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GUIDE TO DISPERSANT - USE DECISION MAKING FOR OIL SPILLS IN THE CANADIAN SOUTHERN BEAUFORT SEA

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READ THIS FIRST

This document provides a step-by-step guide to be used by the On-Scene Commander and Dispersant Decision Team in deciding whether or not to use chemical dispersants in the event of oil spills in the southern Beaufort Sea.

Before a spill takes place users of this guide should read the background information and familiarize themselves with the decision making process outlined in Steps I-VII (pages 32-46).

In the event of a spill decision makers should follow Steps I-VII of the guide, and should pay special attention to the procedure for obtaining government approval for dispersant use (see Step VII, page 45). Fisheries and wildlife resource experts, after assessing sensitivities of the oil-threatened areas and identifying the more vulnerable species (see Steps III-V, pages 37-40), should read the appropriate sections in the appendix to understand the assumptions upon which the assessments of sensitivity were based.

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SUMMARY

This document provides a step-by-step guide to be used by the On-Scene Commander and Dispersant Decision Team in deciding whether or not to use chemical dispersants in the event of oil spills in the southern Beaufort Sea. The contents include:

a) a statement of the regulatory framework for dispersant-use in the Beaufort Sea;

b) practical background information on oil spills and on dispersant decision-making in the Beaufort Sea;

c) a step-by-step guide for making real-time dispersant decisions for Beaufort Sea spills and;

d) an appendix which documents the resource data upon which the assessments of environmental sensitivity in the guide are based.

RÉSUMÉ

Le présent guide a été préparé pour le chef sur les lieux d'un déversement et pour l'équipe chargée de lui faire des recommandations quant à l'utilisation ou non de dispersants chimiques en cas de déversement de pétrole dans le sud de la mer de Beaufort. Il comprend:

a) un énoncé de cadre de réglementation s'appliquant à l'utilisation de dispesants dans la mer de Beaufort;

b) des renseignements de base sur les déversements de pétrole et sur la prise de décisions à l'égard de l'utilisation de dispersants dans la mer de Beaufort;

c) un guide par étapes sur la prise de décisions à effet immédiat en cas de déversements dans la mer de Beaufort; et

d) un relevé des données utilisées pour réaliser les évaluations de la sensibilité environnementale présentées dans le guide.

1. INTRODUCTION

The first priority when responding to an oil spill is the physical recovery of the oil from the sea. In some circumstances, however, the chemical dispersal of oil may offer certain environmental advantages in spite of the drawback of driving a noxious substance such as oil into the water column. At present, decision makers are faced with a dilemma. On the one hand, a dispersant operation must be started within hours after a spill occurs to be effective; on the other hand, the decision making process for dispersant use can be time-consuming because many environmental and technical factors must be considered. This guide simplifies the decision making process for dispersant-use in the southern Beaufort Sea by analysing, in advance, many of the important considerations and presenting the results in a form that will enable workers to formulate decisions quickly.

In the event of a marine oil spill in the Canadian southern Beaufort Sea, a decision regarding dispersant use can be derived by finding answers to three questions.

a) Is the spilled oil of a dispersible type?
b) Can an effective dispersant operation be mounted with the available equipment and material?
c) Will the use of dispersants clearly reduce the overall environmental impact of the oil spill?

Provided that a positive answer is obtained to each of these questions, the use of dispersants is indicated and the On-Scene-Commander can proceed with a dispersant countermeasure operation after having obtained regulatory approval. However, if the answer to any of these questions is negative then there would be little justification for dispersant use.

Finding the correct answers to these three simple questions is complicated by a number of variables including:

- the type of oil spilled;
- the type of spill (batch spill vs. blowout);
- spill volume or rate of discharge;
- wind direction;
- spill location; and
- the location and vulnerability of resources relative to the location of the spill decision making.

This guide integrates the effects of these variables into the decision making process using a step-by-step approach. By working through each step in the guide, one can assemble the pieces of information that influence the dispersant use decision. This can be done quickly because much of the required information is contained within the guide and its appendix. However, prediction of oil fate, which involves the input of real-time information, is left to the user; site-specific models for predicting oil fate and movements are available elsewhere for this purpose.

Generally, one of the most time-consuming aspects of deciding whether or not to use dispersants is the analysis of environmental impact information. This analysis involves collecting information on environmental resources and predicting the potential effects of different countermeasures on these resources. This process has been greatly accelerated in this guide by assembling much of the relevant environmental sensitivity data into a series of sensitivity maps covering the southern Beaufort Sea study area. In these maps the study area has been divided into numbered zones or sections. The maps identify the sensitivity of resources in each sector to treated or untreated spills. The sensitivity assessments of each sector were determined by considering a large number of hypothetical scenarios for batch spills and blowouts occurring in different locations and at different times during the open-water season, and by predicting the effects of each spill on all resources in each sector. The overall sensitivity of each sector was taken to be equal to the sensitivity of the most vulnerable resource in the sector. The sensitivities of all species in each sector have been summarized in a series of tables that accompany the maps. Thus, in the event of an actual spill, the overall sensitivities of resources to the use or non-use of dispersants can be derived directly from the maps and tabular material.

One of the unavoidable drawbacks of this system is the reliance on historical information in assessing the distribution and movements of the local environmental resources. Whereas the vulnerability of resources can be roughly predicted using historical data, the habits of many species vary to some extent from year to year depending on local environmental conditions. Some flexibility has therefore been built into this system in that provision has been made for the input of real-time information on the distribution of resources. In the event of a spill, the user is advised to consult with local resource experts to verify the predicted vulnerability of oil-threatened resources.

LIMITATIONS TO THE USE OF THIS GUIDE

Certain limitations of this work must be borne in mind when using the guide.

1. This work is limited to consideration of spills having effects within the study area shown in Figure 1.

2. The method is applicable both to batch spills and to blowouts but the size of the spills to which the system applies is limited to spills that are small enough to be treated effectively with dispersants (e.g., 1000 m^3 for batch spills and 500 m^3/day for blowouts).

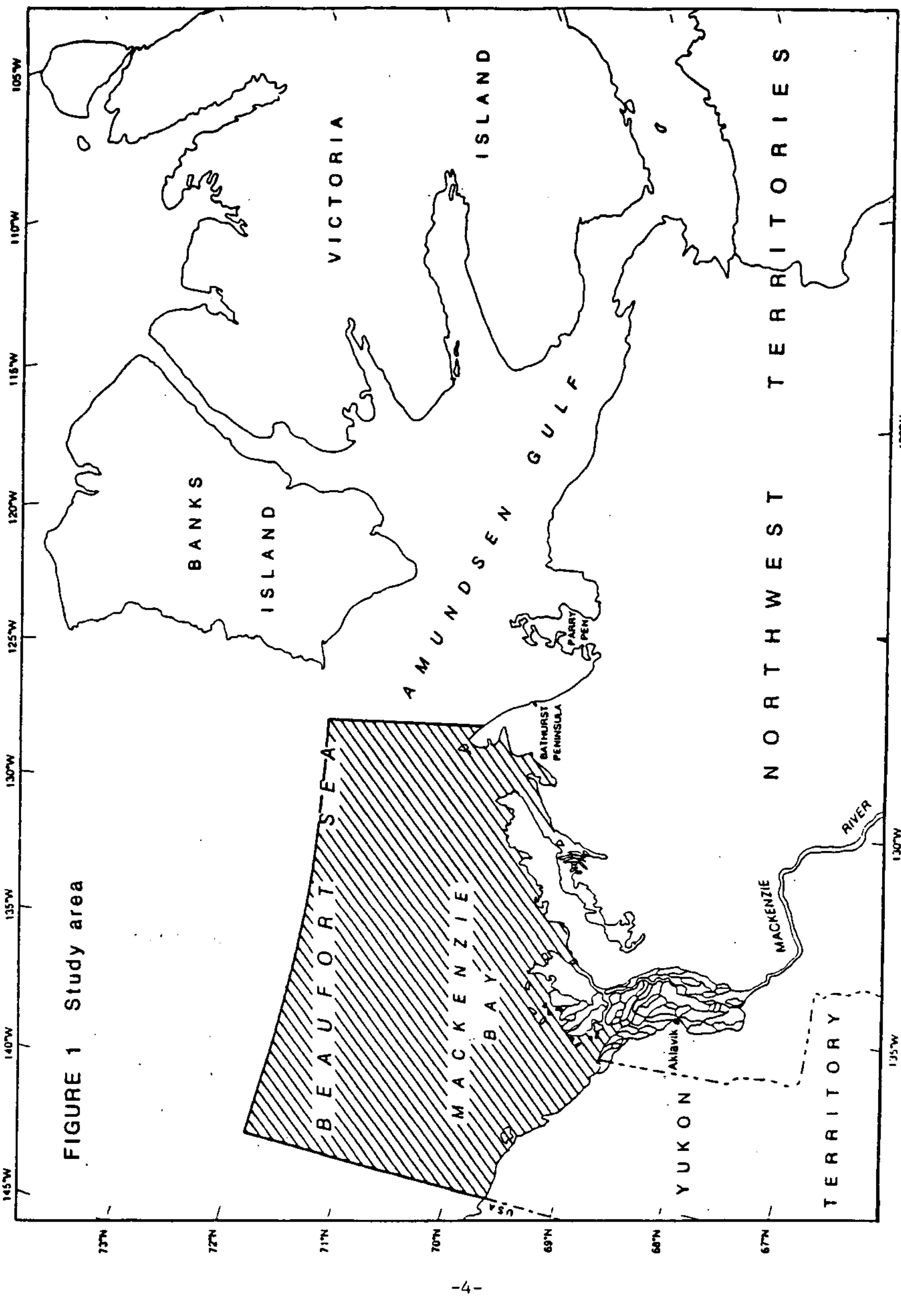


FIGURE 1 Study area

It is estimated, however, that increasing spill volume or flowrate by a factor of two or three would not significantly alter predicted effects in either coastal or offshore situations.

3. Because dispersants are particularly useful for treating spills in the open water season, only the effects of spills occurring between June and September have been considered.

4. The principal emphasis in this work has been placed on the environmental aspects of dispersant use and hence the bulk of the guide refers to this subject. However, because other factors such as dispersant effectiveness, the feasibility of dispersant use, and socio-economic issues are related to spill impact, these subjects have been dealt with, but only briefly.

5. Although there are hundreds of species in the southern Beaufort Sea, it has been necessary to restrict the numbers of species considered to a limited number of waterfowl, marine mammal, and finfish species. However, care has been taken to include the most vulnerable of the ecologically important species in the area. It is thus believed that inclusion of additional species will not significantly alter the assessments of environmental sensitivity or the overall dispersant decision.

6. Because of a severe lack of data on distribution and abundance of benthic resources, the sensitivity of benthos to spills has not been considered, and this omission no doubt biases the decision making process somewhat in favour of dispersant use. However, in the Beaufort Sea it is unlikely that an oil spill will significantly affect benthic production because this resource is uniformly distributed over a very large area relative to the area that would likely be contaminated by even a major spill. In addition, because benthos are not exploited by man in the southern Beaufort Sea there will be no significant direct socio-economic implications of spill effects on benthos.

2. BACKGROUND INFORMATION

2.1 DEVELOPMENT OF ENVIRONMENTAL SENSITIVITY MAPS AND TABLES

To assess the environmental advantages of dispersants, it is necessary to determine both the possible effects of the spill if left untreated and the effects if it were treated with dispersants. Even if all the necessary biological data were on hand, this analysis would be time consuming. For this guide the vulnerabilities of many important environmental resources have been analysed and this information compiled into sensitivity maps for the area. In these maps the study area has been divided into various sub-areas or sectors, each of which bears a sensitivity designation. The sensitivity designation of each sector reflects the sensitivity of the most vulnerable species in each sector. Hence, for any given spill, if the spill location is known and the movement of oil can be predicted, the likely environmental effects of both the chemically dispersed oil and the untreated slick can be derived directly from the sensitivity maps.

These environmental sensitivity maps were prepared by considering a large number of hypothetical spill scenarios and by estimating the effects of each spill on a range of important species in the southern Beaufort Sea ecosystem. In each scenario the effects of oil on defined populations were estimated from the predicted fate of dispersed and untreated oil, and from the sensitivities and vulnerabilities of the species and populations concerned.

2.1.1 Sensitivity of Individual Resources

In the Sensitivity Maps (Maps 1-8 and 9-16), the sensitivity designation of each sector reflects the predicted effect of a spill on the population of the most vulnerable species in that sector. The predicted effects of the spill on all species are summarized in a series of Impact Tables that follow each group of maps. In the present work the sensitivity of a species is defined as the level of exposure to oil required to cause mortality to an individual organism, whereas vulnerability is defined as the proportion of a specified target population that would be affected by a specified spill. For all species only lethal effects of direct contact with oil have been considered. It was assumed that sub-lethal effects of direct contact with oil and effects of indirect contact with oil through food chains would be insignificant compared with the consequences of direct contact with oil. The assumed sensitivities of marine mammals, waterfowl, and fin fish are summarized.

a) The sensitivity of fish to oil varies somewhat under the control of a number of variables but the data of a number of authors reviewed by Trudel (1986) showed the LC50 values lay mostly in the range of 1-20 ppm total oil as water soluble fraction. It was therefore assumed that contact with 10 ppm of total oil in the water column would cause mortality to any life stage (egg, larva, immature or adult). It was further assumed that exposures to less than 1 ppm total oil would be innocuous. The contribution of dispersants to the toxicity of mixtures of oil and dispersant can be assumed to be no greater than that of the oil itself, because of the moderate toxicity of modern, approved dispersants and their low concentration in the water column relative to that of the oil. Hence, it can be assumed that the toxicity of dispersed oil clouds derives from the effects of the oil alone and that the dispersant is innocuous.

b) Waterfowl were assumed to be sensitive to untreated oil but completely insensitive to chemically dispersed oil. Waterfowl are highly sensitive to the effects of oil when contact is through ingestion or direct contamination of plumage. Mortality was assumed to result from levels of contamination as low as one gram of oil per bird. It was further assumed that such levels of contamination would result from contact at sea with oil concentrations greater than 10 g/m^2 of sea surface and from contact on shore with levels of contamination greater than 1 l/m of coastline.

c) The very limited data base suggests that some marine mammals are sensitive to untreated oil but insensitive to chemically dispersed oil. Bare-skinned mammals might be sensitive to oil when inhaled or when the skin becomes contaminated but would be far less sensitive than marine birds in the offshore environment. Polar bear were assumed to be more sensitive than bare-skinned mammals because oil would accumulate on the pellage and might be subsequently ingested. Because polar bears are most vulnerable to oil concentrations at the edge of the pack ice, it was assumed that they would be adversely affected by oil concentrations of 100 g/m^2 water surface for open water among the broken ice at the edge of the pack ice.

2.1.2 Vulnerability of Resources

In assessing the proportion of any population that might be affected by a spill, two techniques were employed. For marine mammals and birds, where some numerical data were available both for population size and for abundance and distribution within the study area, estimates were made of the approximate numbers of individuals that might be affected by a spill. Hence, the proportion of the population affected could be calculated directly. For fish species, where data on absolute abundance were not available, the proportion of a population affected by a given spill was based on the approximate proportion of the population that was in the marine area at the time of the spill (as opposed to the proportion that was using freshwater), the area over which the population was distributed, and the proportion of that area within which lethal exposure conditions might occur.

In identifying target populations of each species, attention was paid wherever possible to identifying groups that are reproductively isolated. For these groups, recovery from spill effects would be largely through reproduction alone rather than by immigration from adjacent areas. The vulnerability of these populations to the effects of oil was influenced by several factors including;

- the proportion of a population using the southern Beaufort Sea area at the time of the spill;
- the proportion of those present using shoreline, coastal, and offshore habitat at the time of the spill; and
- the degree of aggregation of those present in specific coastal and offshore areas of the study area.

Summaries of the information concerning the habits, movements, and distribution of all biological resources considered in this work are given in an Appendix to this guide.

2.1.3 Categorization of Impact on Individual Resources

The impact of oil on resource populations has been defined on the basis of the proportion of the overall population that would be affected through contamination of a given geographic sector. Levels of impact are defined as negligible, slight, moderate, and major as follows:

a) A negligible effect corresponds to the loss of less than 1% of a target population.

b) A slight effect corresponds to the loss of 1-10% of a target population. This level of effect corresponds to the year-to-year variations in the natural rate of mortality in many species.

c) A moderate effect represents the loss of 10-30% of a target population. For many species this corresponds to the annual rate of natural mortality.

d) A major effect represents the loss of 30% or more of the population. For most species, populations affected at this level would require more than one year to recover to pre-spill conditions.

2.1.4 Sensitivity Categorization of Areas

In most sectors of the study area more than one species would frequently be affected significantly if the sector were to be contaminated with oil. In these sectors the sensitivity designation of the sector reflects the sensitivity of the most vulnerable species. In the map series, only the overall sensitivity of each sector is illustrated. However, the sensitivity of all major species for each area are given on a month-by-month basis in a series of tables accompanying the maps.

The four categories of impact on individual species have been reduced to three for purposes of presentation of the sensitivity maps. In the maps the sensitivity of a sector has been designated as either SENSITIVITY-LOW, SENSITIVE, and HIGHLY SENSITIVE based on the following:

- SENSITIVITY-LOW areas - all species suffer no greater than negligible effects;
- SENSITIVE areas - the most sensitive species suffer no greater than SLIGHT effects; and
- HIGHLY SENSITIVE areas - the most sensitive species suffer moderate or major effects.

Certain coastal and nearshore areas within the study area are used by animals only towards the latter part of the open water season and their populations are less sensitive to oil during the earlier month. In these areas early-season spills would have little immediate effect on these resources, but animals moving into these areas at some later date might suffer more severe effects if oil were permitted to persist on shorelines or in nearshore waters. To differentiate between these areas and areas in which oil poses a more direct threat, the effects of oil in these areas in the early part of the season have been designated as INDIRECT (i.e. SENSITIVE-INDIRECT or HIGHLY SENSTITIVE-INDIRECT).

2.1.5 Resources Included in Treatment

It has been impossible to include all of the hundreds of species of biota within the southern Beaufort Sea study area in this study. The decision making system has been developed to take into account the most important and the most vulnerable of the oil-sensitive species. The assumptions upon which the assessments of sensitivity were based can be found in the Appendix to this guide. The inclusion of other less vulnerable species would not significantly alter the overall sensitivity designation of any area, nor would it influence the decision on dispersant use. The following species have been included:

a) Fish Species

- Arctic char
- Broad whitefish
- Lake whitefish
- Arctic cisco
- Least cisco
- Inconnu
- Arctic cod
- Pacific herring

b) Waterfowl

- Whistling swan
- Canada goose
- White-fronted goose
- Lesser Snow goose
- Black brant
- Greater scaup
- Surf scoter
- Oldsquaw
- Common eider
- King eider
- Red phalarope
- Northern phalarope

c Marine Mammals

- Bowhead whale
- Beluga whale
- Ringed seal
- Polar bear.

2.2 INFLUENCE OF CERTAIN VARIABLES ON SPILL IMPACT AND DECISION MAKING

Certain variables exert a strong influence on dispersant decision making through their influence on environmental effects or on the feasibility of dispersant operations. These variables are discussed below.

2.2.1 Oil Type and Weathering

The chemical dispersibility of an oil spill is determined in part by the physical and chemical nature of the oil, especially its viscosity. Oils discovered in the study area range widely from light, non-viscous oils to heavy, viscous oils. Whereas very light oils could be expected to be amenable to chemical dispersion, the highly viscous oils would be virtually impossible to disperse. It is believed that dispersants in general are effective on spilled oils with viscositites less than about 1000-2000 centipoise. Dispersant effectiveness is known to decline rapidly with increasing viscosity and oils with viscosities greater than 5000 centipoise can, in fact, be considered to be non-dispersible. Some recent work has shown that some oils with viscosities far lower than 1000 centipoise are essentially non-dispersible (Fingas et al. 1986) and, hence, some caution should be exercised in applying this rule of thumb.

The weathering of oil once exposed to the environment will also dramatically diminish dispersant effectiveness. As oil weathers on the sea surface, its viscosity increases through the evaporation of lighter, more volatile consitituents and through the process of water-in-oil emulsification. Water-in-oil emulsions, or "chocolate mousses", are particularly viscous and resistant to dispersion. As well, in situations where spilled oil is set afire, the oil is quickly stripped of its lighter non-viscous components. Hence, even for oils that are initially dispersible, certain post-spill processes may render them non-dispersible. It is therefore advisable to verify, using a simple field dispersibility test, whether the spilled oil is indeed amenable to chemical dispersion.

In summary, dispersant use should be considered only for spills of oils with low initial viscosity and for spills in which post-spill conditions (e.g., burning or weathering) have not rendered the oils non-dispersible.

2.2.2 Dispersant Effectiveness

Dispersant effectiveness can be defined as the ratio of the volume of oil dispersed to the volume of dispersant applied under field conditions. Effectiveness is a function of a number of variables including sea state, dispersant type, oil type, temperature, weathered state of the oil, and the type of application vehicle used. For the purposes of this study a dispersant effectiveness of 14 to 1 was assumed for operations involving surface vessels using mixing devices, and 7 to 1 for aircraft operations. These numbers assume average conditions. As mentioned, it is strongly recommended that actual dispersant effectiveness be tested in the field before commencing a massive dispersant operation.

2.2.3 Availability of Dispersant Application Equipment

It must be recognized that the effectiveness of a dispersant operation will be limited not only by the effectiveness of the dispersant itself but also by the logistic capabilities of vehicles available to deliver and apply dispersant to the spilled oil. In the case of smaller batch spills, sufficient equipment and dispersant can be made available to treat all the oil discharged. For very large batch spills (e.g., greater than 1000 m^3) the amount of dispersant and equipment required for complete effective dispersion is correspondingly large and it is unreasonable to expect that these could be stockpiled in the Beaufort Sea area on a pre-spill basis; the costs would be prohibitive. Thus, after a spill occurred, material and aircraft would have to be shipped to the site, which would take time. In addition, the amount of time required to acutally dose a large spill is considerable. Both of these time restrictions mean that only a fraction of a large spill can be treated before the oil reaches dispersant-resistant viscosities.

For oil-well blowouts the situation is somewhat different. Large blowouts, unlike large batch spills, do not demand immediate action in delivering chemicals and equipment to the site. Although several days can be lost before a massive dispersant operation can commence, one can effectively treat the oil continuously discharged thereafter, if the freshly spilled oil at the site is a dispersible type and if appropriate amounts of dispersant and application equipment are ultimately available. The major and only restriction in this case would be the enormous cost of the operation, which could easily run into the tens of millions of dollars. Thus, careful consideration must be given to the cost-benefits of a dispersant operation of this magnitude.

2.2.4 Environmental Implications of Spill Volume

As already mentioned, the feasibility of dispersant use depends on the availability of appropriate materials and equipment. For large batch spills in particular, limitations of supplies, equipment, and time may make it impossible to treat more than a fraction of the oil spilled. The remaining untreated oil may be sufficient to cause the same level of damage as would have occurred if dispersants had not been used. In such cases dispersant use is not a practical treatment option.

Another consideration of spill size concerns the magnitude of the environmental impact. It is reasonable to expect that the effects of a spill, on average, will increase with the volume of oil discharged. For offshore spills the amount of area contaminated with oil will increase with the amount of oil spilled whether the oil is discharged as a batch spill or a blowout. In addition, for offshore spills, the likelihood of oil reaching shorelines in significant amounts increases with the volume of oil spilled.

For nearshore spills the amount of damage will also increase with the amount of oil spilled. In general, the length of shoreline affected will increase as spill volume increases because of the greater degree to which the oil will spread on the sea surface before being driven onto the shore. In addition, the area of shoreline affected will increase as oil is smeared along the shoreline and the extent of smearing will increase with the volume of oil spilled.

This relationship between spill volume and level of spill impact holds in situations in which resources are widely distributed over a large area of sea surface or over a long stretch of coastline. However, at certain times of the open water season, specific resources are not widely distributed but rather are highly concentrated in one or more areas, usually along the coast. Under these conditions, even small spills occurring near such high concentrations of resources may cause highly significant effects and further increases in spill volume may cause little increase in effects. Under these conditions it is the location of the spill rather than the spill volume that largely determines the effects of the spill.

2.2.5 Spill Location and Distribution of Oil-Sensitive Resources

The location of the spill is of importance from both the countermeasures and environmental points of view. From a countermeasures point of view, the choice of dispersant spray vehicles is limited by the distance between the spill and the base of operations. Helicopters have a limited range and hence can be used only for spills near established onshore or offshore bases of operation. This limitation is more important for batch spills than for blowouts because little time is available in which to establish temporary supply bases near the spill site to support helicopter operations. Neither surface vessels nor fixed-wing aircraft suffer these limitations because the area of operation in the southern Beaufort Sea is sufficiently small that both these types of craft can be considered to have unlimited range.

From the environmental viewpoint, spill location is an important factor in determining the effects of an oil spill and in deciding if dispersants should be used. Most coastal and offshore areas of the southern Beaufort Sea are used by one or more oil-sensitive and oil-vulnerable species during the open-water season. Hence, there is generally some justification for the use of dispersants to treat batch spills or blowouts occurring in any part of the study area. The only exception to this would be the trivial case of a small batch spill occurring far offshore where the hazard to offshore resources would be small and the likelihood of oil reaching the shoreline in dangerous quantities would be minimal. In this case dispersants could be used without environmental consequences but there is no compelling justification for doing so.

The urgency of dispersant use is greater for nearshore spills than for offshore spills because many oil-sensitive resources are concentrated in coastal areas and in shallow, nearshore waters. The urgency is greatest near the areas of highest environmental sensitivity.

The environmental drawbacks to the use of dispersants also depend on the location of the spill. For most offshore spills (spills in which dispersants can be applied more than 10 km offshore) there are few drawbacks to dispersant use for either batch spills or blowouts because resources using these areas are widely dispersed and there is little likelihood of significant population effects resulting from the dispersal of spilled oil. On the other hand, in nearshore areas that are used as migration corridors or nursery areas by anadromous fish species, there is some risk of significant effects from a dispersed batch spill. However, even in these nearshore areas the risk to fish populations is slight because the area of toxic conditions is small and relatively short-lived while the fish resources are widely distributed. There are two exceptions to this situation in the southern Beaufort Sea. The first involves the arctic Char populations that use rivers in the western part of the study area and which may concentrate in the estuaries of these rivers in August during their spawning migration. The second involves enclosed bays such as Tuktoyaktuk harbour which support important domestic fisheries. Although a dispersed spill in these bays might have little overall effect on fish populations using the area, the lack of flushing in these relatively enclosed systems might lead to contamination of the transient fish present and might render them unfit for consumption when caught locally.

The likelihood of significant effects of dispersant use during nearshore blowouts is greater than for batch spills because the continuous use of dispersants in migration corridors of anadromous fish populations may create a relatively continuous patch of toxic conditions that could either affect greater numbers of individuals as they migrate through the area or could act as a barrier to migration. Hence for nearshore blowouts the duration of the discharge is equal in importance to the volume of oil discharged from an environmental point of view.

To summarize, there is general justification for using dispersants on offshore batch spills and blowouts and there are few environmental drawbacks in doing so. For nearshore batch spills there is, with certain exceptions, generally strong justification for the use of dispersants as the drawbacks are generally less severe than the advantages. For nearshore blowouts occurring within the migration corridors of anadromous fish species there are both important advantages and drawbacks to dispersant use. In these areas, there will no doubt be local effects to all species present whether dispersants are used or not. However, on balance, it is preferable to use dispersants in the interest of minimizing the amount of untreated oil escaping the spill site and contaminating the shore zone.

2.2.6 Wind Direction

Wind direction is one of the more important variables that determines the effects of oil spills. Winds exert a powerful influence over the direction of movement of the oil slick and, in combination with the location of the spill, determines the areas that will be affected by oil and, hence, the ultimate impact of the spill. Wind direction is an essential consideration in dealing with batch spills but may be of lesser importance in dealing with blowouts as discussed below.

In a batch spill, because events occur over a short period of time, the impact of the spill will be determined largely by the wind regime during the few days following the spill. Wind conditions in the southern Beaufort Sea are highly variable. Therefore, there is a high level of uncertainty associated with the long- and even medium-range movement of the untreated oil spill and with the effects of this oil. Despite this uncertainty the dispersant decision must still be made within hours of the spill to ensure that the dispersant operation is successful.

The decision maker is therefore confronted with a problem and he must make a quick decision on dispersant-use based on rough and uncertain predictions. The real-time spill trajectory models developed for the area provide the only help available. On the basis of previous use and evaluation, the decision maker must determine which of these models to use in formulating the assessment of spill impact. Whichever model is used it is wise to base the dispersant decision on the trajectory that yields the maximum credible effect. In this way the decision is weighted so that the countermeasures deployed minimize the risk of occurrence of this maximum credible impact or worst-case effect.

In dealing with a blowout two basic strategies are possible for dealing with the wind factor. In one approach, each daily discharge could be considered as a batch spill as already discussed. Under this strategy dispersants would be applied only when the day's discharge is predicted to cause significant effects, whereas no dispersant would be used to treat the discharge when the predicted effects of the day's discharge is small. In this case, the dispersant decision would be determined largely by predicted wind conditions. This approach has one serious drawback in that significant amounts of oil may leave the spill site and may persist and accumulate on the sea surface over a prolonged period. Although the effects of a single day's discharge might be insignificant, the build-up of many day's discharge over time might result in significant accumulation over a wide area and might thereby cause significant damage.

An alternative approach would be to consider dispersing all the oil discharged from the blowout. In this approach, the blowout would be considered to be a very large spill that could ultimately result in significant effects over a wide area. If such a spill were to take place instantaneously as a batch spill, it would be unfeasible to treat it with dispersants, but the fact that the discharge takes place slowly over time makes treatment feasible. If it is assumed, a priori, that the effects of such a spill will increase with the amount of untreated oil that is permitted to leave the spill site, then the logical strategy would be to treat as much of the oil as possible in the vicinity of the spill site to minimize the widespread consequences of the spill. Hence it would be preferable to attempt to treat all the oil that is discharged. Cost considerations aside, this latter strategy would appear to be most environmentally prudent.

2.2.7 Timing of Spill

The time that an open-water spill takes place in the southern Beaufort Sea strongly influences the potential effects of the spill and the countermeasures that should be used to deal with it. The effects will vary with time simply because the vulnerability of resources varies seasonally. Consequently, the appropriateness of certain spill control techniques, especially the use of dispersants, will also vary seasonally.

Dramatic changes in vulnerability occur in a variety of species during the span of the open-water season. The vulnerability of beluga whales is low during the part of the season when they are widely distributed through the southern Beaufort Sea and Amundsen Gulf whereas at other times their vulnerability is greater when major portions of the target populations aggregate in waters adjacent to the Mackenzie Delta. Similarily, certain species of waterfowl disperse widely over coastal and inland areas during the nesting season early in the open water season whereas later in the season major proportions of the populations become vulnerable to marine spills when they move to coastal areas to moult or to prepare for the fall migration south. Other waterfowl species that breed in coastal areas may be widely distributed along the coast during breeding season but become more vulnerable when they concentrate in large numbers in certain coastal areas for the moult or during staging for the fall migration.

As a result of these dramatic seasonal movements and changes in vulnerability of many species, the sensitivities of many coastal and nearshore areas also change during the season. Clearly, for spills that threaten to contaminate high risk areas the urgency of deploying dispersants and other countermeasures is high because of the immediate threat to the populations concerned. However, spills occurring earlier in the season near potential areas of concentration may present a less immediate environmental threat if the species have not yet gathered in these locations. Oil would pose a major threat only if it were allowed to persist in these areas to affect resources when they move into the contaminated areas later in the season. In these situations it may be appropriate either to use dispersants to treat offshore spills, thereby eliminating the delayed threat to resources, or to permit the oil to contaminate these areas and then clean up the contamination prior to the arrival of the most vulnerable species. In these areas spill countermeasure strategies must clearly take into account not only the immediate but also the longer term effects of the spilled oil. A similar approach must be taken to spills that occur later in the season after many species have left the study area for the wintering areas in the South. For these spills, although the immediate threat to resources is insignificant, care must be taken to ensure that oil contamination of shorelines is neither not permitted to occur nor is it permitted to persist to affect resources returning to these areas the following year.

2.2.8 Real-Time Verification of Resource Vulnerability

When using the environmental sensitivity information provided in the maps of this document it is important to bear in mind that these sensitivity assessments are based upon the predicted average habits of the target species and cannot take into account year-to-year variations which could significantly change the vulnerability of certain species. In addition, the assessments of sensitivity are based on the best resource information available at the time of writing but these may change as new information on habits of target species becomes available. It is therefore important to confirm with local resource experts that the species that would be most severely affected by the spill are actually using the oil-threatened area at the time of the spill as predicted.

2.2.9 Updating

To be applicable, the vulnerability profiles contained in the Appendix must be updated periodically. These updates would be required every five years and would specifically examine new information on species, and resultant effects on sensitivity analyses. The update would take into account new information on the biology of species, changes in habits, changes in numbers, and any other change that would influence the vulnerability profiles, and would thus change effects.

2.3 INFORMATION CONCERNING SOCIO-ECONOMIC VALUE OF OIL-VULNERABLE RESOURCES

The decision making system described in this guide is based on biological impact criteria. It is clear, however, that any decision must also take into account the concerns of residents of the area on the matter of resource utilization. The following three sections briefly outline the utilization of birds, fish and marine mammals in the area. The primary source of this material is the Beaufort Sea-Mackenzie Delta Region Environmental Impact Statement (1982).

Birds

During the spring, summer, and fall, residents of the southern Beaufort Sea coastal area make use of a variety of bird species. The most commonly harvested species are snow geese, brant, white-fronted geese, Canada geese, and various duck species (eiders, oldsquaw, pintail, scaup, and scoters). Much of this hunting effort is concentrated near Herschel Island, Nunaluk Spit, the outer Mackenzie Delta, and in coastal bays along the Tuktoyaktuk Peninsula.

Residents of Aklavik and Inuvik take a combined annual average of 1500 ducks and a highly variable number of geese annually (e.g., 150 in 1965-66; 3250 in 1973-78) whereas residents of Tuktoyaktuk harvest between 600 and 1000 ducks and 1000 and 2,500 geese annually.

Fish

The residents of the Beaufort Sea coastal area harvest a number of species of fish in both domestic and commercial fisheries. The major species caught are: arctic char, arctic and least cisco, lake and broad whitefish, inconnu, northern pike, and pacific herring. Most domestic and commercial fishing is concentrated in areas such as the Colville and Mackenzie River deltas, in small river outlets, and in coastal lakes. In contrast, little fishing is done in the Beaufort Sea coastal waters even though most exploited species spend considerable time in marine coastal waters during the summer.

Domestic fishing is far more important to Beaufort Sea residents than is commercial fishing. Although estimates are limited by lack of comprehensive catch records, whitefish represent the greatest proportion of fish harvested. In 1979 and 1980 the domestic harvest for the Delta area was in the order of 100,000 kg. In addition to the lake (humpback) whitefish (50%), this total consisted of arctic and least cicso, inconnu, pike, and burbot. Also included in lesser numbers were arctic grayling, arctic char, lake trout, chum salmon, longnose sucker, and pacific herring.

Mammals

Whales. It is illegal to hunt bowhead whales in Canadian waters, and as such they are not considered to be of great socio-economic concern to Canadian Inuit.

Beluga whales, on the other hand, are an important component of the hunting activity of the residents of the southern Beaufort Sea. During the spring and fall migration of the species, residents of Inuvik, Aklavik and Tuktoyaktuk actively participate in the hunt. Statistics on the number of beluga whales harvested between 1972 and 1981 are shown in Table 1.

TABLE 1

Harvest of Beluga Whales in the Mackenzie Estuary (1972-1981)

Location	Number of beluga whales											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1972-79	1972-81
Tuktoyaktuk community	45	87	40	50	51	54	53	49	23	62	53.6	51.4
Kugmallit Bay camps	31	63	50	60	59	32	28	31	14	30	44.2	39.8
Kendall Island camps	4	7	2	3	12	30	10	12	24	22	10	12.6
"Niakunak Bay" camps	33	20	30	29	32	24	30	28	29[a]	35[b]	28.2	29.0
Total harvest	113	177	122	142	154	140	121	120	90	149	136	132.8

a. Includes 8 whales taken near Aklavik - July 14.

b. Includes 13-15 whales taken by Holman Island families with the help of Aklavik hunters.

Seal. The ringed seal is the most abundant marine mammal in the Beaufort Sea, and is harvested throughout the year by residents of the area. These animals provide both a source of food and income to the community involved in the hunt. In addition, bearded seals are also hunted, although they are not as abundant or important in the Canadian Beaufort. Statistics on seal harvest between 1971 and 1980 are shown below in Table 2.

TABLE 2

Seal Harvests in the Beaufort Sea and Amundsen Gulf[a]

Community	1978 Population	Number of seals								
		1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Aklavik	800	n/r[b]	n/r	16	n/r	n/r	n/r	n/r	n/r	17
Inuvik	4150	268	7	61	n/r	n/r	4	n/r	n/r	r/r
Tuktoyaktuk	750	53	26	37	1	4	18	n/r	8	13
Paulatuk	148	179	1	146	n/r	61	72	n/r	n/r	154
Sachs Harbour	167	200	95	n/r	n/r	n/r	298	n/r	1	70
Holman	350	1096	2198	3213	2876	2394	4971	992	2052	792

a. Harvests include primarily ringed seals, but bearded seals, harp seals, and "other seals" recorded in marine mammal harvests are also included in estimates.

b. n/r = no record or unknown

3. STEP-BY-STEP GUIDE FOR THE DISPERSANT-USE DECISION MAKER

This step-by-step guide should be followed in deciding whether or not to use dispersants for batch spills and blowouts in the southern Beaufort Sea. Although the principal emphasis is on environmental protection, other related issues, including dispersant effectiveness, feasibility of dispersant operations, and socio-economics, have been built into the guide because of their importance in this decision making process.

