritimus)

The polar bear has an arctic circumpolar distribution, and the world population is estimated to be around 10,000–20,000 animals, most of which breed in Canada and Siberia. There is a small (probably a few hundred) breeding population in northeast Greenland but it is believed that polar bears arrive regularly in this area with the drift-ice from the east. Some of these animals follow the drift-ice southwards and form part of the exploited population taken in Scoresbysund, Angmagssalik and South Greenland.

Another small population breeds in North Greenland (Melville Bay-Kane Basin area), which is probably closely related to the polar bears of Ellesmere Island, although the nature of the relationship is not fully understood. The establishment of a Nature Reserve Area in Melville Bay offers some protection for this population,

as the National Park does for the northeast Greenland population (Vibe, 1971; 1978a).

The catch in the Scoresbysund and Angmagssalik districts fluctuates considerably from one year to the next, partly due to the unpredictable degree of outside recruitment – but is of the order of 50–150 animals per year. Most of these animals would have little chance to return to suitable breeding areas. The same is definitely true for animals which continue with the drift ice round Kap Farvel to South Greenland, where small numbers (less than 20 annually) are caught regularly. This catch level is the same as in the first part of the nineteenth century, but lower than in the period 1875–1925, when the East Greenland drift-ice occurred in greater quantities and penetrated farther north in the Davis Strait.

In the Thule district polar bear hunting is an important part of life, and long sledge voyages are undertaken between 80° and 75° N in pursuit of these animals. Some hunters from the Upernavik district participate in this hunting, and occasionally a few polar bears are caught farther south. Compared with the effort, the result of hunting in this part of Greenland is rather small, about 50 animals per year.

Caribou (Rangifer tarandus groenlandicus)

The caribou is at present found in West Greenland from the inner part of Disko Bay (69° N) to the Frederikshåb district (62° N), with small isolated herds on the Nûgssuaq and Svartenhuk peninsulas, and on Disko Island. It was previously found in East Greenland and in the Thule district, but disappeared from these parts of the country around 1900 and 1925, respectively.

The population size of caribou in West Greenland fluctuates considerably. The species was abundant around 1820–1860 and again in 1900–1920, but decreased to a very low level in the 1930s and 1940s. It increased during the 1950s and reached a maximum in the late 1960s and early 1970s. A recent study estimates the size of the stock at that time to have been about 100,000 animals, and suggests that the present size may be as low as 20,000–30,000. The occurrence of small and under-nourished animals indicates that poor food supply is the reason for this sudden decline probably as a result of overgrazing by the large population in the 1960s (Vibe, 1971; Strandgaard, 1978; Holthe, 1978).

These fluctuations are, of course, reflected in the catches which also show yearly variations. In the middle of the last century catches of more than 25,000 annually were taken, whereas only a few thousand animals were caught between 1900 and the early 1950s. During the 1960s the annual catch increased from 4,000 to 10,000 and peaked at more than 15,000 in the early 1970s; as mentioned above the condition of the animals is very poor at present, and a drastic fall in catches is expected during the next few years.

Musk-ox (Ovibos moscatus)

The musk-ox is presently found in northeast Greenland from Pearyland to the area just north of Scoresbysund. It was previously found also in the Thule district, but disappeared from this area in the middle of the nineteenth century. The northeast Greenland population has been subject to great fluctuations, primarily due to changing climatic conditions. From a peak period in the 1920s and 1930s the population decreased from about 15,000 to 5,000 animals during the 1940s and 1950s. The population has been recovering since then, and its present size is estimated to 6,000–12,000 animals (Vibe, 1971; 1978b). In the early 1960s the musk-ox was transplanted to central West Greenland; the 27 animals released in the Søndre Strømfjord area evidently thrived, and the size of this herd is at present approximately 200 animals (Vibe, 1971; 1978b).

The musk-ox was to some extent pursued in northeast Greenland by Danish and Norwegian trappers in the 1920s and 1930s, but since the cessation of this activity and the establishment of the National Park, the population should have been well protected. The small hunting carried out by the Scoresbysund hunters (50–75 animals annually) does not constitute a threat to the overall population, but may well be rather high in relation to the size of the local herds.

Arctic fox (Alopex lagopus)

The arctic fox is found all over Greenland in two colour phases: a white phase dominant in High Arctic areas and a blue one in Low Arctic areas, although the two phases intermingle in many areas in Greenland. The size of the populations is not known, but like other arctic animals, foxes are subject to fluctuations as reflected in the catches (Bræstrup, 1941; Vibe, 1967).

The fluctuation in the catches of the arctic fox is most pronounced in southern West Greenland (S+SW). Peak periods with catches of more than 3,000 skins traded annually occurred around 1830, 1875, 1920 and 1930; the general trend was of increasing trade, from an average of ca. 1,000 skins in the period 1795–1810 to ca. 3,300 in the period 1925–1939. A similar gradual increase from ca. 100 to ca. 1,100 annually took place in northern West Greenland (CW+NW), where the yearly variations were less pronounced than in the southern part of the country. This generally increasing trend was probably due to the increasing demand for skins and the increasing number of participating hunters. The most recent statistics show a new peak in the early 1960s (ca. 3,000 and 900 skins annually for southern and northern West Greenland, respectively), and a subsequent decrease to less than half that level in the early 1970s (ca. 1,300 and 400 skins, respectively). To the above figures should be added the figures for the Thule district (500–2,000 annually), where an unknown additional number of skins are used locally for clothing, and for East Greenland (50–300 annually, not including up to 2,000 skins traded annually by Norwegian and Danish trappers in the 1920s and 1930s).

Wildfowl

Shooting of birds is a significant part of the hunting pattern in most regions of Greenland: in the northern districts especially in summer and autumn; in the southern areas mostly in autumn and winter. In this way bird-hunting helps to fill the periods when marine mammals are less abundant – and also provides a welcome change in the diet.

A wide variety of sea-birds – and a few terrestrial ones – are of some importance and it is not possible in this survey to give due consideration to them all. At least twenty species are caught in significant numbers in one or more regions; some species are quite important in several districts, e.g. gulls (*Larus* sp.), whereas others are extremely important in one or two areas but only caught occasionally in others, e.g. the dovekie or little auk (*Plotus*

alle) (Salomonsen, 1970). We have limited our discussion to the three most important species considered below.

For most species exact assessments of population sizes are lacking, although some idea of hunting pressure has been obtained from extensive banding experiments. The magnitude of the annual catch of birds in Greenland is rather a 'guesstimate' than an estimate; the level seems to be somewhere between 500,000–1,000,000.

Thick-billed murre, or Brünnich's guillemot (Uria lomvia)

The thick-billed murre breeds in large colonies in West Greenland between 77½° N and 69½° N, particularly in the Upernavik district, and a few small colonies are found farther south. The total population is estimated to be 1–2 million breeding pairs with a decreasing trend, at least in the southern part of the breeding area. The wing-moulting adults and immatures migrate slowly southwards along the West Greenland coast, and most of them cross the Davis Strait to winter in the Newfoundland area. Birds wintering in the waters off South West Greenland are mainly visitors from the Lancaster Sound population, or from populations in northern Europe and USSR. A rather small breeding population (probably 10,000–20,000 pairs) is found in the Scoresbysund area, which apparently winters farther south on the east coast (Salomonsen, 1950; 1967).

The murre is caught in larger numbers than any other species in Greenland, and is also by weight the most important wildfowl in the country. Reliable catch statistics do not exist, and estimates of the actual kill vary considerably. The birds are pursued both in the breeding areas (where egg-collecting also takes place at some localities), on the migration path and in the wintering areas. The number of murres killed in Greenland was estimated at about 70,000 annually in the middle of the nineteenth century and about 100,000 at the turn of the century. Estimates of the present kill vary between 200,000 and 750,000 annually, of which the greater part is believed to be wintering birds from populations outside Greenland. During the period of the non-Greenlandic salmon fishery in the later 1960s and early 1970s an additional large number of murres was taken (and only partly utilised) as a by-catch in drift nets (estimated by Christensen and Lear [1977] to be at least 200,000 birds in 1972).

Eider duck (Somateria mollissima) *and king eider* (S. spectabilis)

The eider duck used to breed in large numbers along the entire west coast of Greenland from the Thule district to Julianehåb. It is still common today in the Thule and Upernavik districts, but the colonies are rather small and scattered farther south. Birds from the northern breeding colonies mainly winter in South West Greenland, whereas those from the southern part of the population are stationary. The size of the present population is estimated at about 50,000 breeding pairs with an annual production of about 200,000. In the nineteenth century the population undoubtedly numbered several hundred thousand breeding pairs (Salomonsen, 1950; 1970).

The king eider breeds in large numbers in the Thule district and in northeast Greenland between Pearyland and Scoresbysund. Adult males and immatures from the Thule population leave the area before the end of the breeding season, and conduct a 'wingmoult migration' to the waters around Disko Island. Here they meet with birds from northern Canada, and the number of king eiders occurring in Central West Greenland in August is at least 200,000 birds. The adult females and the young follow in September, and part of the joint Greenland–Canadian population winters in southern Greenland waters (approximately 68° N–60° N), whereas another part continues to wintering grounds in the Labrador–Newfoundland area. Part of the northeastern Greenland population is believed to winter in northern Iceland, and part in southern West Greenland (Salomonsen, 1950; 1970).

Unfortunately, catch statistics for eider ducks combine both species, and banding results are of little use in estimating the relative importance of the two species. In the past large amounts of both down and eggs were collected during the breeding season, but due to current regulations this is only carried out to a small extent today. Shooting in the breeding season is also restricted, and at present most eider ducks are shot in the period September–April, and outside the breeding areas. However, the present regulatory system is rather complicated and does not really satisfy anybody (Salomonsen, 1970).

Around 1900 the catch of eider ducks in Greenland was estimated at about 150,000 annually (in addition to around 60,000 eggs collected), which was considered much less than in the preceding century. An analysis for 1948–51 estimated the kill by shooting at 144,000 eiders per year, but during the following years the annual yield probably decreased to 100,000 or less. The decline in the population as measured by the catch since the nineteenth century has been related to climatic changes (Vibe, 1967), but the extensive exploitation for down, eggs and birds during many decades of the nineteenth and the first part of the twentieth century is probably more important (Salomonsen, 1970).

Plate 7. Fishing vessel with harpoon cannon anchored in Uvkusigssat, Umanaq district, July 1978. (Photo, F. Kapel)

Fishing resources

The preceding sections survey the living resources currently hunted in Greenland. Considering the nature of

occupation and industry in modern Greenland it is, however, relevant to also give some consideration to the fisheries resources.

In ancient Greenland, fishing was carried out only as a minor supplement to hunting. Capelin (*Mallotus villosus*), arctic char (*Salvelinus alpinus*), Greenland shark (*Somniosus microcephalus*), and to a lesser extent Greenland halibut (*Reinhardtius hippoglossoides*) and some other fish species were caught seasonally for domestic use, which included dog feeding.

Export of fish products started in the late nineteenth century, when small quantities of arctic char and Greenland halibut were salted and sent to Denmark, but it was not until the beginning of the present century, that a commercial fishery really began (Hansen and Hermann, 1953; Mattox, 1971). The importance of the fishery grew slowly until 1925, thereafter increasing more rapidly, especially in the 1940s and 1950s. In recent years the most important species for this fishery have been cod (*Gadus morhua*), Greenland halibut, Atlantic salmon (*Salmo salar*) and deepwater prawn (*Pandalus borealis*), and these are discussed in more detail below. The secondary species are listed at the end of this section.

Cod (Gadus morhua)

For a boreal species like the cod, small changes in the sea temperature are likely to have tremendous effects in such areas as the Greenland waters, where the species is near its biological limits. Cod occurred periodically in these areas in two or three periods in the first half of the nineteenth century, but were rare during the second half. After 1920 the species again became abundant, and this can almost certainly be related to an increase in the sea temperature (Hansen, 1949).The last 'cod period' was apparently longer than previous ones, and peaked in the 1950s and early 1960s, when the yield was estimated at about 300,000 tons per year.

Since 1963, however, there has been a decrease in most year classes partly due to a fall in the sea temperature, but also as a result of the heavy exploitation during the 1950s and 1960s, and there is some concern that the present spawning stock may be too low. The present stock could possibly yield about 100,000 tons per year for a few years, but the management strategy, based on scientific advice, is to maintain or possibly rebuild the stock to a high level.

The Greenlanders' cod fishery began around 1920, but remained at a rather low level (less than 10,000 tons per year) until 1940. During the 1940s and the 1950s their catches increased to 20,000–30,000 tons, peaking in 1962 at 44,000 tons, but decreasing again to the 20,000 tons during the next fifteen years. Until recently the foreign fishery in the Davis Strait was much larger than the Greenlanders'. Already in the late 1920s the Faroese had begun cod fishing in Greenland waters, and other nations soon followed. The international fishery in the Davis Strait was of the magnitude 300,000 tons in the 1950s and 400,000 tons per year in the 1960s – after which it suddenly collapsed (380,000 tons in 1968, 120,000 tons in 1970, and 63,000 tons in 1973). Quota regulations were introduced in 1974. Total catches in 1975, 1976, and 1977 were 48,000, 33,000, and 39,000 tons, respectively, of which 19,000, 16,000, and 25,000 tons were taken by the Greenlanders. Since 1978 a direct fishery for cod has been permitted only for the Greenlanders who caught 37,000 tons in 1978 and 49,000 tons in 1979, but similar quantities were taken by other nations as by-catch in other fisheries. Particularly large by-catches of cod by West German redfish trawlers have caused concern in Greenland.

Greenland halibut (Reinhardtius hippoglossoides)

The Greenland halibut is widely distributed from Thule to the Nanortalik district in West Greenland and along the southern part of the east coast. It is a true arctic species, and the effect on stocks of changes in sea temperature will probably be opposite to that of cod; this is apparently what happened in South Greenland in the first part of the present century. At the same time as the cod became abundant, the number of Greenland halibut declined (Smidt, 1969). The Greenland halibut is a slow growing species which could be vulnerable to heavy exploitation, but the Greenland stock is considered far from fully utilised, although it is apparently not as large as the stocks on the Canadian side of the Davis Strait.

The local fishery for Greenland halibut began earlier than the cod fishery, but remained at a low level (less than 1,000 tons per year) until the mid-1950s. Catches increased to a maximum of ca. 3,200 tons in 1965, decreased again to ca. 1,200 tons in 1971, but since 1972 have fluctuated between 3,000 and 6,000 tons per year. These ups and downs are in part to be explained by changes in market conditions, landing facilities and fisheries technology. An international fishery in the Davis Strait (10,000–20,000 tons annually) led to the introduction of quota regulations in 1976. The total allowable catch in 1980 was 25,000 tons, of which 7,500 tons were allocated to the Greenlanders. It should be added that large quantities of undersized Greenland halibut are taken as by-catches in the prawn fishery, and small catches taken for local consumption and dog feeding in the northern districts are not included in the above figures.

Atlantic salmon (Salmo salar)

The Atlantic salmon spawns in European and North American rivers and spends 1–4 years in freshwater, before it migrates into the sea. Most animals return to their home river to spawn after one year in the sea. Some salmon however, spend more than one year (2–3) in the sea, and part of these migrate to Greenland waters. Tagging experiments have shown that salmon occurring in the Davis Strait comes from various rivers in Europe and North America, but mainly from Canada and the British Isles (Horsted, 1972; ICES, 1973). It is estimated that about 2 million salmon migrate to the Davis Strait, corresponding to 6,000–7,000 tons at this time when the fish in Greenland waters have reached an average weight of 3–3½ kg. Salmon was only caught in small numbers by the Greenlanders until 1960 (less than 100 tons). During the following three years the catch increased steadily to ca. 500 tons and fluctuated between ca. 600 and 1500 tons (average 1,100 tons) in the period 1964–68. This fishery was carried out near-shore with set gill-nets. In 1965, however, Faroese and Norwegian vessels began an offshore drift-net fishery in the Davis Strait, and in 1967 vessels from the Danish mainland joined the venture. The foreign fishery rapidly increased to the same level as the local, and the total catch reached almost 2,700 tons in 1971.