There are three components to the guide.

a) Step-by-step instructions for assembling the necessary information concerning dispersant effectiveness, feasibility, and environmental sensitivity to oil spills are outlined in Steps I-VII (pages 32-46).

b) A series of blank forms (Forms 1-5) should be completed while working through the instructions. These forms will facilitate the assembly of information and will serve as documentation for the dispersant-use decision. Blank forms are given on pages 47 to 53.

c) Two series of multi-coloured Sensitivity Maps indicate the overall sensitivity of areas of the southern Beaufort Sea to contamination with oil. Each series of maps has been developed to identify the sensitivity of different areas of the southern Beaufort Sea to chemically dispersed or untreated oil from batch spills or blowouts. Within each series, sensitivity data are given for each of the four months of the open-water season. In addition, Impact Tables following the maps contain an assessment of the sensitivity of individual resources on a monthly basis. These maps and tables should be used in assessing the potential effects of spills.

The general procedure for making a dispersant-use decision is outlined in the decision tree in Figure 2 (page 29). The steps in this procedure are summarized below.

1. Determine the dispersibility of the oil and the sufficiency of available equipment and chemicals (STEPS I and II).

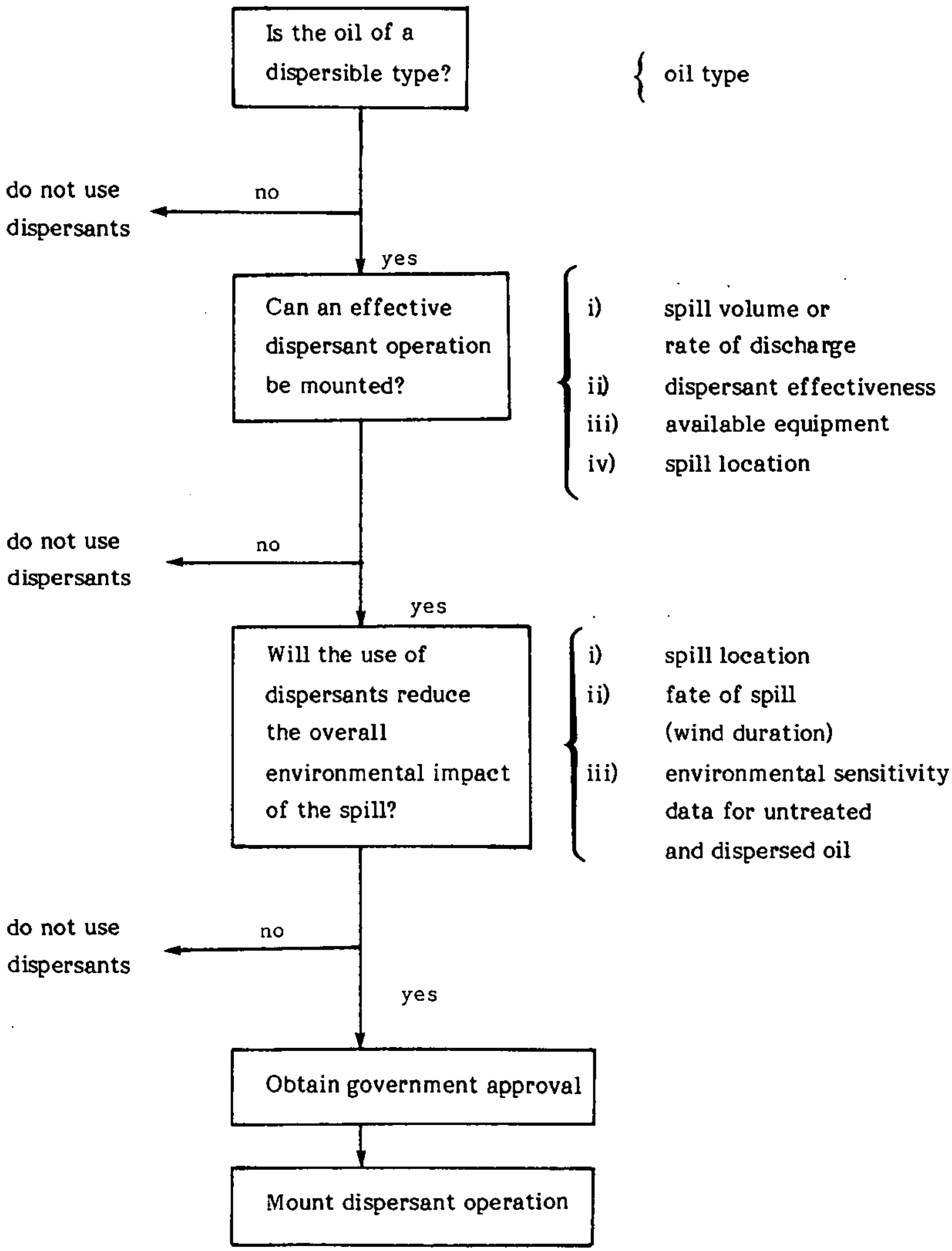
2. Determine whether the untreated spill poses a threat to environmental resources (STEP III).

   a) Locate the initial spill position on the sensitivity map for untreated oil for the appropriate month and spill type (batch versus continuous spill).
   b) Obtain a plot of the predicted fate of the untreated oil using a computer model available for this purpose. (The groundwork for this should be laid in advance of the spill.)
   c) Using the plot of the predicted fate and movement of untreated oil identify all numbered areas that may become contaminated with oil and note their respective sensitivities (such as Sensitivity-Low, Sensitive, or Highly Sensitive-Indirect).

3. Determine whether the oil, if dispersed, threatens any environmental resource (STEP IV).

   a) Refer to the sensitivity map for dispersed oil for the appropriate month and spill type (batch versus continuous spill).
   b) Obtain a plot of the predicted fate of the chemically dispersed oil and note the point at which dispersed oil concentrations drop below critical concentrations.
   c) Use this plot and the selected map to identify all numbered areas that may become contaminated with dispersed oil and their respective sensitivities of these areas.

FIGURE 2. Summary of the dispersant-use decision tree and the variables required as input into the decision.



4. Prepare a Preliminary Dispersant Decision (Form 2) by comparing the overall sensitivities of all areas threatened by dispersed oil with those threatened by the untreated spill (STEP V). Prepare arguments both in favour and against dispersant use.

5. The following steps take into consideration the influence of three additional factores that may influence your decision (STEP VI).

   a) Verify that real-time resource sensitivity is actually consistent with predicted levels. To do this, first identify all resources that suffer significant effects from the untreated oil using the impact tables provided.

   b) Verify the predicted sensitivity for each resource by consulting with local resource experts. Where actual sensitivities are lower than predicted, revise downward the sensitivity level for the resource and, if appropriate, for the overall sensitivity of the area.

   c) Repeat a and b for areas and resources threatened by chemically dispersed oil in order to verify their real-time sensitivity as well.

   d) If estimates of sensitivity of any of the more sensitive resources are revised downward due to real-time verification, re-evaluate the dispersant decision by reviewing STEPS III to V.

   e) If indirect effects constitute the most severe effect in oil threatened areas it may be advantageous to let the oil come ashore and clean it up prior to the arrival of critical species rather than to disperse it in offshore areas. To consider this option, determine whether cleanup can be accomplished to avoid significant effects. If shoreline clean-up is feasible within the required time, further revise downward the assessment of sensitivity and re-evaluate the dispersant decision by reviewing STEPS III to V.

f) <u>In making your decision, take into account socio-economic considerations as discussed earlier (Section 2.3).</u>

6. Formulate your <u>Final Decision</u> (Form 5) by reviewing your Preliminary Dispersant Decision and your subsequent revisions (STEP VII).

The full steps in the operation are provided in the following pages. For each step some background information is given and this is followed by specific instructions.

STEP I: DETERMINE THE DISPERSIBILITY OF THE OIL

Background

Not all oils are amenable to treatment with chemical dispersants. A number of oil properties influence dispersibility, but one of the more useful indicators is the viscosity of the oil. A general "rule-of-thumb" is that most oils with viscosities lower than 1000-2000 centipoise are at least partially amenable to chemical dispersion, but dispersibility declines rapidly with increasing viscosity at viscosities greater than 1000 cp. Oils with viscosities greater than 5000 cp can be considered undispersible. The information in Table 3 shows the relationship between viscosity and dispersibility for certain oils. These results show that fresh and weathered oils are all highly dispersible where viscosities are less than about 200 cp. For oils with viscosities in the approximate range of 200 to 5000 cp dispersibilities may vary from very low to very high and is clearly under the control of factors other than viscosity alone. For such oils it may be necessary to emperically determine dispersibility.

Action

Assess the viscosity of the spilled oil and determine whether the oil might be dispersible by virtue of its initial viscosity. If possible, conduct a quick field test of dispersibility. Enter this information in the appropriate locations (items 5-7) in Form 1. If the oil is of a dispersible type, either on the basis of its initial viscosity or on the basis of the results of a field test then proceed to STEP II. If the oil appears to be non-dispersible, there is little point in considering dispersant use further.

TABLE 3

Relationship between dispersibility and viscosity among certain oils using the dispersant, Corexit 9527

Oil Type	Degree of Weathering %	Viscosity (@ °C) cp	Percent Dispersed 0-10	10-25	26-50	50-75	76-90	91-100
Automobile gas	0	1				54		
Auto diesel	0	4						92
No 2. fuel oil	0	8					86	
Norman Wells Cr.	0	9					79	
Tarsiut	0	12					76	
Amauligak	0	25						93
Tarsiut	12	27				57		
Tarsiut	16	29				62		
Alberta S.M.B.	0	47				73		
Elect. insol. oil	0	38				72		
Amauligak	13	42					84	
Bent Horn B	0	53				54		
Amauligak	20	68				74		
Bent Horn A	0	60					86	
Adgo	0	165						92
Issunagnak	0	199		16				
Adgo	3	220					88	
Elect. lub. oil	0	350			49			
Avalon	0	575	10					
Transmountain Bl	0	650			40			
Avalon	9%	1000	10					
Lago Medio	0	4355				73		
Avalon	20%	5000	10					
Alberta S.M.B.	15%	7500			36			
Lago Medio	9	7800				62		
Transmountain	19	10,000	0					
Alberta S.M.B.	25	1100					76	
Bent Horn A	20	14750	5					
Lago Medio	15	16500		20				
Bent Horn B	33	110,000	0					
Bunker "C"	0	70,000,000		0				

STEP II: DETERMINE THE SUFFICIENCY OF AVAILABLE EQUIPMENT AND DISPERSANT

Background

If the spilled oil is of a dispersible type, it is necessary to determine whether sufficient equipment and dispersant are available to successfully disperse the oil. For small batch spills or blowouts of low discharge rate only a limited amount of equipment and dispersant is necessary to successfully disperse the spilled oil. However, for large batch spills or blowouts the available equipment, dispersant, or both may be sufficient to disperse only a fraction of the oil discharged. If large amounts of oil remain untreated the resulting environmental damage may be as great as if the spill were left untreated.

The most important variables limiting the capacity of a fleet of dispersant-application vehicles are the types, carrying capacities, and numbers of available vehicles. For batch spills the fleet must be capable of dispersing the bulk of the spilled oil before the oil becomes highly weathered, say, within 48 hours after the spill. Hence the size of a spill that can be considered treatable is limited by what can be done within this period of time. For a blowout, the start-up time is less important because the spill may continue for a relatively long period; however, when the dispersant operation is in place, it must involve sufficient equipment and dispersant so that the daily capacity for dispersant application is appropriate for the daily rate of discharge of oil from the blowout.

Action

Collect information concerning the amount of dispersant immediately available and the types and numbers of availabledispersant spraying vehicles. Record this in item 8 of Form 1. Using this information and the data in Table 4 determine the maximum size of spill that can be treated on the basis of the vehicles available. Do the same in terms of the amount of dispersant available.

For batch spills, if the stockpile of available dispersant and capacity of available fleet of vehicles exceeds about 90% of the volume spilled, and if the operation can be completed within one or two days, then conclude that the dispersant operation is feasible and proceed to STEP III to consider the environmental implications of the spill. If not, then dispersants are not a feasible option as a first-line countermeasure treatment and proceed to consider other options.

For blowouts, if the dispersant capacity of regionally available vehicles is insufficient to deal with the discharge rate of the oil, then determine whether supplementary equipment are accessible and can be incorporated into the existing countermeasures system. If sufficient equipment can be made available and if continuous dispersant deliveries to the site can match the requirements of the blowout, conclude that the dispersant operation is feasible and proceed to STEP III to consider the environmental implications of the spill.

TABLE 4

Dispersant and Equipment Requirements as a Function of Spill Size[a]

Application Vehicle	Number of Vehicles	Batch Spills: maximum volume of oil treatable (m^3)	Batch Spills: minimum amount of dispersant required (m^3)	Blowouts: maximum size of blowout treatable (m^3/d)[e]	Blowouts: minimum amount of dispersant required (m^3/d)
Helicopter[b]	1	100	14	50	7
	2	200	28	100	14
	3	300	43	150	22
	4	400	57	200	29
	5	500	71	250	36
Supply boat[c]	1	260	19	130	10
	2	520	37	260	19
	3	780	56	390	28
	4	1040	74	520	37
	5	1300	93	650	46
Fixed Wing Aircraft (DC-6B)[d]	1	1500	214	750	107

a. It is assumed that the distance from the base of operations to the spill site does not exceed 75 km. For batch spills it is assumed that dipersant application is possible for 24 hours during the first 48 hours following the spill. For blowouts, operations are possible for 12 hours per day; oil discharged during the nighttime is assumed dispersible during the daylight hours.

b. Assumes helicopters have a dispersant capacity of 1 m^3 dispersant per sortie and return to base for refueling and resupply.

c. Assumes supply boats have a dispersant capacity of 13 m^3 per sortie and are resupplied on station.

d. Assumes a DC-6B has a dispersant capacity of 13.25 m^3 dispersant per sortie.

e. Assumes dosage of dispersant to oil of 1 in 20 disperses 35 % of the oil for aerial application and 70 % for boat application.

STEP III: ASSESS WHETHER THE UNTREATED OIL SPILL POSES A SIGNIFICANT THREAT TO ENVIRONMENTAL RESOURCES

Background

The high cost of mounting a dispersant operation can be justified only if the spilled oil poses a significant threat to environmental resources. For a preliminary assessment of the potential impact of the untreated spill or blowout, use the predicted fate of the spilled oil and the estimates of environmental sensitivity contained in the sensitivity maps included at the end of the section.

Action

Refer to the sensitivity map for untreated oil for the appropriate month and spill type (batch vs continuous spill). Using a computer model that predicts spill fate and surface oil concentrations, identify all numbered areas in the map that may be contaminated with oil. Consider only offshore areas that are predicted to have sea surface oil concentrations greater than about 10 g/m^2 and shoreline areas that will have levels of contamination greater than about 1 litre of oil per linear metre of coastline. Values less than these figures can be considered innocuous. Note these affected areas and their identified sensitivities (e.g., SENSITIVITY-LOW, SENSITIVE, SENSITIVE-INDIRECT) in the appropriate places in the upper left hand point of Form 2. Bear in mind that existing methods for predicting oil fate and movements are only approximate; hence, assume that areas adjacent to those lying on the predicted trajectory of the spilled oil may also become contaminated with oil and include these areas in your assessment. If the spilled oil threatens any area that bears a sensitivity designation of SENSITIVE, SENSITIVE-INDIRECT or greater, then there is justification for considering mounting a dispersant operation. Hence proceed to STEP IV to consider the potential effects of chemically dispersed oil. If no oil-sensitive areas are threatened by the untreated oil slick then the assessment procedure can be stopped here with the conclusion that there is no environmental justification for using dispersants.

STEP IV: ASSESS WHETHER THE OIL IF CHEMICALLY DISPERSED POSES A SIGNIFICANT THREAT TO ENVIRONMENTAL RESOURCES

Background

When chemicals are used to disperse oil into the water-column they increase the hazard of the spill to water-column and benthic resources. The increased risk of dispersant use to these resources must therefore be weighed against the existing threat of the untreated oil. The hazard of dispersed oil to water-column dwellers is determined by assessing two factors: first, the predicted fate of the dispersed oil, and second, the vulnerability of resources in the vicinity of the spill to the dispersed oil.

Action

Refer to the sensitivity map for dispersed oil for the appropriate month and spill type (batch versus continuous spill). Using a computer model that predicts the fate of dispersed oil and water-column oil concentrations, identify all numbered areas in the map that may be contaminated with dispersed oil. Consider only areas containing dispersed oil concentrations greater than 1 ppm total oil. Concentrations less than this can be considered innocuous. Note these oil-threatened areas and their identified sensitivities (e.g., SENSITIVITY-LOW, SENSITIVE) in the appropriate places in Form 2. If the sensitivity of the areas are LOW as they are, for example, in offshore areas, then there are few environmental drawbacks to the use of dispersants and the environmental impact process can be terminated here. If, on the other hand, dispersants pose a significant threat to oil-vulnerable resources, it will be necessary to determine whether dispersants might reduce the overall impact of the spill. Proceed to STEP V to compare the possible effects of dispersed oil with those of the oil left untreated.

STEP V: DETERMINE WHETHER THE USE OF CHEMICAL DISPERSANTS REDUCES THE OVERALL IMPACT OF THE OIL SPILL

Background

If both untreated oil and chemically dispersed oil pose a significant threat to certain environmental resources, it will be necessary to determine whether dispersant use might yield an overall reduction in the environmental risk of the spill. This can be done by comparing the overall sensitivities of the areas threatened by the chemically dispersed oil to those threatened by the untreated oil. The areas and their respective sensitivities to chemically dispersed and untreated oil have already been listed in Form 2.

Action

Compare the sensitivities of the most sensitive areas for the treated and untreated oil spills to identify the treatment that yields the lower overall impact. Prepare arguments both in favour of and against dispersant use and list these in Form 2. Prepare a dispersant decision based on these arguments. This decision must be that dispersants either will clearly reduce the effects of the spill, or will clearly increase the overall impact of the spill, or will neither increase nor decrease the effects of the spill. This decision is only a PRELIMINARY DISPERSANT DECISION because the estimate of impact on which the decision is based is in turn based on historical information on the habits, distribution and movements of resources. Before making a final decision it will be necessary to confirm that the actual distributions of target resources are as predicted. This confirmation is done in STEP VI where several additional factors are considered as well.

STEP VI: ASSESS THE OTHER CONSIDERATIONS THAT COULD NECESSITATE A MODIFICATION TO THE PRELIMINARY DISPERSANT DECISION

There are three factors that must be considered to ensure that the possibility of error in formulating the dispersant decision is minimized. These are that: first, resources may not be present as predicted; second, indirect effects may occur; and third, socio-economic conditions may affect protection priorities. These are discussed below.

Step VI-1: Confirm Real-Time Distribution of Oil-Threatened Resources

Background

Because of a number of factors, the distribution and movements of some resources may differ from the predictions used in developing the sensitivity maps. Consequently, the predicted sensitivities of certain areas may vary as well. Because these predictions have been made assuming worst-case conditions of concentrations of the target species (i.e., the highest degree of aggregation that has been observed historically), the real-time sensitivities of these areas may be lower than predicted. It is important therefore to confirm with resource experts that the predicted concentrations of resources are actually present in the areas concerned at the actual time of the spill. The most vunerable or critical resource in each oil-threatened area can be identified by referring to the area-specific Impact Tables which follow the sensitivity maps.

Action

Refer to the appropriate area-specific Impact Tables for the areas threatened by untreated oil slicks or dispersed oil and identify the critical resources (i.e., the more vulnerable resources) for the areas and month concerned. List the critical resources and their predicted sensitivities for both treated and untreated oil in Form 3. Confirm with the appropriate resource experts that the level of concentration of each critical resource and hence the sensitivity of each species-stock is as predicted for the oil-threatened areas concerned. If the sensitivities of the most sensitive resource (or resources) remain unchanged then the overall sensitivity of the oil threatened area remains unchanged. However, if the sensitivity of the most sensitive resource (or resources) is less than predicted, then the overall sensitivity of the area must be reduced to reflect the real-time situation. If the sensitivities of one or more species are revised, then re-evaluate the dispersant decision by repeating STEPS III to V using the confirmed assessments of sensitivity. Then proceed to consider the significance of indirect effects to the dispersant decision, STEP VI-2.

Step VI-2: Determine Indirect Effects of Untreated Oil (June or July Spills Only)

Background

In the sensitivity maps for June and July, certain coastal or nearshore areas have been classified as sensitive even though few resources are present in these areas during these months. It has been assumed that if oil were permitted to contaminate these areas and persist for some time, oil-sensitive resources would be affected when they move into the area later in the season. If this is the case the user may have the option of either dispersing the oil in offshore areas or permitting the oil to come ashore providing the contamination can be removed prior to the arrival of the oil-sensitive resources. It is important to bear in mind, however, that although the most vulnerable species are not present at the time of the spill, there might be other less vulnerable resources present which would suffer if oil were permitted to enter the area. If the latter is true then the dispersant decision must take into account the more immediate threat to these less vulnerable species.

Action

If indirect effects constitute the most severe impact in the oil threatened areas, continue below. If not proceed to consider socio-economic factors in STEP VI-3.

If appropriate clean-up is feasible in areas where indirect effects might occur, it is possible to further revise downward the sensitivity designations in these areas. Identify the areas listed in Form 3 in which indirect effects are significant and revise downward the sensitivity designations of the areas concerned and the total sensitivity designation of the untreated spill. Then re-evaluate the dispersant decision as in STEPS IV to V and proceed to consider socio-economic effects.

Step VI-3: Consider Socio-economic Factors

Background

Because of the socio-economic value of certain resources to the local inhabitants it may be preferable to protect certain important resources even at the cost of more significant damage to other less vulnerable resources. This question is highly subjective and few guidelines can be provided for this process. The important socio-economic resources are identified in the area-specific Impact Tables which follow sensitivity maps.

Action

Document the relevant socio-economic issues in Form 4 and revise the dispersant decision accordingly. As mentioned above, few guidelines can be given here for consideration of these socio-economic factors because this question is highly subjective.

STEP VII: FORMULATE A FINAL DISPERSANT DECISION AND SEEK REGULATORY APPROVAL

For offshore waters throughout Canada, including the southern Beaufort Sea, the use of dispersants requires permission from Environment Canada. Only dispersants on Environment Canada's accepted list are allowed to be used. Guidelines for the use and acceptability of oil-spill dispersants have been published by Environment Canada (March 1984) and these should be understood before considering the use of dispersants. The Environmental Protection Service (EPS) of Environment Canada has the prime role of co-ordinating the necessary scientific and environmental advice from various federal, provincial, and territorial agencies, and for providing this advice to the On-Scene Commander.

Action

Ensure that all of the arguments bearing on the dispersant-use decision are summarized in Form 5. Review these arguments, formulate a final dispersant decision and document this decision in Form 5. Armed with this information proceed to obtain approval for dispersant use from the appropriate regulatory agencies in accordance with existing national and regional guidelines and procedures. In each spill incident the On-Scene Commander must seek approval from the EPS Regional Office prior to using dispersants. The person to contact for spills in the Northwest Territories is shown below. EPS officials in the district office in Yellowknife will work hand-in-hand with staff of the the Edmonton office in making the required decision.

Contact:

Regional Environmental Emergency Coordinator
Environmental Conservation Branch
Western and Northern Region
Environmental Protection Service
Environment Canada
Twin Atria #2 2nd Floor
4999-98 Avenue
Edmonton, Alberta
T5K 2J5

Phone:	Emergency:	403-468-8020 (24 hour service)
	Office:	403-468-8020
Telex:	037-3699 (DOE EPS EDM)	

4. BLANK FORMS

FORM 1

Information on spill, oil dispersibility, and
feasibility of dispersant operations

SPILL INFORMATION

1. Location of the spill (lat., long., place name):

2. Date and time of spill:
3. Type of spill (batch spill, blowout):
4. Volume of spill or discharge rate:

DISPERSIBILITY INFORMATION

5. Initial viscosity of oil (centipoise):
6. Results of field dispersibility test (% dispersed):
7. Is spilled oil dispersible (yes/no):

FEASIBILITY OF DISPERSANT OPERATION

8. Type and number of vehicles available for dispersant application and the oil dispersion capacity of the fleet.

i)	Helicopters	Number	Fleet capacity (m^3 oil)
ii)	Fixed-wing aircraft	Number	Fleet capacity (m^3 oil)
iii)	Surface vessels	Number	Fleet capacity (m^3 oil)
	Total fleet capacity to disperse oil (m^3 oil)		

9. Amount of dispersant immediately available:
10. Is the available equipment and dispersant sufficient to treat present spill (yes/no):
11. If the available system is inadequate, can additional equipment and supplies be shipped to the site as required (yes/no):
12. Are dispersants a feasible first-line countermeasure? (yes/no):

Date:

On-Scene Commander:

Dispersant Decision Team: i)

ii)

iii)

FORM 2

Sensitivity of areas upon which untreated oil slicks or clouds of dispersed oil might impinge and Preliminary Dispersant Decision.

Untreated oil slick		Dispersed oil cloud	
Area	Level of Sensitivity	Area	Level of Sensitivity
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________
___	___________	___	___________

Arguments in favour of dispersant use:

i)
ii)
iii)
iv)

Arguments against dispersant use:

i)
ii)
iii)
iv)

PRELIMINARY DISPERSANT DECISION (based on predicted effects)

i) Dispersants will clearly reduce the overall impact of the spill.
ii) Dispersants will clearly increase the overall impact of the spill.
iii) Dispersants will neither clearly increase nor clearly reduce the overall impact of the spill.

FORM 3

Sensitivity of areas and specific resources for treated and untreated cases

UNTREATED OIL SLICK				CHEMICALLY DISPERSED OIL			
Areas affected	More vulnerable species	Species sensitivity predicted/ confirmed	Area sensitivity pred./conf.	Areas affected	More vulnerable species	Species sensitivity pred./conf.	Area sensitivity pred./conf.
Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___	Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___
Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___	Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___
Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___	Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___
Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___	Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___
Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___	Area No. ___	___ ___ ___ ___ ___	___ ___ ___ ___ ___	___

Overall trajectory sensitivity for untreated slick pred./conf. ______________

Overall trajectory sensitivity for chemically-dispersed oil pred./conf. ______________

FORM 4

Socio-economic considerations

Resources affected by untreated oil				Resources affected by chemically dispersed oil			
Area	Resources suffering significant effects	Sensitivity	Socio-economic importance	Area	Resources suffering significant effects	Sensitivity	Socio-economic importance

a) Important Socio-Economic Considerations:

i)
ii)
iii)
iv)

b) Revisions to dispersant decision based on Socio-Economic Considerations:

FORM 5

Summary of arguments and final dispersant decision

1. PRELIMINARY DISPERSANT DECISION (From Form 2)

a) Arguments in favour of dispersants:

i)
ii)
iii)
iv)

b) Arguments against dispersant use:

i)
ii)
iii)
iv)

2. REVISIONS TO ARGUMENTS AND DECISIONS

2.1 Revisions Based on Confirmation of Resource Data

a) Revised information:

i)
ii)
iii)
iv)

b) Revised dispersant decision:

Form 5 continued on next page.

FORM 5 (Cont.)

2.2 Revisions Based on Indirect Effects

a) Important Indirect Effects:

i)

ii)

iii)

iv)

b) Revised dispersant decision:

2.3 Revisions Based on Socio-Economic Considerations

a) Important considerations:

i)

ii)

iii)

iv)

b) Revised dispersant decision:

3. FINAL DISPERSANT DECISION

3.1 Arguments in favour of dispersants:

i)

ii)

iii)

iv)

3.2 Arguments against dispersant use:

i)

ii)

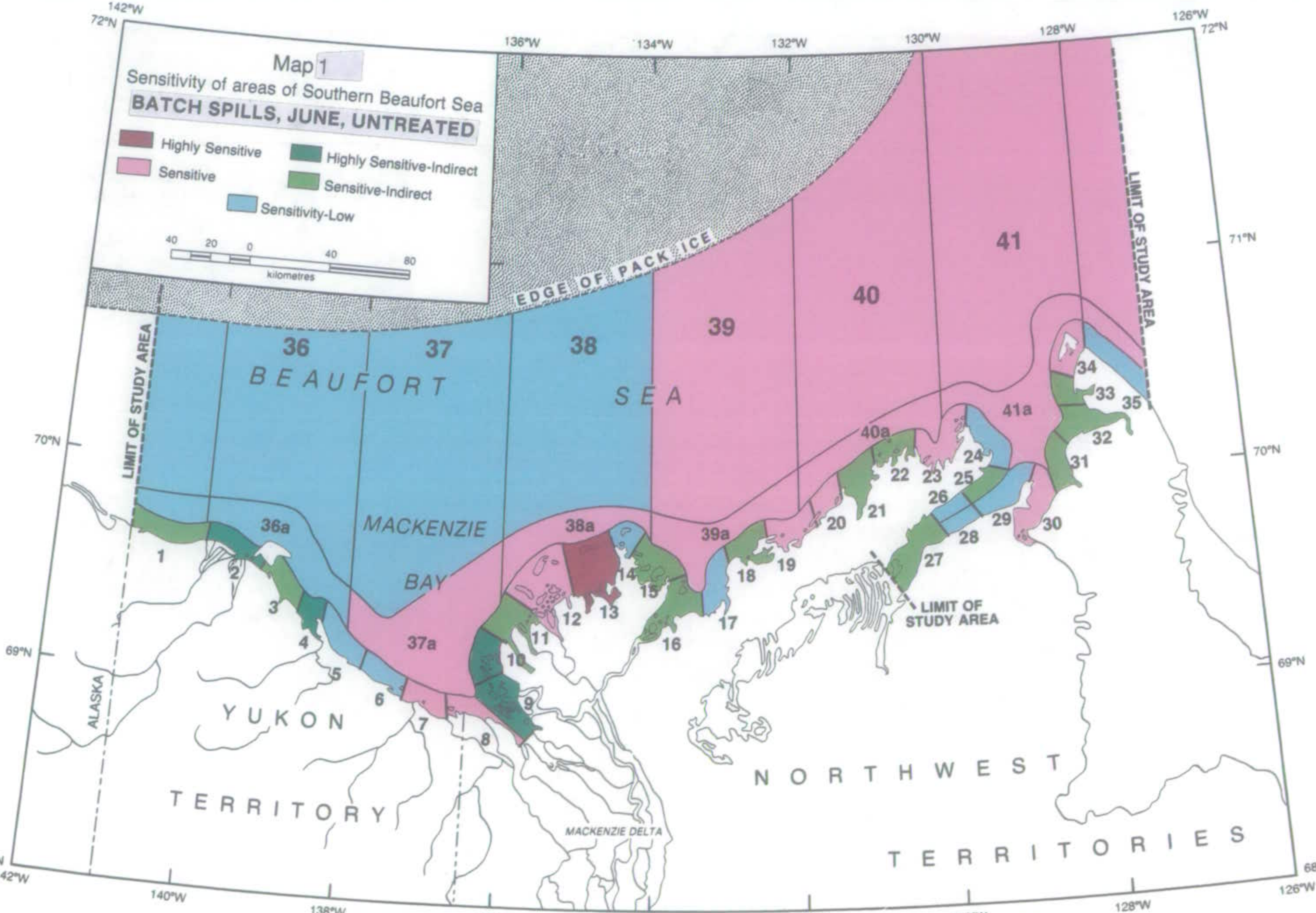
iii)

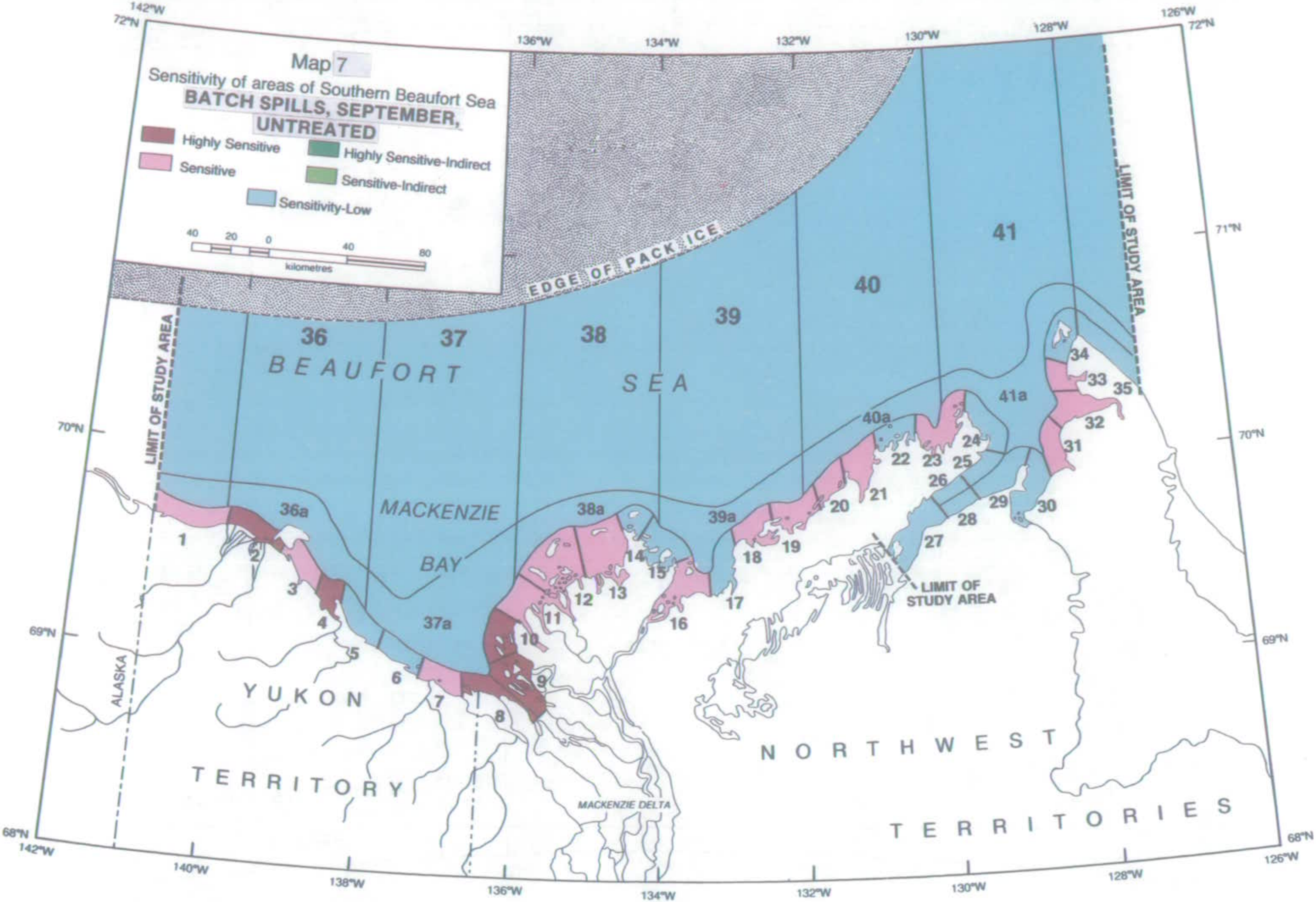
iv)