This development caused some concern – to put it mildly – especially in certain circles in the salmon

Plate 8. Several fish species are dried in the open air. In the hunting district, production is mainly for local human consumption and dog food. (Photo, F. Kapel, Qaersut, Umanaq district)

homelands where it excited public discussion and a campaign was mounted, extensive international research was carried out and official notes were exchanged. In short, the result was an international agreement which limited the Greenlanders' salmon fishery at the same level as in the period 1964–71, while the foreign fishery was to be phased out from 1972 and cease in 1976. For this reason the Greenlanders' catch since 1972 has remained at 1,200 tons per year.

Deepwater prawn (Pandalus borealis)

The deepwater prawn is distributed along most of the West Greenland coast and on the southern part of the east coast. The prawn lives mainly at depths of 100–600 m in all fiords and offshore waters with positive temperatures (1°–4 °C). The most important inshore prawn grounds are situated in Disko Bay; major offshore grounds are found from Nordostbugten (71° N) to Juliånehabbugten (60° N), with the areas north and west of Store Hellefiskebanke as the most important (Horsted and Smidt, 1956; ICNAF, 1978). The offshore stock of exploitable prawns is at present estimated to be approximately 100,000 tons, and the estimated yield to be approximately 30,000 tons (ICNAF, 1979).

The fishery for deepwater prawn in Greenland began in 1935, but prior to World War II only small quantities were taken (less than 100 tons per year). After the war the fishery was resumed, and during the 1950s catches increased rapidly to nearly 1,000 tons per year. A further expansion of the inshore fishery took place during the 1960s, and the catch was nearly 9,000 tons in 1971; the Greenlanders' fishery remained at this level (7,000–10,000 tons per year) in the following five years, but the international situation changed completely during this period.

Already in 1969, the Faroese had started prawn fishing in the offshore areas off West Greenland to be followed by the Norwegians in 1972 and other nations later on. Catches were 500 tons in 1971, 2,200 tons in 1972, 4,500 tons in 1973, 11,800 tons in 1974, 28,100 tons in 1975, and nearly 40,000 tons in 1976. This development, of course, caused some concern in Greenland and a quota system was introduced into the prawn fishery in the Davis Strait in 1977. The TAC for 1977 was set at 36,000. The catch by foreign vessels amounted to ca. 27,000 tons in 1978; the Greenland catch was nearly 6,000 tons on the offshore grounds and ca. 9,000 tons by the inshore fishery, the latter not included in the quota. The offshore quota for 1978 was set at 40,000 tons, of which 5,000 tons were to be taken in the Canadian fishing zone. However, this quota was not fully fished. For 1979 and 1980 the quotas were ca. 30,000 tons, of which the Greenlanders took ca. 17,000 and 22,000 tons, respectively.

Other fisheries

Although the above species are the most important in the Greenlanders' fishery, other species are taken as well. Wolffish (especially *Anarhichas minor*) have been caught in significant numbers, especially in the late 1950s and early 1970s, and still are (2,000–6,000 tons annually). Catches of redfish (*Sebastes marinus*) increased in the early 1970s (maximum ca. 2,900 tons in 1974; this species is caught in large quantities by foreign nations off West Greenland as well as East Greenland (magnitude 100,000–200,000 tons per year), and under-sized redfish are a frequent by-catch in prawn trawling. In recent years a fishery for uvak (*Gadus ogac*) has developed and may to some degree compensate for the failing cod fishery (nearly 6,000 tons in 1977). The capelin (*Mallotus villosus*), which is still important for local consumption, has also been subject to commercial fishing experiments in Greenland, but with limited success to date. A commercial fishery for capelin has, however, developed off East Greenland in recent years, but without Greenlandic participation.

Seasonal variation and long-term fluctuation

In concluding this survey of the living resources of Greenland, it is appropriate to stress the importance of seasonal variation and long-term fluctuations to life in the hunting (and to some degree also the fishing) districts.

Fig. 8

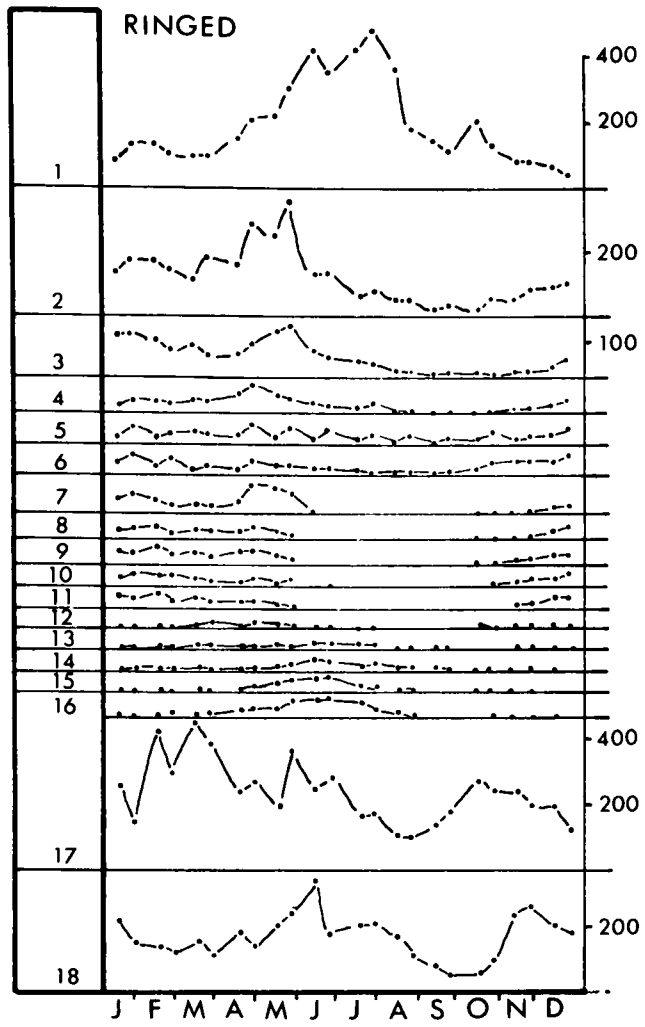

Fig. 9

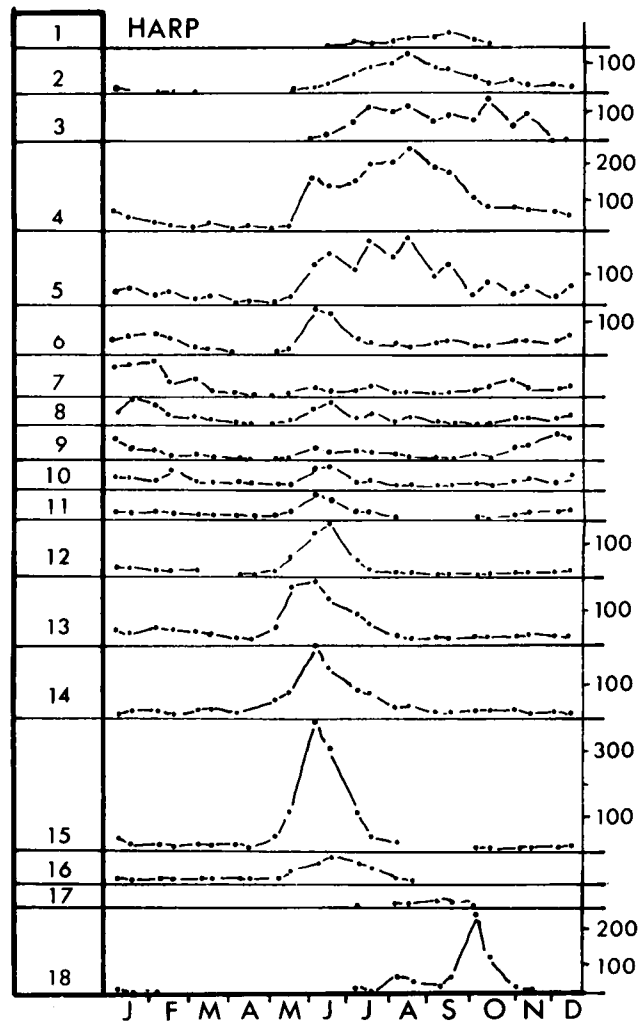

Fig. 10

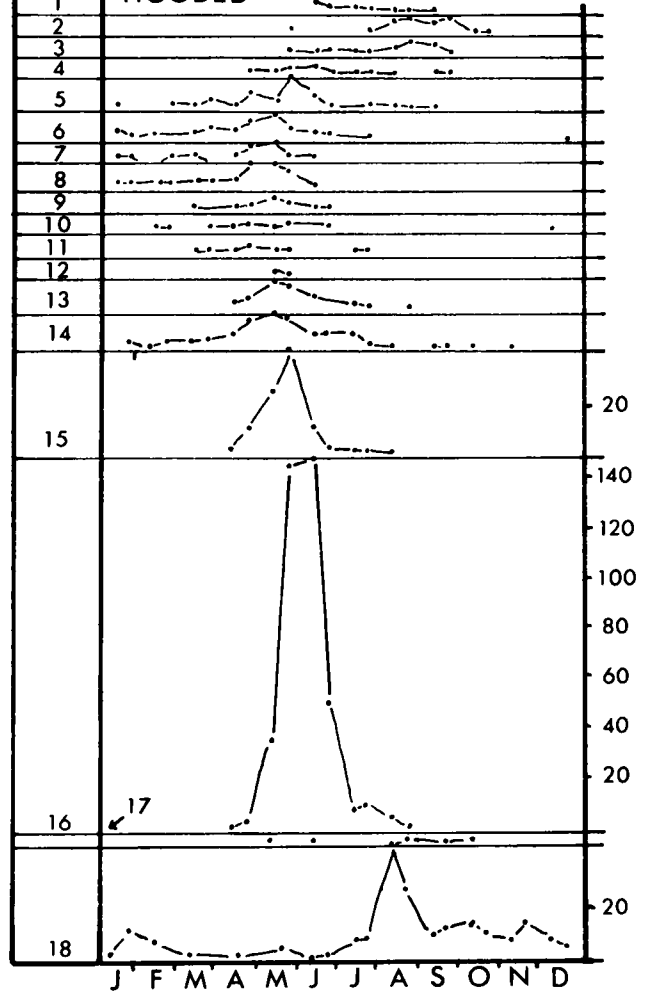

Fig. 11

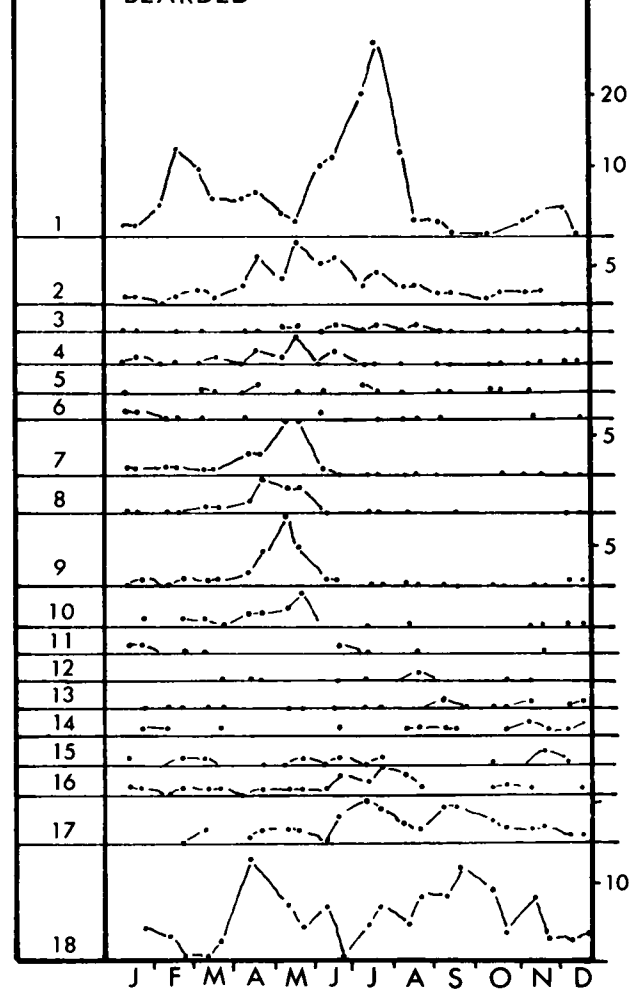

Fig. 8–11. The average catch of seals per half-month per 100 hunters, 1948/49–1950/51 (after Rosendahl, 1961). 1: Thule; 2: Upernavik; 3: Umanak; 4: Vajgat; 5: Jakobshavn; 6: Christianshåb; 7: Godhavn; 8: Egedesminde; 9: Kangatsiak; 10: Holsteinsborg; 11: Sukkertoppen; 12: Godthåb; 13: Frederikshåb; 14: Narssak; 15: Juliane- håb; 16: Nanortalik; 17: Scoresebysund; 18: Angmagssalik.

For the migrating species, such as the harp and hooded seals, most cetaceans and several species of wildfowl, it is obvious that their occurrence in one particular area is subject to seasonal variation. The same is to some extent true of the 'stationary' species, e.g. the ringed seal, because part of the population – and very often the exploitable part – carries out extensive movements from one area to another, even though the breeding part of the population is relatively stationary. The variation in availability is not only due to movements of the prey

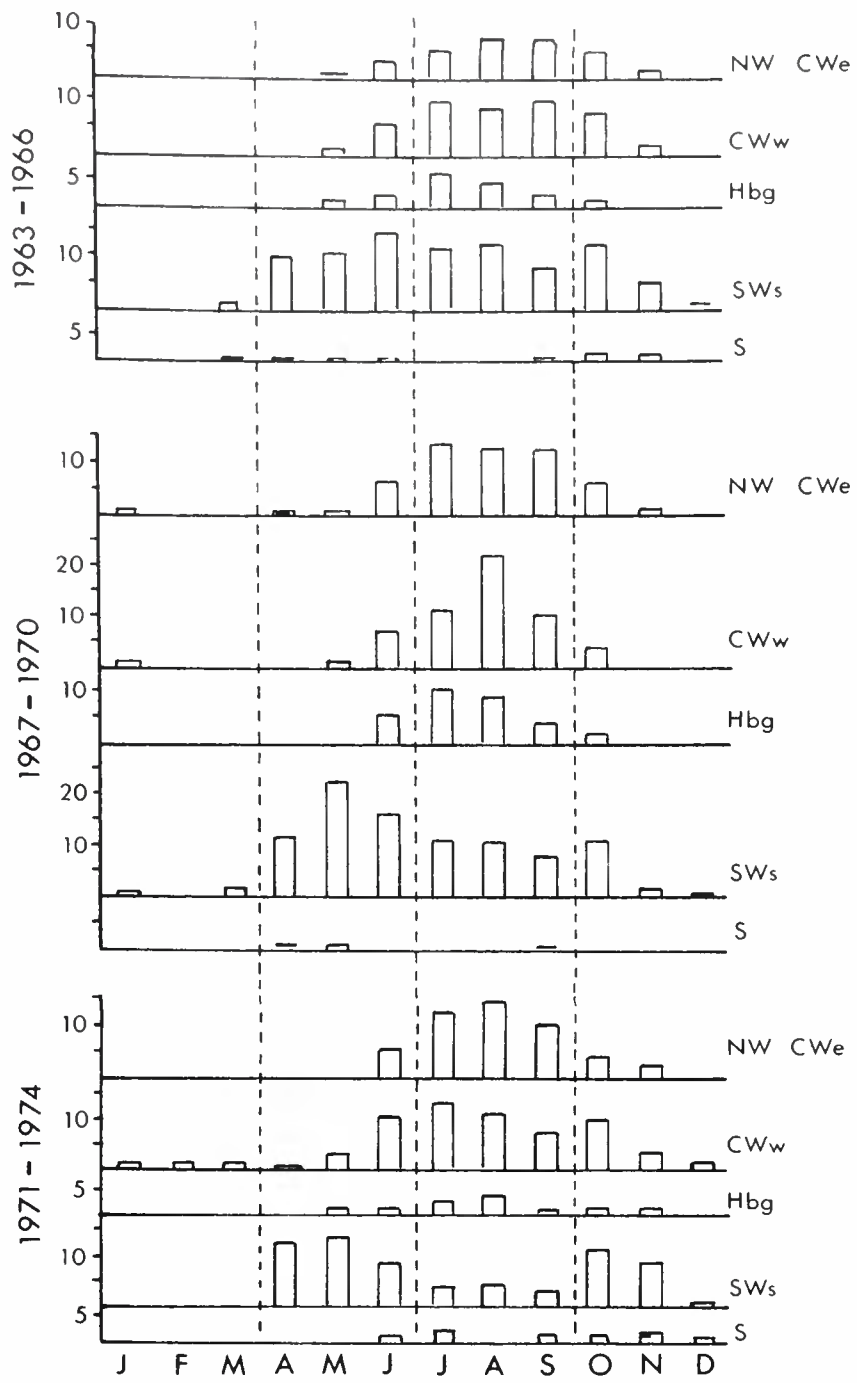

Fig. 12. West Greenland catch of minke whales by month and region.