3.3 Final dispersant decision:

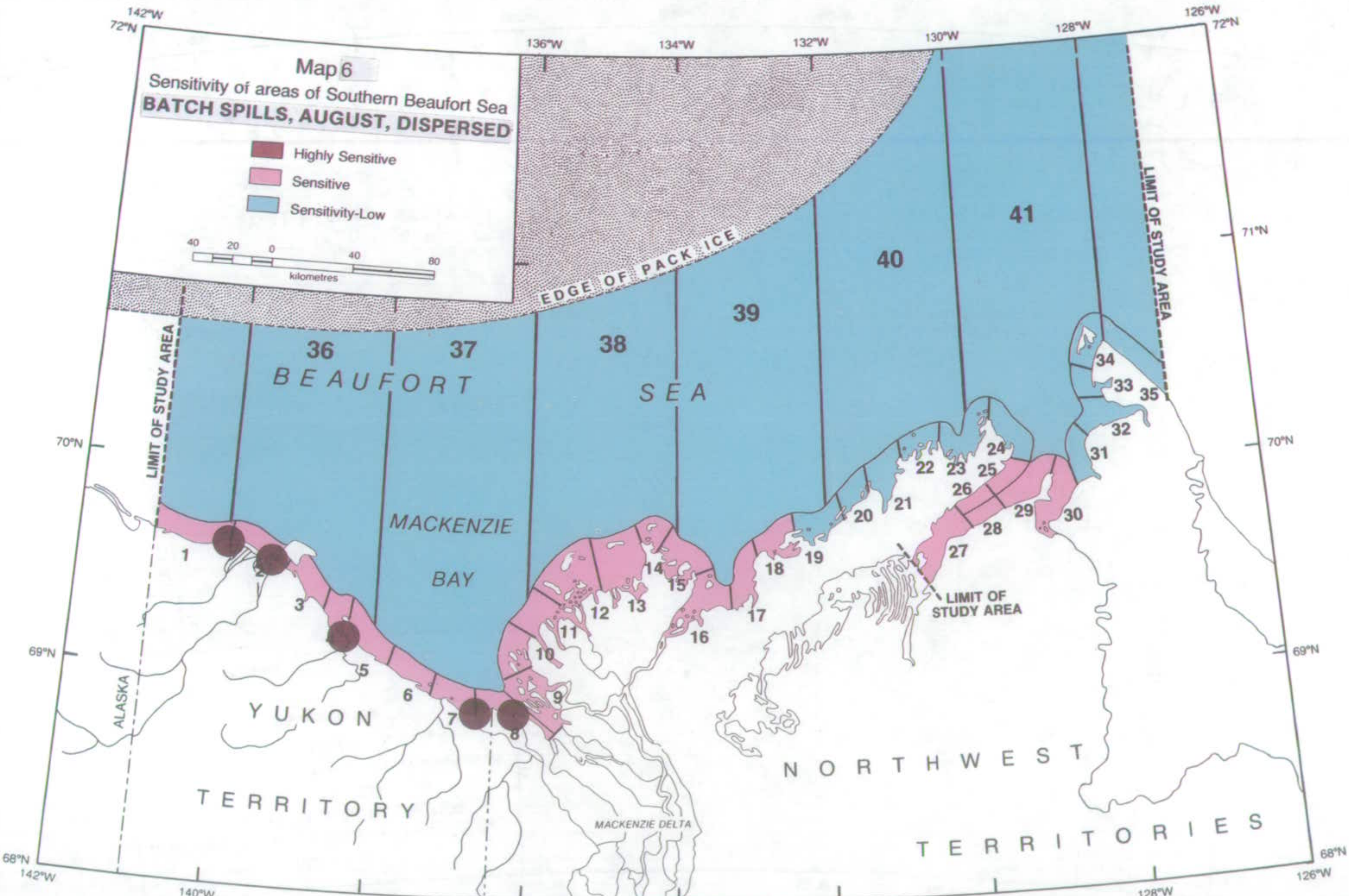
LIST OF ENVIRONMENTAL SENSITIVITY MAPS AND IMPACT TABLES

ENVIRONMENTAL SENSITIVITY MAPS 1-8

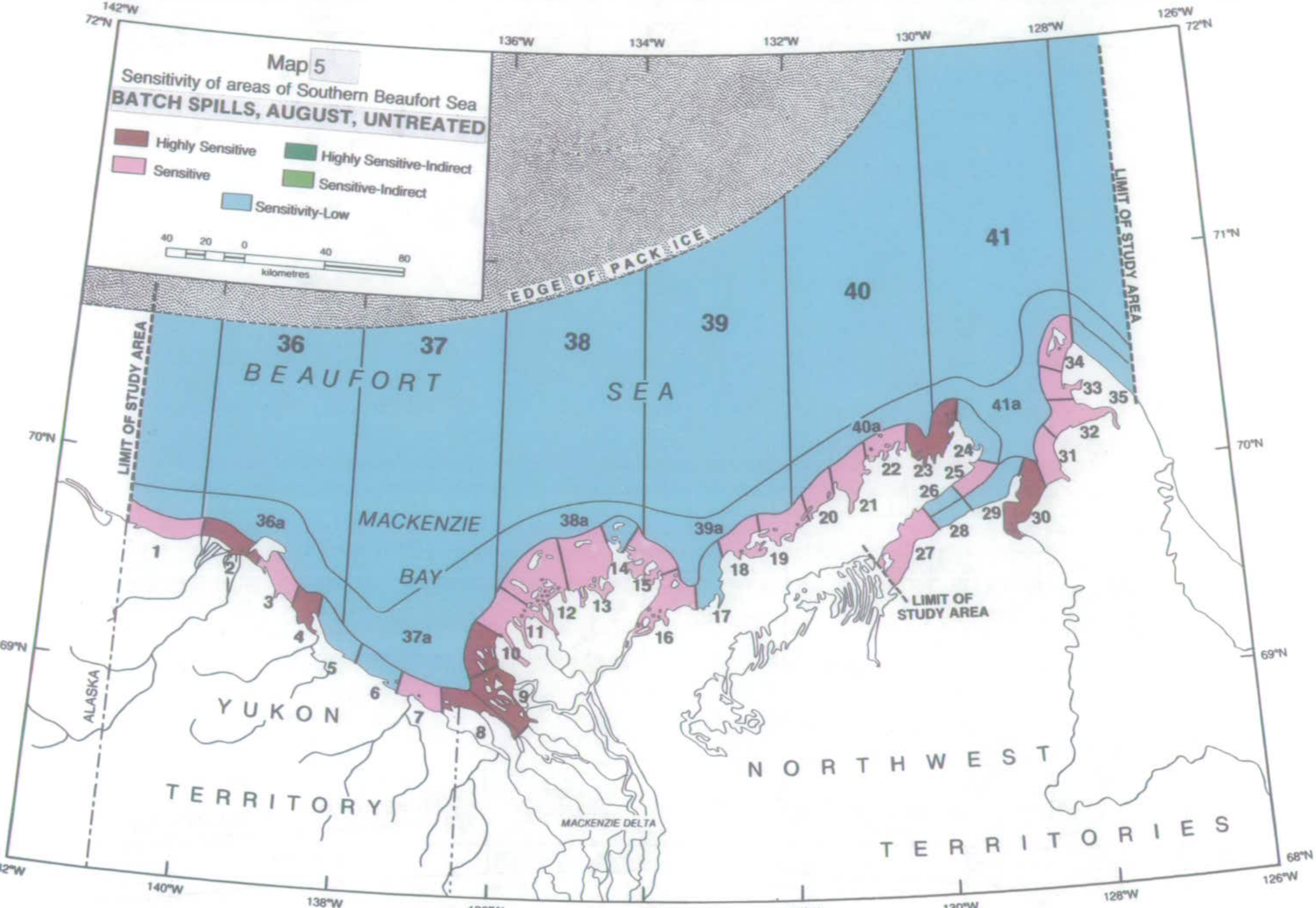

Map 1
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, JUNE, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
MACKENZIE DELTA
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
36 37 38 39 40 41
36a 37a 38a 39a 40a 41a
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W
72°N 71°N 70°N 69°N 68°N

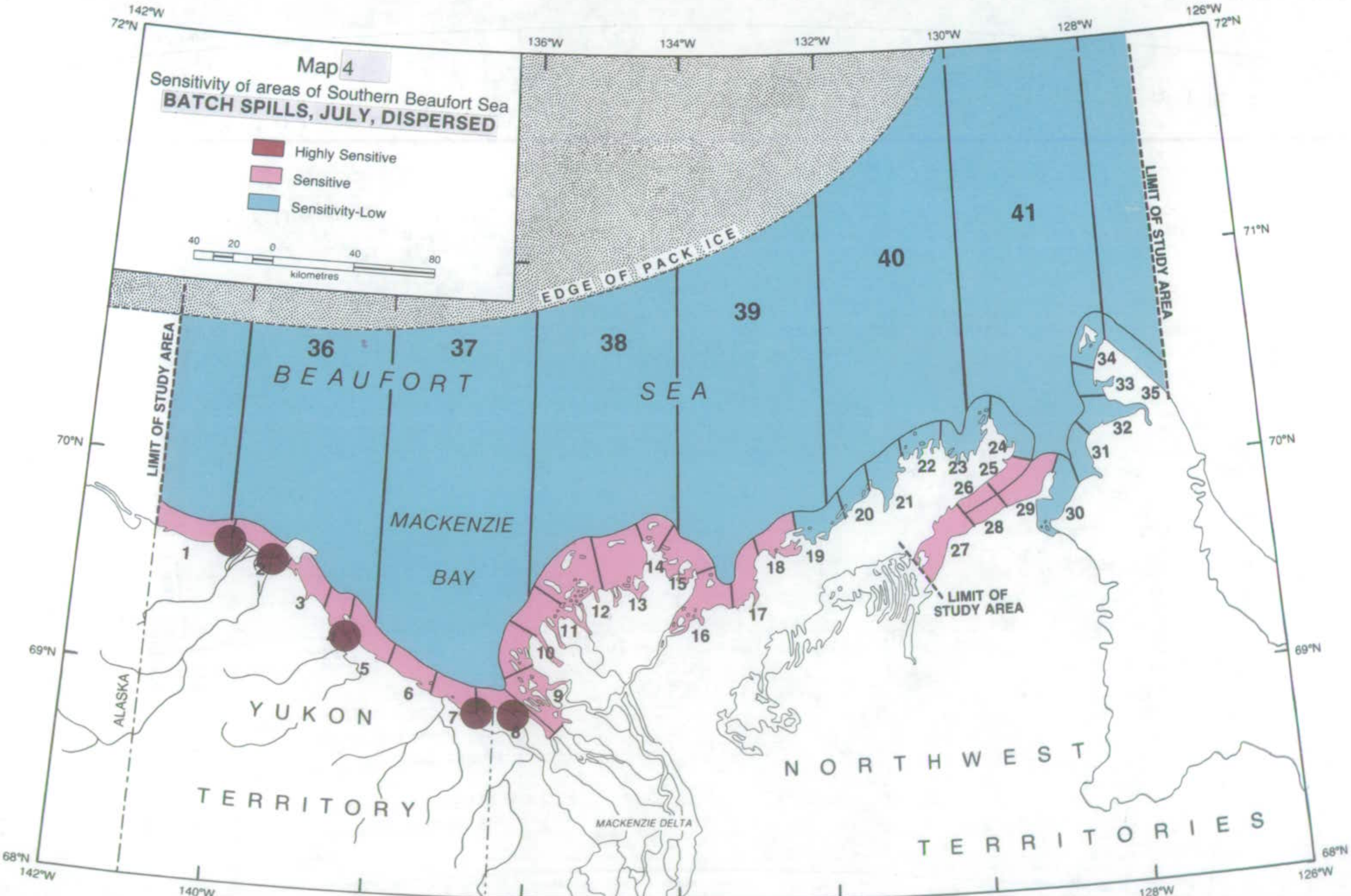


Map 7
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, SEPTEMBER, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
LIMIT OF STUDY AREA
36 37 38 39 40 41
36a 37a 38a 39a 40a 41a
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W
72°N 71°N 70°N 69°N 68°N



Map 6
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, AUGUST, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
MACKENZIE DELTA
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
142°W
140°W
138°W
136°W
134°W
132°W
130°W
128°W
126°W
72°N
71°N
70°N
69°N
68°N
1 2 3 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
36 37 38 39 40 41


Map 5
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, AUGUST, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
36
37
38
39
40
41
36a
37a
38a
39a
40a
41a
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
LIMIT OF STUDY AREA
142°W
140°W
138°W
136°W
134°W
132°W
130°W
128°W
126°W
72°N
71°N
70°N
69°N
68°N



Map 4
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, JULY, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
LIMIT OF STUDY AREA
142°W
140°W
138°W
136°W
134°W
132°W
130°W
128°W
126°W
72°N
71°N
70°N
69°N
68°N
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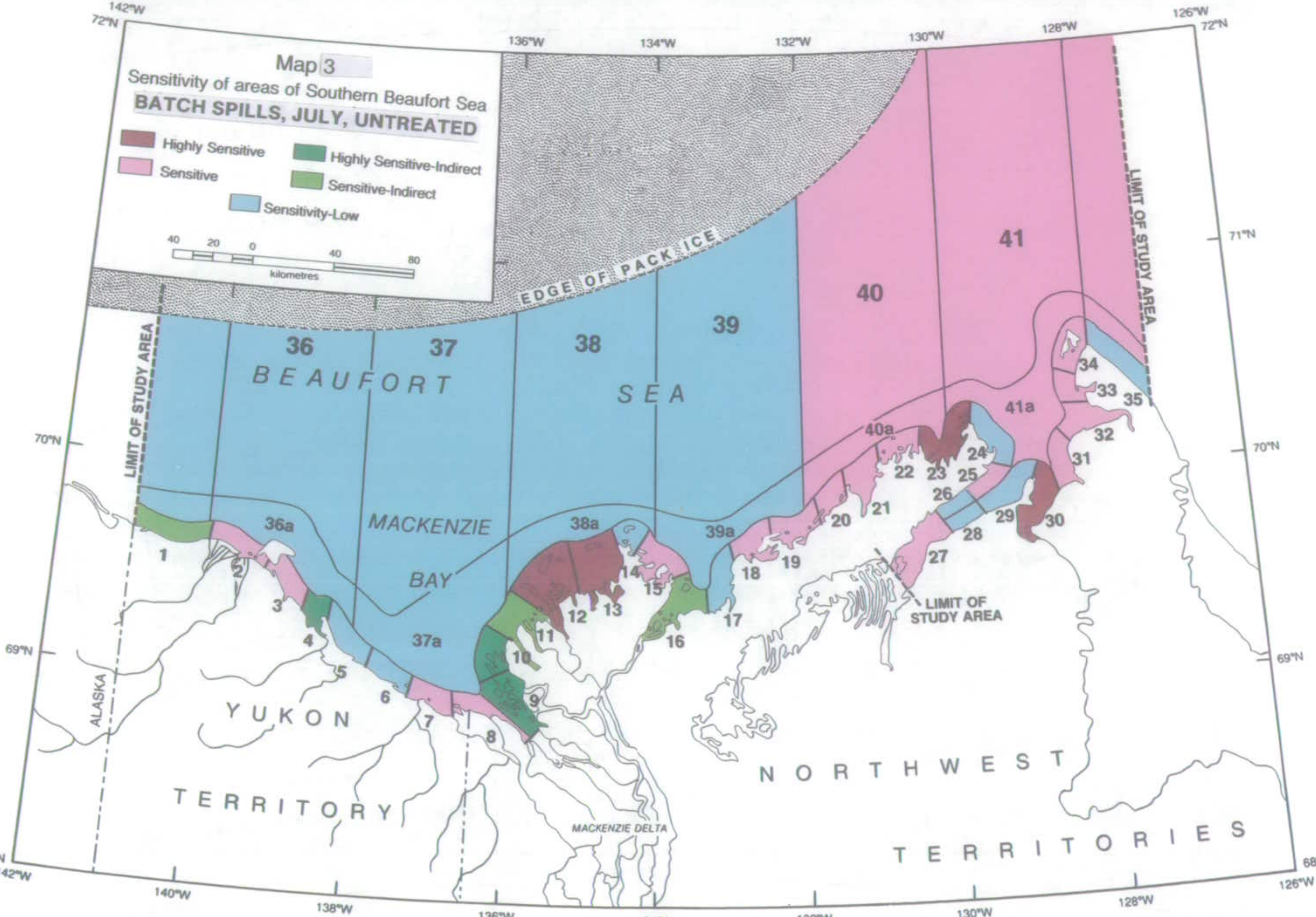
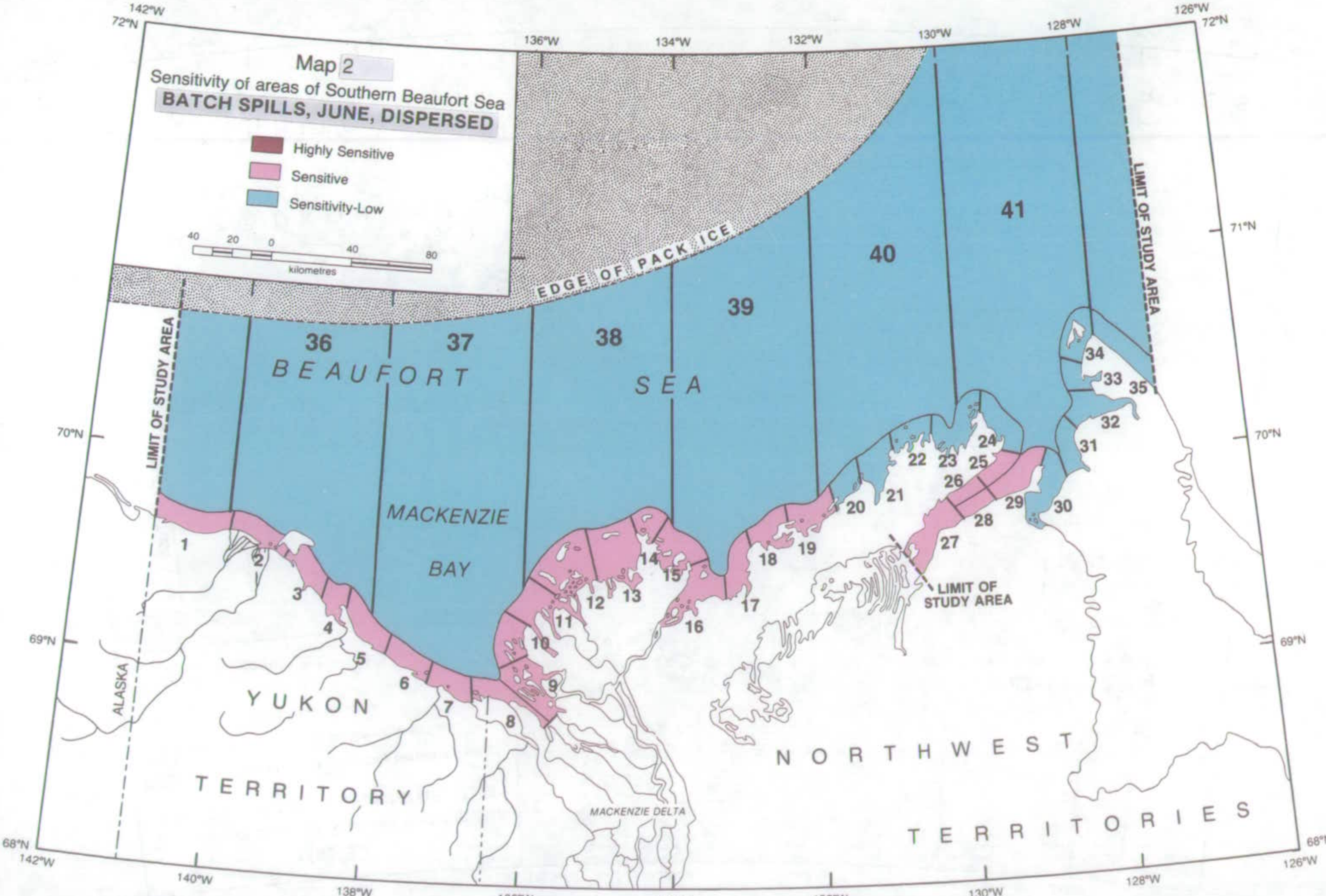

Map 3
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, JULY, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
LIMIT OF STUDY AREA
36 37 38 39 40 41
36a 37a 38a 39a 40a 41a
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W
68°N 69°N 70°N 71°N 72°N



Map 2
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, JUNE, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT
SEA
MACKENZIE
BAY
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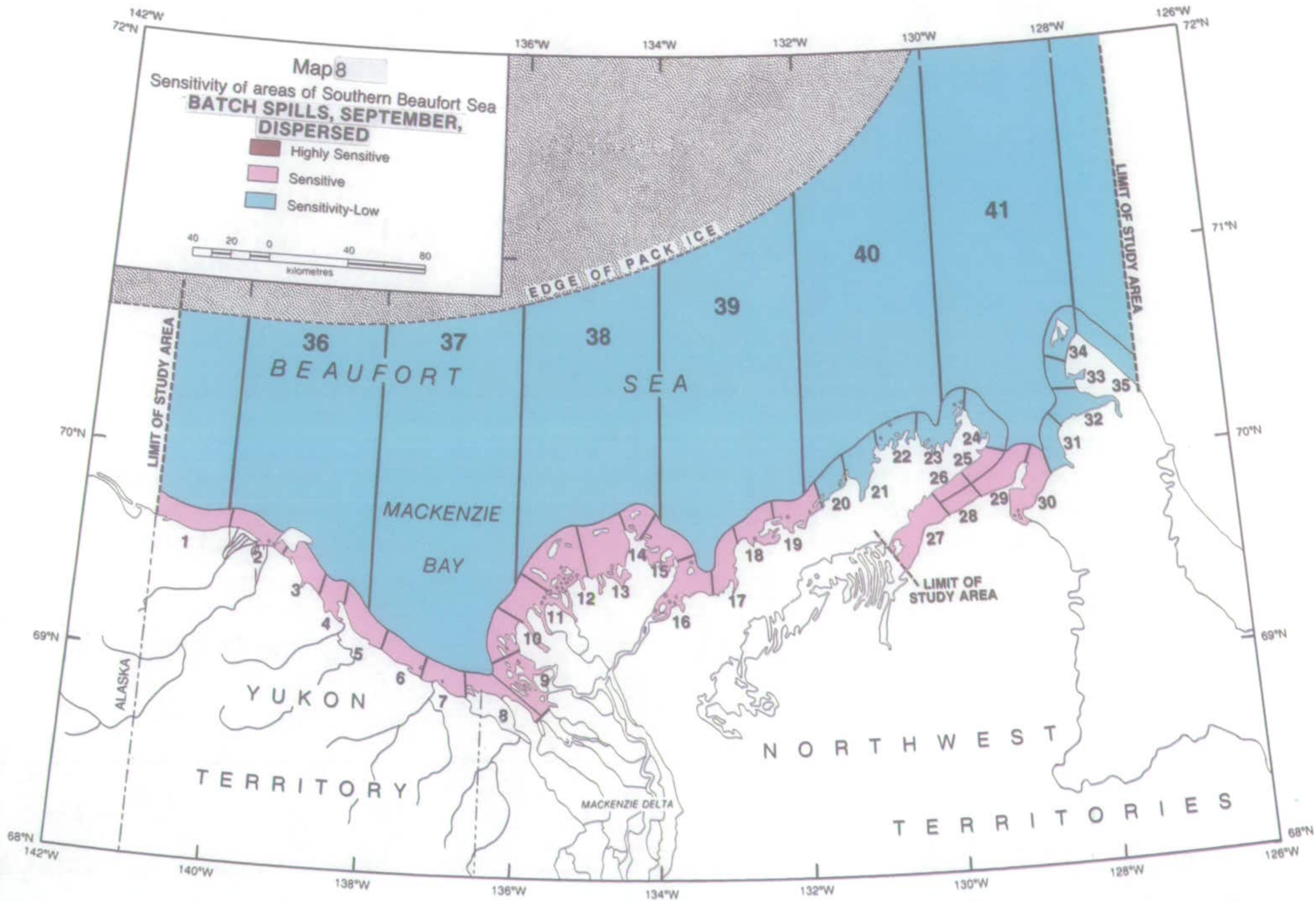
LIMIT OF STUDY AREA
ALASKA
YUKON
TERRITORY
MACKENZIE DELTA
NORTHWEST
TERRITORIES
142°W
72°N
136°W
134°W
132°W
130°W
128°W
126°W
71°N
70°N
69°N
68°N
140°W
138°W


Map 8
Sensitivity of areas of Southern Beaufort Sea
BATCH SPILLS, SEPTEMBER, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
BEAUFORT
SEA
MACKENZIE
BAY
ALASKA
YUKON
TERRITORY
MACKENZIE DELTA
NORTHWEST
TERRITORIES
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32
33
34
35
142°W
136°W
134°W
132°W
130°W
128°W
126°W
140°W
138°W
72°N
71°N
70°N
69°N
68°N

IMPACT TABLES FOR BATCH SPILLS, UNTREATED

SPILL IMPACT BY SPECIES AND MONTH

AREA: 1 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE		x					x							x		x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x					x							x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 2 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT			x					x							x					x
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER		x							x					x					x	
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE		x					x							x		x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x						x						x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 3 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW		x					x							x						
SURF SCOTER		x							x					x					x	
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE		x					x							x		x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 4 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW		x					x							x					x	
SURF SCOTER		x					x							x					x	
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x					x							x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 5 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 6 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 7 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN				x					x		x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 8 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN				x					x					x					x	
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x						x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 9 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE		x					x							x					x	
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x					x							x					x

ADDITIONAL CONSIDERATIONS:

AREA: 10 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE		x					x							x					x	
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x					x							x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 11 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x					x							x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 12 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE			x							x				x					x	
LESSER SNOW GOOSE				x					x					x					x	
BLACK BRANT				x					x					x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x						x				x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 13 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN					x				x					x		x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE				x						x				x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x				x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 14 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 15 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

ADDITIONAL CONSIDERATIONS:

AREA: 16 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x					x							x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 17 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 18 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x		x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 19   TYPE OF SPILL: Batch Spill   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT				x					x					x		x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW			x						x					x					x	
SURF SCOTER		x					x							x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 20   TYPE OF SPILL: Batch Spill   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT				x					x					x		x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER		x							x		x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 21 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x							x					x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 22 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x							x					x		x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 23 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT				x						x					x	x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x						x					x				x	

ADDITIONAL CONSIDERATIONS:

AREA: 24 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 25 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

ADDITIONAL CONSIDERATIONS:

AREA: 26 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 27 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW	x					x					x					x				
SURF SCOTER		x							x		x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

ADDITIONAL CONSIDERATIONS:

AREA: 28 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 29 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 30 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE				x					x		x					x				
BLACK BRANT				x						x					x	x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x					x							x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x						x					x	x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 31 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x							x					x		x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x					x	
SURF SCOTER		x							x		x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 32 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 33 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 34 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER	x					x					x					x				
COMMON EIDER		x							x					x		x				
KING EIDER		x							x		x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE				x					x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x		x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 35 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 36 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 36a TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 37 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 37a **TYPE OF SPILL:** Batch Spill **TREATMENT:** Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 38 **TYPE OF SPILL:** Batch Spill **TREATMENT:** Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 38a TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 39 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 39a TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 40 TYPE OF SPILL: Batch Spill TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 40a   TYPE OF SPILL: Batch Spill   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 41   TYPE OF SPILL: Batch Spill   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER				x		x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 41a   TYPE OF SPILL: Batch Spill   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER				x		x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

IMPACT TABLES FOR BATCH SPILLS, DISPERSED

SPILL IMPACT BY SPECIES AND MONTH

AREA: 1 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x[1]					x[1]					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x[1]					x[1]					x	

ADDITIONAL CONSIDERATIONS: 1. Mouths of spawning streams in late July and August

AREA: 2 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x[1]					x[1]					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x[1]					x[1]					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS: As for Area 1

SPILL IMPACT BY SPECIES AND MONTH

AREA: 3 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x					x					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 4 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x[1]					x[1]					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x[1]					x[1]					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS: As for Area 1

SPILL IMPACT BY SPECIES AND MONTH

AREA: 5 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x					x					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 6 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x					x					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 7 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x[1]					x[1]					x	
ARCTIC CISCO	x					x					x					x				
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x[1]					x[1]					x	

ADDITIONAL CONSIDERATIONS: As for Area 1

AREA: 8 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR				x					x[1]					x[1]					x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x[1]					x[1]					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS: As for Area 1

SPILL IMPACT BY SPECIES AND MONTH

AREA: 9 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 10 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 11 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 12 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 13 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 14 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 15 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 16 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 17 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 18 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH				x					x					x					x	
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 19   TYPE OF SPILL: Batch Spill   TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x		x					x								x	

ADDITIONAL CONSIDERATIONS:

AREA: 20   TYPE OF SPILL: Batch Spill   TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 21 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 22 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 23 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 24 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 25 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 26 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 27 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING				x		x					x								x	
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 28 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 29 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 30 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x								x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x								x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 31 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 32 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 33 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 34 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 35 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE *L	S-I	H-I	S	H	JULY L	S-I	H-I	S	H	AUGUST L	S-I	H-I	S	H	SEPTEMBER L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 36 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE *L	S-I	H-I	S	H	JULY L	S-I	H-I	S	H	AUGUST L	S-I	H-I	S	H	SEPTEMBER L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 37 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 38 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 39 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 40 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

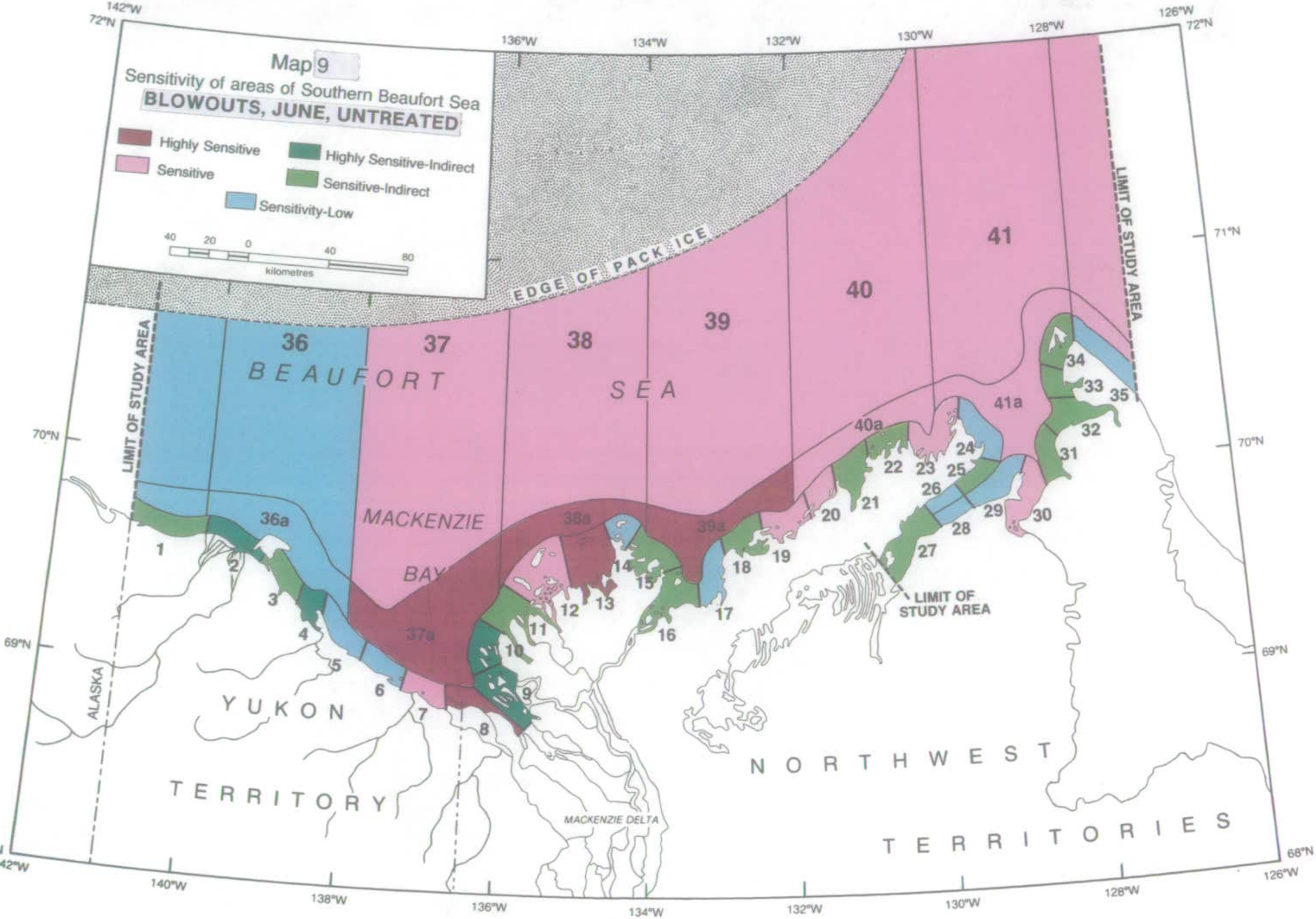
AREA: 41 TYPE OF SPILL: Batch Spill TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

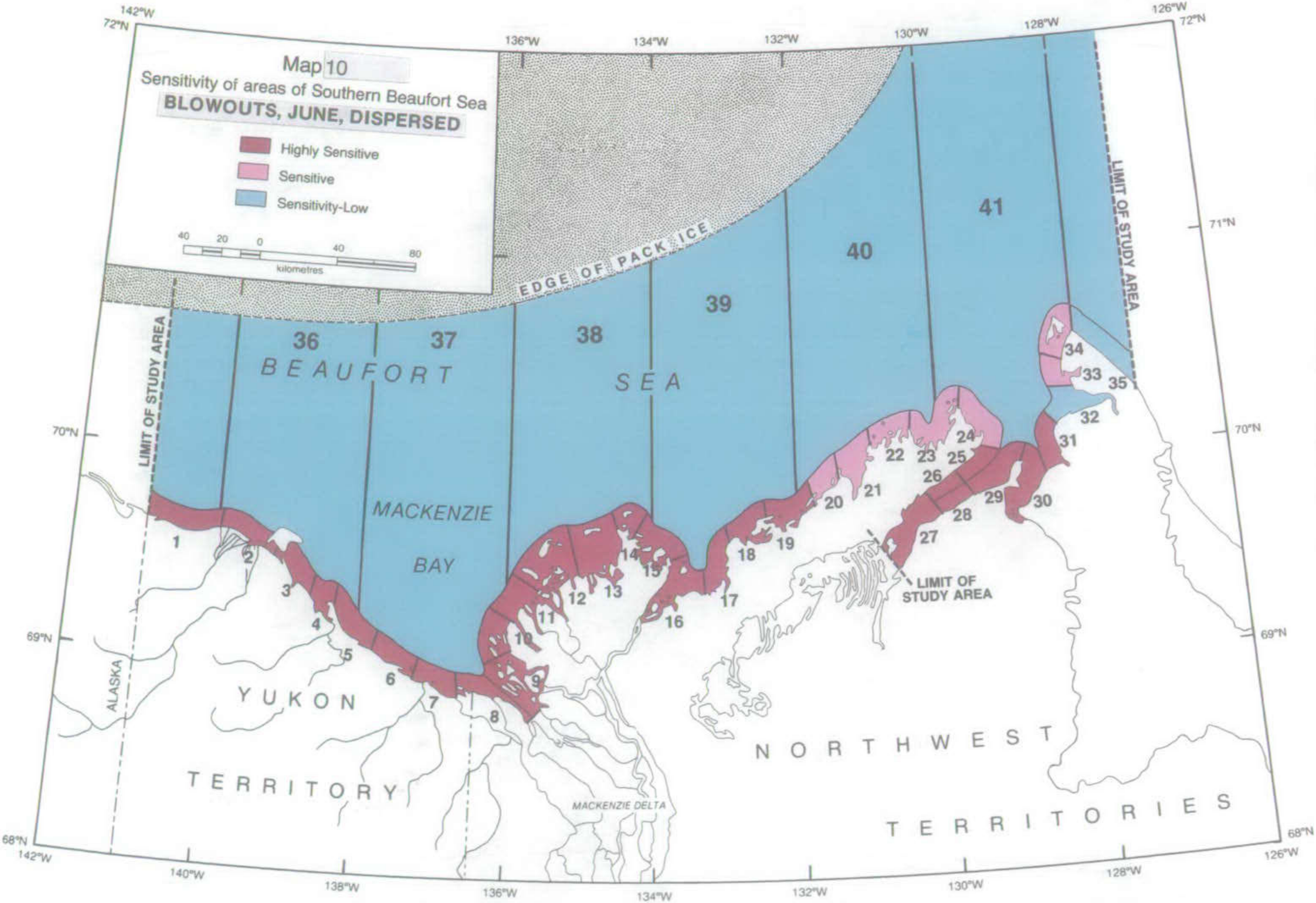
* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

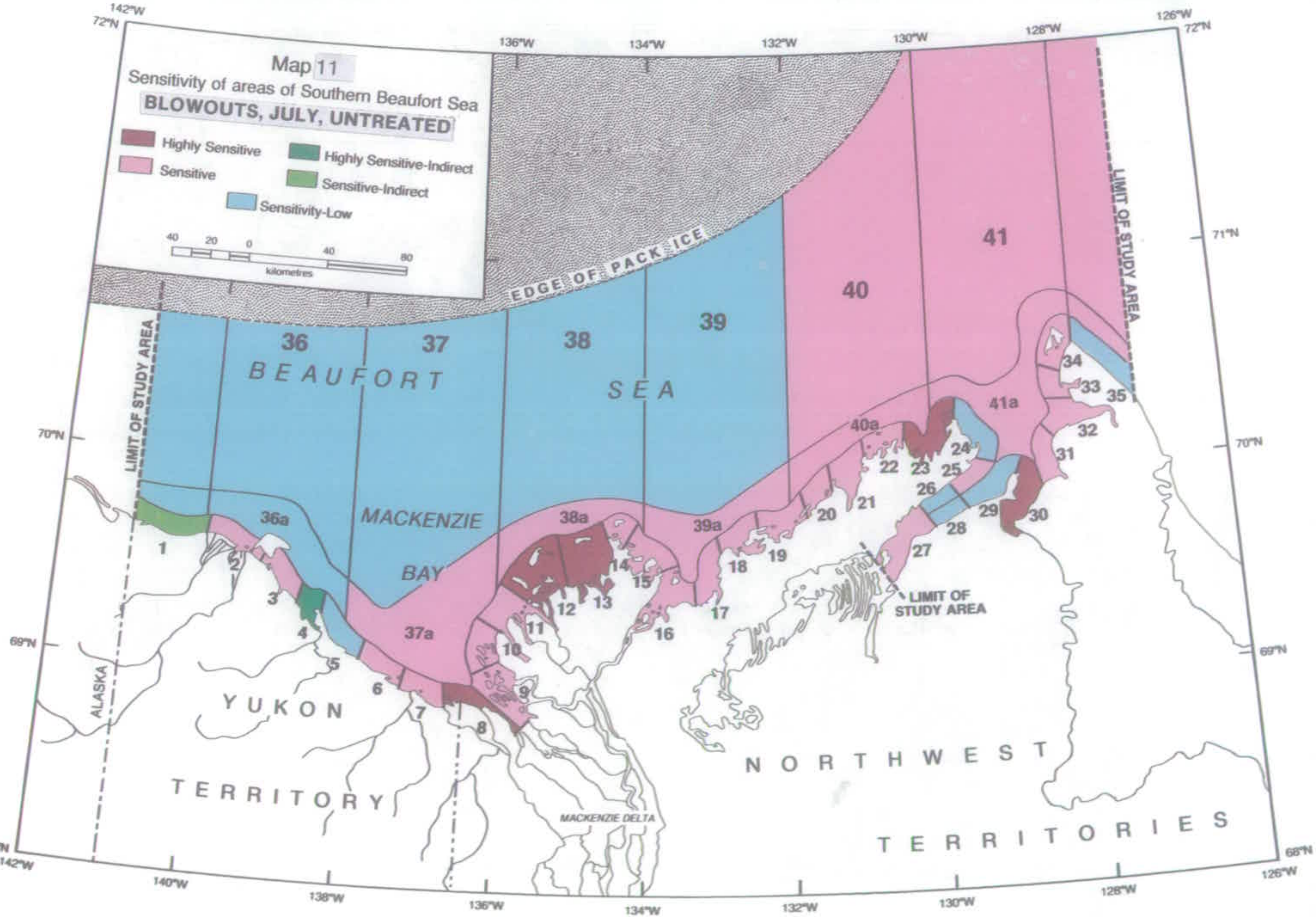
ADDITIONAL CONSIDERATIONS:

ENVIRONMENTAL SENSITIVITY MAPS 9-16

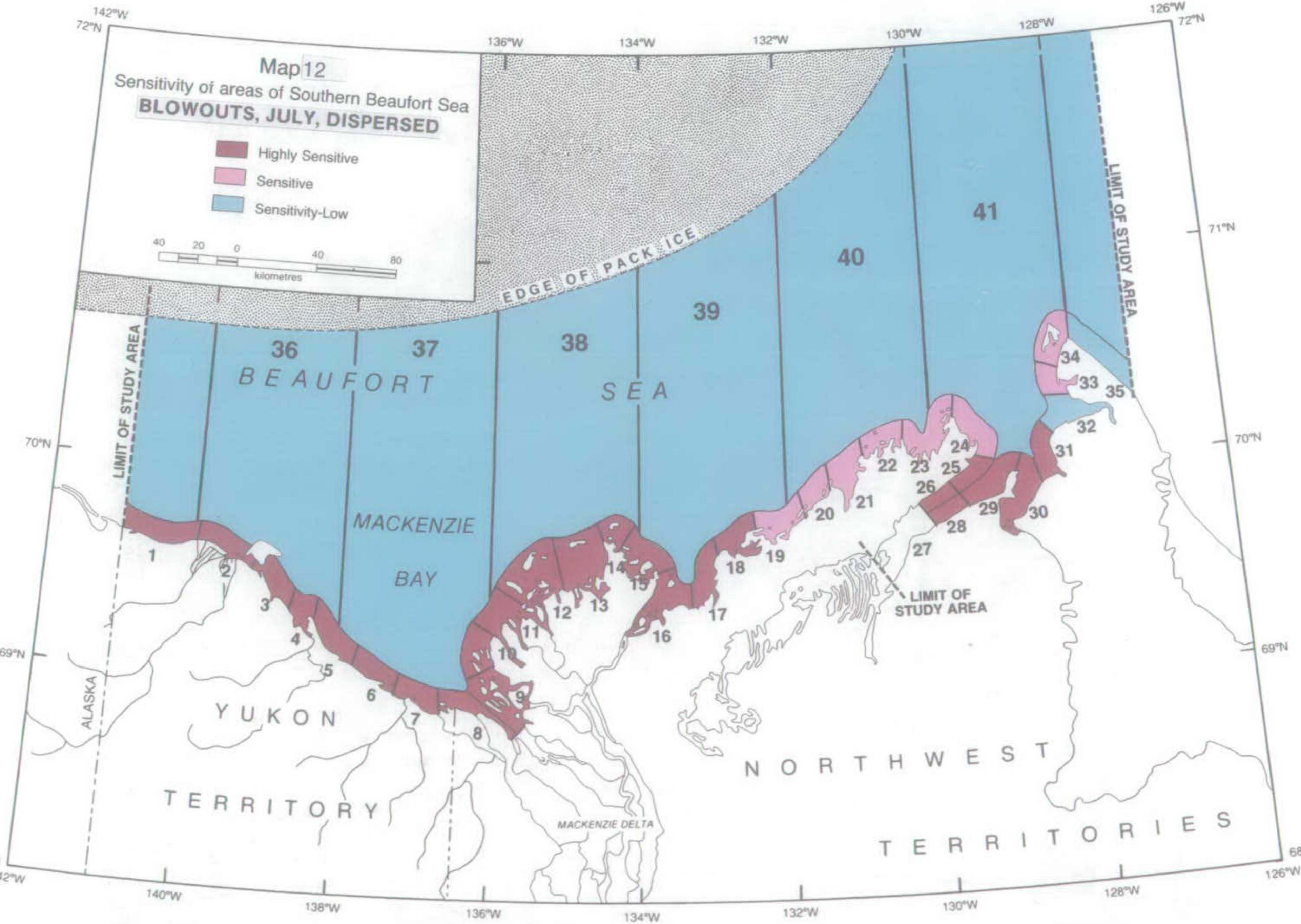


Map 9
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, JUNE, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
LIMIT OF STUDY AREA
36 37 38 39 40 41
36a 37a 38a 39a 40a 41a
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W
68°N 69°N 70°N 71°N 72°N

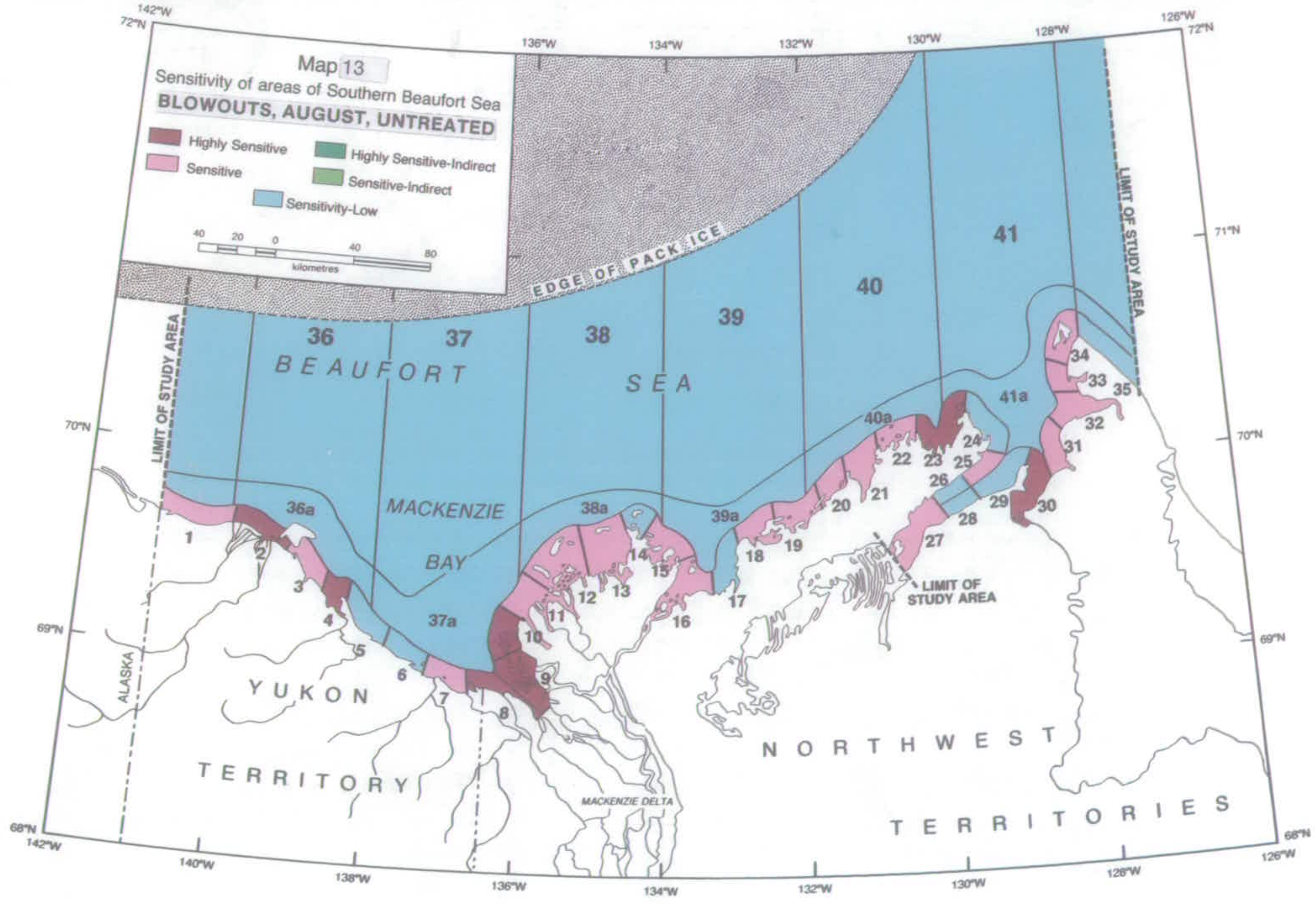

Map 10
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, JUNE, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
LIMIT OF STUDY AREA
142°W
140°W
138°W
136°W
134°W
132°W
130°W
128°W
126°W
72°N
71°N
70°N
69°N
68°N
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41

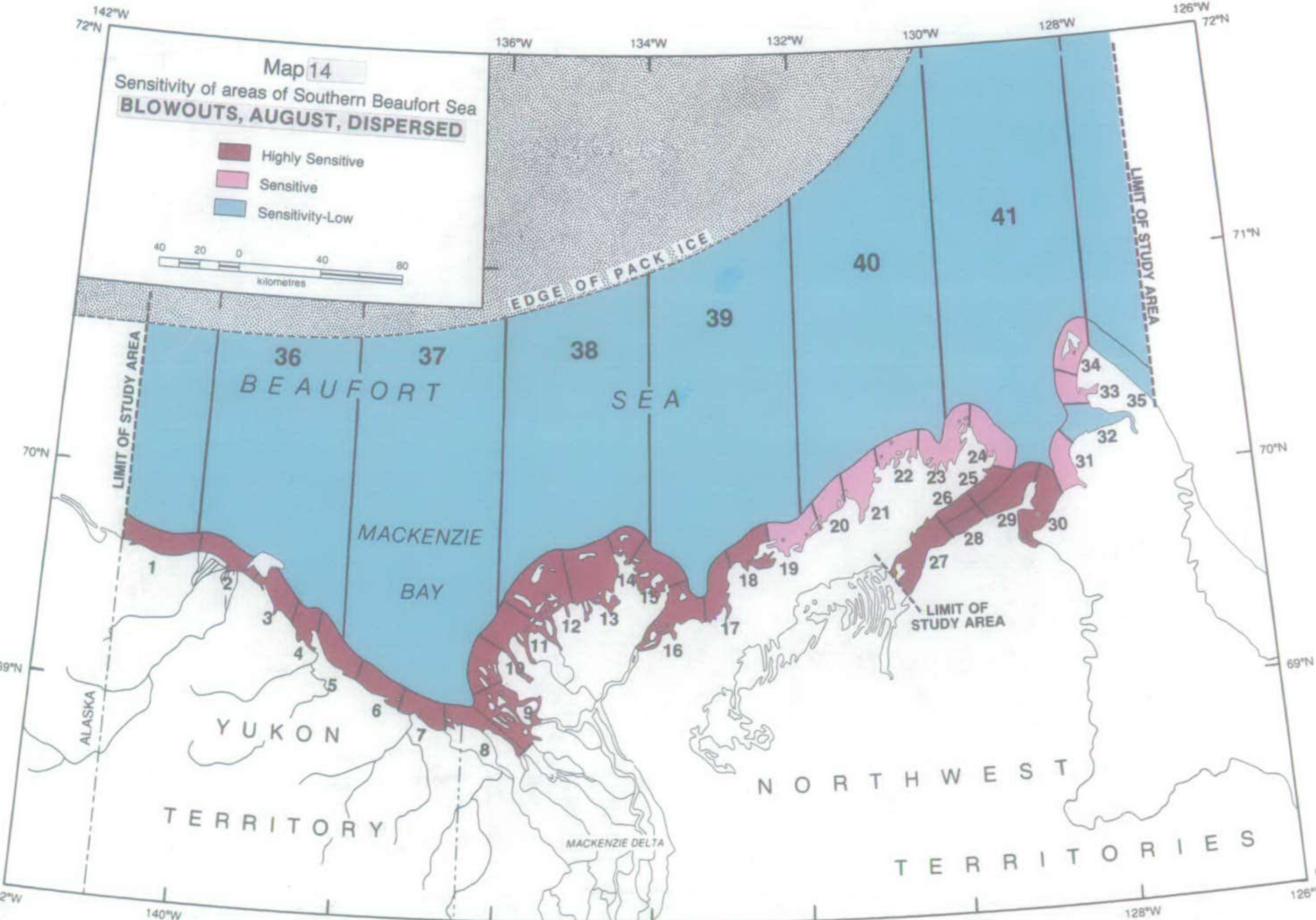


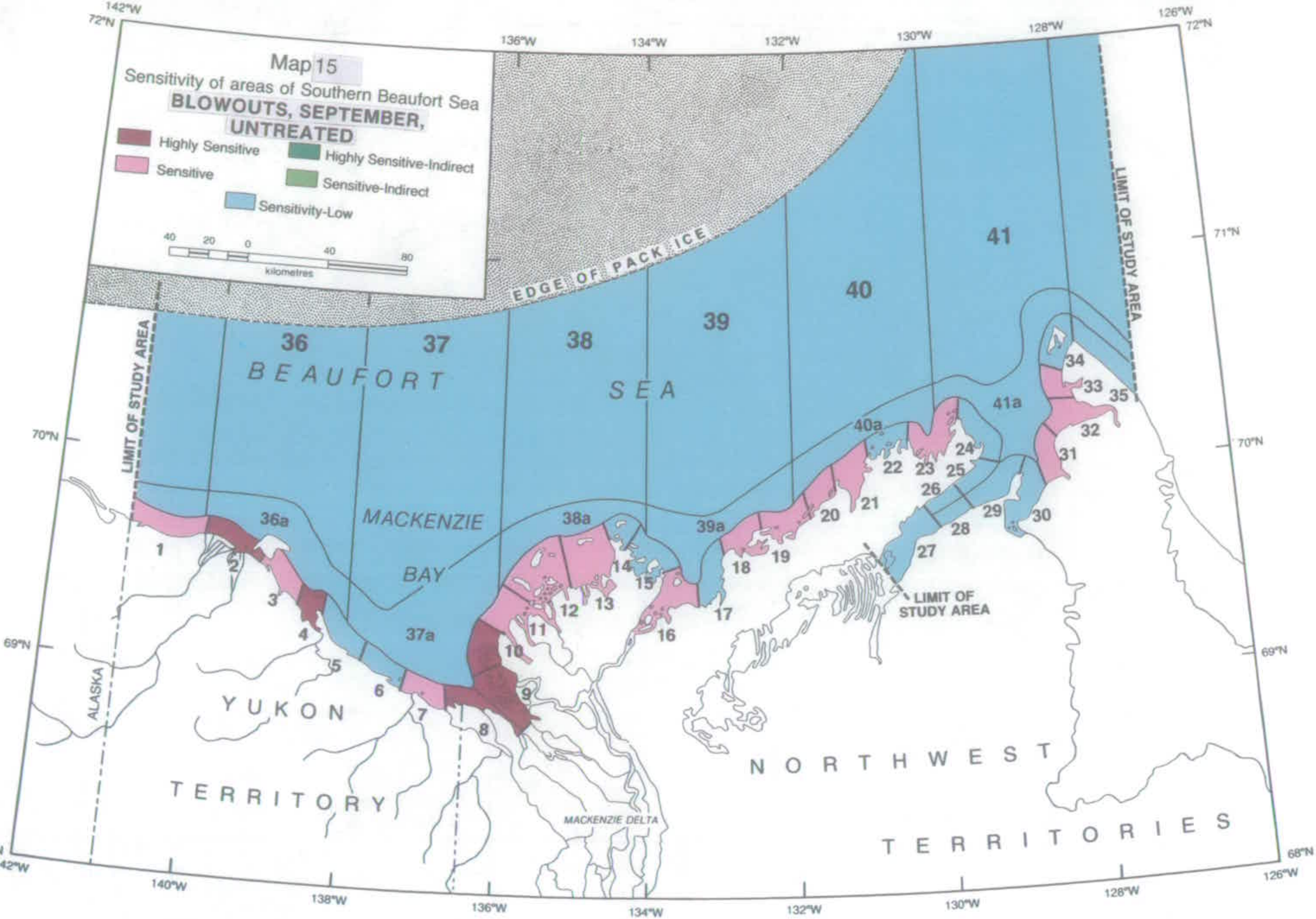
Map 11
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, JULY, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA
MACKENZIE DELTA
36 37 38 39 40 41
36a 37a 38a 39a 40a 41a
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W
72°N 71°N 70°N 69°N 68°N



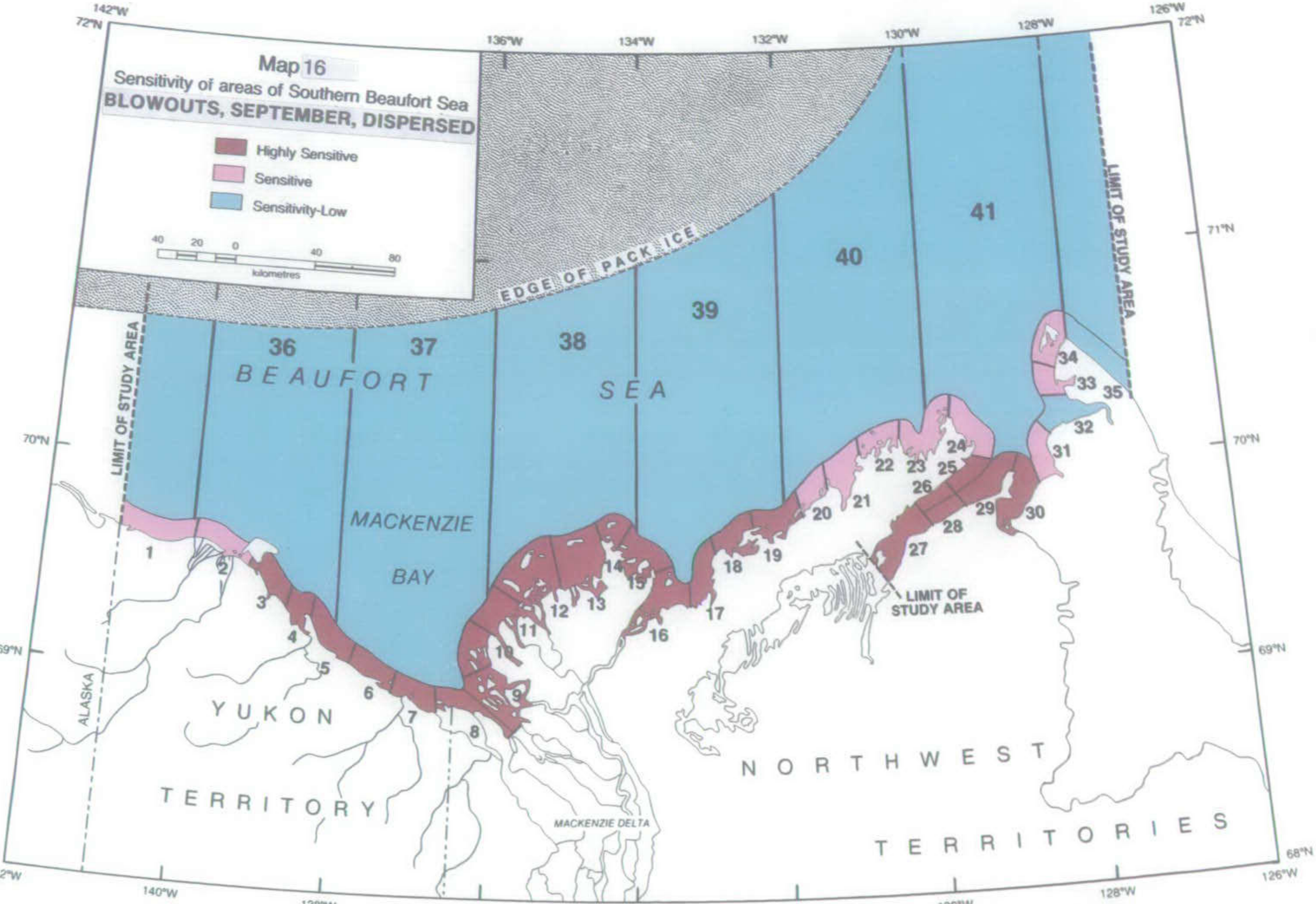
Map 12
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, JULY, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
BEAUFORT
SEA
MACKENZIE
BAY
YUKON
TERRITORY
NORTHWEST
TERRITORIES
ALASKA
MACKENZIE DELTA
36
37
38
39
40
41
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
142°W
72°N
136°W
134°W
132°W
130°W
128°W
126°W
72°N
71°N
70°N
70°N
69°N
69°N
68°N
142°W
140°W
138°W
136°W
134°W
132°W
130°W
128°W
68°N
126°W


Map 13
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, AUGUST, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
36
37
38
39
40
41
36a
37a
38a
39a
40a
41a
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
MACKENZIE DELTA
142°W
140°W
138°W
136°W
134°W
132°W
130°W
128°W
126°W
72°N
71°N
70°N
69°N
68°N


Map 14
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, AUGUST, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
MACKENZIE DELTA
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W
72°N 71°N 70°N 69°N 68°N



Map 15
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, SEPTEMBER, UNTREATED
Highly Sensitive
Sensitive
Highly Sensitive-Indirect
Sensitive-Indirect
Sensitivity-Low
40 20 0 40 80
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
MACKENZIE DELTA
YUKON TERRITORY
NORTHWEST TERRITORIES
ALASKA


Map 16
Sensitivity of areas of Southern Beaufort Sea
BLOWOUTS, SEPTEMBER, DISPERSED
Highly Sensitive
Sensitive
Sensitivity-Low
kilometres
EDGE OF PACK ICE
LIMIT OF STUDY AREA
BEAUFORT SEA
MACKENZIE BAY
YUKON TERRITORY
NORTHWEST TERRITORIES
MACKENZIE DELTA
ALASKA

IMPACT TABLES FOR BLOWOUTS, UNTREATED

SPILL IMPACT BY SPECIES AND MONTH

AREA: 1 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x					x							x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 2 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT			x					x							x					x
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER		x							x					x					x	
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x						x						x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 3 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW		x					x							x		x				
SURF SCOTER		x							x					x					x	
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 4 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW		x					x							x					x	
SURF SCOTER		x					x							x					x	
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x					x							x					x

*. Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 5 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 6 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x								x		x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 7 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN				x					x		x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 8 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN					x					x				x					x	
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 9   TYPE OF SPILL: Blowout   TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE		x					x							x					x	
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x						x						x					x

ADDITIONAL CONSIDERATIONS:

AREA: 10   TYPE OF SPILL: Blowout   TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE		x					x							x					x	
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT			x					x							x					x
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY			x						x						x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 11 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 12 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE			x							x				x					x	
LESSER SNOW GOOSE				x					x					x					x	
BLACK BRANT				x					x					x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 13 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN					x				x					x		x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE				x						x				x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x				x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 14 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x								x		x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 15 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

ADDITIONAL CONSIDERATIONS:

AREA: 16 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE		x					x							x					x	
BLACK BRANT		x					x							x					x	
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 17 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x								x		x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 18 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x					x							x		x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 19 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT				x					x					x		x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER		x					x							x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 20 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x					x							x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT				x					x					x		x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x					x	
SURF SCOTER		x							x		x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 21 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE		x							x					x					x	
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 22 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x							x					x		x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 23 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT				x						x					x	x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x						x					x				x	

ADDITIONAL CONSIDERATIONS:

AREA: 24 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 25 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

ADDITIONAL CONSIDERATIONS:

AREA: 26 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 27 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW	x					x					x					x				
SURF SCOTER		x							x		x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

ADDITIONAL CONSIDERATIONS:

AREA: 28 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 29 TYPE OF SPILL: Blowout TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 30 TYPE OF SPILL: Blowout TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE				x					x		x					x				
BLACK BRANT				x						x					x	x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x					x							x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x						x					x	x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 31 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT		x							x					x		x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x					x	
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 32 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER		x							x					x		x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 33 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x					x	
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 34 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP		x							x					x		x				
OLDSQUAW		x							x					x		x				
SURF SCOTER	x					x					x					x				
COMMON EIDER		x							x					x		x				
KING EIDER		x							x		x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY		x							x					x		x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 35 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 36 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 36a   TYPE OF SPILL: Blowout   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-II	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 37   TYPE OF SPILL: Blowout   TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-II	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 37a TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW					x	x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x				x		x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 38 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 38a TYPE OF SPILL: Blowout TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW					x	x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x				x		x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 39 TYPE OF SPILL: Blowout TREATMENT: Untreated

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x		x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x		x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 39a TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW					x	x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER					x	x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x								x		x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x				x		x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 40 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 40a TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 41 TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER				x		x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 41a TYPE OF SPILL: Blowout TREATMENT: Untreated

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW				x					x		x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER				x		x					x					x				
KING EIDER				x		x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x		x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

IMPACT TALES FOR BLOWOUTS, DISPERSED

SPILL IMPACT BY SPECIES AND MONTH

AREA: 1 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x				x	

ADDITIONAL CONSIDERATIONS:

AREA: 2 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x				x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 3 TYPE OF SPILL: Blowout TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x				x	

ADDITIONAL CONSIDERATIONS:

AREA: 4 TYPE OF SPILL: Blowout TREATMENT: Dispersed

	JUNE					JULY					AUGUST					SEPTEMBER				
RESOURCE	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH					x					x					x					x
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 5 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH					x					x					x					x
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 6 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH					x					x					x					x
INCONNU				x					x		x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 7 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO				x					x					x					x	
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH					x					x					x					x
INCONNU				x					x		x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 8 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR					x					x					x				x	
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 9 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 10 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 11 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x					x					x
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 12 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH					x					x					x					x
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x					x					x
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 13 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH					x					x					x					x
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x					x				x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 14 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH					x					x					x					x
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x					x				x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-1 = Sensitive Indirect; H-1 = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 15 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH					x					x					x					x
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 16 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH					x					x					x					x
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x					x					x
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 17 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH					x					x					x					x
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x					x					x
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 18 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH					x					x					x					x
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 19 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU				x					x		x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 20 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU				x					x		x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 21 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU				x					x		x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 22 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 23 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO				x					x					x					x	
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 24 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 25 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 26 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 27 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x					x					x
ARCTIC COD	x					x					x					x				
PACIFIC HERRING					x	x					x									x
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 28 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 29 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO					x					x					x					x
LEAST CISCO					x					x					x					x
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

ADDITIONAL CONSIDERATIONS:

AREA: 30 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH				x					x					x					x	
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x					x					x
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x					x					x

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 31 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU					x					x				x					x	
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY					x					x				x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 32 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 33 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

ADDITIONAL CONSIDERATIONS:

AREA: 34 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO				x					x					x					x	
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY				x					x					x					x	

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 35 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 36 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 37   TYPE OF SPILL: Blowout   TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 38   TYPE OF SPILL: Blowout   TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-1	H-1	S	H	L	S-1	H-1	S	H	L	S-H	H-1	S	H	L	S-1	H-1	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 39 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

ADDITIONAL CONSIDERATIONS:

AREA: 40 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

SPILL IMPACT BY SPECIES AND MONTH

AREA: 41 TYPE OF SPILL: Blowout TREATMENT: Dispersed

RESOURCE	JUNE					JULY					AUGUST					SEPTEMBER				
	*L	S-I	H-I	S	H	L	S-I	H-I	S	H	L	S-H	H-I	S	H	L	S-I	H-I	S	H
WHISTLING SWAN	x					x					x					x				
CANADA GOOSE	x					x					x					x				
WHITE-FRONTED GOOSE	x					x					x					x				
LESSER SNOW GOOSE	x					x					x					x				
BLACK BRANT	x					x					x					x				
GREATER SCAUP	x					x					x					x				
OLDSQUAW	x					x					x					x				
SURF SCOTER	x					x					x					x				
COMMON EIDER	x					x					x					x				
KING EIDER	x					x					x					x				
RED-NECK, RED PHALAROPE	x					x					x					x				
BOWHEAD WHALE	x					x					x					x				
BELUGA WHALE	x					x					x					x				
RINGED SEAL	x					x					x					x				
POLAR BEAR	x					x					x					x				
ARCTIC CHAR	x					x					x					x				
ARCTIC CISCO	x					x					x					x				
LEAST CISCO	x					x					x					x				
LAKE WHITEFISH	x					x					x					x				
BROAD WHITEFISH	x					x					x					x				
INCONNU	x					x					x					x				
ARCTIC COD	x					x					x					x				
PACIFIC HERRING	x					x					x					x				
OVERALL SENSITIVITY	x					x					x					x				

* Symbols: L = Sensitivity Low; S-I = Sensitive Indirect; H-I = Highly Sensitive Indirect; S = Sensitive; H = Highly Sensitive

ADDITIONAL CONSIDERATIONS:

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APPENDIX
to
Guide to Dispersant-Use Decision Making for Oil Spills
in the Canadian Southern Beaufort Sea

VULNERABILITY OF KEY SPECIES IN THE SOUTHERN BEAUFORT SEA TO UNTREATED AND CHEMICALLY DISPERSED OIL SPILLS

TABLE OF CONTENTS

INTRODUCTION

This appendix contains information concerning certain key species in the southern Beaufort Sea ecosystem. This information was used in formulating the assessments of vulnerability that appear in the "Guide to Dispersant-Use Decision Making for Oil Spills in the southern Beaufort Sea." Although the information provided herein is not needed in the real-time use of the guide, it may be of assistance to resource experts in quickly reviewing the assessments of resource sensitivities contained in "Sensitivity Maps" and Impact Tables.

The document contains biological summaries for 22 key species of fish, waterfowl, and marine mammals. In each case, target populations for the effects of spills are defined. For each species, information concerning the life history, habits, habitat utilization, and distribution is summarized and the contribution of these factors to the vulnerability of the species to marine oil spills is discussed. In each case, the possible level of effect of oil contamination in different areas of the southern Beaufort Sea area are summarized.

This document represents a summary of the state of knowledge at the time of publication. As new biological knowledge of the key species is developed, it should be used in conjunction with the data in this volume to re-evaluate the assumed vulnerability of the species concerned. As well, many species were not included for lack of data (e.g., arctic and starry flounder, sabines gull). As data become available, new species may be added as new information indicates these species might show quantifiable sensitivity to oil.

For birds, most sensitivity is associated with shorelines, and little change in sensitivity is expected with increased oiling beyond a certain level. As a result, batch spills and blowouts will result in similar sensitivities for birds. Hence, only batch-spill sensitivity maps are included for birds as blowout maps would be identical. This is also the case for mammals in that greater amounts of oil will not increase the effect.

Both birds and mammals are virtually invulnerable to the effects of dispersed oil. Sensitivity maps are therefore only included for untreated oil spills.

Fish are relatively invulnerable to untreated oil spills. As a result, only sensitivity maps for dispersed oil spills are included. Dispersed oil from batch spills has a short lifetime, and only direct effects would occur. Dispersed oil from blowouts however would be less transient in nature and could have additional behavioural effects, such as blocking migration routes. This is noted in the text and on maps where applicable.

1.0 FISH

1.1 ARCTIC CHAR (*Salvelinus alpinus*)

Arctic char have been included in this analysis because they support an important domestic and sport fishery in the western part of the study area and because they are a common constituent of the coastal fish community during the ice-free period. Char are rather unique among the anadromous fish species of this area in that they are restricted to the western part of the study area and because the population is composed of a number of discrete sub-populations each of which spawns in one of the major river systems that flow into the Beaufort. Not all of these populations are of economic importance however, since only the populations spawning in the Mackenzie and Firth Rivers appear to be exploited.

1.1.1 Life History

Spawning adults begin moving up-river to the spawning grounds from mid-summer to early autumn. Spawning takes place over an extended period in late summer, autumn, and early winter with the peak of spawning taking place in September and October. Unlike salmon, adult char do not die after spawning, but survive to spawn more than once in their life time, although not in consecutive years. Presumably adults descend the spawning rivers to their overwintering areas immediately after spawning.

Young char emerge from the gravel in May but remain in fresh water for several years before moving seaward for the first time as smolts between the ages of 2 and 5 years. Adulthood is reached at age 6 to 8 years. Immatures and adults feed in nearshore marine areas during the summer months and return to winter in the rivers. Available evidence suggests that char enter the ocean during spring breakup in June, feed in nearshore areas until late summer, and return to overwintering areas in rivers between late July and early September.

These habits mean that char become vulnerable to the effects of marine oil spills only after they reach the age of 2 to 5 years. The young and juvenile fish are invulnerable since they remain in fresh water. Immature and adult fish are vulnerable to spills only during the summer months from June to late August while they are feeding in the nearshore marine areas, after which they return to the rivers. Char are at their most vulnerable during their upstream migration when they may aggregate at the mouths of spawning rivers for days or weeks prior to moving into the rivers.

1.1.2 Distribution Within the Southern Beaufort Sea Area

The marine and estuarine habitats favoured by arctic char in the study area are restricted to the nearshore environment to the west of the Mackenzie Delta and char seldom appear in surveys in the remainder of the study area. This is not remarkable since only the streams in the western portion of the study area support spawning populations of char. Since char appear to spawn in a number of the larger river systems in the western part of the Beaufort Sea and since the species appear to move long distances (several hundreds of km) along the coast from their home stream, individuals encountered at any point along the coast in this area may be derived from a variety of different populations.

According to Hunter (1975) char populations from the Mackenzie River and Firth Rivers support substantial fisheries. Fish are caught principally in rivers during the summer seaward migration and during the autumn upstream migration with small numbers taken in the sea. Although individuals are vulnerable to coastal spills throughout the area of the coastal distribution, individual populations would be affected most severely by spills in the mouths of rivers during the seaward out-migration in the early summer and riverward migration in the late summer. As a result of these habits, arctic char are susceptable to effects at the SLIGHT level for batch spills, except at the mouths of home streams in July and August where effects at the MODERATE level would be felt. For blowouts, effects at the MODERATE level would be expected throughout their range.

1.1.3 Fishery

Arctic char populations in the southern Beaufort Sea are the basis for a domestic fishery. Much of the catch is used for human consumption. These fisheries are based largely on the spawning populations of the Mackenzie and its tributaries with a smaller fishery on the Firth River. Char are taken in the fishery primarily during the seaward and upstream migration with some taken in the coastal areas.

Marine oil spills have two potential effects on the fishery, by causing either mortality or tainting. Coastal spills might affect populations at any time the immature and adult fish are in the coastal marine waters. Tainting however will be of concern only when spills occur near the point where fishihg occurs, in the case of char primarily in rivers. Marine spills are thus most important when they occur near the mouths of rivers during upstream migration. Contact with oil at some distance from the spawning stream will be of little consequence due to the rapid depuration of tainting hydrocarbons..

In areas of open coast, the likelihood of damage arising from treated or untreated spills is probably quite low. Even if hydrocarbon concentrations in the water column reach lethal concentrations, the areas affected will be small relative to the area over which the populations are distributed. As well, the duration of the lethal conditions will be brief (several days at most) and hence the proportion of any population in the affected area will be small.

Conversely somewhat greater damage might be expected if spills were to occur in lagoons or in estuaries where fish aggregate in large numbers to feed. Unfortunately there is little quantitative data available to determine the numbers of individuals using the lagoons at any given time. Nor is there any indication as to whether char loiter in the estuaries at the mouths of home rivers prior to entering the rivers. Clearly if members of a population arrive at the mouth of the home stream over a period of several weeks and pass quickly through the estuary into the river spending little time in the estuary, the likelihood of damage arising from a spill of short duration will be much less than if the population arrives at the river mouth all at once and loiters there for a period of several weeks. For the purpose of this work it has been assumed that the char loiter in the estuary for approximately a week, and are therefore vulnerable to dispersed oil at this time.

<u>Reference</u>: Bond W.A. 1982; Craig and McCart; 1976. Galbraith and Hunter 1975; Hunter 1975; Lawrence et al 1984.

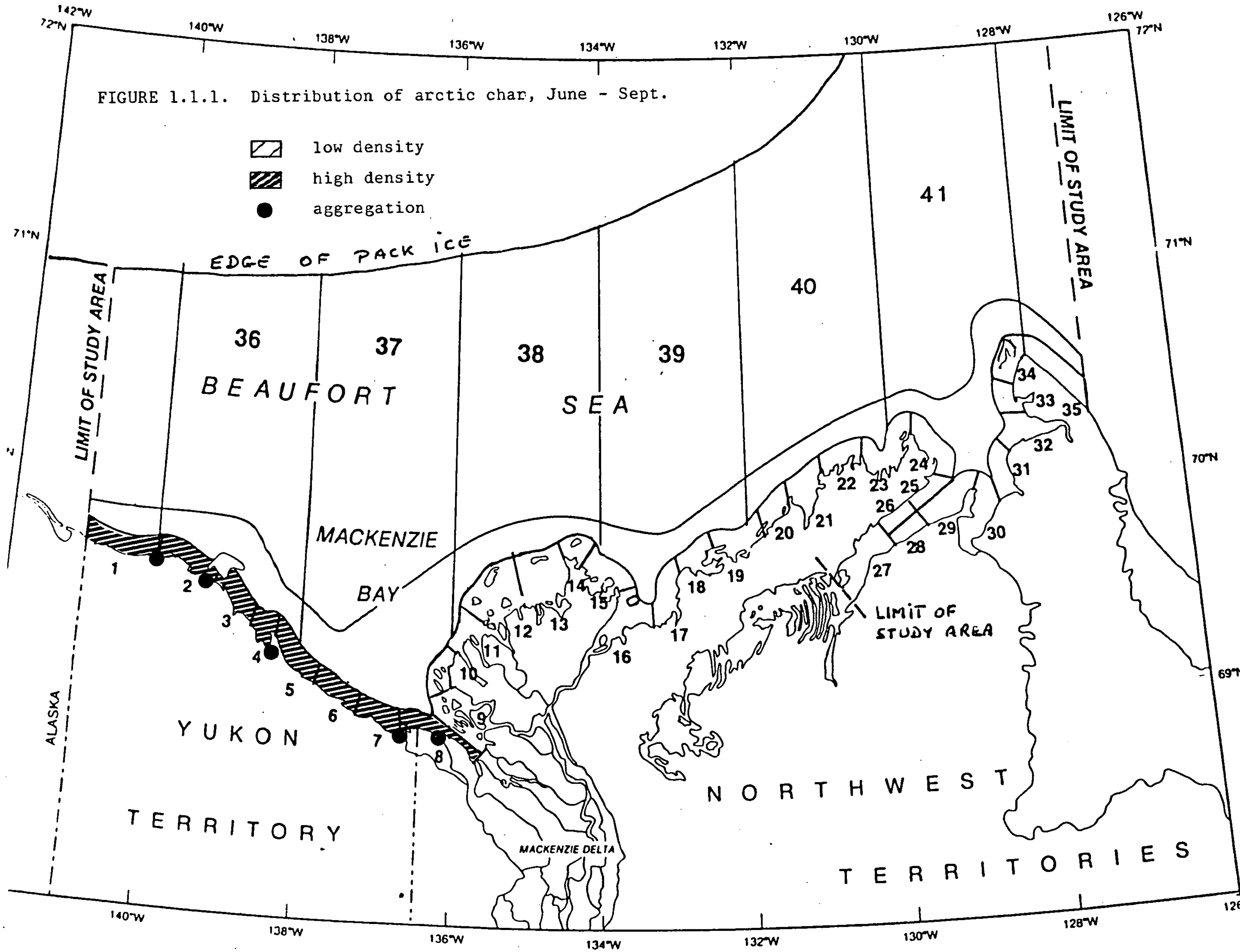


FIGURE 1.1.1. Distribution of arctic char, June - Sept.

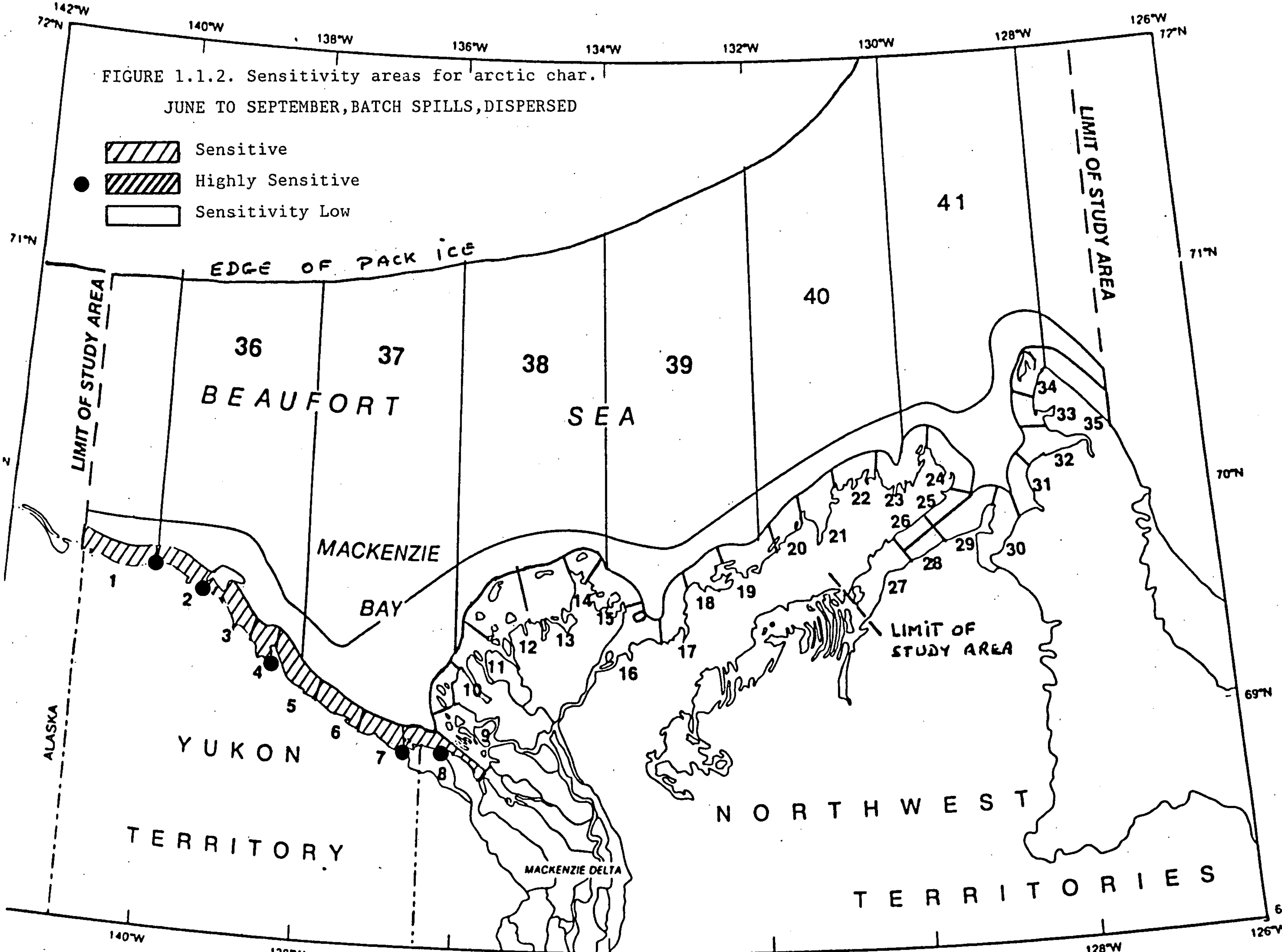


FIGURE 1.1.2. Sensitivity areas for arctic char.
JUNE TO SEPTEMBER, BATCH SPILLS, DISPERSED

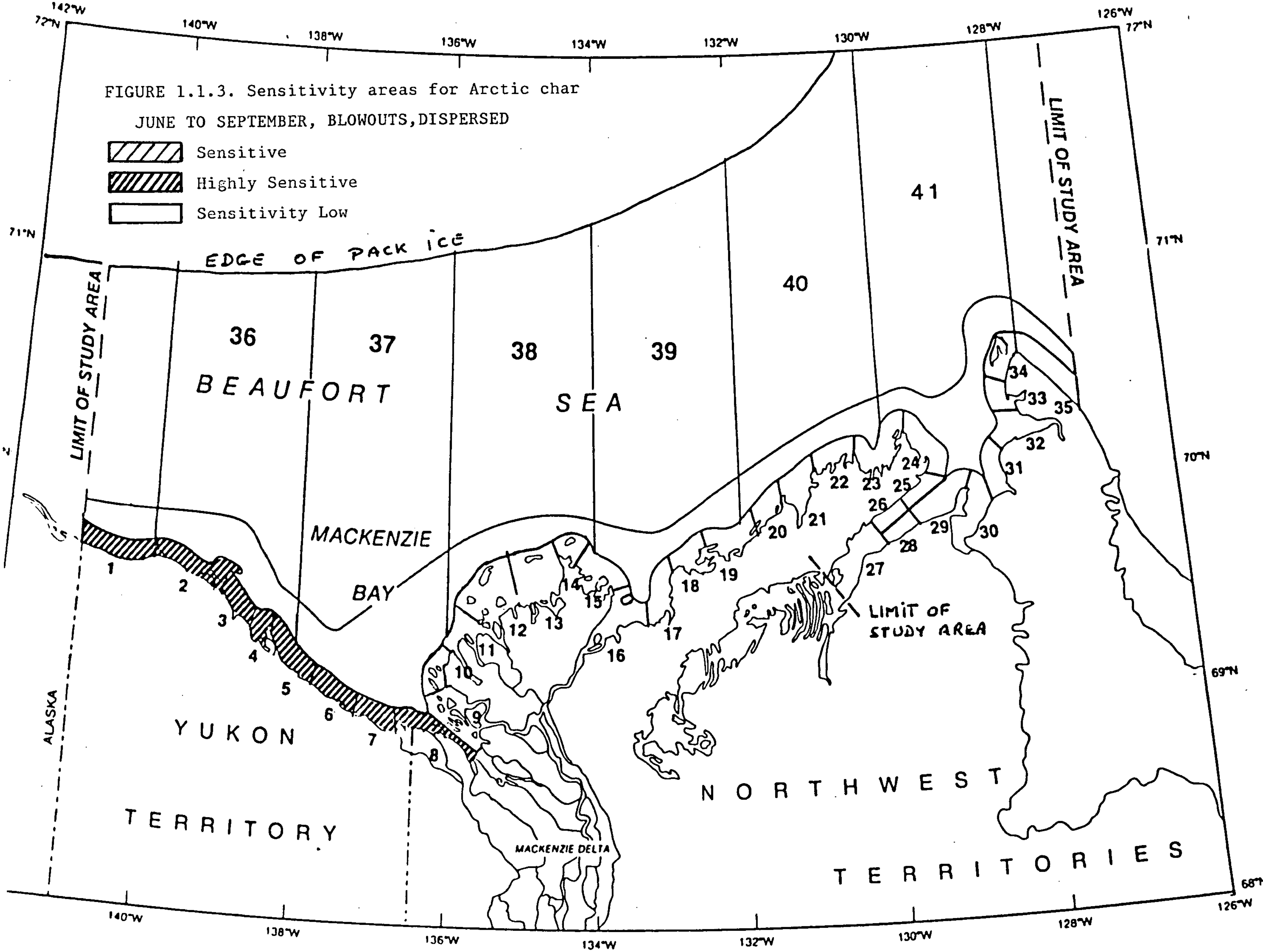


FIGURE 1.1.3. Sensitivity areas for Arctic char

JUNE TO SEPTEMBER, BLOWOUTS, DISPERSED

1.2 BROAD WHITEFISH (Coregonus nasus)

Broad whitefish are one of the more abundant species of anadromous fish in coastal areas of the southern Beaufort Sea. They occur in coastal waters, in the Delta, and in coastal freshwater lakes and streams from the Phillips Bay area in the west to Mckinley Bay on the east. It is not immediately clear if the population is composed of different stocks and hence the population has been treated as a single stock.

Broad whitefish do not appear to be exploited commercially at present but it does constitute a major proportion of the domestic harvest in the Mackenzie Delta.

1.2.1 Life History

Broad whitefish spawn in the lower Mackenzie system and its tributaries in October. The fry move downstream after hatching and are abundant in brackish areas of the delta and in coastal waters during the summer months. They appear to use coastal areas as migration routes to reach brackish coastal rearing areas and to reach smaller streams and lake systems along the coast where they forage during the summer, and where they in some cases overwinter. Presumably as for adults, the young and juveniles are restricted to very shallow inshore waters of lower salinity. Presumably some young will return to the deeper channels and freshwater lakes of the Mackenzie Delta in September to overwinter. At least a portion of the young-of-the-year population will therefore be vulnerable to the effects of spills in coastal areas of the Mackenzie Delta from June through September. Several important rearing areas have been identified in the southern Beaufort Sea including Stokes Lagoon, Phillips Bay, Shingle Point, Mackenzie Bay, Mallik Bay and Kugmallit Bay. Spills in these areas and other rearing areas as yet unidentified may result in the loss of a significant portion of the young and juveniles, but because of the long life span of broad whitefish (up to 16 years) the loss of even the entire young-of-the-year age class would represent only a small proportion of the population.

Some anadromous broad whitefish reach sexual maturity as early as age 4 or 5 years, but the majority mature later at ages 7 to 9 years. Broad whitefish in the southern Beaufort Sea area appear to have a maximum life span of 16 years, but the mean life span is no doubt somewhat less than this. Mature broad whitefish do not appear to spawn in consecutive years and the seasonal movements of spawners differs somewhat from those of non-spawners and immatures. Their vulnerability to oil spills is therefore somewhat different from non-spawners and immatures.

Immatures and non-spawning adults overwinter in deep channels of the Mackenzie Delta and in freshwater lakes of the Mackenzie Delta and coastal areas of the Tuktoyaktuk Peninsula. Broad whitefish leave these wintering areas and move along the coast to coastal feeding areas and to freshwater lake systems where they forage over the summer. These movements appear to begin as early as late spring before break-up but there is some information to indicate that some older individuals delay in leaving wintering habitats until July. There is some evidence to suggest that for summer foraging broad whitefish rely more heavily on lakes and streams of the Tuktoyaktuk Peninsula than those of the Delta, which would indicate a net eastward movement of the population along the coast in the early summer and a net westward movement along the coast in September when the population returns to the wintering areas in the Mackenzie Delta. This coastal movement of broad whitefish in both easterly and westerly directions between wintering areas and summer feeding areas continues all summer. There is a peak of coastal movement in a westerly direction along the Tuktoyaktuk Peninsula in early September as whitefish return from foraging areas to their wintering areas in the Mackenzie Delta.

Spawning adults overwinter mostly in deep channels of the Mackenzie Delta and move briefly into coastal areas to feed in early summer. Most have returned to the Mackenzie Delta by early July where they remain until they begin their migration to their spawning grounds in September. Spawning occurs in the main stream of the Lower Mackenzie System and the major tributaries in October immediately after which the spent spawners move downstream to their overwintering areas in the Mackenzie Delta.

Because of their use of coastal areas for migration between wintering areas and summer foraging areas, broad whitefish immatures and adults are vulnerable to the effects of spills from break-up in June until their return migration is completed in September. Aside from references to Stokes Lagoon, Phillips Bay, Shingle Point, Mackenzie Bay, Mallik Bay and Kugmallit Bay as rearing areas (presumably for juveniles and immatures) there is no indication that broad whitefish congregate at any coastal sites for foraging. Because whitefish spend so little time in coastal waters and because their movements are asynchronous, the likelihood of significant damage resulting from spills is small even for spills occurring during the fall return migration.

The vulnerability of spawners is even less than for the balance of the species since they make very little use of coastal areas in the summer.

1.2.2 Distribution in the Southern Beaufort Sea Area

Broad whitefish are common in the brackish waters of the Delta and in freshwaters of coastal lakes and streams. Whitefish also use the shallow, inshore, brackish coastal waters for migration between wintering areas and summer foraging areas but they seldom venture offshore into more saline waters.

The coastal distribution of broad whitefish within the study area is illustrated in Figure 1.2.1. Young, immatures, and non-spawning adults of the anadromous population originating in the Mackenzie System have been observed as far west as Stokes Lagoon and Phillips Bay on the Yukon Slope and as far east as McKinley Bay on Tuktoyaktuk Peninsula, but they appear to be most common in coastal waters in the eastern part of the Delta and Tuktoyaktuk Peninsula.

Several coastal areas have been identified as foraging areas including Stokes Lagoon, Phillips Bay, Shingle Point, Mackenzie Bay, Mallik Bay, Kugmallit Bay and possibly Parlaiyat Bay. The south eastern coast of Kugmallit Bay also appears to be an important migration corridor for broad whitefish.

Even though these areas have been identified as areas of aggregation it is questionable whether these areas support significant proportions of the broad whitefish population since whitefish appear to prefer to forage in freshwater environments in coastal lakes and streams. Until some qualitative data are available concerning the level of use of these coastal areas it has been assumed that they support only minor proportions of the total population.

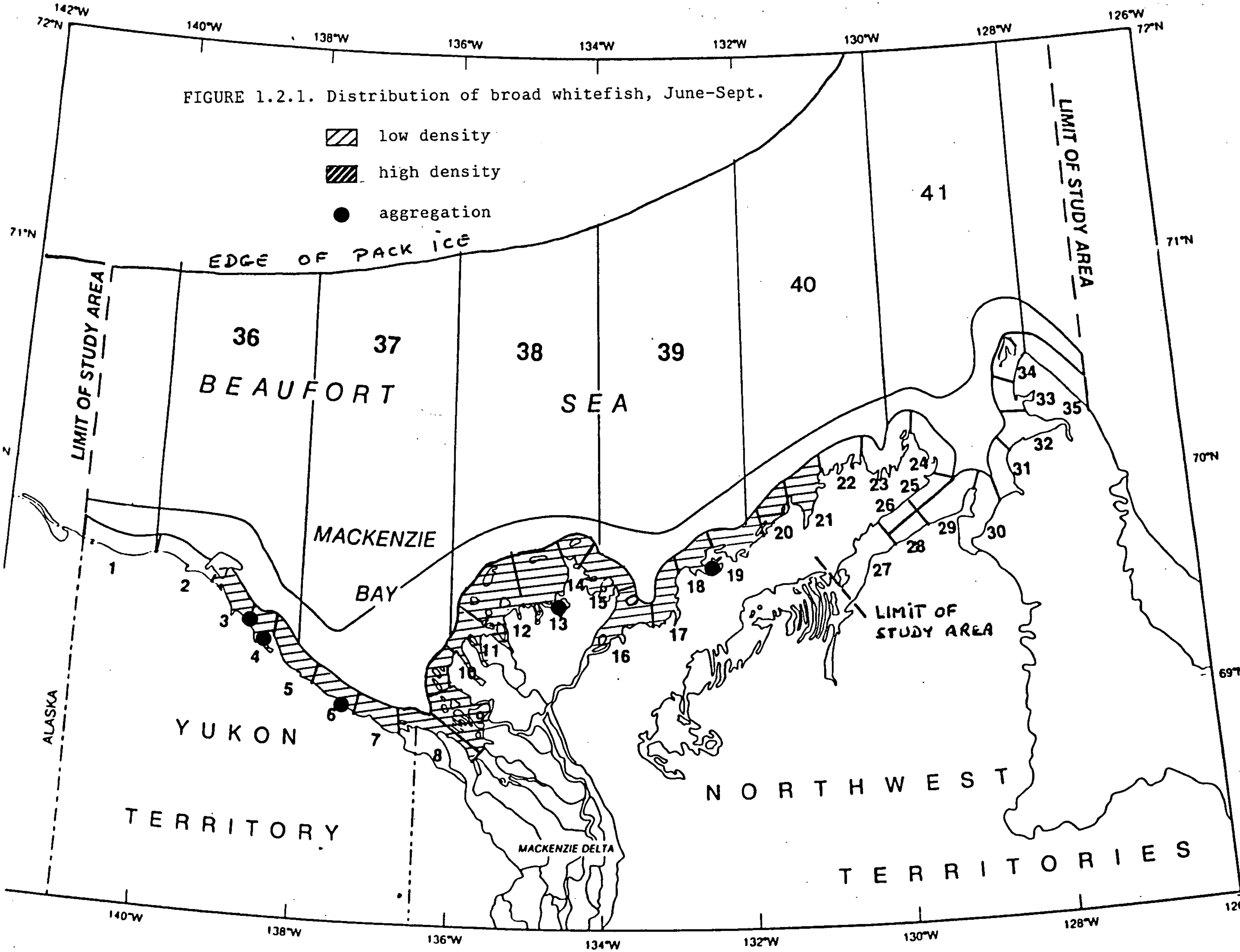
Due to the apparent lack of aggregation sites for broad whitefish, effects at the SLIGHT level would be the maximum response to a dispersed batch spill. For dispersed blowouts however, MODERATE effects are to be expected since they would have the effect of blocking coastal migration routes.

1.2.3 <u>The Fishery</u>

The fishery for broad whitefish in this area takes place primarily within the Delta. There appears to be little commercial fishery for the species but it does constitute a major proportion of the domestic fish harvest in the Delta. Broad whitefish are common in the vicinity of Tuktoyaktuk Harbour from June until September and are fished for domestic use over this period. The fishery in the Mackenzie Delta is probably based heavily on the mature adults during their spawning migration. Coastal oil spills will do little to effect the fishery and it is unlikely that coastal spills will cause tainting of adult fish since they make little use of coastal waters prior to migration. However, oil spills in the vicinity of Tuktoyaktuk harbour may disrupt the fishery and contamination of adjacent coastal waters by treated or untreated oil may result in tainting of fish taken in this fishery.

<u>References:</u> Bond 1982; Bond and Ericksen 1985; Craig and McCart 1976; Galbraith and Hunter 1975; Hunter 1975; Lawrence et al 1984.

FIGURE 1.2.1. Distribution of broad whitefish, June-Sept.



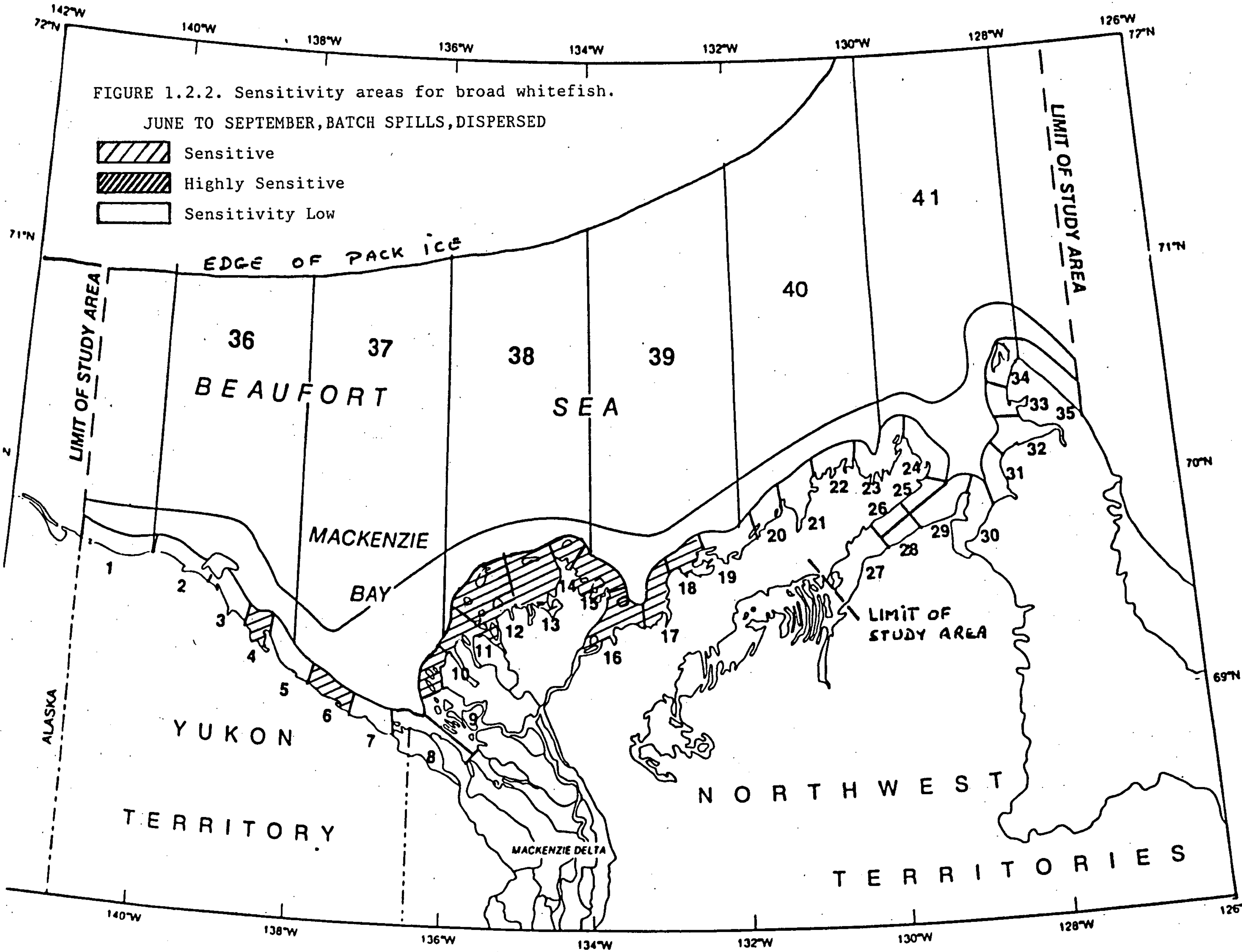
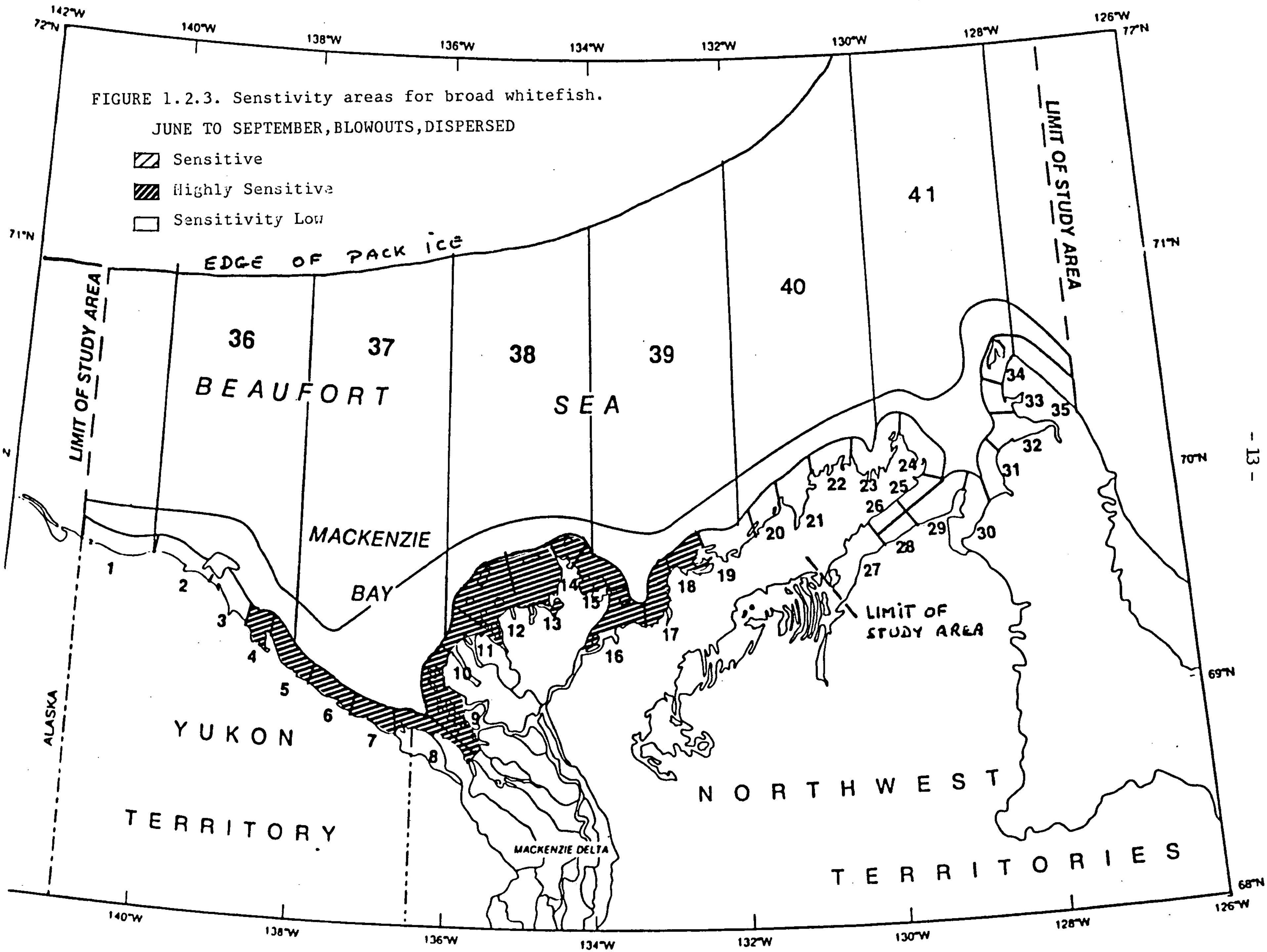


FIGURE 1.2.2. Sensitivity areas for broad whitefish.

JUNE TO SEPTEMBER, BATCH SPILLS, DISPERSED

FIGURE 1.2.3. Senstivity areas for broad whitefish.

JUNE TO SEPTEMBER, BLOWOUTS, DISPERSED



1.3 LAKE (HUMPBACK) WHITEFISH (Coregonus clupeaformis)

The lake whitefish is an abundant fish species in coastal areas of the southern Beaufort Sea and is an important constituent of the domestic fishery in the Mackenzie Delta area. There are two major populations of lake whitefish in the southern Beaufort Sea area, one in the Colville River System in Alaska, and one in the Mackenzie System. Only the latter is of significance in the present study. Within the Mackenzie Delta there are two strains of lake whitefish, a lake-resident variety, and an anadromous variety. Only the latter is vulnerable to coastal marine oil spills. Although there are probably a number of stocks of lake whitefish in the Mackenzie Delta area the entire population has been treated as a single stock.

Lake Whitefish are an important component of the domestic fishery in the Mackenzie Delta. Exploitation takes place primarily during the spring and fall movements between overwintering areas in the inner Delta and summer feeding areas in estuaries and coastal waters.

1.3.1 Life History

Anadromous lake whitefish spawn in the upper reaches of the Mackenzie Delta and its tributaries in the fall. Young-of-the-year and juveniles move into the delta and nearshore coastal areas in the summer months when they would be vulnerable to the effects of spills.

Lake whitefish reach maturity at ages seven to nine years and have a life expectancy of 13 to 18 years. Adults and immatures over-winter in the channels and freshwater lakes of the Delta, in coastal embayments such as Tuktoyaktuk Harbour and some in Kugmallit Bay. They move into estuarine habitats of the outer Delta and nearshore coastal areas in June and spend the summer in these estuaries and coastal habitats with low salinity over the summer.

There is some evidence that adults move under the ice in early June to reach feeding areas in streams along the Tuk Peninsula. They return to their overwintering areas in the Delta and elsewhere in late August and September at which time adults begin their upstream migration to spawning habitats. It is during the spring and fall movements between overwintering areas and summer feeding areas that the peak of fishing activity takes place in the Delta.

From the above it is clear that a significant proportion of the lake whitefish population occurs in the low saline nearshore coastal areas of the Mackenzie Delta during the open water season from June until September and would be vulnerble to the effects of spills in coastal areas at that time. The fall fishery is based on fish moving from these coastal areas to wintering areas, the tainting of fish in coastal areas in late August and early September may be of some concern to the fishery where fish are taken in the Outer Delta near the sites where the fish have come into contact with oil.

1.3.2 Distribution in the Southern Beaufort Sea Area

Lake whitefish originating from the Mackenzie System have been observed from Rolands Bay on the Yukon coast to Hutchison Bay in the Tuk Peninsula but they occur in greater densities in the Delta area from Kendall Island to Toker Point. In addition, they appear to be strongly restricted to nearshore habitats of low salinity and hence are not found further offshore as are the ciscoes. Hence lake whitefish are relatively invulnerable to spills in coastal areas of the Yukon slope and the Tuk Peninsula. Significant effects may result from spills in the Delta area but since there is little evidence of aggregation in any location, the effects of spills in the area will be no greater than SLIGHT regardless of location or timing of the spills.

1.3.3 The Fishery

References: Bond 1982; Bond and Erickson 1985; Craig and McCart 1976; Galbraith and Hunter 1975; Hunter 1975; Lawrence et al 1984.

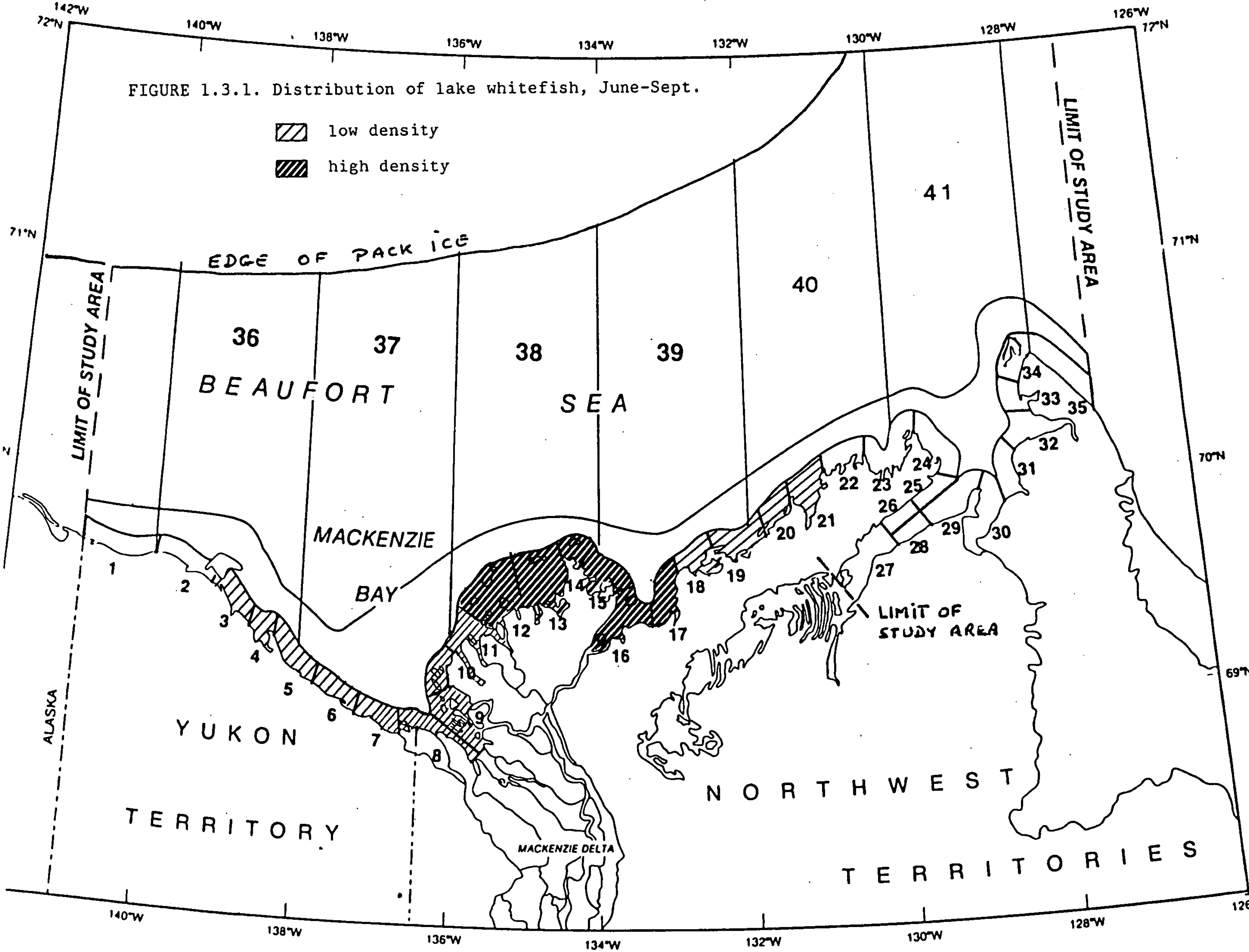


FIGURE 1.3.1. Distribution of lake whitefish, June-Sept.

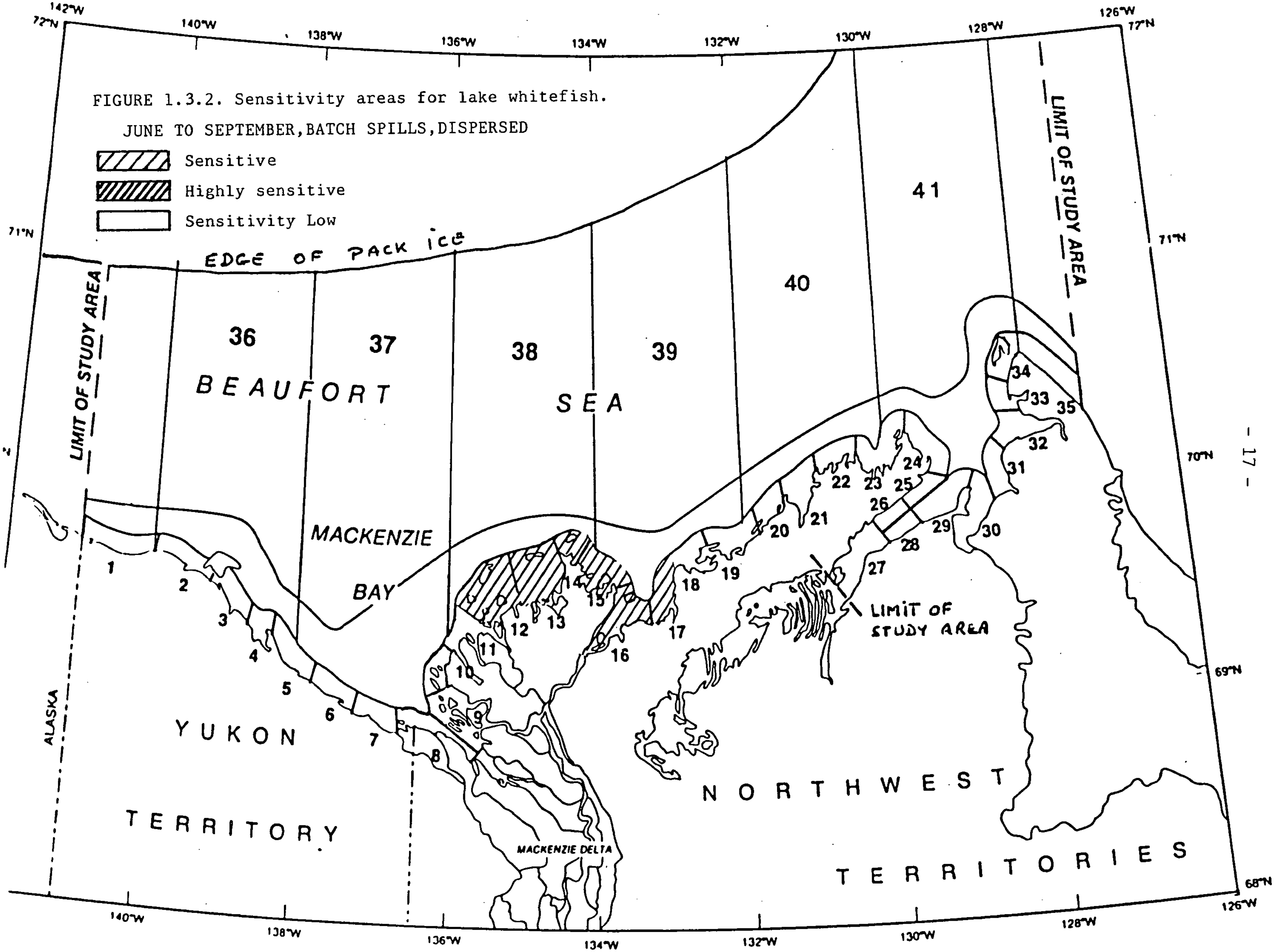


FIGURE 1.3.2. Sensitivity areas for lake whitefish.