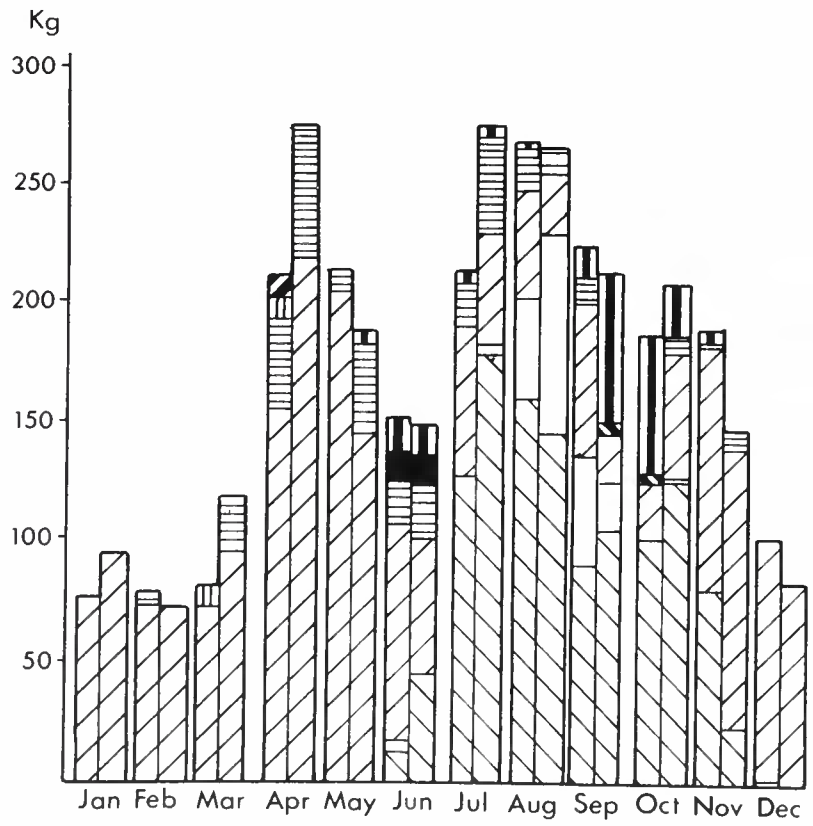

Fig. 13. Amount of meat obtained from hunting in Ivnarssuit, Upernavik district, expressed in kg per family (5 persons) per half-month. Average for the years 1948–55 (after Rosendahl, 1958). ▯: eiders; ▧: other birds; ▨: narwhals; ▥: belugas; ■: walrus; ▤: bearded seals; ▨: ringed seals; □: hooded seals; ▧: harp seals.

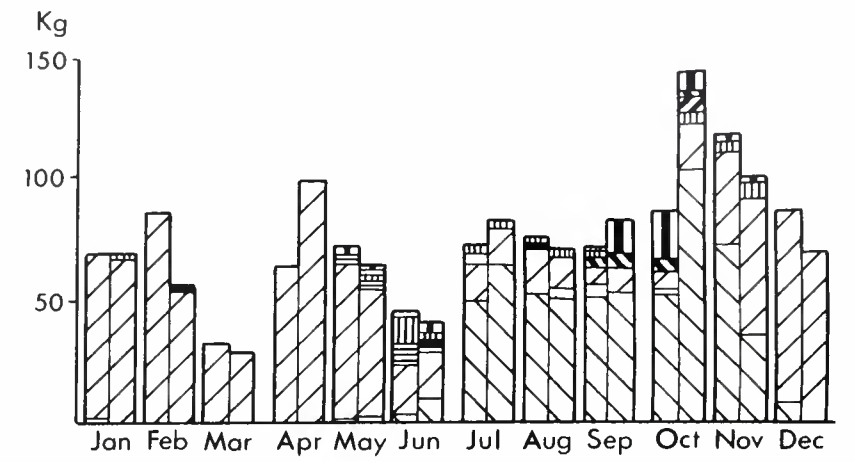

Fig. 14. Amount of meat obtained from hunting in Augpilagtoq, Upernavik district, expressed in kg per family (5 persons) per half-month. Average for the years 1950–55 (after Rosendahl, 1958). Symbols: see Fig. 13.

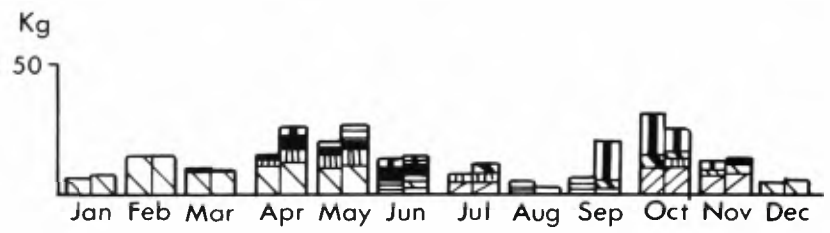

Fig. 15. Amount of meat obtained from hunting in Upernavik, expressed in kg per family (5 persons) per half-month. Average for the years 1950–55 (after Rosendahl, 1958). Symbols: see Fig. 13.

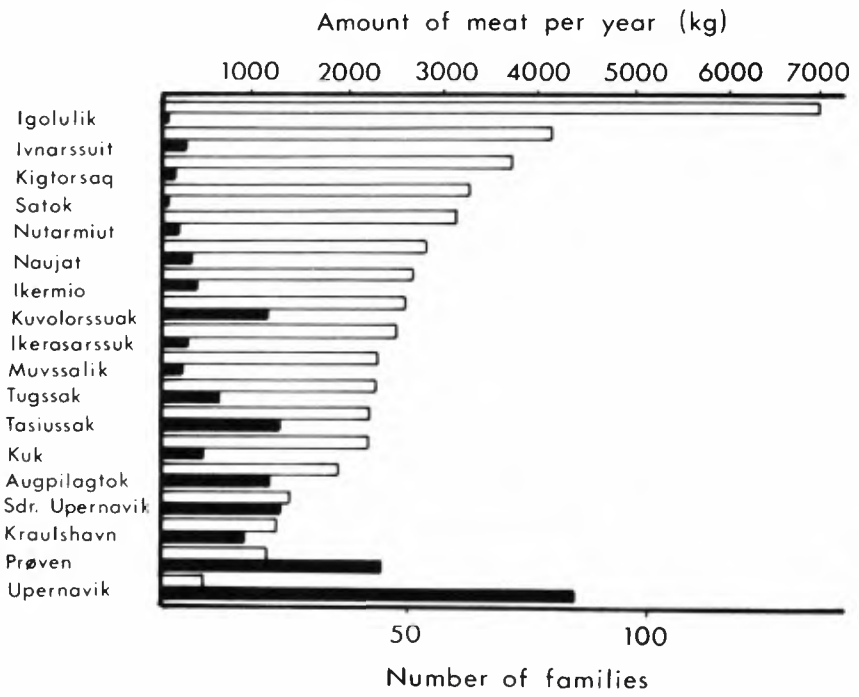

Fig. 16. Amount of meat obtained per year, and number of families (of 5 persons) at different settlements in the Upernavik district, 1945–55 (after Rosendahl, 1958). □: meat in kg; ■: no. of families.

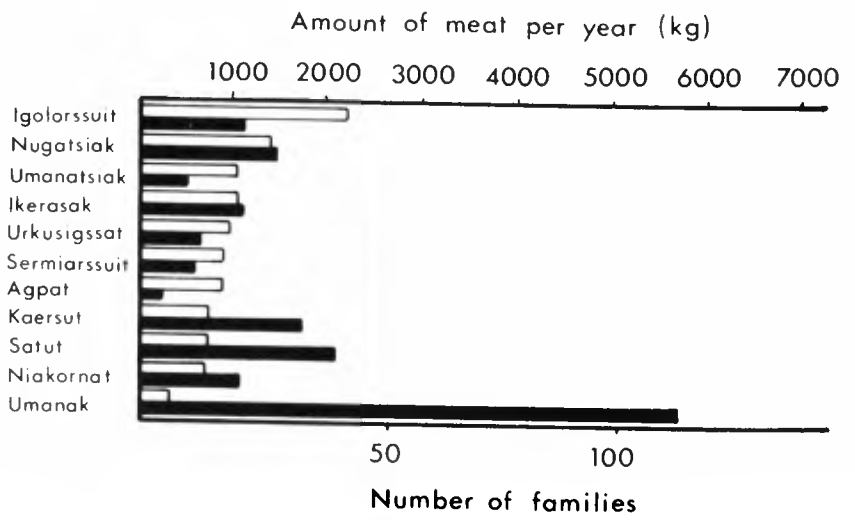

Fig. 17. Amount of meat obtained per year, and number of families (of 5 persons) at different settlements in the Umanak district, 1950–55 (after Rosendahl, 1958). □: meat in kg; ■: no. of families.

animals, but is also often caused by changing weather conditions, especially ice and wind. Other social and economic factors may also play a role, but these will not be discussed in this section.

Whatever the reasons, seasonal variation in catches is a fact of life which must be taken into account by the hunters, and which may differ significantly from one area to another, as demonstrated by the examples given in Figs 8–12. Even between neighbouring localities seasonal availability of some prey animals may differ considerably (cf. Figs 13–18). Because of this seasonal variation multispecies exploitation has become an important feature in the life of the Greenland hunter. Detailed accounts of seasonal variations and their importance of Greenland have previously been given by several authors (e.g. Amdrup, 1921; Anon; 1944; Rosendahl, 1958; 1961; Kapel, 1975d; etc.).

It has been stated repeatedly in the preceding sections that not only do catches vary from one year to the next, but that long-term fluctuations can be demonstrated for a number of species. In some cases the possible reason for these fluctuations (climate, exploitation etc.) have been indicated but a more detailed discussion of these matters can be found in the literature (e.g. Anon., 1944; Bræstrup, 1941; Vibe, 1967; Hansen and Hermann, 1953).

This is not the place to enter the discussion of the reasons, and what we wish to stress is simply the fact that both the yearly and long-term fluctuations exist, and that as a result of them multispecies exploitation is of vital importance to the Greenlanders' way of life.

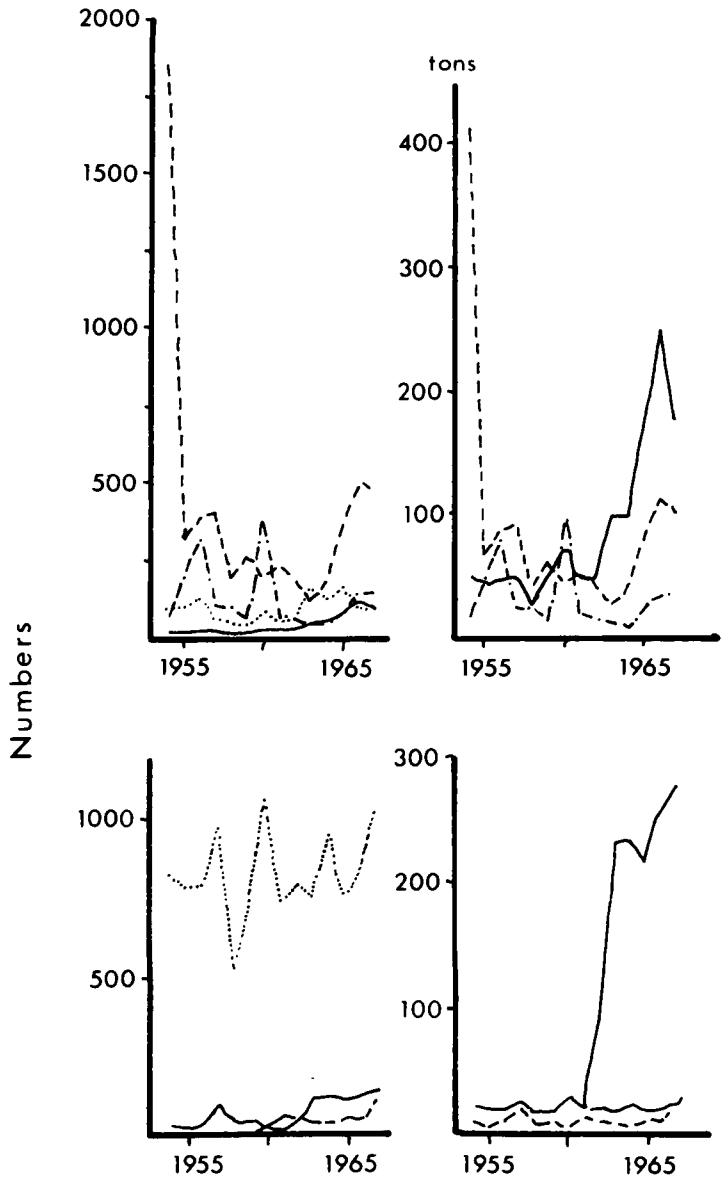

Fig. 18. Catches of minke whale (—), narwhal (– – –), harbour porpoise (– · –) and beluga (· · · –) in Greenland 1954–67. Left: numbers; right: estimated amount of meat in tons; upper: regions CW, NW, N, NE and SE; lower: regions SW and S.

NUTRITIONAL NEEDS

Abundance and shortage

The fluctuating nature of the hunt resulted in successive periods of abundance and shortage of food and several accounts of the extremes, enormous eating feasts and the starvation of entire settlements, can be found in the literature (e.g. Gad, 1967: 340; Jensen, 1965; Holm, 1972 (1889): 150–165; Petersen, 1957: 102; Thalbitzer, 1914).

These ancient communities had some means of counteracting the risk of periodical hunger in their methods of food storage and systems of sharing prey and exchanging products, but these systems only worked locally and could not prevent disaster if long periods of shortage occurred.

In the modern Greenlandic community these old systems are only maintained to a limited degree, and mainly at the small settlements. A modern welfare system based on money allowances has been instituted in principle, which in emergency cases will act as a safety factor, but does not prevent periodic shortage of basic provisions, particularly in the hunting settlements where the hunting products are the major food source with alternatives being very limited, and communication with towns or neighbouring settlements may be impossible for weeks or even months.

Basic food requirements

The concept of basic food requirements for a particular population group is complex, involving aspects of tradition, environmental conditions and the evaluation of possible alternatives, with both a quantative and qualitative side, as well as an economic one. Although we feel incompentent to discuss these matters in detail, and a search for precise information in the published literature proved rather unsatisfactory, we believe some general remarks should be given here.

It is beyond doubt that hunting products are held in high esteem as food and are preferred to alternatives all over Greenland, even in the fishing districts. Although the nutritional values have not yet been examined in detail in a general way they are considered to be high. Hunting products contain much protein and little carbohydrate, and have a rather high content of vitamins (Uhl, 1955). Although the fat content is considered high, it is not exceptionally so compared with an average Danish diet for example. It is further very important to stress that the composition of the fats in the Greenland diet is quite different, and according to recent investigations is apparently prophylactic with respect to coronary atherosclerosis (Bang and Dyerberg, 1972; 1975; Bang, Dyerberg and Hjørne, 1976). There may, of course, be other similar effects of this special diet, even if they have not been demonstrated, and one general observation is that the population in the hunting districts appears to be in a very healthy condition after a period of successful hunting.

Quantitative information for recent years on the diet of the Greenlanders' is scarce, but some data can be found (Uhl, 1955; Bang *et al.*, 1972; 1975; 1976). As part of their investigations, the latter carried out detailed analyses of the diet of several families at a small settlement in the Umanak district. Some of their results may serve as reference material in an attempt to estimate the quantitative food requirements in the hunting districts. The investigation covered both a late winter and a

summer period, and it was found that the average intake per day per capita was ca. 315 grammes hunting products and ca. 90 grammes fish products. This corresponds to 115 kg meat and 35 kg fish per year per capita.

In terms of food intake the settlement in question is considered fairly representative of the whole Umanak district, but the figures must be adjusted for other hunting districts, e.g. Thule, where fish products are unimportant. The total intake of meat (plus fish) may also be higher in other districts, but in the present calculations the figure 150 kg per year for all hunting districts (NW, N, NE, and SE) was used, and the relative importance of meat and fish was estimated for each district separately. Without going into details, the total consumption by human beings in the hunting districts was estimated to be at least 1,000 tons of meat and 200 tons of fish annually.

There is one important additional point: the sledge dogs. It is well known that the dog-sledge is still the most common means of transportation in the winter in the Greenland hunting districts: the animals required for this transportation consume considerable amounts of food – and eat almost everything they are given, which in practice means that they are fed with what is most abundant at the locality in question. This differs from place to place, but is generally meat at the northern settlements and fish at the southern ones.

Using this general information, and estimating the daily consumption per dog at 2 kg in winter and ½ kg in summer, we arrive at an annual consumption of ca. 400 kg per dog. The next question is then the number of dogs in present-day Greenland. In 1935 the number was actually counted (Anon., 1944) and amounted to ca. 8,800 (or approximately one dog per inhabitant in the hunting districts). A similar official figure is not available for the most recent years, but the actual number of dogs in Greenland is estimated to be 5,000–10,000 by the present authors. When using the median figure of 7,500 dogs it is calculated that they consume ca. 3,000 tons of meat and fish annually, tentatively divided into 1,300 tons meat and 1,700 tons fish.

The conclusion is then that sledge dogs and the human population in the hunting districts require a minimum of 2,300 tons meat from hunting products and 1,900 tons fish annually.

For comparison, according to the Lists of Game for 1969–1973, the quantity of meat obtained from hunting products in the regions N, NE, SE, NW, and CW was ca. 2,500 tons annually (excl. wildfowl, estimated by the present authors to ca. 200 tons annually for the same regions).

Similar calculations could be carried out for the fishery regions, but the main conclusion would be the same, considering the size of the human population in those areas: there is very little, if any, surplus production of edible products from the hunting in Greenland. The main problems are fluctuations in yield and satisfactory storing and distribution.

Plate 9. The dog sledge is still the only means of transport in winter and spring for the hungers of East Greenland and the northern parts of West Greenland. (Photo, F. Kapel, Kraulshavn, Upernavik district, May 1975)

DEMOGRAPHIC TRENDS

Rate of population increase

At the turn of this century the Greenlandic population was about 12,000 excluding 200 people in the Thule area. At that time almost all the Greenland Inuit population lived from hunting. Of this population 9,500 lived in small settlements (Anon., 1942, p. 421). By 1930 the total population had reached 17,000; of which 4,540 (*ibid.* p. 418) or 26.9% lived in the present 'hunting communities', even though there were many seal hunters in all regions of Greenland in this period. By 1960, 33,000 people lived in Greenland, 7,800 (23.6%), living in these same hunting areas (Anon., 1969b, p. 9).

In 1977 the total population of Greenland was 49,700, of which 40,600 were born in Greenland (there is no clear distinction between the Danes and Inuit in official statistics). Of those people born in Greenland (generally speaking the Inuit population) about 9,000 (22.1%) lived in the 'true hunting areas' (Anon., 1977: 14° *et seq.*). In fact hunting occurs in all Greenlandic local communities, but 6 municipalities are normally regarded as 'true hunting areas'. There hunting is the main occupation, and for some of them the sole occupation outside the wage-earners' circles. This is one of the reasons why it is maintained that 20%–25% of the Greenlandic Inuit population lives from hunting.

Changes in occupation due to changes in climate meant that seal hunting lost its dominant economic position in the central and southern parts of West Greenland, where low technology cod fishing replaced sealing for most of the Greenlandic population from about 1920 onwards. It was in connection with this fishing, which was primarily for export, that in 1950 the Greenlandic politicians pressed for an industrial programme.

This was in conjunction with a series of radical changes: the health service was restructured and made more efficient; tuberculosis, once the most frequent cause of death, lost its importance; while the death rate was declining the birth rate remained high, and so the population began to grow. Of course, this created a series of problems, but the industrialization programme was started with fish refining factories being built and fishing vessels and instruments modernised.

Changes in habitation and occupation

Population policy in Greenland since World War II has focussed on development plans for the central and southern parts of West Greenland, and migration into this area was encouraged in different ways. The effects of this policy can be seen today as the total population of the hunting area proper is not much larger now than it was in 1900 or 1930.

There are several reasons for this. The range of jobs is more diverse, and the wages generally higher in the fishery districts than in the hunting districts. The level of education is normally lower in the small hunting communities than in the larger centres. Young people from the hunting areas are often sent to be educated in the central area or even in Denmark. In this way they miss their training in hunting at the most crucial stage in their life and many of them have difficulty in readapting themselves into the co-operative pattern of the hunting communities, and thus lose one of the most essential factors in hunting community life. This lack of an essential attitude results in the migration of the youth into the centres of population. Although this may appear to have some advantage to the hunting community in that it helps avoid overpopulation, it may also result in the dissolution of the essential hunting culture values, and a transfer of small community problems into the larger communities where there is already an unemployment problem, particularly for young people. The migration of people from the small hunting communities to the larger centres produces a large number of cultural and social problems in both places.

The policy of population concentration realized in the previous decades has, therefore, in recent years provoked severe criticism, not least because of its adverse effects in the hunting areas.

In 1970 the Ministry for Greenland prepared a 'perspektivplan' (development plan) for Greenland until 1985. Some of the predictions in this work have already been shown not to hold true: the predicted 1985 population for Greenland of 55,000 now seems to be high, and will only be correct if unexpected outside immigration occurs. Internal migration is also difficult to evaluate; a decrease in the population in the hunting settlements from 4,511 in 1968 to 3,000 in 1985 was expected, and from 2,855 in the towns in the hunting area in 1968 to 2,000 in 1985, i.e. in the total hunting area 7,365 in 1968 to 5,000 in 1985, a decrease of 29.4% (Anon., 1970a: 43 et seq.). However, one of the assumptions which led to those predictions, the development of the towns in the central area, has slowed down.

The number of the people in the hunting area proper does not give the exact number of people dependent on hunting, because for many hunting is the main occupation whereas for others it is a sideline in combination with fishing, and it is impossible to unravel how the two occupations are mixed. However, in connection with emigration from the true hunting areas the general rule is that these migrants do not continue as full-time hunters in the towns but become wage earners. Even if we lack the exact number of full-time hunters, part-time hunters, and occasional hunters we suggest that the population size in the hunting area proper be used as a parameter of the situation for hunters in that at least their number is not increasing.

The significance of this, particularly with respect to social and economic changes, will be mentioned again in the section of the hunting pattern and methods.

Some other assumptions made in the prediction of population development in the hunting districts are no longer as clear cut as they were once thought to be. The political planning of the 1970s is not so dominated by the centralization of the population, and the development of marginal areas is no longer an alien idea. However, the conditions necessary for development in the true hunting districts are not yet present as there is no feasible plan to develop an infrastructure, or to increase the possibility of obtaining a monetary income in this area. The latter seems to be the main reason for emigration from the hunting population. A policy of this kind which is relevant for the small communities is necessary, and, if formulated may double the population of the true hunting districts by the end of the century.

HUNTING PATTERNS AND METHODS

Traditional methods and attitudes

One of the characteristics of the old harpoon hunting is that although it is difficult to get close enough to an animal to hit it, when you do hit it, the animal has only a small chance of escape. With total or almost total exploitation of the animal this means that exploitation is carried out with as little taxation of the stock as is possible.

During a hunting trip the actual hunting time spent chasing, harpooning and killing the animal is rather limited, while the 'pendling' from the settlement, and particularly from the hunting ground home, takes a long time. Although the kayak is an efficient and seaworthy hunting vessel, its capacity as a transportation vessel is low, and the total exploitation pattern which demands that the captured animal is almost immediately taken to a place where it may be flensed, normally to the settlement, also results in only a short period of actual hunting time.

Especially in those areas where the winter economy was based on seal hunting from kayaks, the idea of retaining an ecological balance was expressed and manifested itself in different ways. Many settlements were populated for only a few years before the people moved. There were in fact several settlements used 'in rotation' in this way. The formulated reason for this rotation was the conservation of local animal stocks (Rosing, 1926, p. 15).

Even though people knew of the periodical fluctuations in hunting conditions and consequently expected the periodical return of bad winters, they only collected their winter supplies (from the surplus in the summer) for a 'normal' winter. Hunting conditions are rather poor in winter even though there is usually some degree of hunting activity. It was only when people spent winters in unknown environments that they would store a large enough winter supply for a 'bad winter', i.e. a winter without successful hunting, as 'nobody could know how the winter should be' (Petersen, 1965, p. 117).

In contrast to what one might have expected, the hunting ceremonies of the past were less for the purpose of making hunting more 'efficient' than to try and give the people a respect for life and living creatures. In this way the avoidance of wasteful use of the captured animals was imprinted into the community mind. Outside Greenland this was also given a religious formulation while in Greenland the social aspects were more obvious. Especially with respect to those hunting expeditions under the leadership of an experienced hunter, young people, common hunters, and even the people at the settlements were taught not to catch more than they could utilize, and even though people normally avoided interfering in matters of other households, hunters who had to throw away meat were scolded by other men (Petersen, 1970, p. 189).

Technological modifications

Although the gun was introduced into land mammal and fowl hunting at the beginning of the colonization period in the early eighteenth century it was not used in kayak hunting until the middle of the nineteenth century for several technical reasons (Steensby, 1912, pp. 141–8). When these were solved, and the gun became part of kayak equipment, a discussion arose resulting from the fact that the increasing catch due to the guns was associated with an increased loss rate, as a proportion of the seals killed sank. (The harpoon gun was never common in Greenland, because it caused too much damage to the sealskins.) Many of the kayak hunters opposed the use of the gun in hunting, maintaining that (1) it frightened animals away, and (2) the loss rate was too high. However, during the course of this century certain hunting methods were developed which made it possible to use the gun and ensure that the prey was fastened before it sank, and using such methods it was even possible to hunt seals from motorboats. However, this development was particularly common in the fishing areas, where motorboats were primarily used for fishing and seal hunting was only occasional and opportunistic, i.e. if a seal was seen *en route* to or from the fishing grounds.

A further use of the motorboat is in the transportation to and from the hunting grounds of both people and equipment. The carrying capacity of a motorboat is so much greater than that of the kayak that it has made it possible to combine a limited centralization of the hunting population with exploitation over a greater area. The most deliberate and effective combination of kayak and motorboat use is in the Upernavik district where a well organized Hunters' Association often takes the initiative in suggesting hunting rules which the municipal council introduces.

One of the rules deals with the prohibition of the use of outboard motors throughout large areas considered important for breeding seals, while another rule prohibits the use of all kinds of motorboats near particular breeding areas (Anon., 1965, p. 36). In some natural harbours near the breeding grounds, markers were set showing the area where motorboats are allowed. At these harbours the motorboats serve as hunting camps from which the hunting operations themselves start. Often a group of hunters sails with the same motorboat, fitted with 'wings' protruding from the gunwhale, with space for six kayaks at a time. Thus both the carrying capacity of the motorboat and the hunting capability of the kayaks are used, while avoiding 'unnecessary' disturbance to the seals. Another essential activity of the Hunters' Association is the building and administration of hunting 'cottages' which are also used as hunting camps and in this way to extend the area exploitation.

In the past hunting regulations were not necessary. The techniques, exploitation pattern, distribution principles, and even the 'taboo' rules only allowed a low exploitation rate with maximum utilization of the animals killed. However, the increase in the population and the introduction of new techniques yielding more profit, resulted in a greater loss of animal life, and new hunting methods and regulations were developed to avoid any unnecessary loss.

In this century the climatic changes already mentioned altered the number and the availability of different

Plate 10. Motorboat with 'wings' for the transportation of kayaks, Upernavik, 1966. (Photo, R. Petersen).

exploited species, and it was found necessary to introduce hunting regulations with periodic provisions. In the succeeding Greenlandic debate it was hard for some people to accept this kind of game regulation. In the debate, climatic changes were rarely mentioned while the increasing traffic and the consequent increase in disturbance on the breeding grounds was the major issue. However after some time, resistance to these game regulations disappeared, and since then the debate has centred particularly on formulating regulations which satisfy both the hunter and the need for the conservation of stocks.

Even in recent years the technical and social aspects of hunting have played a role. In 1970 the Danish dominated Tourist Association arranged a caribou hunting trip by helicopter. The participants were brought into the field and brought back (Janussen, 1970). This expedition was not repeated for at least two reasons: (a) as caribou hunting on foot is in itself arduous and deters several would-be hunters it is therefore in effect a kind of 'hunting regulation' – without this other measures would be necessary, (2) the only people who could afford to hunt by helicopter would be 'sport hunters', a negative concept in Greenland where hunting is the main occupation of many people. The Greenland Provincial Council has in recent years introduced rather strict hunting regulations for people who are not primarily hunters (or fishermen) and in some cases they even affect what might be called 'necessary supplementary hunting' for low income people.

In connection with the decrease in the number of caribou (see p. 59) the Greenland Provincial Council cancelled winter hunting (Anon., 1978). Furthermore, permission given to some travel agencies to include caribou hunting in their programmes has been reduced to one animal per person which has made the Provincial Council rather unpopular among the travel agencies (Bachmann, 1978).