JUNE TO SEPTEMBER, BATCH SPILLS, DISPERSED

Sensitive

Highly sensitive

Sensitivity Low

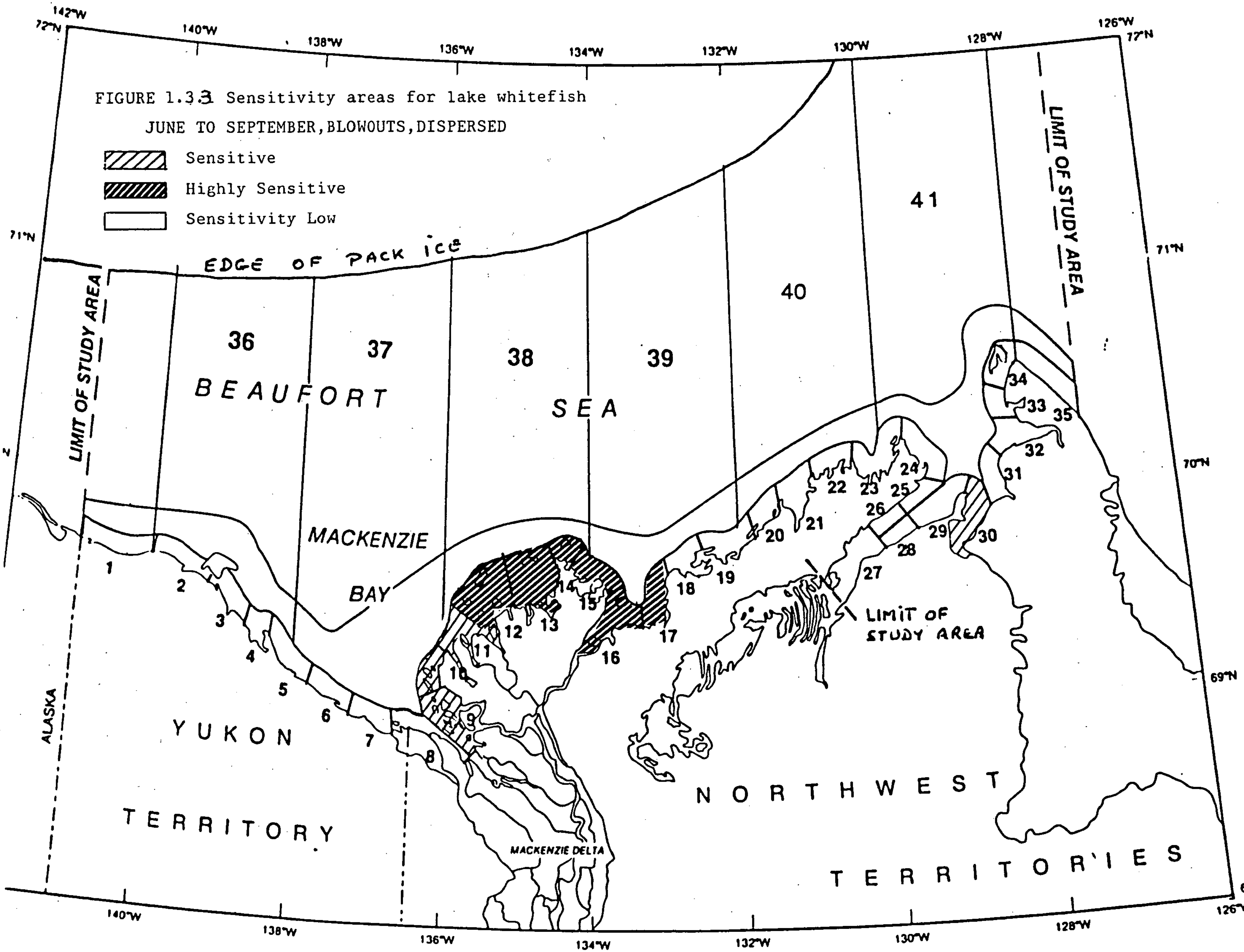


FIGURE 1.3.3 Sensitivity areas for lake whitefish JUNE TO SEPTEMBER, BLOWOUTS, DISPERSED

1.4 ARCTIC CISCO (Coregonus autumnalis)

The Arctic cisco is one of the most abundant fish species in nearshore areas along the Yukon coast, in the Mackenzie Delta, and in Liverpool Bay. Cisco are anadromous but unlike Arctic char populations which can be divided into a number of discrete sub-populations on the basis of the rivers in which they spawn, the Arctic cisco within the study area breed only within the Mackenzie River system. No doubt there are a number of discrete stocks which spawn in different sections of the river and its tributaries, but it is difficult to identify these stocks. Therefore the Arctic cisco found within the study area have been treated as a single stock.

The Arctic cisco stock supports a significant domestic fishery in the Mackenzie Delta and Tuktoyaktuk Harbour where it is used both for human and dog food.

1.4.1 Life History

In general, adults and immatures overwinter in the outer reaches of the Mackenzie Delta. They move into the coastal areas to forage in the summer months and return to the outer delta areas in-mid to late-summer. Spawners move further upstream to spawn in the fall and quickly descend to the delta to over winter.

The spawning migration in the Mackenzie River takes place from late June to August with a peak of movement in early to mid July. Spawning takes place from late September to early October and a well defined post-spawning downstream migration occurs during October as adults return to their over wintering areas in the delta

Unlike char, young Arctic ciscos move downstream in their first year to the middle and lower reaches of the Delta and move immediately into the coastal waters of the delta during the summer. According to Griffith et al (1975) young move from the spawing grounds to major nursing areas in the delta channels and in near by nursery areas.

Unlike the spawners which migrate into rivers in July, immature and non-spawning adults remain in coastal habitats throughout the summer and fall where according to Percy (1975) they are taken primarily in embayments. The population over winters in the outer part of the delta and returns to coastal areas prior to or during breakup.

These habits render Arctic cisco vulnerable to the effects of coastal spills throughout the ice-free season. Even young ciscos are vulnerable since, unlike char, they move to coastal environments in the summer of their first year. Immatures and non-spawning adults remain in coastal habitats from breakup until fall and are vulnerable throughout this period. Spawners, however, begin moving into the rivers in late June and July. Spawners are probably most vulnerable to spills in the outer delta during migration.

1.4.2 Distribution in the Southern Beaufort Sea

The reports of Craig and McCart (1976), Griffith et al (1975), Lawrence et al (1984), Percy (1975) and Worbets (1979) summarized in Figure 1.4.1 show that arctic cisco are commonly observed in coastal environments throughout the study area. As a consequence this species is vulnerable to spills in coastal areas in all parts of the study area. There is no indication from the data of any major aggregation of immatures or adults within the study area and hence there is no indication that such areas of greater sensitivity to spills might exist. It is possible to surmise, however, that possible spawning migration routes such as Shallow Bay, Middle and East Channels might be areas of greater risk when used for spawning migration in July. There is some indication in the literature that young may aggregate in major nursery areas in the outer delta and in coastal areas, but there is little indication as to the areas involved.

As a result of their widely distributed population, arctic cisco are only at SLIGHT risk from batch spills. A 30-day blowout would result in sensitivity at the MODERATE level, since this would interupt coastal migration routes.

1.4.3 The Fishery

The Arctic cisco population supports a significant domestic fishery in the Mackenzie Delta and in the Tuktoyaktuk area. The catch is apparently used for both human consumption and for feed for dogs. In the Mackenzie Delta fish are taken during their spawning migration while the fishery in the Tuktoyaktuk area is based on the population wintering in this area. Although neither fishery would be likely to suffer due to mortalities in the population caused by coastal spills, there is some possibility that the spills might cause tainting. For the Mackenzie Delta fishery, spills in the mouth of channels used as spawning migration routes would be especially important.

<u>References</u>; Bond 1982; Craig and McCart 1976; Craig and Mann 1974; Hunter 1975; Mann 1974; Percy 1975; Worbets 1979.

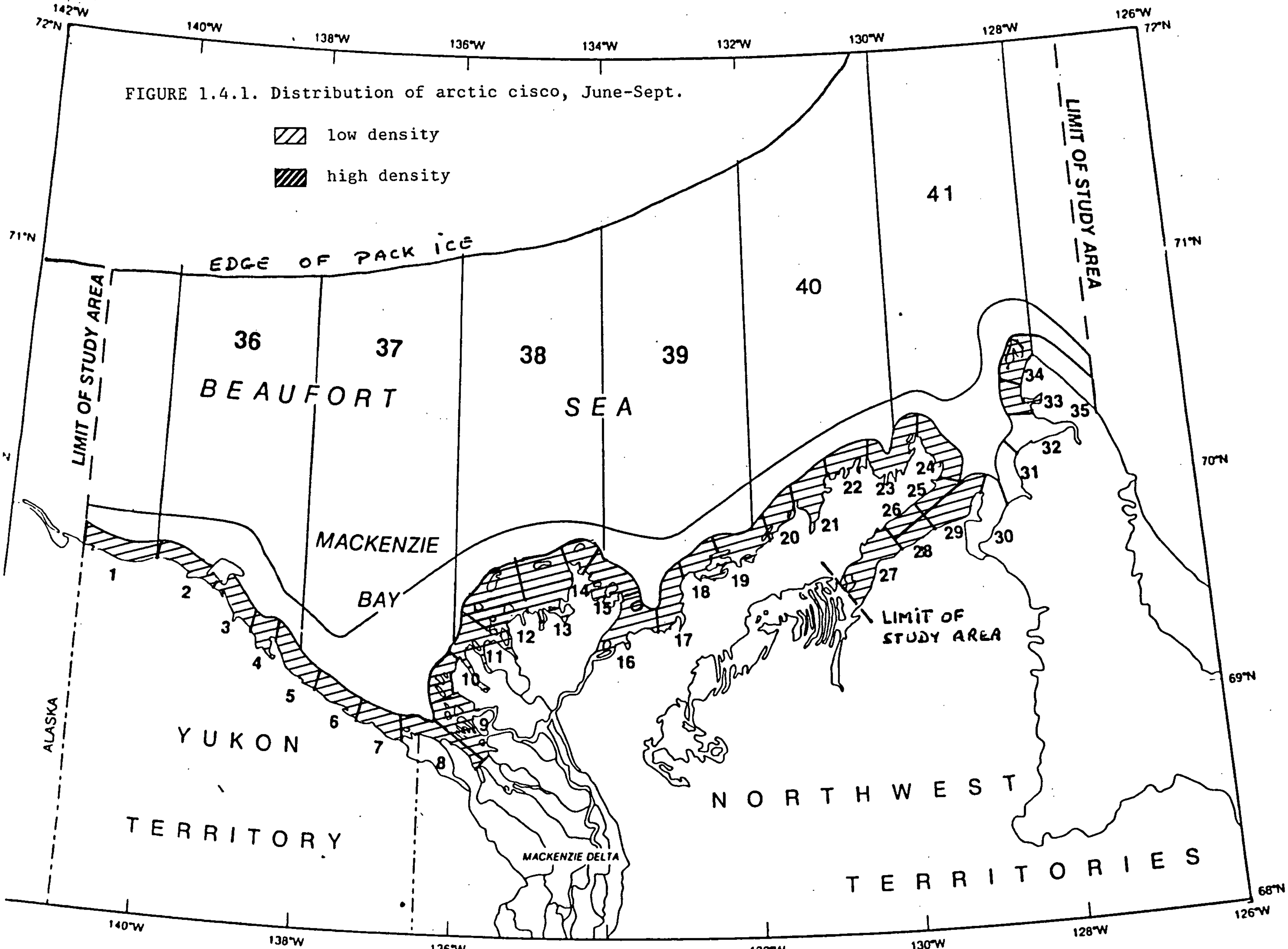


FIGURE 1.4.1. Distribution of arctic cisco, June-Sept.

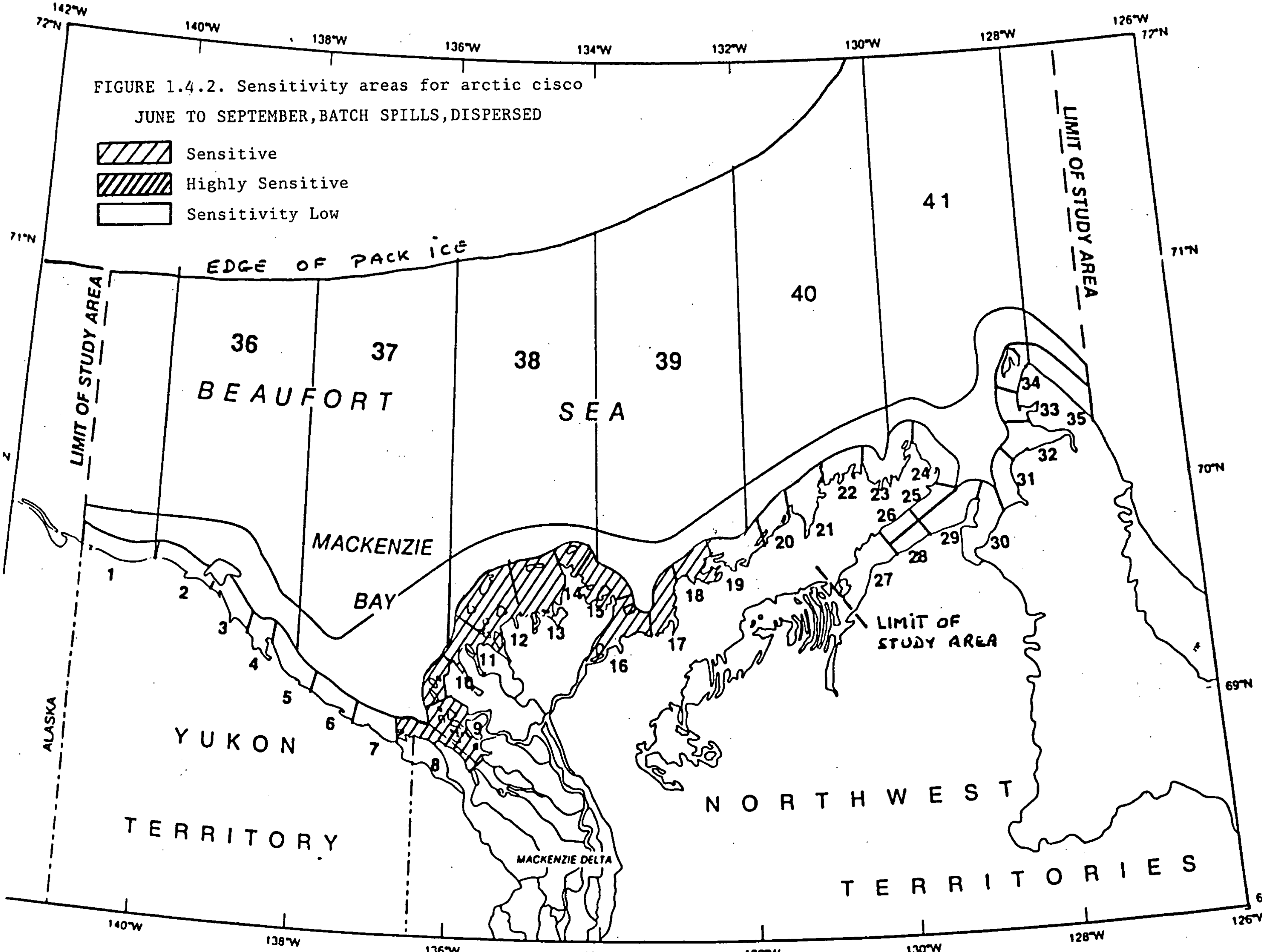


FIGURE 1.4.2. Sensitivity areas for arctic cisco
JUNE TO SEPTEMBER, BATCH SPILLS, DISPERSED

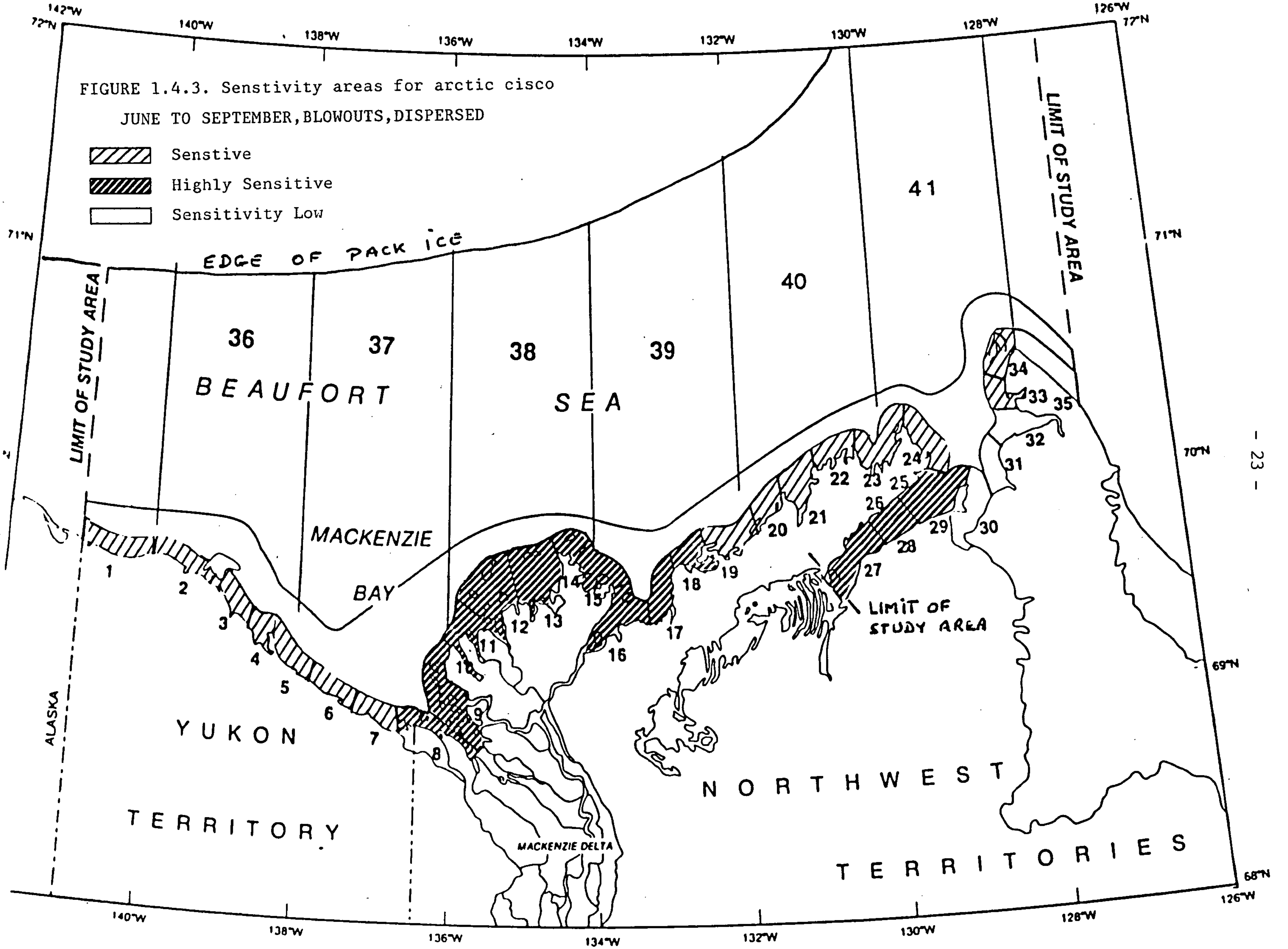


FIGURE 1.4.3. Senstivity areas for arctic cisco
JUNE TO SEPTEMBER, BLOWOUTS, DISPERSED

1.5 LEAST CISCO (Coregonus sardinella)

The least cisco is one of the more abundant species of fish in coastal areas of the outer Mackenzie Delta during the ice-free period. The least cisco that occur in coastal waters of the study area are members of anadromous populations that spawn in the Mackenzie River System. No doubt there are a number of discrete stocks within the area that spawn in different parts of the system, but no data is available at present to permit the identification of discrete stocks. Therefore least cisco within the study area have been treated as a single population.

Least cisco appear to be of secondary importance to the local fishery. There is no commercial fishery for least cisco and only low numbers are taken in the domestic fishery.

1.5.1 Life History

Least cisco spawn in lakes and rivers of the Mackenzie River System in the fall months. Young move downstream in the spring and during the open water season are found in coastal marine areas. In late summer and early fall they probably move to overwintering areas in the lower reaches of the Mackenzie Delta. Young-of-the-year are hence vulnerable to the effects of marine oil spills throughout the ice-free period. There is little evidence to indicate that young aggregate routinely in specific locations and hence it has been assumed that they are distributed widely over the Yukon coast, Mackenzie Delta, and along the Tuktoyaktuk Peninsula. Therefore a spill of dispersible proportions will threaten only a very small proportion of the young-of-the-year.

Least cisco reach maturity at four to nine years of age. Once maturity is reached, adults do not spawn in consecutive years. Hence the population is composed of immatures, spawning adults and non-spawning adults which differ somewhat in their habits and in their vulnerability to spills.

Immatures and non-spawning adults winter in freshwater lakes and rivers in the outer Mackenzie Delta, as well as in coastal areas such as Tuktoyaktuk Harbour, Kugmallit Bay, Mason and Mallik Bays and in coastal areas of the Tuktoyaktuk Peninsula. Immatures and non-spawning adults disperse into coastal areas during the summer months to feed. Indications are that they do not disperse as widely as do the arctic cisco, moving as far as Herschel Island to the west and McKinley Bay to the east, with the majority remaining in the vicinity of the Delta and Kugmallit Bay. They move into coastal areas in the late spring prior to break-up and reach peak numbers in coastal areas by mid-August. They then return to their overwintering areas gradually over the late summer. Mature adults also disperse into coastal areas but data suggests that these spawners return to spawning rivers earlier than immatures and non-spawners. Spawners move upriver to spawning sites in the tributaries of the Mackenzie in late summer and spawning takes place in late September and early October. From these data it appears that immatures and non-spawners are vulnerable to marine oil spills in coastal areas from break-up until mid-September with spawning adults being vulnerable from break-up until late August.

Although there does not appear to be any significant fishery for least cisco, spawning adults are probably taken incidentally in river fisheries for other species during the cisco's upstream spawning migration in the fall. Fish taken in the this way might become tainted if they encounter oil either dispersed or untreated in coastal areas during their return to their spawning rivers. However, since the return migration of spawners takes place over a broad span of time it is unlikely that a significant number of fish would be tainted by any spill either treated or untreated.

1.5.2 Distribution in the Southern Beaufort Sea Area

The distribution of least cisco in coastal waters of the Beaufort Sea is illustrated in Figure 1.5.1. Least cisco young, immatures, and adults from the Mackenzie River population are found in the summer months from Herschel Island in the west to McKinley Bay on the east. Their abundance appears to be greatest in the Mackenzie Delta area, with densities declining toward the extremities of this range. This appears to reflect the fact that this species tends to move only a short distance from their spawning and wintering areas in the Mackenzie River and Delta.

The lack of quantitative data makes the assessment of vulnerability of least cisco and other fish species in this area rather difficult. It is impossible to determine the proportion of the population in any given area since absolute estimates of population size and abundance in different coastal areas are lacking. This does not appear to pose a serious problem however, because i) the overall vulnerability of fish populations is low due to their broad distribution and ii) the fact that there is little evidence to indicate that any species aggregate strongly at any location in the study area. For the most part therefore, the data suggests that least cisco and few if any other species will be vulnerble to MODERATE or MAJOR effects from spills. The few situations in which populations risk SLIGHT effects have been identified using the limited semi-quantitative data available.

The data in Figure 1.5.1 show that although least cisco occur in all coastal areas from Herschel Island on the west to Mackinley Bay on the east, their greatest abundance occurs in the area of the outer Mackenzie Delta from Garry Island to Kugmallit Bay. A conservative assessment is that dispersed batch spills in coastal waters in the latter area may have SLIGHT effects on the population of least cisco that breeds in the Mackenzie River System. Blowouts (30-day) would be expected to exert effects at the MODERATE level, because of their effect on coastal movements.

1.5.3 The Fishery

As mentioned above, there is no significant fishery for least cisco in the study area.

References; Bond 1982; Corkum and McCart 1981; Craig and McCart; Griffiths et al; Hunter et al 1984; Lawrence et al 1984; Worbets 1979.

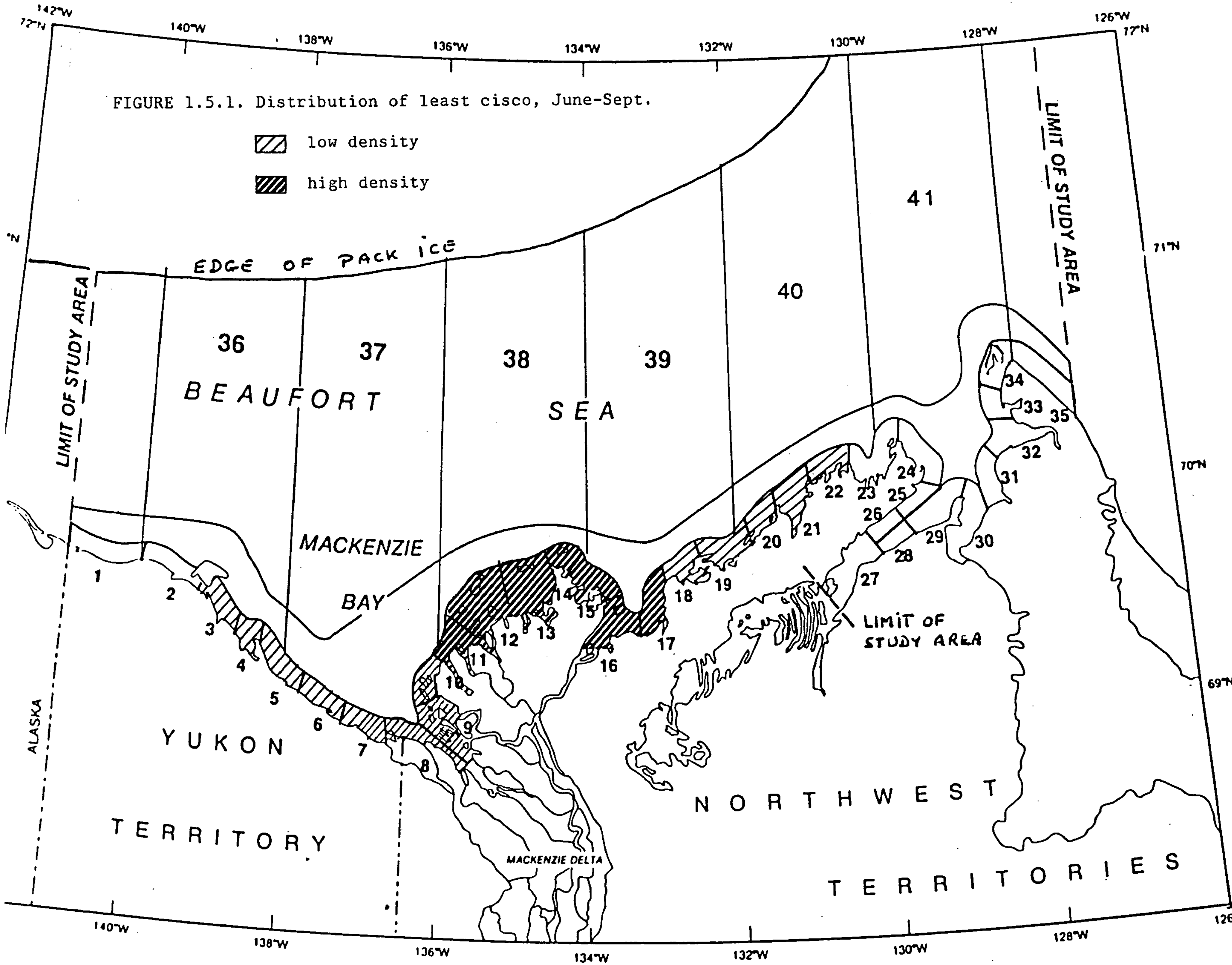
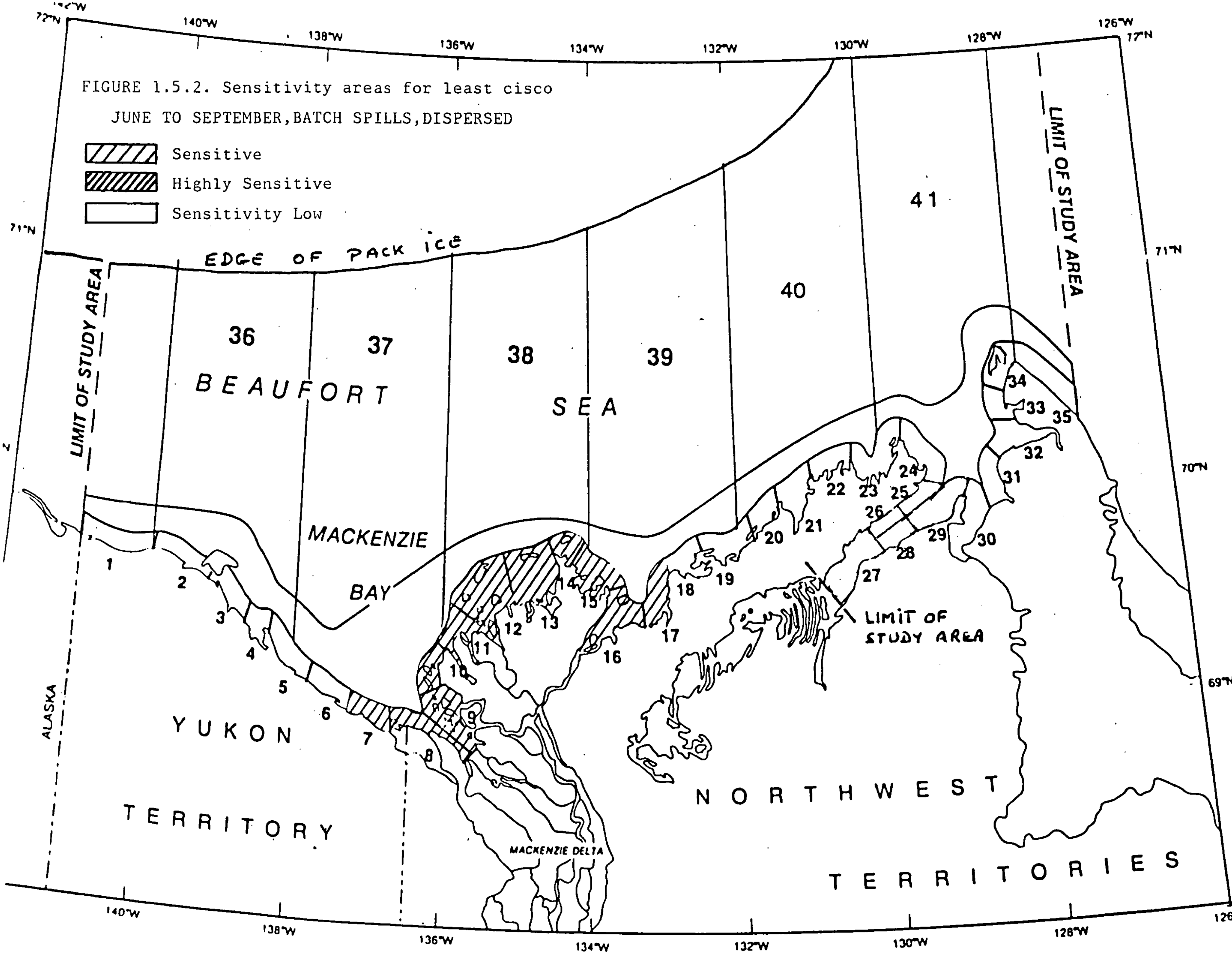


FIGURE 1.5.1. Distribution of least cisco, June-Sept.

FIGURE 1.5.2. Sensitivity areas for least cisco
JUNE TO SEPTEMBER, BATCH SPILLS, DISPERSED

- Sensitive
- Highly Sensitive
- Sensitivity Low



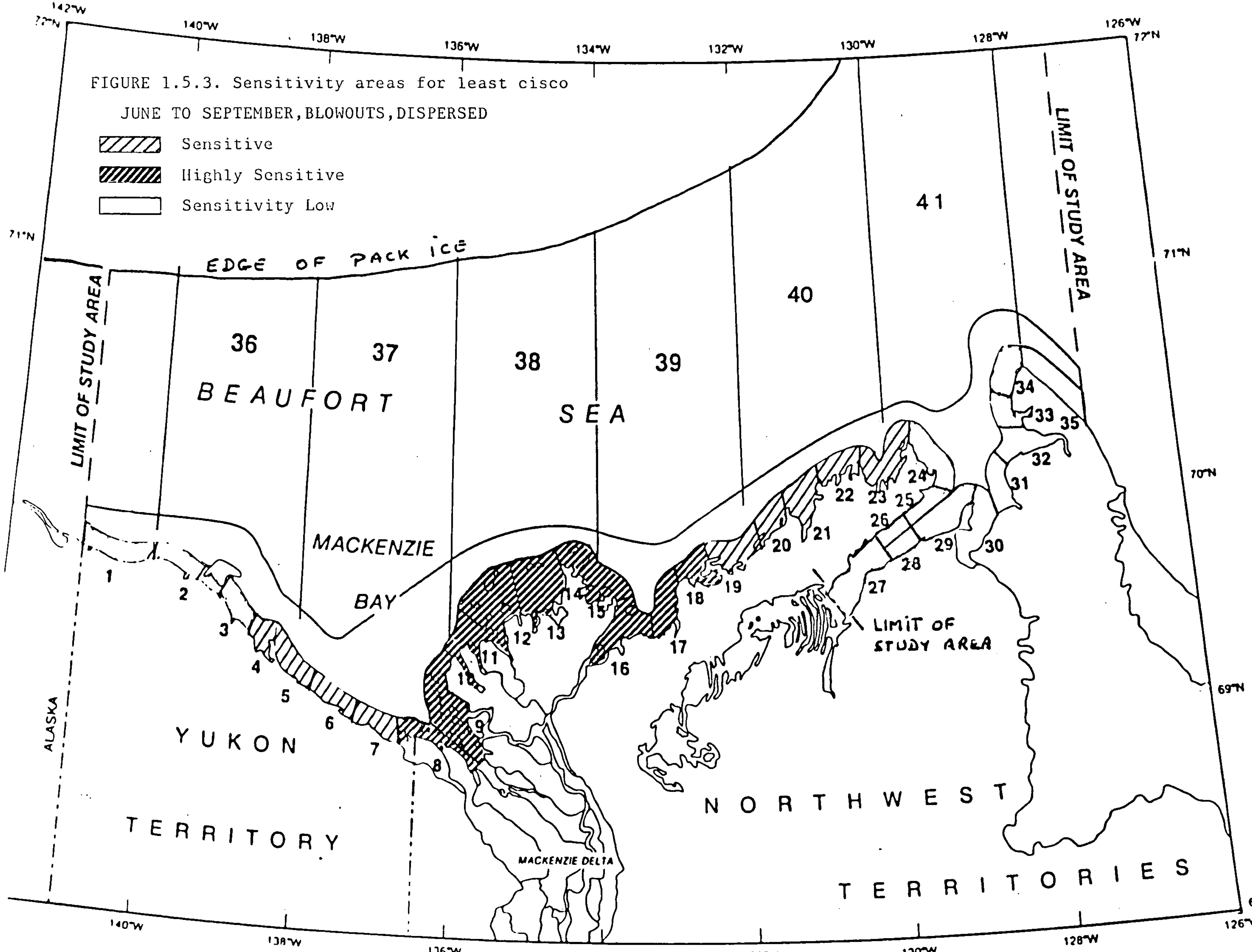


FIGURE 1.5.3. Sensitivity areas for least cisco
JUNE TO SEPTEMBER, BLOWOUTS, DISPERSED

- Sensitive
- Highly Sensitive
- Sensitivity Low

1.6 INCONNU (*Stenodus leucichthys nelma*)

Inconnu are commonly found in the coastal waters of the southern Beaufort Sea. They occur in coastal waters and in channels and lakes in the Delta and in areas of Liverpool Bay. At least two populations are identifiable in this area. One population breeds in the Mackenzie System and forages in the coastal waters of the Yukon Slope, the Delta, and Kugmallit Bay, while the second population spawns in the Anderson River and forages in the Liverpool Bay area.