Skidoos (which resemble motorbikes on skis) are not allowed to be used for hunting in Greenland (Anon., 1967, p. 415). This may be considered as the voluntary avoidance of more efficient equipment. In 1974 a Danish teacher argued for the introduction of the skidoo in hunting in Greenland, listing a series of advantages this would bring (Kirk, 1974). However, the reaction towards its use was negative. Noise and the smell of gasoline were used as arguments against it, but it was also obvious that

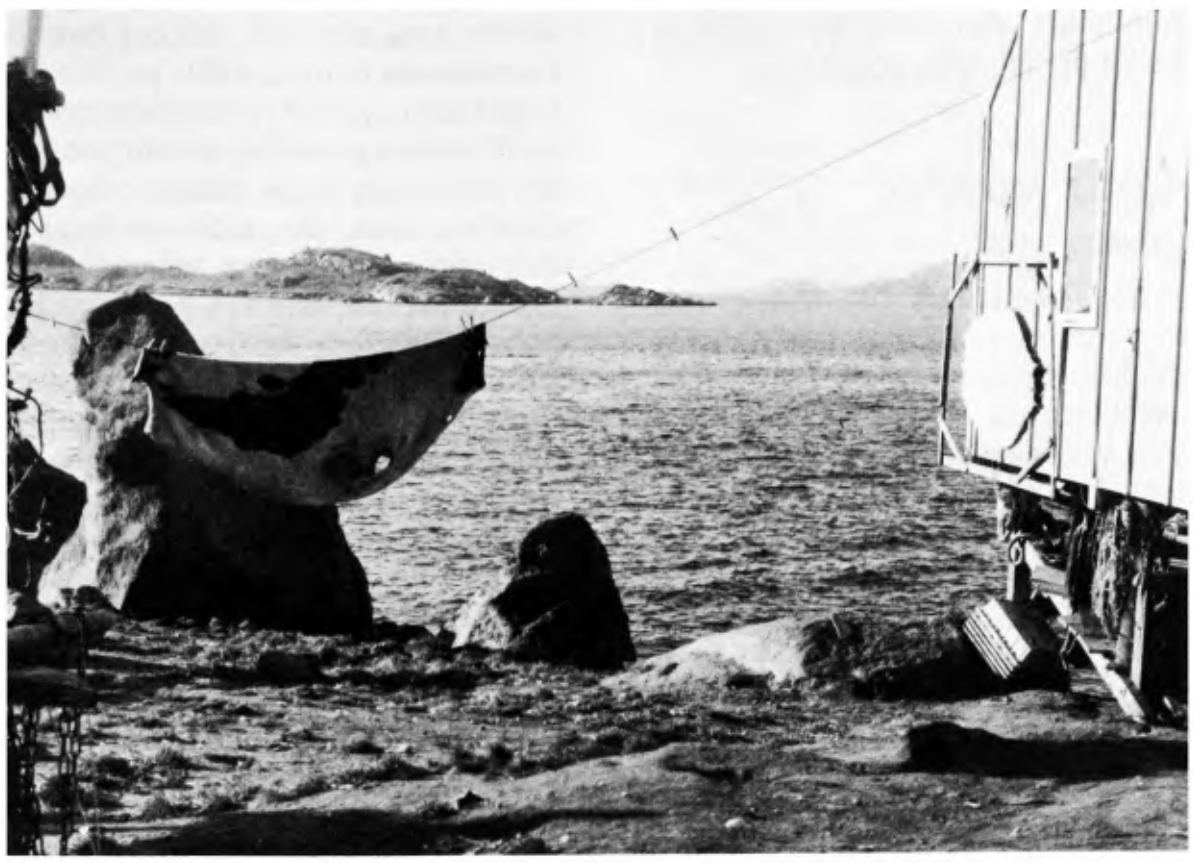

Plate 11. After flensing, the blubber is removed and the skin is washed several times. Between washes the skins are dried and finally stretched on a frame outside the houses. Harp seal skins at Proven, Upernavik district, September 1979. (Photo, K. Kapel)

the people were also trying to stop the expansion of hunting by wage-earners who could easily buy skidoos and would prefer to buy oil rather than fodder for the dogs, and who would probably have little respect for Greenlandic hunting traditions.

The skidoo plays a different role in Arctic Canada where the problem of feeding the dog team is different to that in Greenland, especially in those areas where the dogs were fed with caribou – an animal that needs protection. In Greenland, especially in the true hunting areas, the question of feeding the dog team is not a resource problem. The dogs are fed with meat that would otherwise be surplus, because of the lack of development of transportation to potential customers in the fishing areas, and furthermore the dogs are also fed with fish that are as yet under utilized. As a hunter therefore, you have 'free' fodder, as the time used for acquiring it cannot unequivocally be regarded as 'money'. So for the Greenlandic seal hunters in the dog traction area (north of 66° N), arguments *pro* and *contra* the skidoo are quite different to those in Arctic Canada. The Greenlandic dogsled is well suited for the Greenlandic conditions, and is based on Greenlandic resources.

Most of the examples discussed here concern hunting. Fishing in Greenland has generally been modernised to a greater extent and is more efficient than hunting. The investments in connection with the fish production are considerably greater than those of hunting. Nevertheless, there are clear statements by the president of the Hunters' and Fishermen's Association (KNAPP), Niels Carlo Heilmann, a fisherman himself, that regulations concerning fish protection may not be avoided in the long run, even if they would be unpleasant for the people in the present situation (Geisler and Egede, 1973, p. 32 *et seq.*).

Social and economic changes

Trade in some hunting products was introduced at the beginning of the colonization of Greenland; whale blubber which rapidly lost its importance; seal blubber which was exported until 1963; and seal skins, still the most important source of money income in the hunting area. The fur trade had always been of low importance, and cannot be described as even a 'secondary' occupation for anybody; it is at most of tertiary or perhaps quaternary importance in any household economy. Trade, and especially export, of hunting products was introduced as and is still a source of money necessary for covering the costs of guns, motorboats, wooden houses, daily clothes etc. Local consumption of hunting products is still the most important part of the hunting economy in Greenland. In the hunting area proper, national economic considerations are still of secondary concern when compared with the household economy: hunting products are still preferred for daily food, for hunting clothes, a great part of the hunting equipment and dog traction etc. In this area, only a little meat, and not all the skins are sold, some being used by people themselves.

Trade in hunting products in Greenland was introduced by the colonial authorities. The state authorities ran a campaign in the 1950s in order to increase the consumption of (imported) goods, hoping that it would encourage people to greater production. This campaign for increased dependence on a monetary income was of only limited success in the hunting area. Some of the monetary income in the hunting area proper originates from the sale of meat to the fishing districts. Production for home consumption is far better in the hunting area than in the fishing area where export production is structured in such a way that it demands the consumption of imported goods so that the need for money income is of vital importance. The fish products are exported, while the hunting products – with the exception of skins – are almost totally used within Greenland. The internal trade of hunting products may, therefore, again with the exception of skins, be regarded as an adaptation of the

old distribution pattern, where the principle was to give free meat to those households who could give meat in return, and sell it to those people who could not.

ECONOMIC ASPECTS

At individual and community level

The modernisation of the Greenlandic community has also touched the hunting communities, with new housing programs, limited technical innovations etc., such that the need for money has increased. Even though the sale of skins – the sole source of money income in the hunting area – is to some degree taken from 'surplus', i.e. skins that would not have been utilised at once, it did lessen the reserve supply, and was of course paid for by animal life.

However, there are no plans for modern production in the hunting area and no factories which process hunting products. This means therefore that there is no requirement for a constant supply of raw material and thus that the intensity of hunting is not dependent on an investment rate, and can survive the fluctuations in hunting conditions. Even though variation in the price of seal skins can be serious, as it has been in recent years, the value of the products for local consumption is almost totally unaffected.

Fishing on the other hand has been an export occupation from the beginning. Investments in the fishing industry are of a different character and a different magnitude to those in hunting: national and international economic considerations play a crucial role. The structuring of this occupation cannot disregard competition with foreign fishermen. The technological innovations within Greenlandic fishing are also linked to a wish to have a 'reasonable' share of the catch in Greenlandic waters. Nevertheless, the wish to protect the fish stocks around Greenland is one of the points in the Greenlandic fishing policy, as stated by the president of KNAPP.

REGULATION AND ADMINISTRATION OF THE HUNT

We have already mentioned two kinds of local regulations, one concerning new hunting technology, i.e. the prohibition of boats with outboard motors (Anon., 1965, p. 36), and one concerning the preservation of local hunting areas, i.e. the introduction of motorboat-free zones in the breeding grounds of the local seal stocks (*ibid.* p. 1). Municipal authorities are normally responsible for the latter type of regulation and for example many trout rivers are protected in certain years and no guns may be used near bird cliffs. In fact there are many examples of such regulations (Anon., 1969a, p. 4; Anon., 1972 (14), p. 79).

Another category of game and hunting regulations deals with hunting implements, e.g. the use of poison, electric shocks or the like is forbidden; the use of guns in fishing is forbidden (Anon., 1954, p. 179); the use of certain types of gun is forbidden (Anon., 1962, p. 323); and there are regulations concerning trout nets etc. with with aim of avoiding destructive fishing (Anon., 1957, p. 21).

The Greenland Provincial Council is responsible for other regulations which are concerned with time and place of hunting (e.g. of caribou and certain species of birds); there are seasonal or permanent rules which forbid hunting and the collection of eggs etc. In 1960 one fifth of the area in which the caribou lives was denoted as reservations (Anon., 1960, p. 152). It was not too difficult to get this accepted, as it was introduced in a period when caribou were plentiful, so that people did not feel the need for hunting in those remote corners of the hunting area. Caribou, hare, fox, eider ducks, ptarmigans and other different sea fowl are only allowed to be hunted for limited periods, and as a general principle, not during the breeding season; other species must not be hunted at all (Anon., 1959, p. 51–56; Anon., 1970, p. 201).

There are other kinds of regulations for conserving marine mammals. A vast area in North and East Greenland has been declared a national park, part of Melville Bugt has been denoted as a natural reserve, and the previously mentioned motorboat-free zones offer partial protection for some species. Quotas have been introduced for certain species of whales (as is also true for salmon and other fish species).

Many of the regulations concerning bird cliffs and trout rivers etc. are based on local regulations, some of which are permanent while others are introduced for a limited period when it is felt necessary. These regulations normally apply to everyone without exception. Nevertheless, there are a few cases in which some families with special local ties have priority and are made responsible for a 'reasonable' exploitation (Anon., 1965, p. 36). Normally these are families with a long tradition of local exploitation, and who have an interest in the protection of the local animal stocks.

The regulations dealing with the equipment are often of a permanent nature, and the same is true to some degree for the periodical protection of certain species, even though such regulations may be amended many times.

International agreements play the main role in the introduction of catch quotas, and Greenlandic political bodies normally have (at least in recent years) representatives at international meetings concerned with maritime rights (e.g. the Northwest Atlantic Fisheries Organization/NAFO).

Game regulations passed by local authorities seem to be regarded as the most relevant for the practising hunters, in that they seem to be more conscientiously obeyed than government notes and international agreement made at a central level, although of course, international agreements connected with export production, and thus sensitive to market pressure, have a rather obvious persuasive power. Game regulations seem to be better observed the more clearly the underlying reasons are understood by and brought to the attention of the hunters and in this connection game regulations at the local authority level seem to be the best path for effective management.

CONCLUSION

The concept of subsistence hunting may be interpreted as hunting for one's own need, but not necessarily as hunting for one's own (private) consumption, i.e. hunting without a distribution system. In the traditional Greenlandic hunting a distribution system based on reciprocal relationship was an important factor. Accordingly, subsistence hunting should be regarded as hunting for the household economy, with a distribution system which secures that the community shares the products.

From this point of view, the present Greenlandic hunting may be characterized as mainly subsistence hunting with only a minor commercial element. We regard the present internal trade of hunting products in Greenland as a development of the traditional distribution system in an adaptation to modern conditions, and in this connection it is significant that the basic hunting principles are still maintained, particularly in the true hunting districts. There is in Greenland a policy of conscious avoidance of making hunting implements or means of transportation too efficient, and any steps towards more 'rational' hunting is followed by new regulations.

In the preceding section we have made an attempt to describe the conditions for existence in Greenland, and some of the hunting principles which people have tried to comply with. Today between 20 and 25% of the population in Greenland is totally dependent on hunting, and for the remainder of the population a social and economic plurality rules. In this part of the population many individuals are no longer familiar with the traditional hunting principles, so violation of hunting regulations and even of the hunting principles do occur.

Nevertheless, through the public debate and the official game regulation policy traditional hunting principles are maintained in order to prevent a development towards unlimited exploitation of wildlife resources. The best way to counteract violations of game regulations seems to be the evolution of a conscious attitude to the need for wildlife protection, and in this respect game regulation at the local authority level offers an extra advantage in securing public participation in the formulation of exploitation and conservation policies.

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A/G – *Atuagagdliutit/Grønlandsposten*, a weekly newspaper in Greenlandic and Danish.

Gr. Fangstl. – Sammendrag af grønlandske fangstlister; Hunting statistics based on the Greenlanders' List of Game...

Grønland – *Tidsskriftet Grønland*, a periodical in Danish.

Grønland 1977 – A yearbook issued by the Ministry for Greenland.

ICES – International Council for the Exploration of the Sea.

ICNAF – International Commission for Northwest Atlantic Fisheries.

IWC – International Whaling Commission.

NAFO – Northwest Atlantic Fisheries Organization.

Lrsfh. – Grønlands Landsråds Forhandlinger, proceedings of the Greenland 'Lands' (Provincial) Council.

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Plate 12. Fishing vessel equipped with harpoon cannon, Igdlorssuit, Umanaq district, 1978. (Photo, F. Kapel)

Plate 13. Sperm whale blowing, resting quietly at the surface on the eastern slope of Fylla Banke, Southwest Greenland, August 1980. (Photo, F. Kapel)

Plate 14. Fin whale surfacing west of Umanaq Fjord, Northwest Greenland, September 1981. (Photo, F. Kapel)

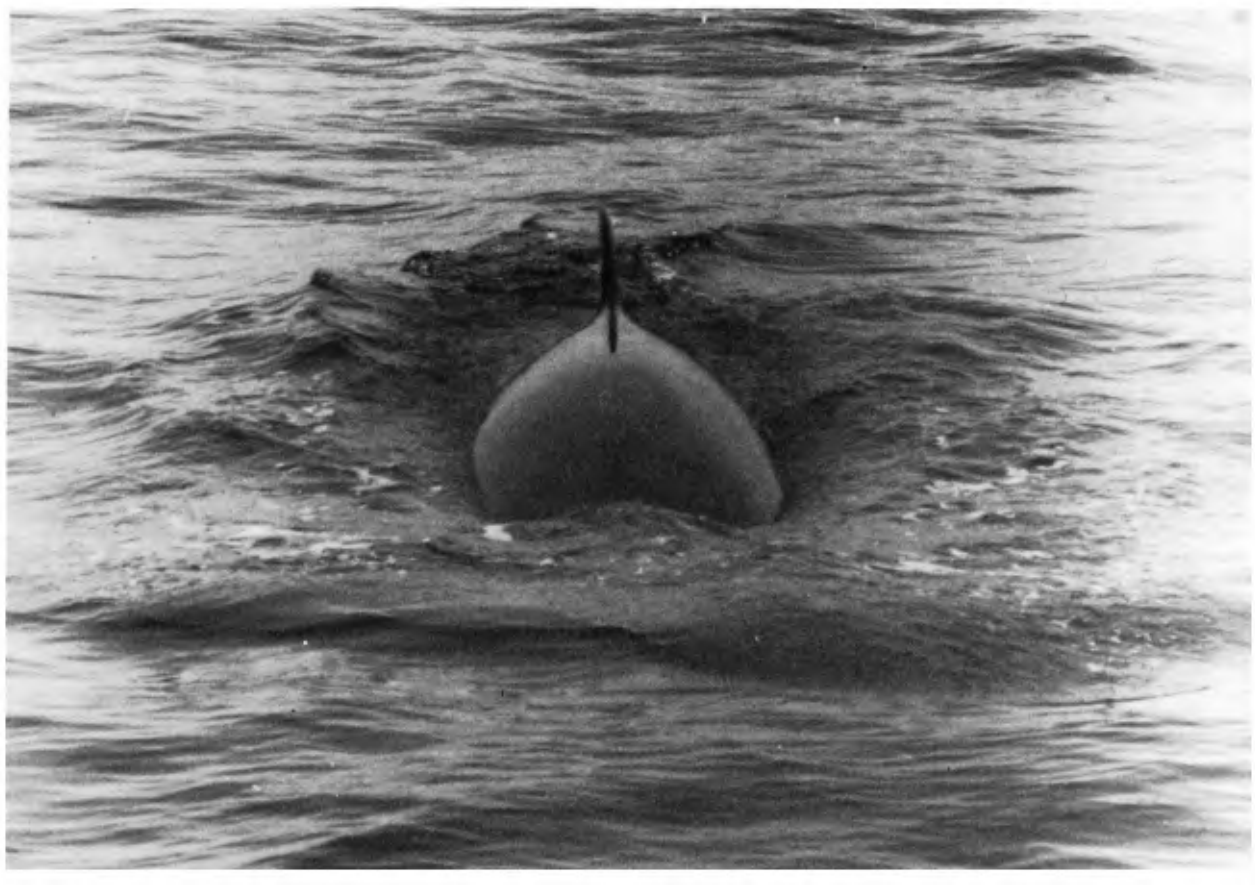

Plate 15. Minke whale diving under the vessel after marking west of Hareø, Northwest Greenland, September 1981. (Photo, F. Kapel)

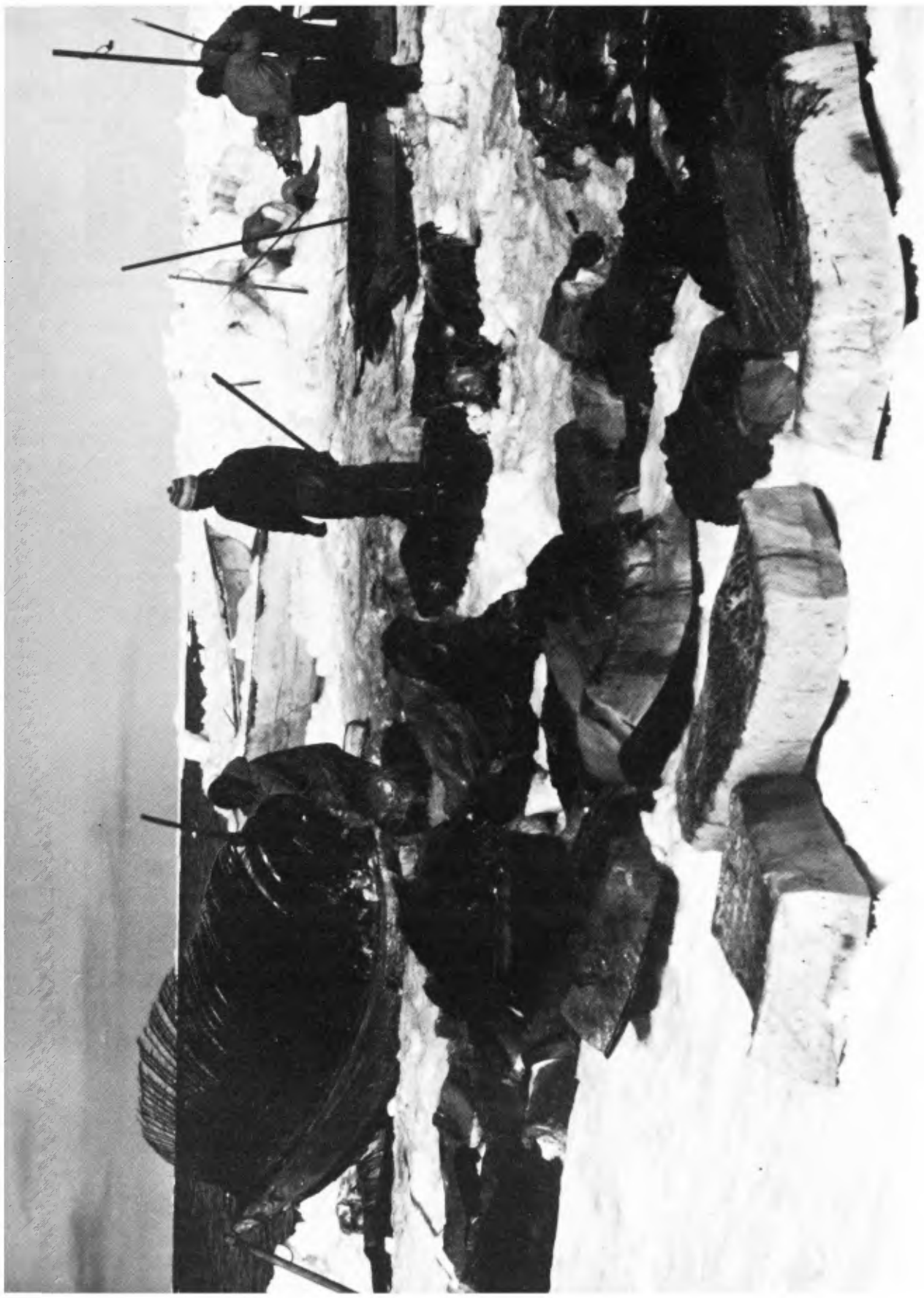

Fig. 8. Flensing of a bowhead whale has been completed, except for side of baleen that is about to be removed. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

Demographic Diversity, Length of Life and Aleut-Eskimo Whaling

W. S. Laughlin and A. B. Harper

Hunting is the master behavioral pattern of the entire human species, the regime under which our single species evolved and migrated to different areas of the world including America. Hunting therefore has many ramifications in human behavior and should not be minimized as a technique. The Eskimos and the Aleuts have distinguished themselves as masters of marine mammal hunting (Laughlin, 1968).

The early development of whaling by Aleuts and by Eskimos, at least five or six thousand years ago, is registered in several forms of evidence. One of the significant ways in which marine mammal hunting is registered in the human population structure is in their demographic diversity and closely correlated with this, in the thickness, mineralization and osteonal structure of their bones.

Archaeological evidence suggests that Aleuts have been hunting a full suite of sea mammals for at least five or six thousand years, and possibly many more. The stabilization of modern sea level as recently as 5,000 or 4,500 years ago has erased many or most earlier coastal village sites and therefore much more evidence.

The possibility that sea cows formerly lived in the Aleutian Islands is very good. Considering the distribution of Stellar's sea cow and its habits (Commander Islands), and the California and Amchitka fossil forms, and considering the habits of the sea cow and its incompatibility with human hunters, it is likely that sea cows inhabited appropriate parts of the Aleutian Islands. It is likely that their bones have been reworked into artifacts and continued in use long after the disappearance of the sea cow. Suggestive specimens have been found in the Nikolski Bay excavations, Umnak, but none has yet been examined histologically nor with other relevant techniques. One Hydrodamalis rib has been found in a sixteenth-century Eskimo midden in North Alaska likely traded from Siberia (Hall, 1971). Owing to their shallow habitat, their dependence upon sea weeds, their relative immobility and slow reproduction, they were as easily disposed of by skilled marine hunters, the first entrants into the Aleutians, as by the Russians on Bering and Medni Islands between 1741 and 1768. This appears to be the only sea mammal in the North Pacific whose extinction was caused by human hunting. That it served as a learning model for whaling, as suggested by Domning (1972), is reasonable. It is possible that the first inhabitants were already sufficiently skilled in marine mammal hunting that extinction of the sea cow in the Aleutians was foreordained. It is important to note that other sea mammals in the Aleutians were not discernibly affected in their numbers until the comparatively recent rise of the large Aleut population of some 16,000 and especially by commercial sea otter hunting under Russian administration.

Both Aleuts and Eskimos have slow population growth rates. This slow rate of growth coupled with originally small sized immigrant numbers, posed no problem for sea mammals for the first eight or nine thousand years of their population history. Even the sea otter, a notably slow colonizer, survived a century and a half of skilled and intensive commercial hunting. Numbers of sea otters, fur seals, and sea lions as well, were seriously diminished during the Russian and American periods. Kayak (*baidarka*) hunting of whales and porpoises appear to have had no discernible effect on the several species of whale and porpoises.

There are two different methods of whaling. One developed in the ice-free Aleutian area, possibly before the divergence of Aleuts and Yupik Eskimos from the ancestral Bering Sea Mongoloids on an earlier Bering Sea Coast, and apparently spread to the Kodiak Eskimo area, and perhaps later into the winter ice area of more northern Eskimos. The Aleut methods of hunting several species of whales depended upon a lance, propelled by a throwing board to achieve maximum penetration and hemorraging, from kayaks (*baidarkas*). The northern Eskimo methods used umiaks and harpoons with floats or drags, and astute observations on the movements of the bowhead whale near ice fronts and in leads. The actual retrieval of whales is difficult to compare. Comparable data on numbers of whales pursued, whales struck and whales retrieved is very sparse prior to the introduction of gunpowder and commercial whaling. There is tentative evidence that the effectiveness of kayak-lance-throwing board methods were more effective than umiak whaling and also that they were used effectively by Aleuts and Koniags as far south as the California coast. Comparisons are qualified by the differences in natural conditions: ice versus open water; kayak teams versus umiaks; greater frequency of whales and greater diversity of whale and porpoise species in the ice-free area of the Aleutians; greater penetration of the lance propelled by throwing board; and larger number of passes, straits and complex coastlines in the Aleutian domain. The deployment strategy of the Aleut kayak hunters, either single-hatch or the faster two-hatch (more common in the 1800s) enjoyed several advantages in speed and numbers that were important to pursuit of the whale, striking, and retrieval.

The cultural attention of Aleut and Eskimos to whales is well demonstrated from Attu in the west to Angmagssalik in the farthest east of the Aleut–Eskimo domain in the burial practices which commonly employed some bones of the whale (Laughlin, 1952) and in the religious beliefs (Marsh, 1954). Both Aleuts and Eskimos are clearly addicted to whales and this is often manifested in whaling. There are important exceptions, as noted by Kroeber (1939) and by Freeman (1979) in the

central Canadian Arctic where the population numbers are inadequate to, (*a*) maintain adequate numbers of umiak crews, and (*b*) maintain the whaling crews with adequate supplies of food and other materials necessary to the long period in which they must give their attention to whaling and refrain from other economic activities.

A fundamental cultural difference is the 'fear of the dead' of Eskimos; and the diametrically opposite preparation of the dead into mummies and consultation with the dead as continuing village members and mentors in the Aleut culture. Aleuts regularly prepared their dead as mummies and interred them in their villages or in nearby mausoleums, caves, and rock shelters. Some 240 mummies have been inventoried for Kagamil Island alone, including among them infants and old people of both sexes, not just the honored whalers erroneously suggested by literary sources. Similarly, the use of an effective poison (aconite) is unsubstantiated and is a part of a dubious literary exegesis (Bisset, 1976).

In analyzing the aboriginal whaling systems it is useful to evaluate them in terms of their productivity and effectiveness posed by the demands of the populations that used them. This approach yields a very useful observation, that these systems, either of kayak or of umiak whaling, were effective for the populations that depended upon them. Conversely, they could not satisfy the requirements of commercial whaling. Using the Aleut system for the explanation, it is immediately apparent that it prospered upon a large number and diversity of whales present, passes, bays, and facing island clusters with complex coastlines, lever propulsion of a deep penetrating lance, deployment of several whalers in kayaks, and the capability of towing some of the whales back to the initial sighting village. Stranded whales were made use of, wherever they stranded, and many of the whales struck were stranded sometime later on a coastline over which the whalers had little control. A major difference between commercial and aboriginal whaling immediately becomes apparent. The Aleuts and Eskimos, individually, as families, and sometimes as entire villages, went to the whale, spending as long as necessary there to process the whale for their food and fabricational purposes. The commercial whalers in marked contrast had to retrieve their whales and return them to the mother ship or to a fixed processing station on land, and then by a manufacturing process deliver selected products only to customers some thousands of miles away. In terms of most thorough utilization of a whale, the Aleuts and Eskimos had both effective systems for whaling and for consumption by the local populations that depended upon those whales.

Demographic diversity provides an informative insight into aboriginal subsistence sea mammal hunting, including whaling. In broad perspective, the Eskimo communities are characterized by high fertility, high infant mortality and relatively short length of life (Harper, 1979), in contrast to the closely related Aleuts who are characterized by lower fertility, lower infant mortality and greater length of life (Table 1). Both Aleuts and Eskimos share a slow population increase rate. Population size and population growth rates are worth exploring for past millennia as well as the most recent. It directly concerns discussions of extinctions of both marine and land mammals. The possible extinction of the sea cow in the Aleutians is a case in point for the earliest period, and the inability to bring about extinction of the sea otter during the recent century, even with the addition of commercial hunting, represents the other end of the range.

Table 1
Life expectancy of Aleut versus Eskimo

	Male	Female
Paleo–Aleut[a]	35.8	37.7
Sadlermiut Eskimo[a]	19.7	23.8
Fox Aleut, 1820[a]	32.7	39.0
Labrador Eskimo, 1820[a]	30.7	30.7
Aleut, 1948[b]	25.2	26.8
Angmagssalik Eskimo, 1954[b]	21.1	21.1
Aleut, 1973[b]	41.4	35.9
Wainwright Eskimo, 1968[b]	28.7	24.1

[a] At age 10.
[b] At age 15.

One of several aspects of demographic diversity affecting hunting is that of length of life. The Aleut hunting communities are distinguished by many older persons of both sexes than are found in northern Eskimo communities. There is accumulating evidence from Greenland, Canada, north Alaska, and the Soviet Union, that a shorter length of life has long been characteristic of northern Eskimos and that this pre-contact characteristic continues into the living populations (Laughlin, Harper and Thompson, 1979). In the Aleutians the contributions of older persons, those over age seventy, were tangible (Laughlin, 1980). First, owing to the extensive strandflats, shores, and reefs, they could collect a significant part of their own dietary requirements. They procured sea urchins, octopus, limpets, mussels, whelks and chitons, along with various edible seaweeds. They also fished from the shore by handline and old men also fished from baidarkas (kayaks) and from baidars (umiaks), usually inside bays and other protected waters. They were useful also in helping with the drying of salmon, halibut and cod, and sea animals (Table 2). This contrasts remarkably with the situation in northern communities where there were fewer options for old persons and fewer old persons to exercise those options.

The other major area in which old people were an important factor lay in their sophisticated knowledge of human anatomy and medical practices (Marsh and Laughlin, 1956). Skilled practitioners delivered babies, sutured, studied comparative anatomy, conducted autopsies, practiced blood letting, acupuncture, and prepared mummies of the dead for retention by the community. Older persons were asked for advice by younger midwives during problem deliveries. Long after their actual participation in active hunting or as midwives, they continued as mentors and advisors.

An interesting aspect of the aging process and the life expectancy tables with important connotations for nutritional and metabolic analysis lies in the bone biology of the Aleuts and Eskimos. There is a significant difference in bone mineralization. The Aleuts have greater cortical thickness and higher bone mineral content at equivalent ages. This is crucially important in terms of frequency of induced and spontaneous fractures and of osteoporosis in general in which northern Eskimos appear to be at higher risk.

The bone biology of pre-contact Eskimos and of living Eskimos (Mazess and Mather, 1974, 1975; Harper and Mazess, 1980), is much the same from Siberia through

Table 2
Habitats keyed to kinds of individuals

Individuals*	Inland	Lakes and streams	Beach	Reef	Bay	Offshore islands	Cliffs	Open sea
Old infirm females	+	+	+	+	+	–	–	–
Old infirm males	–	+	+	+	+	–	–	–
Pregnant women	(+)	–	(+)	(+)	(+)	–	–	–
Children	–	+	+	+	+	(+)	(+)	–
Young to middle-aged females	–	(+)	+	+	+	+	+	–
Young to middle-aged males	(+)	+	+	+	+	+	+	+

* Increasing mobility from top to bottom.
Beginning with the kinds of people, their use of the habitats is indicated by a plus sign. Parentheses indicate qualified use or special limitations. This chart provides no indication of the different methods of using the same area nor the different resources procured. Thus old men hand-line fish the bay from boats; old women fish from the shore. Men collect driftwood suitable for manufacture of boat frames; women collect driftwood suitable only for fuel.

northern Alaska, Southampton Island and Greenland, although the consumption of whales appears to have been greatest in Alaska. Aleuts consumed as many or more whales, with whales providing an approximately similar proportion of their diet (and toothed whales for lamps, but not for dietary consumption) as north Alaskan Eskimos. Clearly, we may infer that whales, as such, do not inhibit bone growth or mineralization.

Another area of relevance in aboriginal subsistence hunting is in the corollary between longer length of life, the period of child and adolescent growth, and the intensity of specific tutoring of children. Marine mammal hunting which depends on the use of either the kayak or umiak, or on both, stipulates more intense and more specific programming of children in boat handling, navigation, animal behavior and the combination of these and other behaviors in whaling than is the case for land mammal hunting. The Aleut and the Koniag Eskimo monopoly on sea otter hunting is fairly well known. The actual child training practices are probably better known for the eastern Aleuts (Laughlin, 1980). There is no record of any European in western Alaska who learned to successfully hunt from a kayak with the native technology. The Russians were forced to depend upon the Aleuts and Koniags because kayak hunting was more efficient than any of their hunting methods. What may be overlooked is the efficiency of sea mammal hunting generally, including whales, with kayak hunting. In contrast, European whaling methods were emulated to some extent by umiak whalers.