The Mackenzie population appears to have been exploited commercially in the past but at present there is no commercial fishery. Inconnu in the Delta and in adjacent coastal waters support a significant domestic fishery.

1.6.1 Life History

The Mackenzie River population of inconnu spawn in the tributaries of the Mackenzie System in late September and early October. Young inconnu seldom appear in surveys of the lower Mackenzie Delta and coastal regions indicating that they remain in the river or inner Delta for one or more years before moving to coastal areas.

Inconnu in the Mackenzie System begin to mature sexually at the age of six years and reach a maximum age of 17 years. Although inconnu of all ages appear in surveys of the outer delta and coastal areas, only individuals four years of age or older were common, suggesting that younger fish avoided these areas and are hence invulnerable to marine spills. Both immatures and mature individuals of all ages appear in coastal surveys but few individuals in spawning condition were encountered, indicating that inconnu do not spawn in consecutive years and only the immatures and non-spawning adults forage in the coastal areas during the open water season.

Inconnu overwinter in the mouths of the deeper channels of the Delta and in coastal areas including Shoalwater Bay, Mallik and Mason Bays, Tuktoyaktuk Harbour and Kugmallit Bay. There is little evidence to indicate that immature and non-spawning inconnu display dramatic coastal migration between wintering areas and summer foraging areas although some authors have reported significant changes in abundance at various points in the outer delta suggesting that inconnu disperse into coastal areas during the summer and return to bays and estuary channels in the fall in preparation for overwintering.

Spawning adults leave the overwintering areas in the outer Delta before break-up in the spring and begin moving upstream to their spawning areas. Spawning occurs in the Mackenzie System and its major tributaries in late September and early October after which adults move downstream immediately to their wintering areas in the outer Delta.

This information suggests that neither spawners nor young are vulnerable to marine spills in this area during the open water period. Immatures and non-spawning adults are, on the other hand, vulnerable to marine spills throughout the open water period. Inconnu appear to be widely distributed in coastal waters during the summer months in the Mackenzie Delta system and it is therefore unlikely that any given spill, whether treated or untreated, would cause significant effects on the population. However, if, as is indicated by Percy (1975), inconnu congregate in specific areas along the outer delta and at the mouths of overwintering channels in September, spills in these areas at that time might have significant effects on the population. Specifically, batch spills would result in sensitivities of the SLIGHT level, while blowouts would exert MODERATE effects.

1.6.2 Distribution Within the Southern Beaufort Sea Area

There are two significant populations of inconnu in the study area, one originating in the Mackenzie System and another in the Anderson River System. The Mackenzie population overwinters in the outer channels of the Delta and in coastal bays and disperses into coastal areas in the open water season. During the open water season this population disperses as far west as Shingle Point and as far east as McKinley Bay, but the greatest concentrations occur in the area of the Delta and the south shore of Kugmallit Bay. Inconnu appear to move further offshore than some other anadromous species but their concentrations are greatest in shallow inshore areas. Because the population is so widely dispersed from June to August, it is unlikely that an oil spill will have a significant effect on the population, especially since at least a portion of the adults are absent, spawning in the Mackenzie River at this time. However, if as suggested, inconnu congregate at the mouths of the Delta channels in September, spills of significant size occurring in these areas at this time may have significant effects at the SLIGHT level.

The habits and distributions of inconnu within the Liverpool Bay area are less well documented, but it appears that this population(s) overwinter in the Eskimo lakes area and in Anderson River. Inconnu disperse through Liverpool Bay during the openwater season and congregate in the western end of Liverpool Bay and in Wood Bay in August and September. Spills in June and July do not appear to pose a significant threat but spills in August and September in the areas of aggregation may cause significant effects on this population(s) (Figures 1.6.2-1.6.5).

1.6.3 The Fishery

Inconnu of the Mackenzie Delta have been commercially exploited in the past but at present there is no commercial fishery. McCart and Den Beste (1979), report that inconnu are exploited for domestic consumption in the Mackenzie Delta and in adjacent coastal waters. Oil spills in coastal waters may effect these fisheries both through tainting of the catch and through disrupting fishing activity taking place in coastal waters.

The Anderson River population does not appear to be exploited.

References: Bond 1982; Craig and McCart 1976; Galbraith and Hunter 1975; Hunter 1975; Lawrence et al 1984.

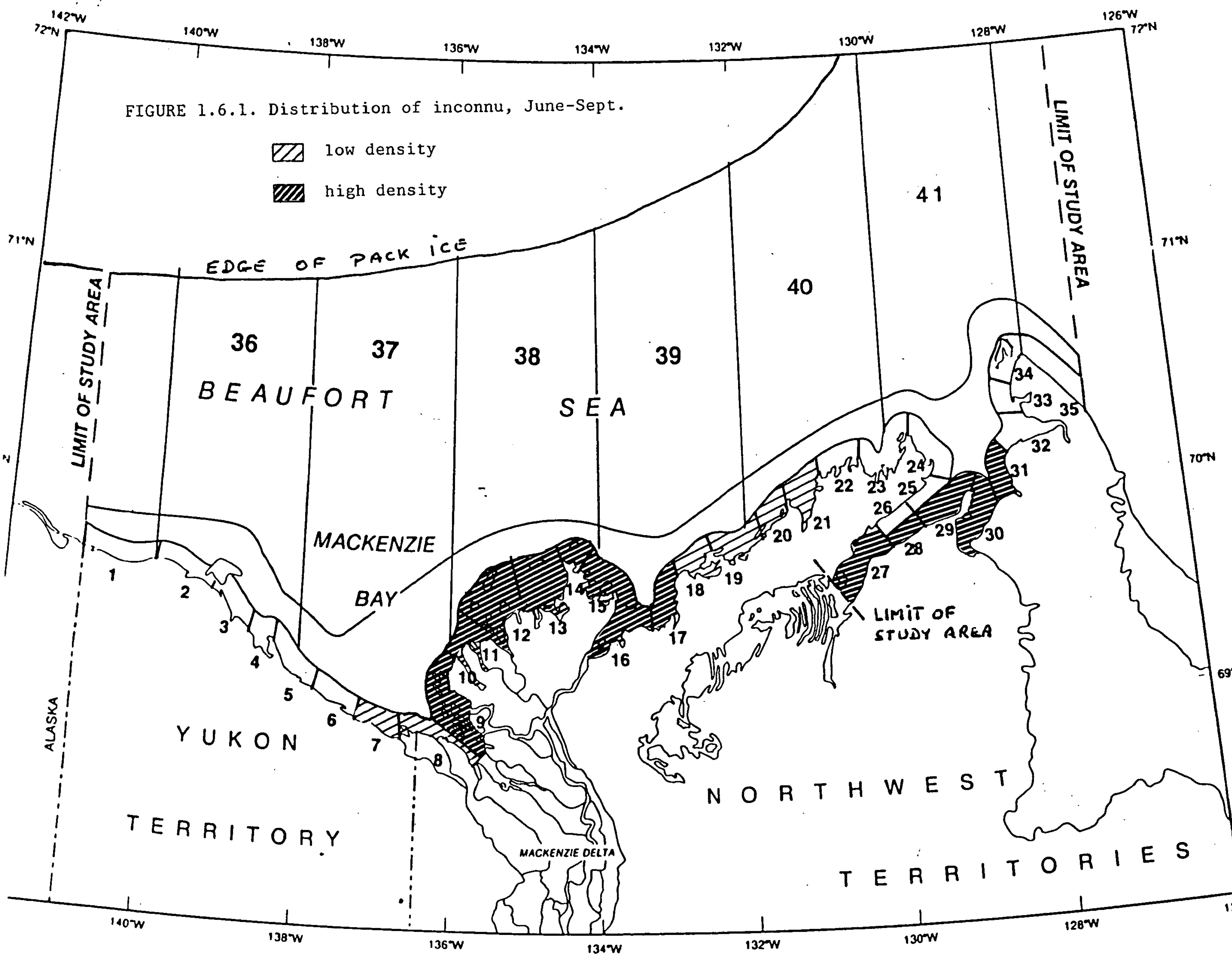


FIGURE 1.6.1. Distribution of inconnu, June-Sept.

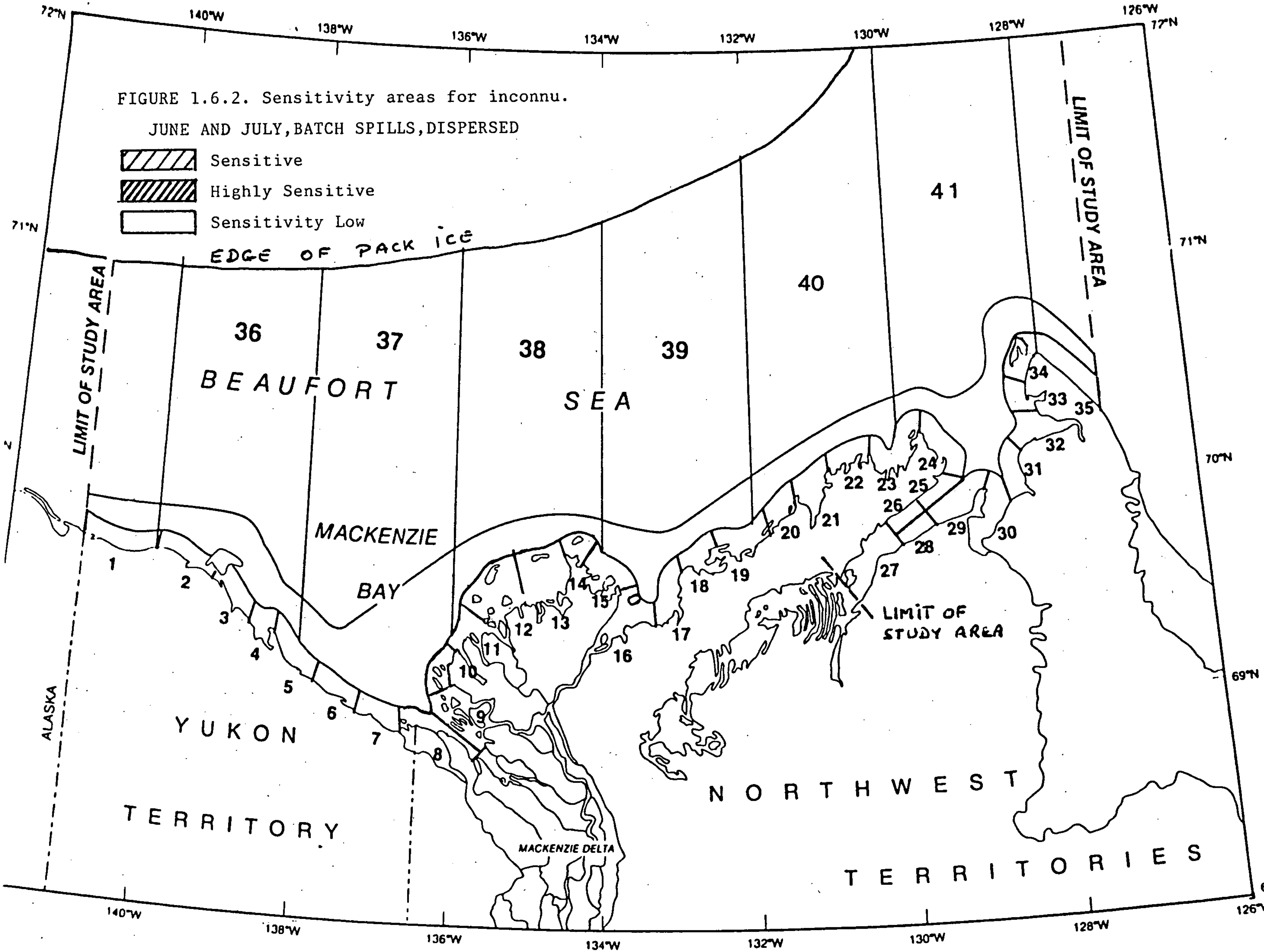


FIGURE 1.6.2. Sensitivity areas for inconnu.
JUNE AND JULY, BATCH SPILLS, DISPERSED

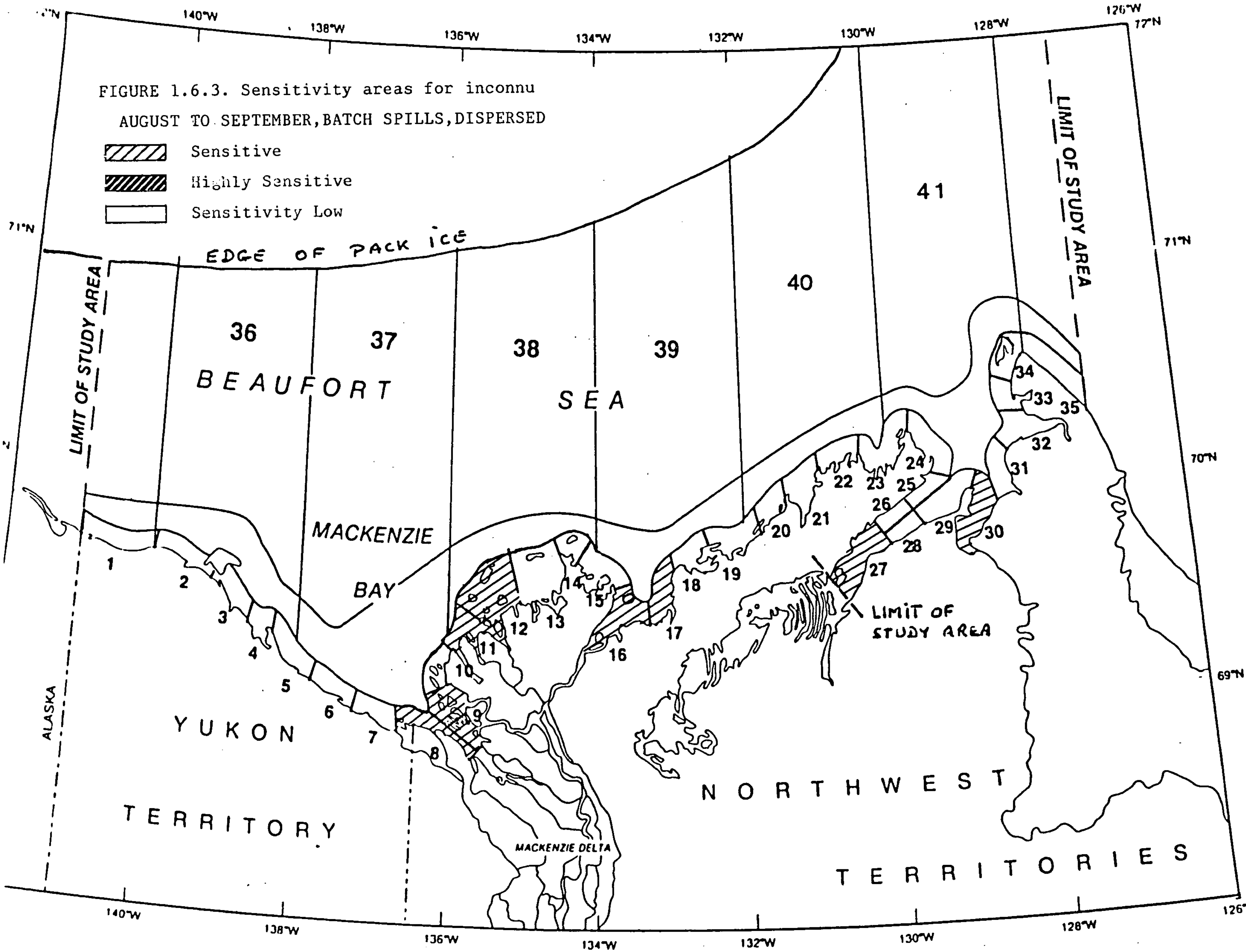


FIGURE 1.6.3. Sensitivity areas for inconnu AUGUST TO SEPTEMBER, BATCH SPILLS, DISPERSED

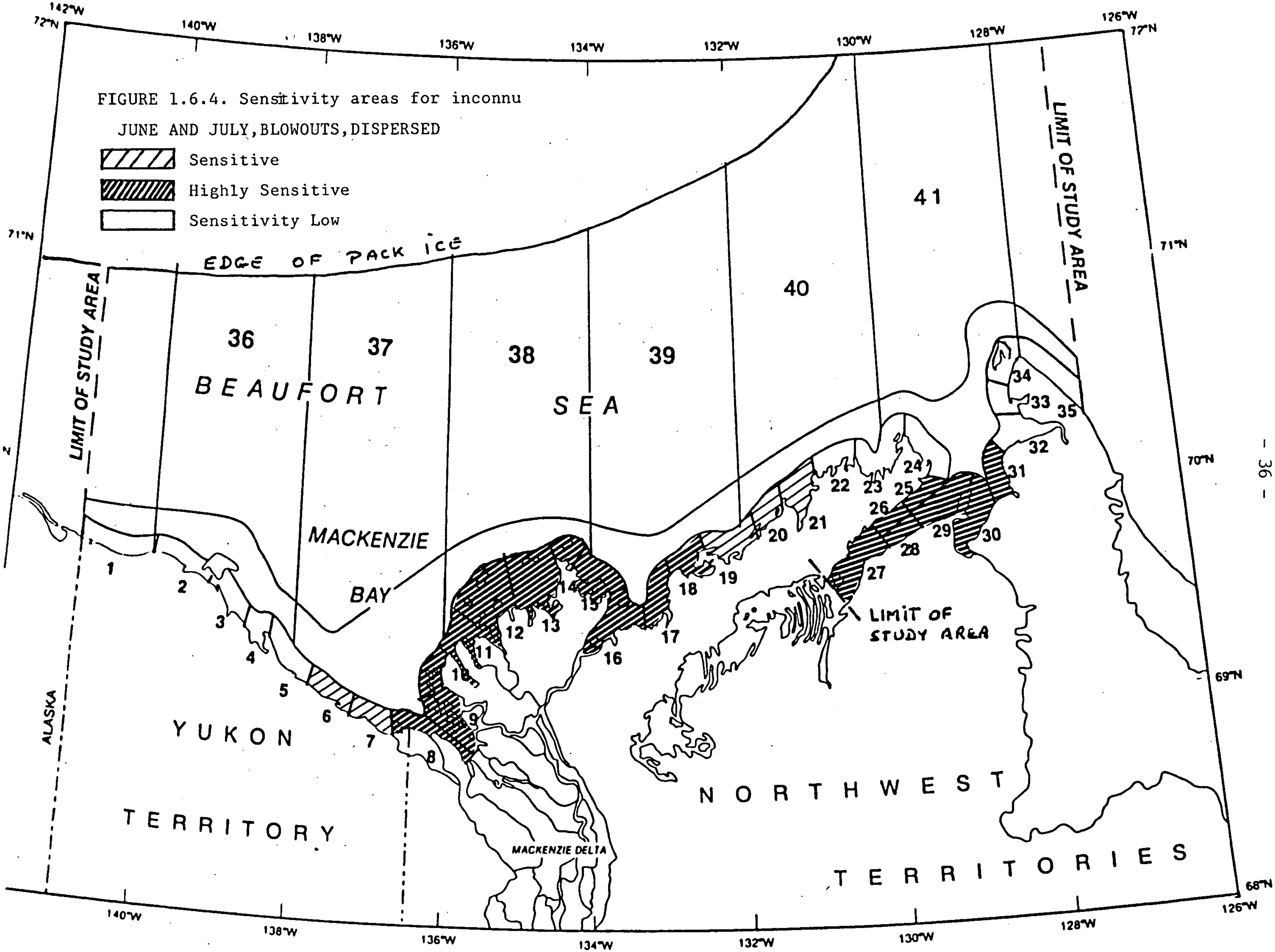


FIGURE 1.6.4. Sensitivity areas for inconnu
JUNE AND JULY, BLOWOUTS, DISPERSED

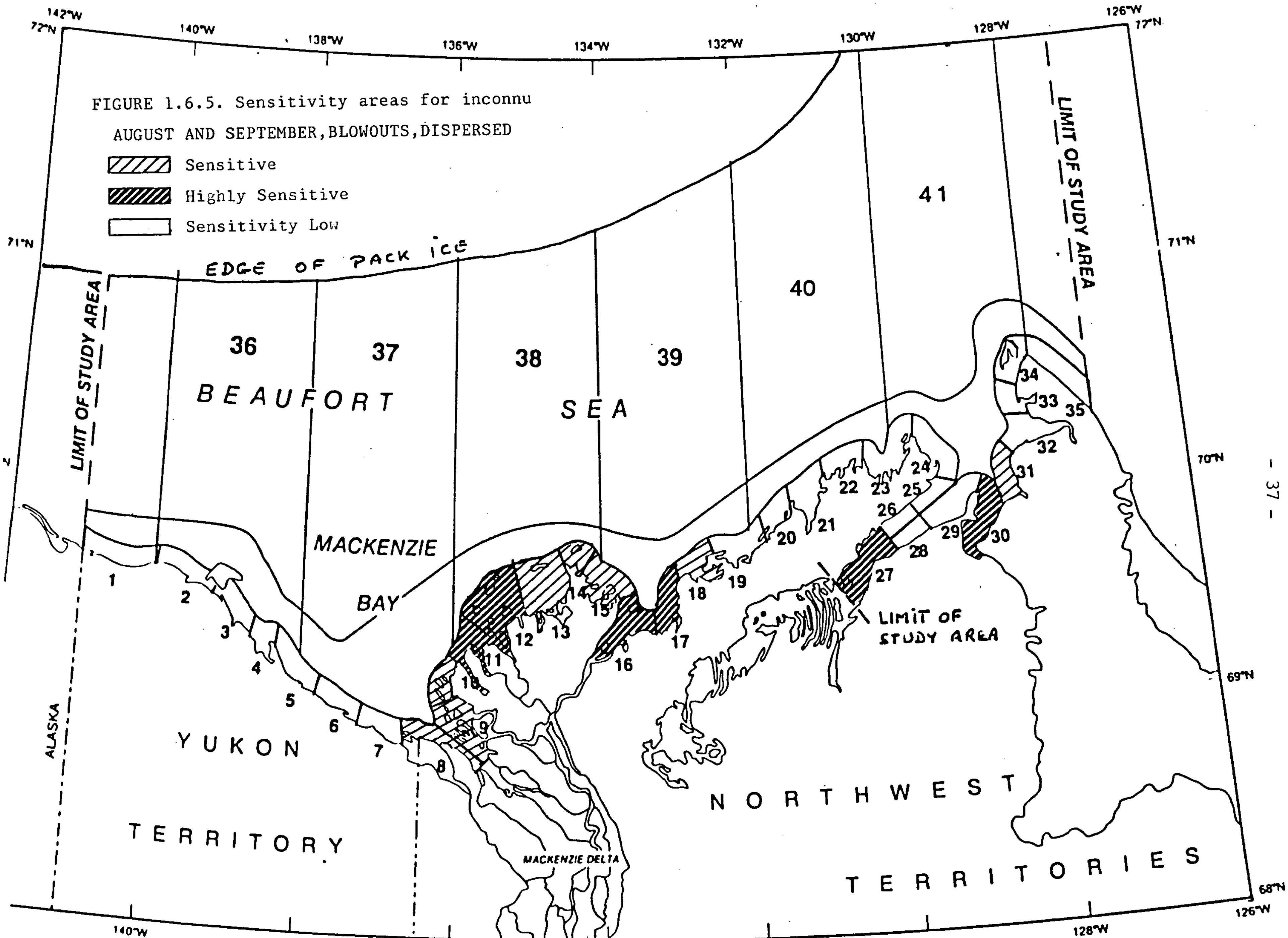


FIGURE 1.6.5. Sensitivity areas for inconnu

AUGUST AND SEPTEMBER, BLOWOUTS, DISPERSED

Sensitive

Highly Sensitive

Sensitivity Low

1.7 ARCTIC COD (Boreogadus saida)

Arctic cod is a dominant marine species in arctic environments where it also forms a major trophic link in arctic ecosystems, feeding upon zooplankton and in turn forming the principle food source for marine birds and mammals. There are indications however, that arctic cod may not be as important a constituent of the marine community within the study area as it is in adjacent areas. Regrettably despite it's important role in marine ecosystems our knowledge of the biology of arctic cod is quite limited. There is some information available on the life history of the species, but knowledge of its distribution and movements is poor. Likewise, there is little information on the division of arctic cod into stocks and hence it has been assumed that all arctic cod in the study area are part of a single stock.

Arctic cod is exploited to some extent outside the study area but there are no fisheries for this species within the study area.

1.7.1 Life History

Data from other arctic areas indicates that arctic cod spawn in both inshore and offshore areas from November to February, with the peak of hatching occurring in May. Larvae and juveniles are found in both inshore and offshore areas throughout the open water months. There is little information on the location and extent of spawning grounds. Larvae are distributed vertically throughout the water column. In the Chuckchi Sea Quest (1974) found that larvae were present in only low numbers but were far more abundant at greater depths. However, in the southern Beaufort Sea area Hunter (1979) found that larvae were more abundant near the surface although large numbers were present at depths below 20 m. Because of their wide spread distribution both horizontally and vertically it is unlikely that even a major oil spill whether treated or untreated will have a significant effect on the young-of-the-year age class of arctic cod.

Arctic cod reach sexual maturity at age two to three years and have a maximum longevity of about six years.

1.7.2 Distribution in the Southern Beaufort Sea Area

Information concerning the distribution of immature and adult arctic cod in the study area is almost completely lacking but information from the Alaskan Beaufort Sea indicates that arctic cod in that area utilize both inshore and offshore areas. Although the results of Craig et al (1982) indicate that cod are abundant in coastal areas in both winter and summer months there is little information to indicate the proportion of the overall population that utilize these inshore habitats.

Surveys of coastal and near offshore habitats in the study area have yielded only low numbers of arctic cod. This is due at least in part to the use of gear that is inappropriate for capturing arctic cod, but even the trawl surveys of Hunter and Galbraith (1976) yielded very few arctic cod and most of these appear to have been young-of-the-year specimens rather than adults. This would suggest that nearshore spills would have little effect on the arctic cod population in the study area.

Although there is little data on the distribution of arctic cod in the study area, the results from adjacent areas suggest that cod are probably widely distributed across the study area. If this is the case, there is little likelihood that spills of any size either treated or untreated will have a significant effect on the local arctic cod populations.

1.7.3 The Fishery

Arctic cod are not exploited commercially or for domestic use within the study area.

References: Bond 1982; Craig and McCart 1976; Galbraith and Hunter 1975; Lawrence et al 1984.

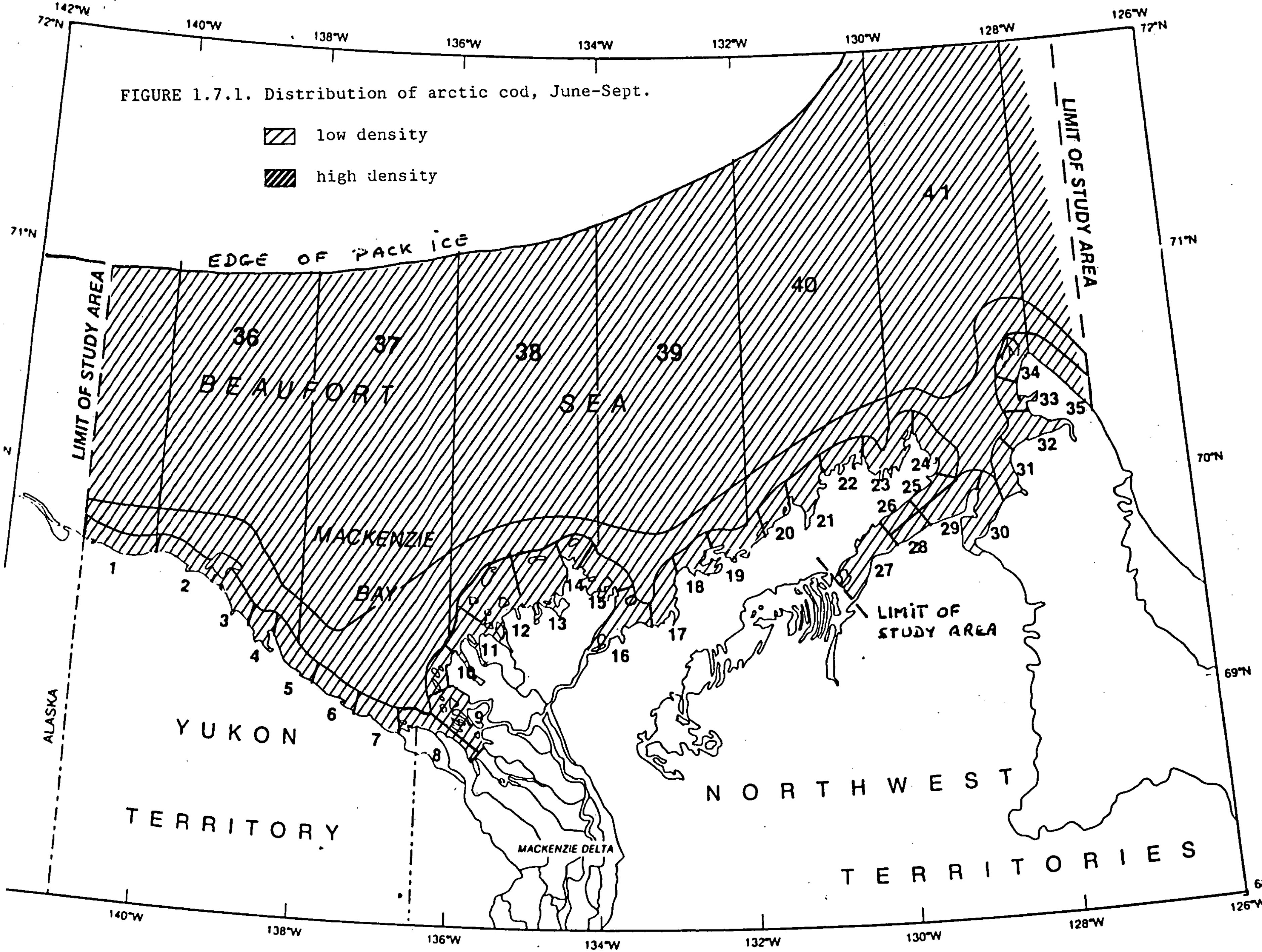


FIGURE 1.7.1. Distribution of arctic cod, June-Sept.

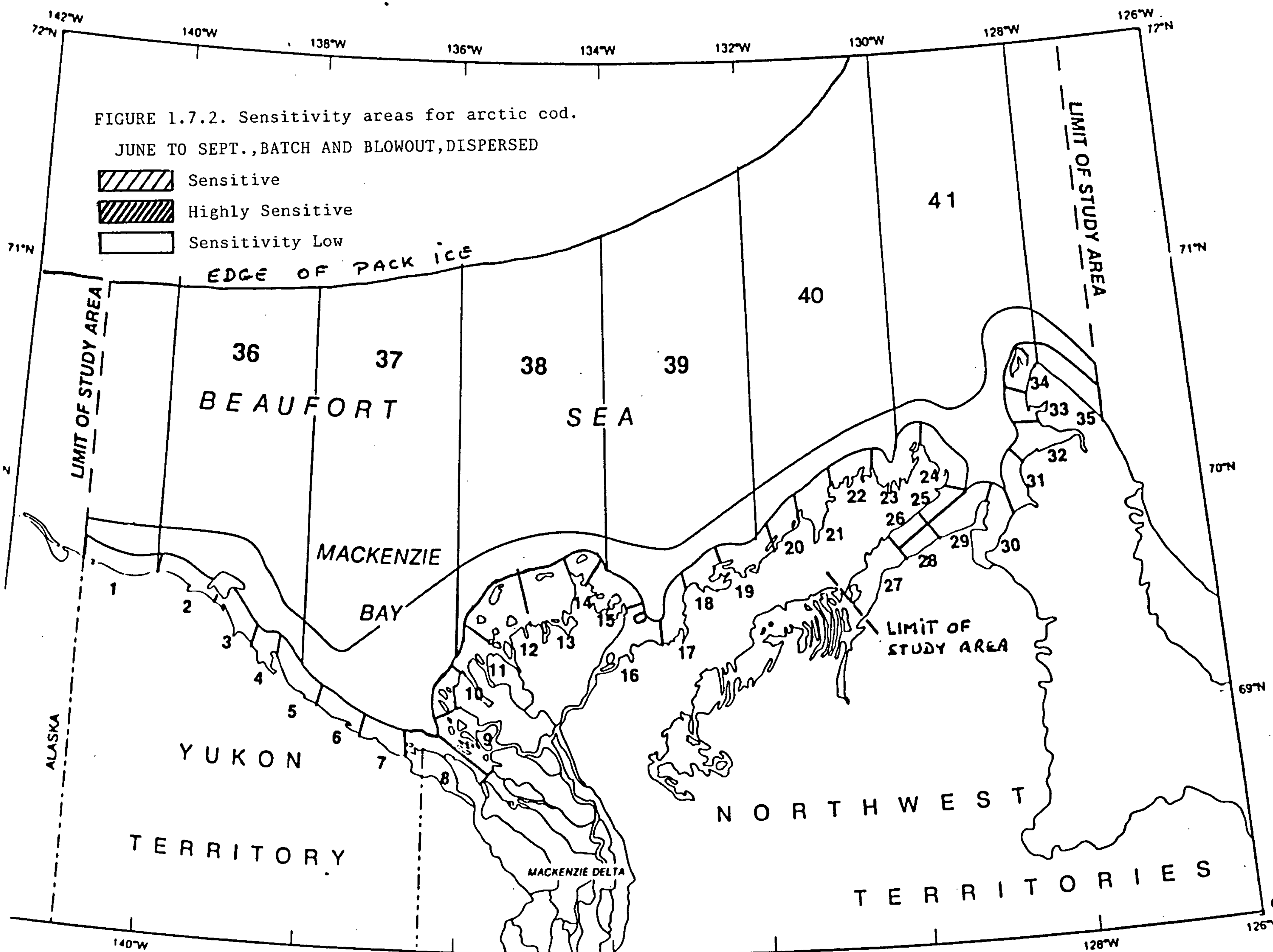


FIGURE 1.7.2. Sensitivity areas for arctic cod.
JUNE TO SEPT.,BATCH AND BLOWOUT,DISPERSED

1.8 PACIFIC HERRING (*Clupea harangus pallasi*)

Pacific herring is one of the more abundant marine species occurring in coastal areas of the southern Beaufort Sea, and one of the few marine species to support a domestic fishery. Although they are found in coastal and offshore habitats throughout the study area, they are most abundant in coastal waters in the eastern portion of the study area, including the coast of Richards Island, Kugmallit Bay, Tuktoyaktuk Peninsula, and Liverpool Bay. There appear to be several important spawning sites for herring in the study area, but the biology of pacific herring in this area is too poorly understood to identify discrete stocks. Hence all herring have been assumed to be part of a single population.

There is currently a small domestic fishery for herring in the Tuktoyaktuk area where herring is used for human and dog food. There is potential for development of a commercial fishery for herring roe, but to date no such fishery has been developed..

1.8.1 Life History

In the southern Beaufort Sea Pacific herring spawn in the shallow brackish waters of coastal bays and in river mouths of the Mackenzie Delta, Tuktoyaktuk Peninsula, and Liverpool Bay. Spawning occurs in the latter part of June prior to and during break-up. Young-of-the-year appear to move offshore during the summer months and may return to coastal areas in the fall in preparation for wintering in these coastal areas. Young-of-the-year are likely therefore to be invulnerable to coastal oil spills for most of the open water period, except for spills occurring in the fall.

Pacific herring reach maturity in 6 - 7 years and have a maximum life expectancy of roughly 13 - 14 years in this area.

Adults and immatures appear to have similar seasonal habits. After spawning, it has been suggested that adults move offshore to feed during the summer months. However, the results of Lawrence et al (1984) suggest that at least part of the population disperse to coastal areas to feed during July and early August. Herring densities in coastal areas increase in late August and early September indicating that adults and immatures return to coastal areas at that time in preparation for overwintering. Herring congregate in coastal areas during the winter. Surveys indicate that coastal bays such as Tuktoyaktuk Harbour, Mallik Bay and other areas along Richards Island may be areas of such aggregation. No doubt similar aggregations occur in areas in Liverpool Bay. If spills were to occur in these areas of aggregation when herring were presents there would appear to be a risk of significant effects on local populations.

1.8.2 Distribution in the Southern Beaufort Sea Area

Pacific herring are present in the southern Beaufort Sea area from Cape Bathurst to Point Barrow. Within the study area, herring have been observed along the Yukon coast, but are most abundant in coastal areas of the eastern Delta (Richards Island), Kugmallit Bay, the Tuktoyaktuk Peninsula and Liverpool Bay. Although herring are a marine species, they are taken in abundance in surveys both in nearshore and offshore areas. Herring appear to be widely distributed along the coast and in offshore areas in the summer months. There is considerable evidence that they aggregate in coastal bays in the fall and overwinter and spawn in these areas. All of the locations of aggregation are not known but these areas appear to include Mason and Mallik Bays, Kugmallit Bay, Tuk Harbour, and Hutchison Bay and the Eskimo Lakes in Liverpool Bay. Aggregations of herring in these areas might suffer significant effects at the SLIGHT level from batch spills in June and September, while being relatively insensitive in July and August. A 30-day blowout would result in sensitivity at the MODERATE level for June and September, with no significant effects in July and August.