Owing to the environmental limitation on the numbers of active male hunters who continued ice hunting through the winter and early spring and the diminished numbers of species available, whaling was more important in northwestern Alaska and Chukotka than in southern Alaska where there was greater species diversity and also a higher percentage of the population engaged in hunting, fishing and collecting activities throughout the year.

It may be reliably remarked that a perduring concern with whales has long been firmly woven into the fabric of Aleut and Eskimo culture and population history. The ramifications are diverse and complex. The antiquity of whaling likely precedes the division into Yupik and Inupiaq Eskimos of some 5,000 years ago, and possibly precedes the division into Aleut and Eskimo of some 10,000 years ago. Pinnipeds and fish have been the principal nutritional foundation of Aleuts and Eskimos with few exceptions. Whales, porpoises and narwhals have been of critical importance in several areas within the Aleut–Eskimo domain at various times in their long history.

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Belukha killed by Eskimo hunters during spring bowhead whaling season is being towed to shore-fast ice for butchering. *Photo by W. M. Marquette, National Marine Mammal Laboratory, Seattle WA 98115.*

The International Whaling Commission and Aboriginal/Subsistence Whaling: April 1979 to July 1981

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INTRODUCTION

At its 30th Annual Meeting, the International Whaling Commission (IWC) adopted a resolution to examine the aboriginal whaling problem and develop proposals for a management scheme for the Alaskan bowhead fishery and, if appropriate, for other aboriginal fisheries (IWC, 1979a, p. 26).

Gambell (1982), has summarised the bowhead whale problem up to the panel meeting of experts on aboriginal/subsistence whaling which was held in Seattle in February, 1979. This paper is intended to be a summary of (and not a comment on) the action taken by the IWC since that meeting concerning aboriginal/subsistence whaling and particularly the Alaskan bowhead and Greenland humpback whale fisheries. A commentary on the Alaska bowhead problem is given by Mitchell and Reeves (1980b).

TECHNICAL COMMITTEE WORKING GROUP, 1979

A Technical Committee Working Group (IWC, 1979b) met in Washington D.C. in April to discuss the report of the panel meeting (IWC, 1982a) and to attempt to formulate proposals for the management of the bowhead and other aboriginal fisheries in accordance with the above resolution. The working group's recommendation concerned only bowhead whales and took the form of a Schedule[1] amendment and a supporting resolution. The proposed Schedule amendment allowed for a take of bowhead whales not to exceed the lesser of:

(i) the 'documented need' of aborigines
(ii) 50% of the estimated net recruitment provided this did not exceed the number of whales which may be taken from a stock at 91% MSY level under the existing rules of the Commission (IWC, 1979c, para 8(a)).

However recognizing the scientific problems involved in estimating either net recruitment or MSY some members of the working group proposed:

(i) that the catch should be 1%, or the number struck 1.5%, of the current population size, whichever occurred first,
(ii) that the catches for 1980 and 1981 should not exceed 20 whales landed or 27 struck, whichever occurred first.

These latter points were referred to the Scientific Committee for comment.

[1] The Schedule contains the IWC regulations concerning whaling operations (catch limits, seasons etc.). To amend a provision of the Schedule a three-quarters majority of the votes cast is required.

SCIENTIFIC COMMITTEE MEETING 1979

(i) Bowhead whales of the Bering Sea Stock

The sub-committee on protected species and aboriginal whaling (IWC, 1980a) examined the results of the spring 1979 census (Braham *et al.*, 1980) and concluded that for various reasons, including unsafe ice conditions, the estimate of population size obtained for 1978: 1,783–2,865 with a mean of 2,264 (IWC, 1979c), should be regarded as the best available estimate. One of the major concerns expressed by the sub-committee was over the very low apparent gross recruitment rate (2.5–3.5%). Between 1973 and 1978 (assuming that 50% of the animals struck and lost subsequently died) the average annual number of removals from the stock was 45, of which 90% were immature. Thus a very high proportion of the recruitment to the adult stock had been removed. Assuming that the natural mortality rate of the bowhead lies in the range of 4.0–8.5% found for other baleen whales, then the stock must decline even in the absence of catching. In accordance with the sub-committee, the Scientific Committee (IWC, 1980b, p. 55) (in addition to recommendations on future research, particularly concerning recruitment estimates) reconfirmed its view of three previous meetings that 'from a biological point of view the only safe course is for the kill of bowhead whales from the Bering Sea stock to be zero'.

(ii) Humpback whales off Greenland

The sub-committee reviewed (IWC, 1980a) the known removals (30) from this stock which on the basis of the available estimates of stock size (800–1,500: Mitchell, 1973; Winn *et al.*, 1975), represented 2–4% of the population. Two thirds of these removals were due to the Greenlandic fishery. The Scientific Committee (IWC, 1980b, p. 56) adopted the recommendation of the sub-committee that 'the exemption for a Greenland catch of 10 humpbacks be removed and that steps should be taken to reduce the deaths due to net entrapment off the US and Canadian coasts'.

COMMISSION MEETING 1979

(i) Bowhead whales

The Commission reviewed the report of the Technical Committee Working Group (IWC, 1979b) in the light of the Scientific Committee's recommendation. After two proposals, one for 18 whales landed and 27 struck and one for a zero catch, failed to obtain the necessary three-quarters majority, the Commission adopted a quota of 18 landed or 26 struck for the 1980 season (12 votes for, 4 against and 7 abstentions). It also adopted

a resolution (IWC, 1980c, Appendix 4) which stated that the IWC would institute a management regime such as that indicated by the Technical Committee Working Group following completion of scientific analyses, and that the stock would not be subjected to undue risk. The resolution also detailed the type of management plan that it expected the US Government to implement, including practical details such as numbers to be taken and research and reporting requirements. The USA was also to submit annually, documentary evidence on the needs of the Eskimos based upon nutritional, historic and cultural factors. The Commission retained the 'authority to take emergency action if an unforeseen circumstance should create an imminent threat to the bowhead whale population.' The resolution was to be reviewed at the 1981 Annual Meeting.

(ii) Humpback whales off Greenland

Denmark explained that the take of 20[2] whales (10 more than allowed) in 1978, was due to reporting problems and that the 1979 catch had been stopped at 10 whales. The proposal to remove the exemption clause for 10 humpback whales failed to obtain a majority (6 votes for, 7 votes against, 9 abstentions) and so remained in the Schedule but the Commission adopted the recommendation of the Scientific Committee regarding net entanglements.

SCIENTIFIC COMMITTEE MEETING 1980

(i) Bowhead whales

The sub-committee on protected species and aboriginal whaling (IWC, 1981a) examined the data from the US research programme up to June 1980 (Johnson *et al.*, 1981). It noted with concern that the 1980 quota had been exceeded by 5 animals (the majority of the catch had occurred over a two day period). The census results for 1980 were considered more reliable than those for 1979 as effectively 100% coverage was achieved during the main migration period. Prevailing ice conditions had delayed the migration by about one month. The resultant estimate was 1,643 animals (range 1,483–1,786). The sub-committee believed that the principal reason for the counts being lower than in 1978 was the greater width of the ice leads in 1980 which increased the possibility of missing animals. Estimates of initial stock size based on historical studies were presented ranging from 10,000–40,000 (Bockstoce and Botkin, 1980; Tillman *et al.*, 1980). Although there was considerable debate over the validity of the methods used, the sub-committee noted that even with the range of estimates available, the current population size was still only 6–23% of its initial size. Furthermore, a simulation study (Braham and Breiwick, 1980) indicated that the population would decline even in the absence of catching, unless the 'most optimistic' set of parameters were used, although it was recognised that most of the parameters for the bowhead were poorly documented or completely unknown. Again concern was expressed at the low proportion of calves. The full Scientific Committee (IWC, 1981b, p. 65) reiterated its view that the only safe course was for no whales to be taken. However it noted 'that the Commission has consistently rejected this recommendation on grounds other than scientific ones' and recommended, should the Commission again reject its advice, that the kill be restricted to sexually immature animals to maximise reproduction in the short term and that whales should be taken in a manner that would reduce the struck-and-lost rate to zero.

The sub-committee had also examined the scientific aspects of a proposal to substitute gray whales for bowheads in the fishery (Storro-Patterson, 1980; Marquette and Braham, 1980; Mitchell and Reeves, 1980a). It noted that gray whales were not equally available to all villages and that gray whaling was possibly only feasible for villages south of the Bering Strait; gray whales were also available at a different time of year (summer) when other subsistence activities took place. The sub-committee was unable to evaluate the relative dangers in gray and bowhead whaling but noted that the feasibility of gray whaling using traditional methods was shown by its occurrence in earlier years in the Bering Sea and along the northwest coast of Alaska.

(ii) Humpback whales

The West Greenland fishery in 1979 took 14 humpback and 7 fin whales, although the IWC regulations stated that the combined catch of humpback and fin whales should not exceed 15 whales of which no more than 10 should be humpbacks. This followed a catch of 21 humpbacks (quota 10) in 1978. The sub-committee on protected species and aboriginal whaling (IWC, 1981a) was informed that this was largely a problem of communications between the whalers and the authorities and that this would be improved in 1980.

The total known removals from this stock of humpback whales in 1979 was a minimum of 32 animals. At least 18 animals had died as a result of net entanglement in fishing gear off the eastern seaboard of the USA and Canada. Although two new estimates of the population size of this stock on the breeding banks were presented, one contained insufficient information for review while the other arrived at too late a stage in the meeting to be considered. Accepting Mitchell's (1973) estimate of 1,259 animals, removals represented about 2.5% of the total population which may be close to its net recruitment. The full Committee (IWC, 1981b, p. 66) recommended that studies on net entanglement and the development of warning devices be continued as a matter of urgency and that 'until such time as more reliable estimates of population size are available...that the exemption for a Greenland catch of 10 humpbacks be removed (as previously recommended)'.

US DEPARTMENT OF THE INTERIOR INTERIM REPORT ON ABORIGINAL/SUBSISTENCE WHALING OF THE BOWHEAD WHALE BY ALASKAN ESKIMOS

In accordance with the Resolution adopted by the Commission in 1979, the USA presented an interim report (Department of the Interior [USA], 1980) which discussed the historic, cultural and nutritional aspects of the bowhead fishery and attempted to quantify the needs of the Eskimos in terms of whales landed based on these three aspects of the hunt. A critical review of this document is given by Mitchell and Reeves (1980b, Appendix).

[2] Later revised to 21 (IWC, 1981a).

Table 1.
Historical records of bowhead whaling, including average annual catch per capita (K) and estimates of projected historical needs for selected villages. Data from Department of the Interior [USA], 1980

	Barrow	Point Hope	Wainwright	St Lawrence	Kaktovik	Kivalina
1930s						
Average population	336	258				
Total whales caught	63	5 (2 yrs)				
K	0.0188	0.0097				
1940s						
Average population	657	261	284			
Total whales caught	39	28 (7 yrs)	5 (4 yrs)			
K	0.0059	0.0153	0.0044			
1950s						
Average population	1,153	294	240	334[1]		
Total whales caught	52	24	3 (2 yrs)	5 (5 yrs)		
K	0.0046	0.0082	0.0063	0.0030		
1960s						
Average population	1,709	355	284	358[1]	122	166
Total whales caught	77	30	11	2 (2 yrs)	2 (1 yr)	1 (1 yr)
K	0.0045	0.0085	0.0039	0.0028	0.00164	0.0060
(i) K, 1930–69	0.00845	0.014	0.0049[2]	0.0029	I.D.	I.D.
(ii) K, 1960–69	0.0045	0.0085	0.0039	0.0028	0.0164	0.0060
(iii) K, 1977. Estimate based on regression analysis of K, 1930–69	0.0034	0.0096	I.D.	I.D.	I.D.	I.D.
(iv) Population in 1977	2,200	412	398	420 (?)	134	191
Projected needs						
1: (i) × (iv)	19	6	2	1	—	—
2: (ii) × (iv)	10	4	2	1	2	1
3: (iii) × (iv)	8	4	—	—	—	—

[1] Gambell [2] Wainwright, 1940–69 [3] Gambell, 1950–69 I.D. Insufficient data.

Table 2.
Estimation of the nutritional need of Eskimos in Alaska from Department of the Interior [USA], 1980

Village	(1) Population[1]	(2) Food from native sources (%)[4]	(3) Native food from bowhead (%)[1]	(4) Total food from bowhead (%)[2]	(5) Estimated quota landed or struck[3]
St Lawrence	842 (1978)	71	5	3.5	2
Wales	168 (1976)	59	1	0.6	0
Kivalina	191 (1976)	80	6	4.8	0.5
Point Hope	412 (1977)	75	36	27.0	4
Wainwright	398 (1977)	56	14	7.8	2
Barrow	2,220 (1977)	53	35	19.0	23
Nuiqsut	157 (1977)	?	?	?	0
Kaktovik	134 (1977)	73	25	18.0	1
Total					32–33

[1] Source: Peterson (1978)
[2] I.e. column (2) × column (3) ÷ 100.
[3] I.e. (column (1) × column (4) ÷ 100) ÷ 18.4 (18.4 is calculated man years of food from an average bowhead, Milan, 1980).

(i) Historic need

The report presented the available catch data by village for the period 1930–69 – a period during which it was considered that the take of bowheads both met Eskimo needs and was not affected by external sources. It was found that for the two villages where sufficient data were available, there had been an almost uniform decline in the *per capita* whale catch. Several possible explanations were advanced, including the increasing availability of other (non-native) foods and an increasing reliability on a cash economy. Table 1 summarises the available data and provides estimates for the current need based on:

(1) the average catch *per capita* 1930–69
(2) the average catch *per capita* 1960–69
(3) the extrapolation of the 1930–69 trend in average catch *per capita*.

The report concluded that on a historical basis, the annual needs are:

Barrow: 8–19 whales
Point Hope: 4–6 whales
Wainwright and Kaktovik: 2 whales each
Gambell and Kivalina: 1 whale each
Wales: 1–2 whales

The value for Wales was based on 'sporadic historical records and comments by Worl (1979)'.

(ii) Nutritional need

The report examined the available alternative food sources including other marine mammals, birds, fish and

terrestrial mammals, the possible effects on the health of the Eskimo population if a shift in diet to non-native foods occurred and the food preferences of the Eskimos themselves. To quantify the nutritional need an approach similar to that proposed by McLoskey (1980) was used but which incorporated two important corrections: the estimated contribution of an average bowhead was revised from 80 to 18.4 man years per whale (Milan, 1980, p. 14) and the calculation of the % contribution of the bowhead to the Eskimo diet was also revised (Peterson, 1978). Table 2 below is based on Table 4 of the report. The report concluded that between 32–33 whales per year must be taken to maintain a proportional share of the subsistence diet in accord with the share in 1969.

(iii) Cultural need

The report described the significance of bowhead whaling to Eskimo culture. Before attempting to quantify the size of any catch required on cultural grounds the report noted that the wide fluctuations in the historic catch had not changed the Eskimo culture and that indeed they were part of that culture. It was also noted that 'because the culture was based on the opportunity to hunt, to participate in whaling activities, and not the number of whales landed, it is difficult to quantify a catch on the basis of cultural needs'. With this proviso the report then went on to estimate the cultural need making the following four assumptions:

(i) that the catch per crew is an important cultural measure of the hunt,
(ii) that the 1960s provide a base period when cultural needs were met,
(iii) that the best data for whales landed and crews operating during the 1960s are for Point Hope, Barrow and Wainwright,
(iv) that the needs for other villages ('based primarily on recent historic catch records') are six whales annually.

If C_{min} = Minimum cultural need
C_{max} = Maximum cultural need
$C_{max'}$ = Alternative maximum need (avoiding F)
Cr_{60} = Average no. crews, 1960–69 (Point Hope, Barrow and Wainwright)
S_{60} = Average success per crew 1960–79 (above 3 villages)
N_{60} = Average population 1960–69 (above 3 villages)
N_{77} = Average population, 1977 (above 3 villages)
N_{80} = Average population, 1980 (all villages)
F = Correction factor of 6 whales from (4) above.

Then the report estimated the cultural needs as follows:

(1) $C_{min} = (Cr_{60} \times S_{60}) + F$
$= (31.1 \times 0.38) + F$
$\simeq 18$ whales landed per year

(2) $C_{max} = (Cr_{60}/N_{60} \times N_{77} \times S_{60}) + F$
$= (0.013 \times 4460 \times 0.38) + 6$
$\simeq 21$ whales landed per year

$C_{max'} = Cr_{60}/N_{60} \times N_{80} \times S_{60}$
$= 0.013 \times 4460 \times 0.38$
$\simeq 22$ whales landed per year

THE COMMISSION MEETING 1980

(i) Bowhead whales

The USA presented their document (Department of the Interior [USA], 1980) to the Technical Committee, stating that the cultural need had the greatest significance to the community. Its proposal for a catch limit of 18 landed and 26 struck was defeated, and the Technical Committee adopted[3] a proposal for a zero quota. The Commission failed to adopt this proposal (7 votes for, 8 against and 8 abstentions). The Seychelles proposed that as a compromise between the cultural needs of the Eskimos and the biological status of the bowhead stock, a quota of 8 whales landed (one for each traditional whaling village) or 12 whales struck (assuming one whale is lost for every two landed) be adopted. This proposal too was defeated (5 votes for, 9 against and 10 abstentions). The Commission agreed to postpone further discussion of this item until later in the meeting to allow informal consultation to take place.

Following these consultations a proposal was made from the Chair for a catch limit for the three years 1981–83 of 45 whales landed and 65 struck, provided that in any one year the number of whales landed should not exceed 17. The United States pointed out that 'a sustained harvest of bowhead whales at current levels over an extended period of time would endanger the herd and would jeopardise the Eskimo's own interest'. It would therefore 'progressively reduce the quota...within the figure established by the IWC'. The proposal from the Chair was adopted by 16 votes to 3 with 5 abstentions (IWC, 1981c, p. 18).

(ii) Humpback whales

During the Technical Committee meeting Denmark had explained why it was not ready to adopt the Scientific Committee advice: humpback whales had been caught for at least 200 years (evidence from written records) and probably much longer; the catches form part of a complex pattern of exploitation (see Kapel and Petersen, 1982) and are the only basis of subsistence in some areas; humpbacks are easier to catch than fin whales and the hunters believed the numbers to be increasing; the authorities were taking steps to improve the control situation to prevent the catch limits being exceeded. The Technical Committee voted to remove the Greenland exemption by 10 votes to 4 with 10 abstentions but the proposal failed to gain the necessary three-quarters majority in the full Commission (8 votes for, 3 against and 13 abstentions; IWC, 1981c, p. 18).

(iii) Management principles and guidelines for aboriginal/subsistence whaling

The Commission agreed (IWC, 1981c, p. 17) to establish a working group of the Technical Committee which would develop management principles, in particular for the setting of allowable catches. The group would include representatives of the Technical Committee, the Scientific Committee and indigenous peoples involved in whaling. The group was to report to the Technical Committee at the 1981 meeting on the understanding that its report would not be considered for implementation by the Commission until the 1982 meeting in order that it may be reviewed by the concerned indigenous peoples.

SCIENTIFIC COMMITTEE MEETING 1981

(i) Bowhead whales

The sub-committee on protected species and aboriginal whaling (IWC, 1982b) examined the data from the United

[3] A simple majority is sufficient in Technical Committee.

States research programme up to the spring of 1981 (Marquette *et al.*, 1982). It noted with great concern that five crews had operated after the official closure of the hunt in May 1980 when 3 bowheads were struck and 1 landed: the IWC quota was exceeded by 8 strikes. However it was informed that agreement had been reached between the US Government and the Alaska Eskimo Whaling Commission (AEWC) and that it was unlikely that such a situation would occur again. The sub-committee was also concerned at the high proportion of females (78.6%) and animals more than 12 m, given its recommendation of 1980.

The spring census covered 74% of the time the ice leads were open and the population was estimated to be between 2,025 and 2,459 (best estimate 2,242). The 1980 census estimate was revised to take into account an error in percentage missed and a correction factor for reduced sightings distance during periods of high whale density. The revised values were 2,247–2,671. The 1978 estimate of 1,783–2,864 is still considered the most accurate.

An updated estimate of the 1848 population of the Bering/Chukchi Sea stock of bowheads (Breiwick and Mitchell, 1982) gave a range of 9,000–18,000 animals. The sub-committee considered that the magnitude of the catch (15,000) during the first 40 years of the fishery suggested that the population probably lay nearer the upper end of this range. Accordingly the current population is about 10–32% of the 1848 population and probably nearer to the lower value.

Information on calf counts (Marquette *et al.*, 1982; Cubbage and Rugh, 1982) suggested that aerial counts were generally higher and more reliable than ice or ship based counts. Aerial surveys in the eastern Beaufort Sea gave a calf production estimate of 3.4%. Assuming 75% mortality of struck and lost animals, the 1980 kill represents about 1.3% of the current (2,264) population. Assuming a mortality rate within the range of other baleen whales (4–8.5%) then the population may only be stable or even decreasing even if there is no kill.

Reviewing the information the Committee (IWC, 1982c) noted that 'any kill whatsoever will increase the risk of this already small stock declining further'. Yet again the Committee recommended that the catch be zero to 'reduce the probability of the extinction of the population', as the only 'safe course for the Commission to take' – there is no guarantee that this would result in the recovery of the population.

The Committee went on to say that given the 1980 decision of the Commission 'to set a three-year quota for the Bering Sea bowhead population, and if it decides to continue this regime, the Committee strongly recommends that removals of any kind should be (*a*) of sexually immature animals (less than 12 m long) in order to maximise reproduction in the short term and (*b*) taken in a manner that will reduce the struck and lost rate to zero to minimize total removals'.

(ii) Humpback whales

Mitchell and Reeves (1982) provided an estimate of the initial population size of the northwest Atlantic humpback whale of 4,230, which for several reasons was considered to be a minimum estimate (IWC, 1982b). Two estimates of the current population size on three breeding banks (Silver, Navidad and Mouchoir) were presented (Whitehead, 1982; Balcomb and Nichols, 1982). The difference between the estimates (2,000 – 3,500, Whitehead; not less than 1,923, Balcomb and Nichols) was largely due to what proportion of the largest bank (Silver Bank) was suboptimal for the whales. No independent data were available. However the sub-committee agree that it seemed reasonable to conclude that at least 2,000 whales over-winter on these banks. A similar conclusion was reached by a workshop on northwest Atlantic humpback whales in 1980 (Tillman, 1981). The population is therefore substantially below its initial level.

A total of at least 33 animals (1.7% of current population size) was removed from the population in 1980; 13 from Greenland (3 more than the IWC catch limit) and about 20 from net entanglements off Newfoundland. Although the Greenland season was stopped as soon as reports of the landing of 10 humpbacks had been received, it was later found that 12 had been taken before the season had been closed. A further animal was taken after the season was closed. If the number of calves (57) seen on the three breeding banks is considered to be a conservative estimate of gross recruitment then the present removals represent a significant proportion of this. The Committee (IWC, 1982c) recommended the continuation of studies regarding net entanglement and again recommended that the exemption for Greenland's catch of 10 humpbacks be removed 'until such time as more reliable estimates of population size, recruitment, trends in abundance, stock identity and loss rates in the fishery are available'.

(iii) Aboriginal/subsistence fisheries

The sub-committee examined the agenda of the forthcoming *ad hoc* Technical Committee working group and commented on those items on which it believed scientific advice might be required. Acting on sub-committee advice, the Scientific Committee made several recommendations particularly concerning data requirements and monitoring and research requirements. These are given in Appendix 1a and b.

THE *AD HOC* TECHNICAL COMMITTEE WORKING GROUP ON DEVELOPMENT OF MANAGEMENT PRINCIPLES AND GUIDELINES FOR SUBSISTENCE CATCHES OF WHALES BY INDIGENOUS (ABORIGINAL) PEOPLES

The working group met immediately before the 1981 Commission meeting and a summary of those parts of their report (IWC, 1981d) relevant to management is given below.

(i) Definitions

The group agreed to the following three definitions:

Aboriginal subsistence whaling means whaling, for purposes of local aboriginal consumption carried out by or on behalf of aboriginal, indigenous or native peoples who share strong community, familial, social and cultural ties related to a continuing traditional dependence on whaling and on the use of whales.

Local aboriginal consumption means the traditional uses of whale products by local aboriginal, indigenous or native communities in meeting their nutritional, subsistence and cultural requirements. The term includes trade in items which are by-products of subsistence catches.

Subsistence catches are catches of whales by aboriginal subsistence whaling operations.

(ii) Involvement of aboriginal peoples

It was recognised that effective management requires the full co-operation of the native peoples concerned and that they should therefore be involved in the decision making process. Although the responsibility for this rests primarily with the involved national governments, considerable advantages were seen in involving them or their representatives at IWC as well as national level.

(iii) Management principles for aboriginal whaling

There was some disagreement within the group as to whether it was correct to apply separate management objectives to aboriginal/subsistence whaling and commercial whaling. It was suggested that any whaling activity has its own culture, and is deeply rooted in the history of the nation; as both types of whaling involve the same interaction between man and whales as a resource then the same principles and management objectives should apply.

Others considered that there was a much greater dependence on whale products both for direct subsistence and in a cultural context in aboriginal whaling. In commercial operations the primary reason for continued catches was the sale of products, and not, as in the case of subsistence whaling, to meet immediate nutritional and cultural needs. For this reason management objectives for the two types of whaling might well be different: in commercial operations the objective is to obtain maximum yields from individual stocks; in aboriginal/ subsistence whaling the yield does not need to be maximised provided it is at a sufficient level to satisfy nutritional and cultural needs.

The group recognised that some objectives should be developed which could be applied to aboriginal/subsistence whaling in order to avoid the *ad hoc* consideration of such catches which was the current practice of the Commission. It agreed on the following broad objectives:

To ensure that the risks of extinction to individual stocks are not seriously increased by subsistence whaling;

To enable aboriginal people to harvest whales in perpetuity at levels appropriate to their cultural and nutritional requirements, subject to the other objectives;

To maintain the status of whale stocks at or above the level giving the highest net recruitment and to ensure that stocks below that level are moved towards it, so far as the environment permits.

(iv) Establishing catch limits

The working group agreed that for stocks above the level giving the highest net recruitment (HNR), catches should not exceed 90% of that net recruitment. However three alternative procedures were proposed to deal with stocks below such a level:

(i) catches shall be permitted provided the stocks are above protection level ('x% of initial stock size') so long as they allow the stocks to move towards the level of HNR insofar as the environment permits

(ii) catches shall be permitted so long as the stock is in no danger of further decline

(iii) catches shall be permitted so long as the stock is not declining. If it is, then they should be reduced to zero – '(in the shortest possible time) [at least] until the decline is arrested'.

(v) Advice to the Technical Committee

The group agreed that the Scientific Committee should continue to provide advice on each stock each year and that it should not evaluate cultural, socio-economic or nutritional aspects of subsistence hunting.

It agreed that these factors should be considered by a separate group who would provide advice to the Technical Committee. A need for the occasional liason between this group and the Scientific Committee was recognised.

(vi) Interactions with commercial catches

The working group agreed that as a general approach, 'important subsistence needs should not be jeopardised by commercial operations' although it recognised that this was not currently a problem. Removals from a population other than catches (eg. net entanglement) should also be considered.

(vii) Data gathering and reporting requirements

The working group agreed to all the recommendations of the Scientific Committee (Appendix 1a). With respect to struck-and-lost rates the group welcomed the data provided by the AEWC for the 1980/81 hunt.

(viii) Research and monitoring requirements

The working group endorsed the recommendations of the Scientific Committee regarding such requirements (Appendix 1b). In addition the working group recommended that in the absence of one or more of the essential requirements, safeguards should be applied to the catch limits after consideration of biological, nutritional and cultural requirements although the precise nature of these safeguards was not stated.

(ix) Independent observation of subsistence catches

The group agreed 'in principle' that observer schemes similar to those in effect for commercial operations should be developed for aboriginal subsistence whaling operations.

(x) Humane killing

The group agreed that hunting techniques should be made as 'efficient and humane as possible whilst recognising the essential cultural aspects of the hunt'. In addition to the data requirements given in Appendix 1a, the group also recommended that to the 'fullest extent possible' information on death times and circumstances surrounding strikes should be provided. [In fact the AEWC have provided detailed information on the strikes for the 1981 spring hunt – see Table 6 in Marquette *et al.* (1982).]

(xi) Final recommendations to the Technical Committee

The working group recommended that its report should be sent to Contracting Governments of the IWC who should submit their comments[1] on the document by 31 January 1981. These comments should be collated by the Steering Group of the Working Group for consideration by the Technical Committee at the 1982 meeting.

[1] Comments have so far (24.5.82) been received from the following IWC members: Argentina, Denmark, India, Japan and the USA.

COMMISSION MEETING 1981

(i) Bowhead whales

Despite the strength of the recommendations from the Scientific Committee, there was no proposal to change the three year quota adopted at the 1980 Commission meeting. Sweden introduced the following resolution (IWC, 1982d) which was unanimously adopted:

> Recognising the danger of extinction faced by the Bering Sea bowhead whale and the consequences for the Inupiat culture
>
> Mindful of the recommendations of the Scientific Committee which again note the high risk to the stock, recommend zero quota and ask that any catch should be restricted to sexually immature whales (ie. less than 12 m long) and that they be taken in a manner that will reduce the struck and lost rate to zero
>
> Encouraged by the Co-operative Agreement entered into by the US Government and the AEWC and the good will and effort shown by the Inupiat people of Alaska
>
> The IWC commends the Inupiat people of Alaska on their efforts to control the hunt, and their essential contribution of finance and effort in the gathering and provision of data and research
>
> Urges them to restrict the existing quota to sexually immature whales and to reduce the numbers of whales struck but not landed to zero as quickly as possible

Commenting for the USA on the resolution, a representative of the native community reported on the progress being made to fulfill the last paragraph of the resolution. Attention was drawn to the report of the *ad hoc* working group (above) which commended the Co-operative Agreement between the USA and the Eskimos. The Netherlands drew attention to a proposal brought to the *ad hoc* working group by the USA regarding stocks for which on biological grounds, subsistence catches should be reduced, that 'action should be taken to allow the stocks to recover'. They believed that this meant that the bowhead catches should be reduced in the future. They also requested the USA to provide documentation on the effect on bowheads of industrial development in the Bering Sea.

(ii) Humpback whales

The Commission unanimously endorsed the research recommendations of the Scientific Committee and a recommendation that 'every effort be made to reduce the number of removals'. Denmark explained the steps it had taken to ensure no further infractions in the fishery. Again, there was no proposal to implement the recommendation of the Scientific Committee to remove the exemption for 10 humpback whales.

(iii) Management principles and guidelines for subsistence catches

Attention was drawn to the broad composition of the *ad hoc* working group and the Commission unanimously adopted the two recommendations of the Report. In addition it agreed that a decision should be made by correspondance between the Steering Group as to the necessity of reconvening the working group in the light of these comments.

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* Copies of these papers are available at cost price from the International Whaling Commission.

Appendix 1a

DATA GATHERING AND REPORTING REQUIREMENTS

Essential data (from each whale landed)

1. Location, date and time of kill
2. Species
3. Length
4. Sex
5. If female, presence of milk
6. If female, presence of foetus
7. Degree of stomach fill

Extra data

8. Length and sex of foetus
9. Collection and preservation of both ovaries
10. Collection of at least one ear plug, tooth or bulla
11. Collection of an eyeball (frozen)
12. Collection of sample of stomach contents.

Appendix 1b

RESEARCH AND MONITORING REQUIREMENTS

Essential requirements

1. Knowledge of population size and identity;
2. Estimate of yield;
3. Knowledge of population trends.

Extra data

4. Population status (relative to initial)

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