1.8.3 The Fishery

Herring populations appear to support a significant fishery in the southern Beaufort Sea area. There is a domestic fishery for herring in the fall in the Tuktoyaktuk area, probably based on the sub-population that overwinters and spawns in this area. A spill in this area in September might pose a threat to this fishery. Corkum and McCart (1981) suggest that among the marine species in the southern Beaufort Sea, herring show the greatest potential for development of a commercial fishery for roe. If such a fishery were to be developed, it would be based on specific sub-populations that overwinter and spawn in coastal bays and would be at risk if the bays in question were to be contaminated by either treated or untreated oil. However, such potential fisheries have not yet been developed and hence are of no importance in oil spill management decisions at present.

<u>References</u>: Bond 1982; Craig and McCart 1976; Galbraith and Hunter 1975; Hunter 1975; Lawrence et al 1984.

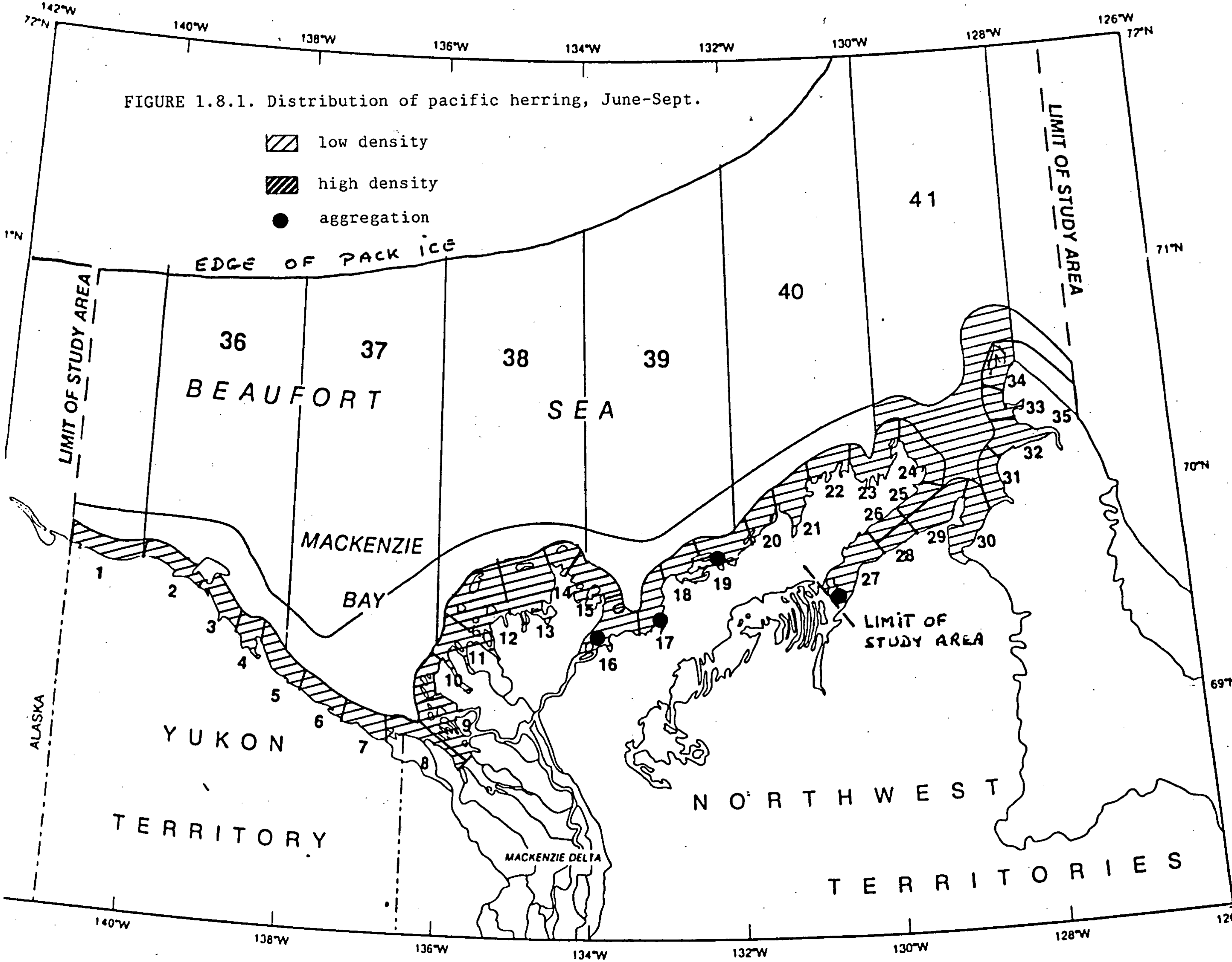


FIGURE 1.8.1. Distribution of pacific herring, June-Sept.

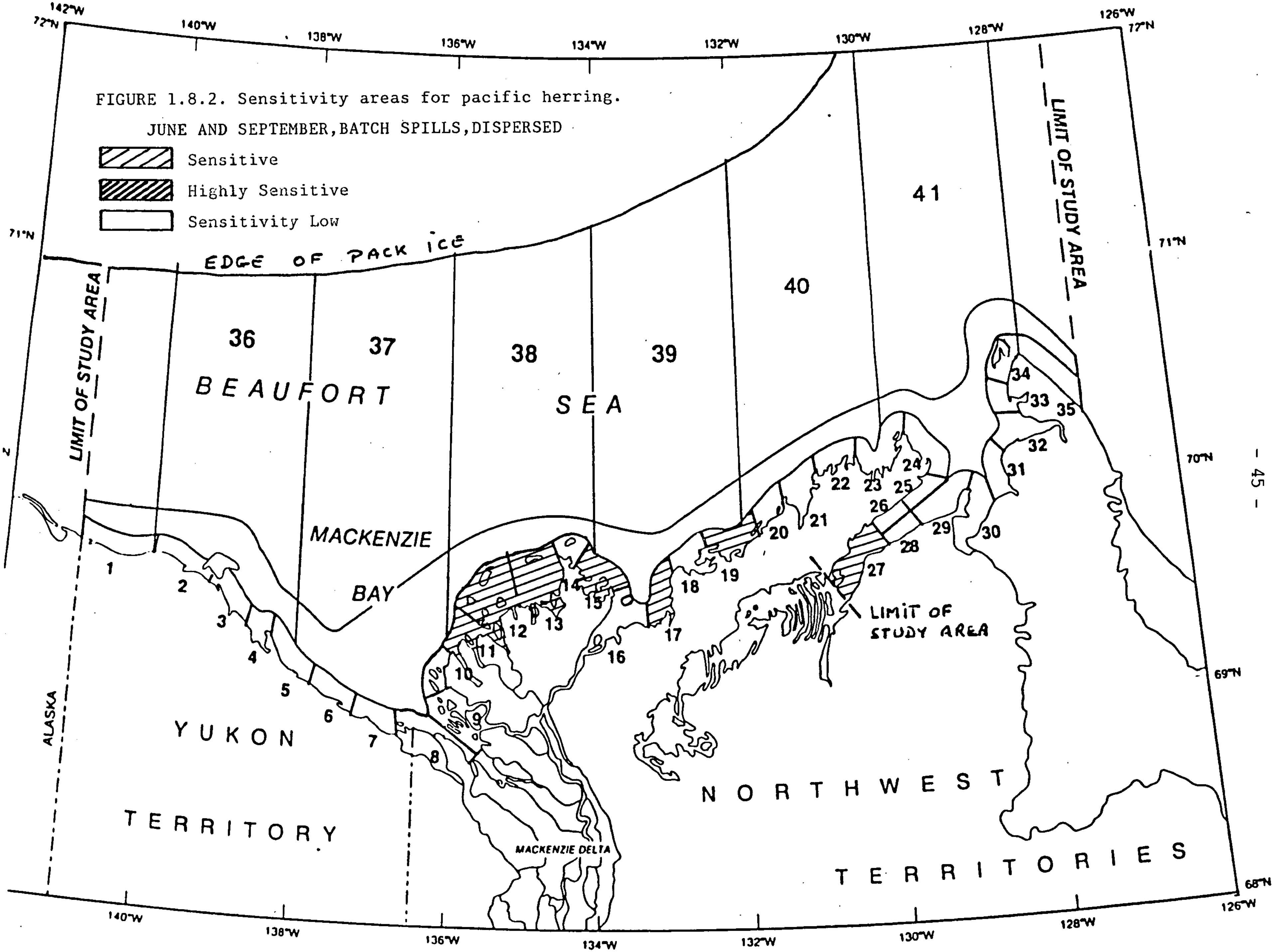


FIGURE 1.8.2. Sensitivity areas for pacific herring.

JUNE AND SEPTEMBER, BATCH SPILLS, DISPERSED

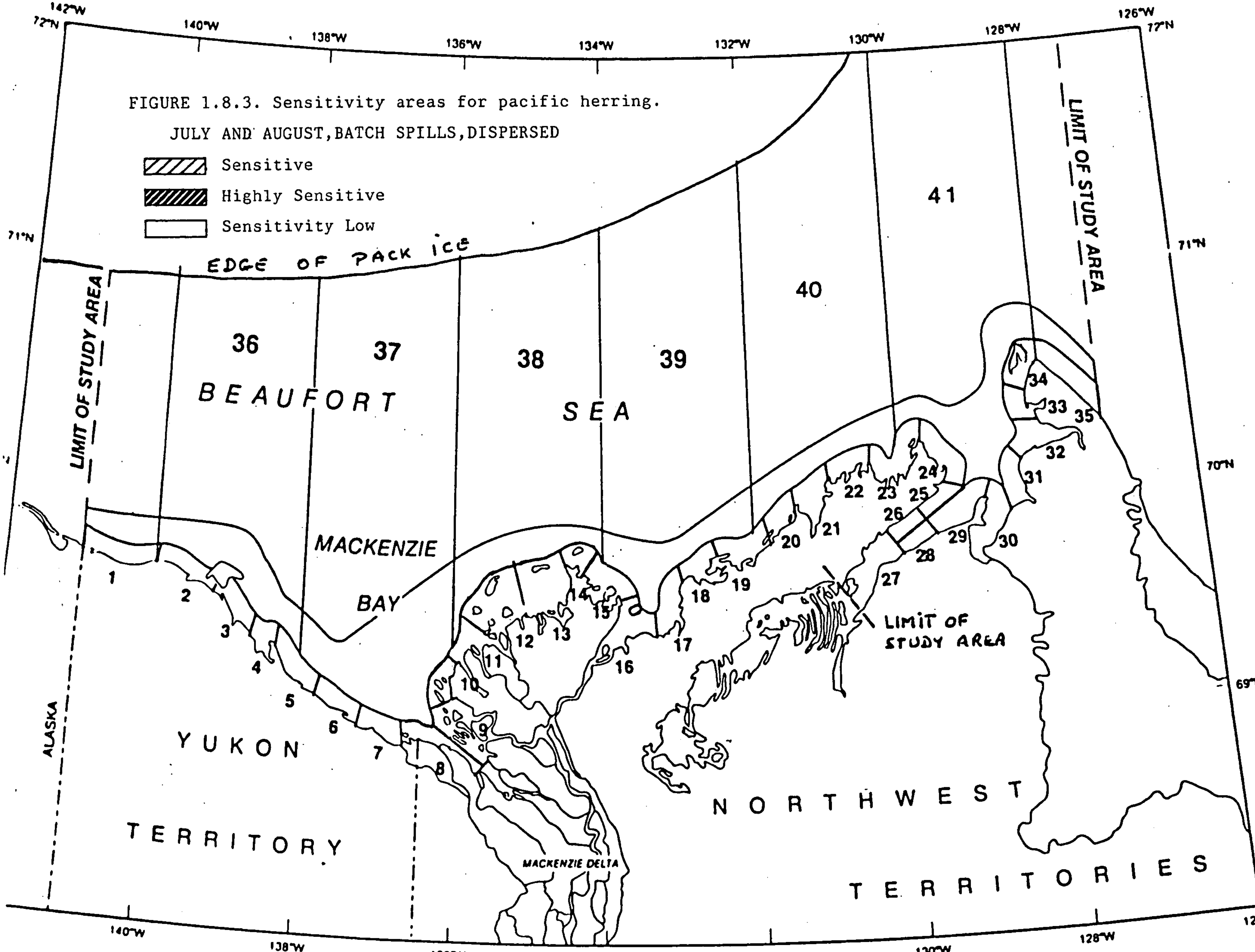
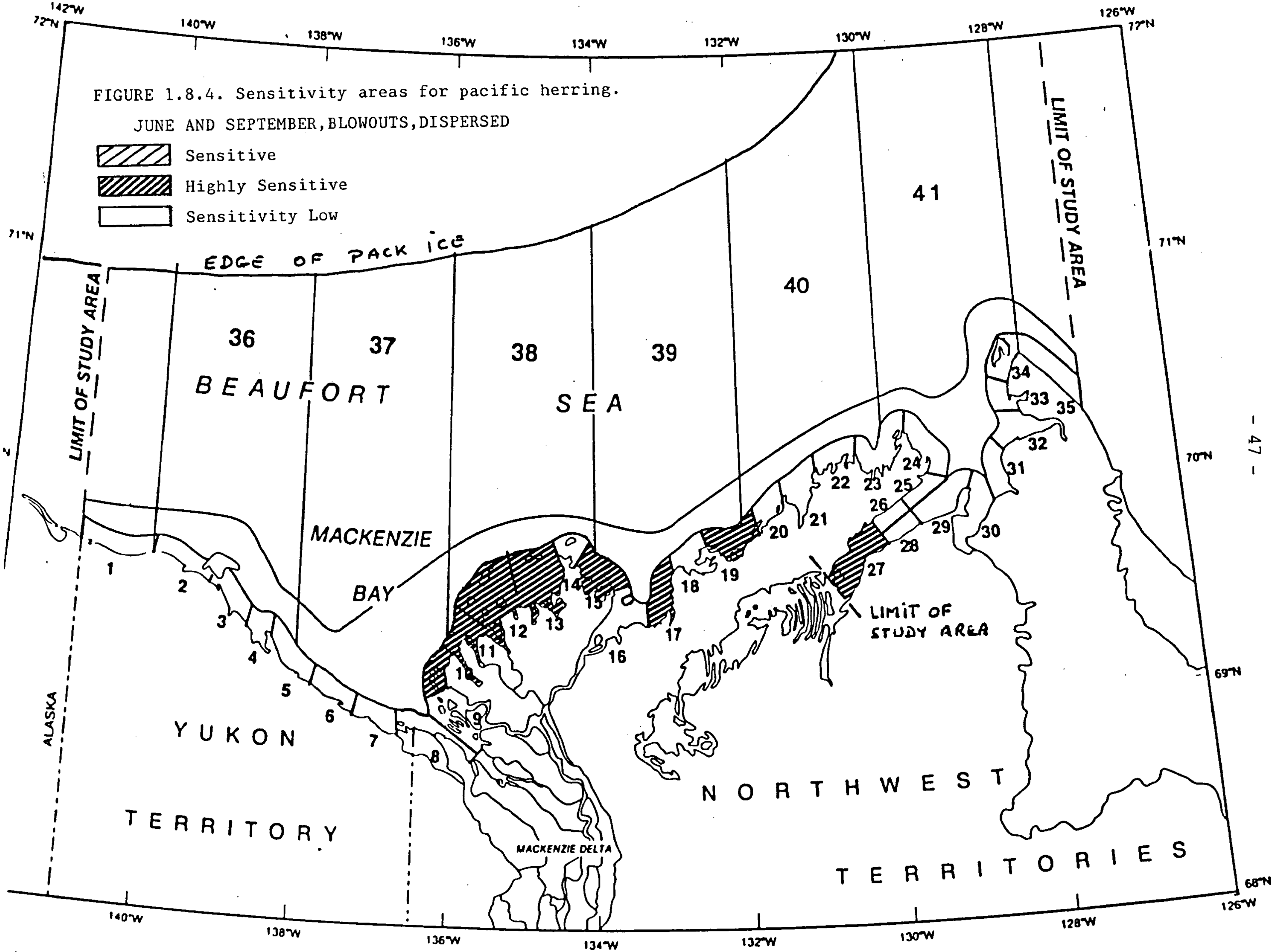


FIGURE 1.8.3. Sensitivity areas for pacific herring.
JULY AND AUGUST, BATCH SPILLS, DISPERSED

FIGURE 1.8.4. Sensitivity areas for pacific herring.

JUNE AND SEPTEMBER, BLOWOUTS, DISPERSED



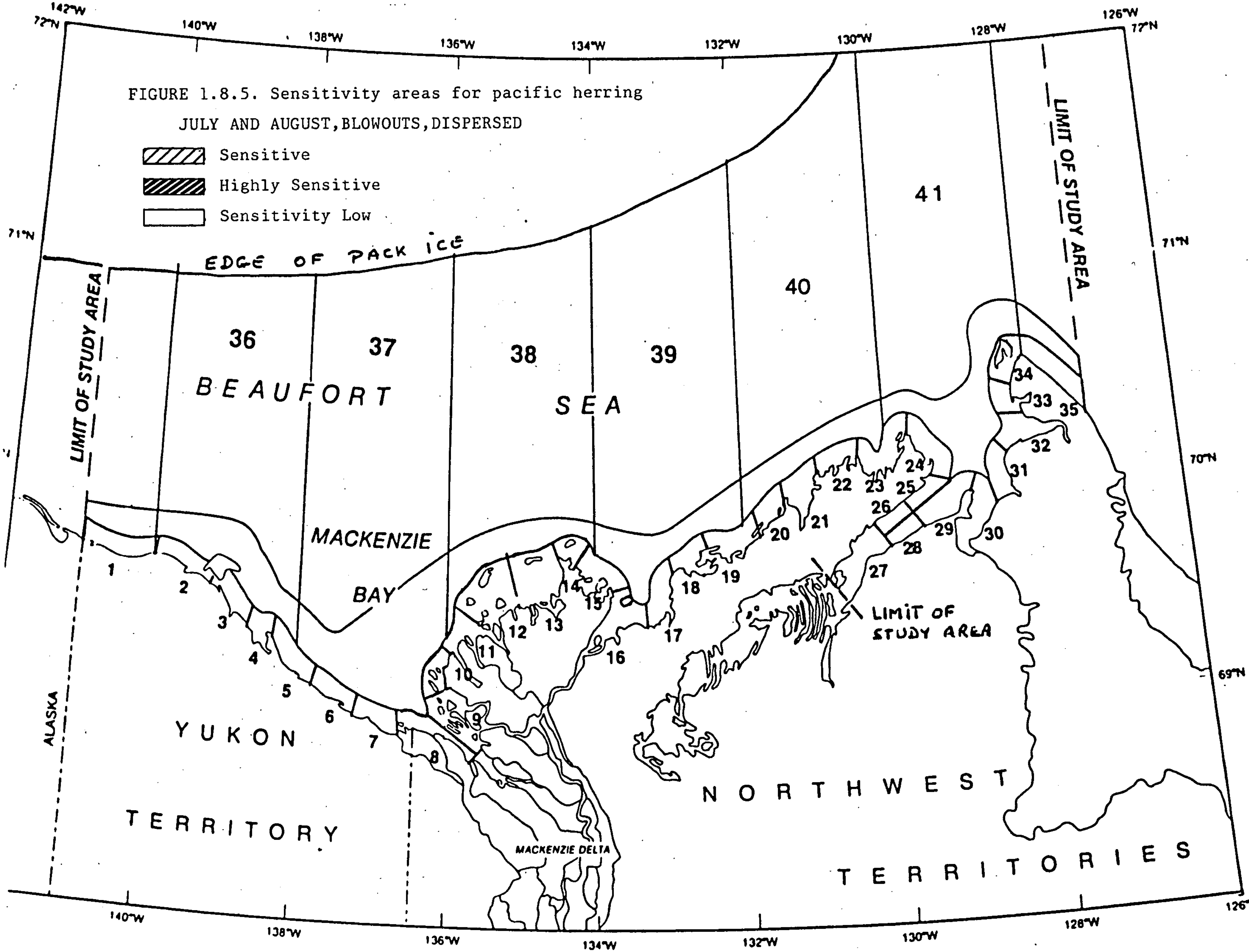


FIGURE 1.8.5. Sensitivity areas for pacific herring

JULY AND AUGUST, BLOWOUTS, DISPERSED

TABLE 1 More Important bird species in the marine areas of the Southern Beaufort Sea Area

1) Swans
   i) Whistling Swans

2) Geese
   i) White-fronted Geese
   ii) Lesser Snow Geese
   iii) Black Brant

3) Ducks: Dabblers
   not considered

4) Ducks: Divers
   i) Greater Scamp
   ii) Surf Scoter
   iii) Oldsquaw
   iv) King Edier
   v) Common Edier
   vi) Merganser

2.0 WATERFOWL

2.1 WHISTLING (TUNDRA) SWAN (Cygnus columbianus)

Whistling swans are common summer residents of the southern Beaufort Sea area and indeed the highest concentration of whistlers in Canada occur within this area. Whistling swans breed in the Canadian Arctic and Alaska, winter on the Atlantic and Pacific coasts of North America and migrate between these areas via overland routes. The population breeds in a number of scattered locations from the Aleutian Islands on the west to Baffin Island on the east. The North American population of this species appears to have varied widely over the past several decades but has generally fallen within the range of 80,000 to 150,000 birds.

2.1.1 Population Status

The segment of the North American population that might be at risk from spills ocurring in the Canadian southern Beaufort Sea include sub-populations that nest and stage in the study area as well as groups that breed in neighbouring areas but which pass through the study area during migration. Within the study area swans nest and stage on the Yukon North Slope in the Mackenzie Delta, along the Tuktoyaktuk Peninsula and in the Liverpool Bay area. The groups that are at risk during migration include those that breed on Banks Island and on the Alaska North Slope. These groups which number collectively between 5000 and 20,000 birds (roughly 10% of the North American population) have been taken to be the target stock for the purposes of this work. The bulk of this group breeds within the study area.

2.1.2 Habits, Movements, and Timing Within the Southern Beaufort Sea Area

Whistling Swans move into the study area in late May and early June and move immediately to their nesting sites. They reach the Southern Beaufort Sea area from their wintering grounds on the Atlantic and Pacific Coast via inland routes, primarily down the Mackenzie Valley. Breeders move immediately to the nesting grounds. Nests are widely scattered on the sedge tundra at some distance from the coast. Both parents are involved in nesting and rearing young and this activity takes place within a few hundred yards of the nest. Nesting and rearing lasts from early June until early September.

Non-breeders, which may make up a sizeable proportion of the population form flocks on large lakes or on coastal areas where they are vulnerable to marine oil spills. These individuals remain in coastal areas to moult from mid-July to late August. According to Bellrose et al (1980) these non-breeders then begin to aggregate into larger flocks in coastal areas or on inland lakes in preparation for migration. Family groups join these groups in early to mid-September when young are fledged. Hence a portion of the non-breeders are vulnerable to oil spills throughout the summer months.

On the other hand, breeders and offspring are invulnerable to the effects of oilspills during nesting and rearing which lasts from late May until early September. Adults and young become vulnerable only in September when they join the flocks of non-breeders in coastal areas prior to migration.

2.1.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

As mentioned above, the population that breeds within the study area or passes through the study area during migration to breeding areas on the Alaska North Slope and Banks Island is variable in size but numbers in the range of 5,000 to 20,000 birds. It has been assumed that the population size in recent years lies in the upper part of this range. The birds that breed in the study area make up most of the number.

Breeders and young appear to make little use of coastal environments except for a brief time in September prior to migration, but rather nest, rear young and moult on the tundra. Hence these birds are largely invulnerable to marine oil spills. Only the non-breeders which make up 20 - 40% of the population (although the proportion may be as high as 60 - 70%) use the coastal area and hence are vulnerable to marine oil spills. Data from surveys of coastal areas within the study area (summarized in Table 2.1.1) indicate that roughly 2000 to 5000 whistling swans are found in coastal areas from June to September and are hence vulnerable to oil spill. This number represents only about 10-30% of the population that uses the study area for nesting (Figure 2.1.2).

The number of whistling swans using coastal habitats appear to be greatest in June, July, and August when these areas are used by flocks of non-breeders for loafing, moulting, and staging for fall migration. During this period flocks of birds occur in coastal areas throughout the study area, but except for areas of the outer Mackenzie Delta flocks appear to be small, being made up of 10-100 birds (Figures 2.1.3-2.1.5). Spills in these areas would result in NEGLIGIBLE population effects. Within the Delta area concentrations of birds numbering in the range of 500-1000 birds have been observed. Spills in these areas might yield significant effects at the SLIGHT or MODERATE level (Figures 2.1.7-2.1.9).

During September whistling swans are less widely distributed. At this time significant concentrations occur only in the western part of the study area (Figure 2.1.6). Although most concentrations consist of only 100-200 birds larger concentrations have been observed in the outer Delta area where spills might have significant effects at the SLIGHT level (Figure 2.1.10).

References: Bellrose et al (1980); Searing et al (1975); Johnson et al (1975); Smyth et al (1986).

TABLE 2 Estimated Numbers of Whistling Swans in Coastal Areas of Study Area in July and August

AREA	MINIMUM	MAXIMUM
Nunaluk	10	50
East Herschel to Phillips Bay	10	10
Phillips Bay	50	100
Moose Channel to Tent Island	50	100
Shallow Bay	50	100
Olivier-Ellice	100	200
Middle Channel	50	100
Garry Island	50	100
Pelly Island	100	200
Kendall Island	100	200
Mallick bay	100	500
Kidluit bay	100	100
Kittigazuit Bay	50	100
Hutchison Bay	10	50
McKinley Bay	150	200
Russel Inlet Area	10	50
North Shore of West Liverpool Bay	10	50
Wood Bay	0	0
Mason River Delta	50	100
Harrowby Bay	50	100
	1100	2410

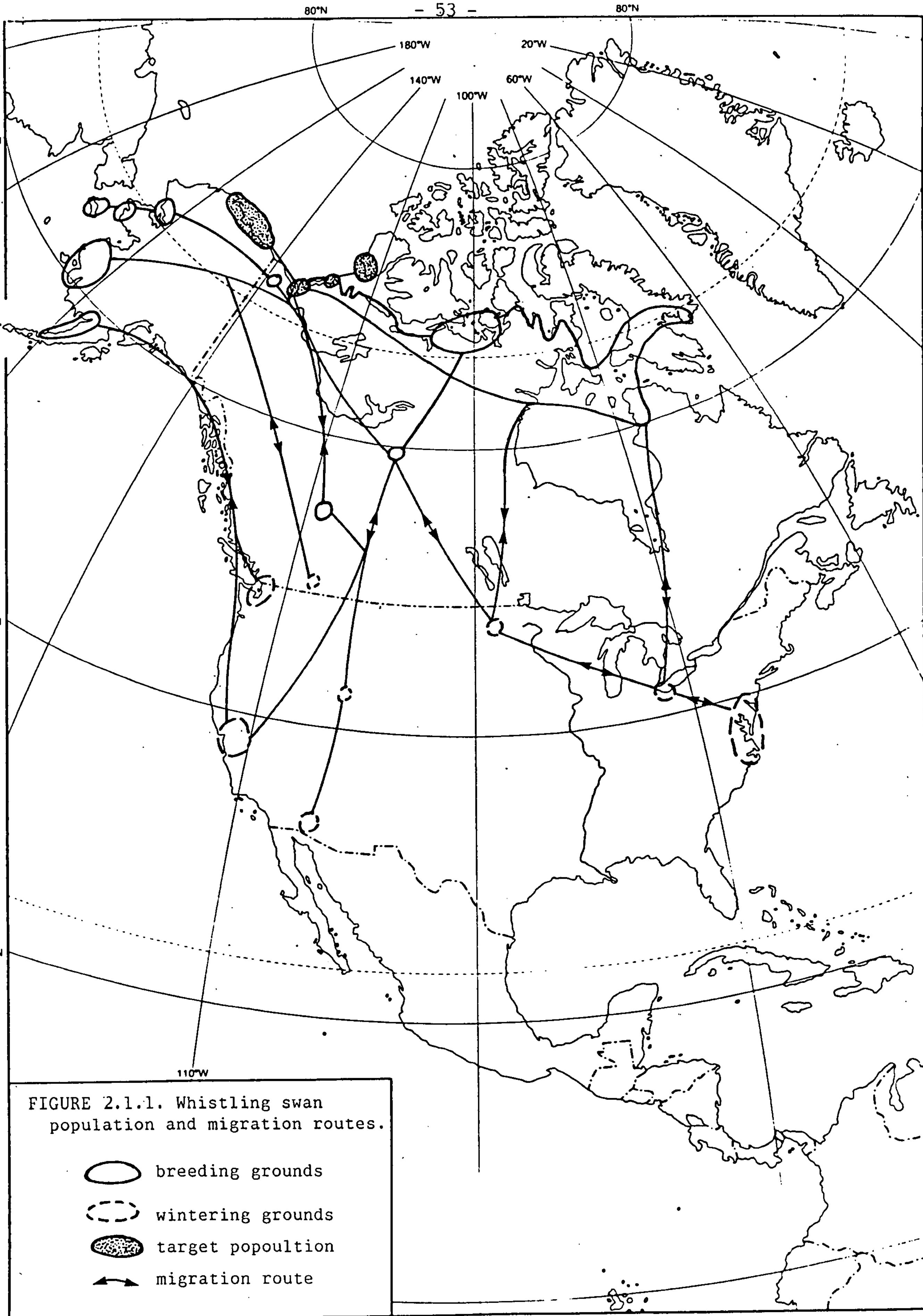
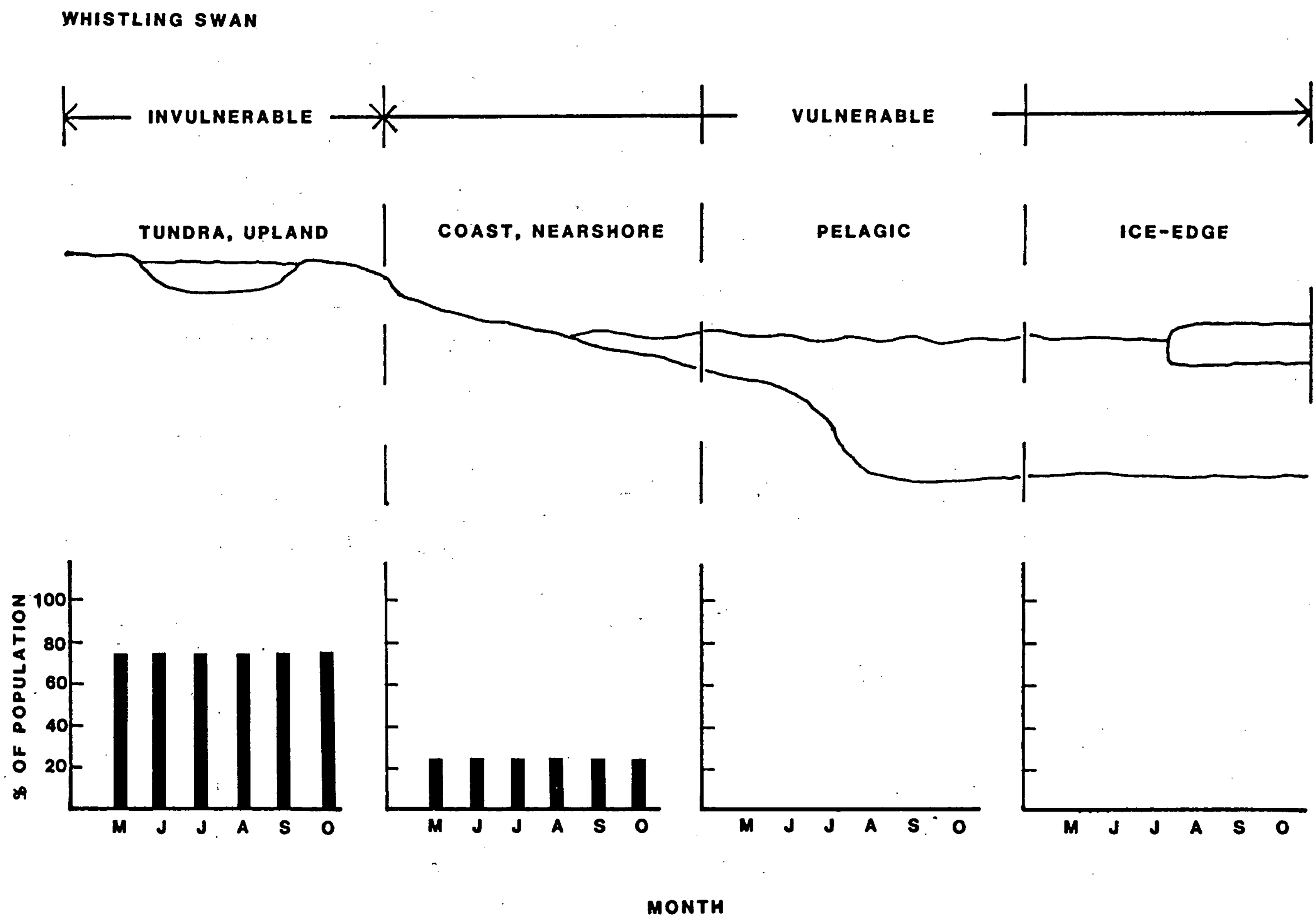


FIGURE 2.1.1. Whistling swan population and migration routes.

breeding grounds
wintering grounds
target popoultion
migration route

Figure 2.1.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



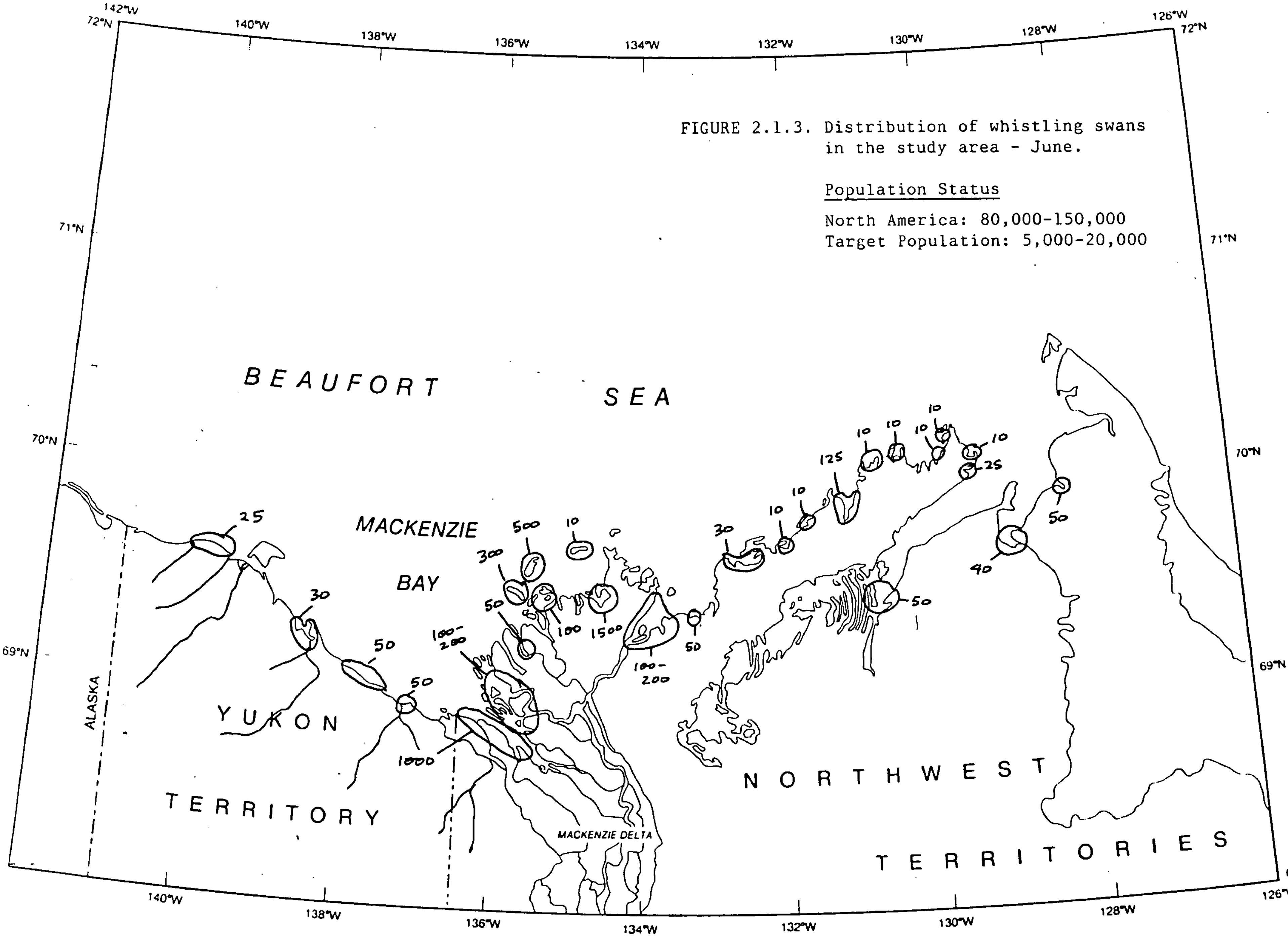
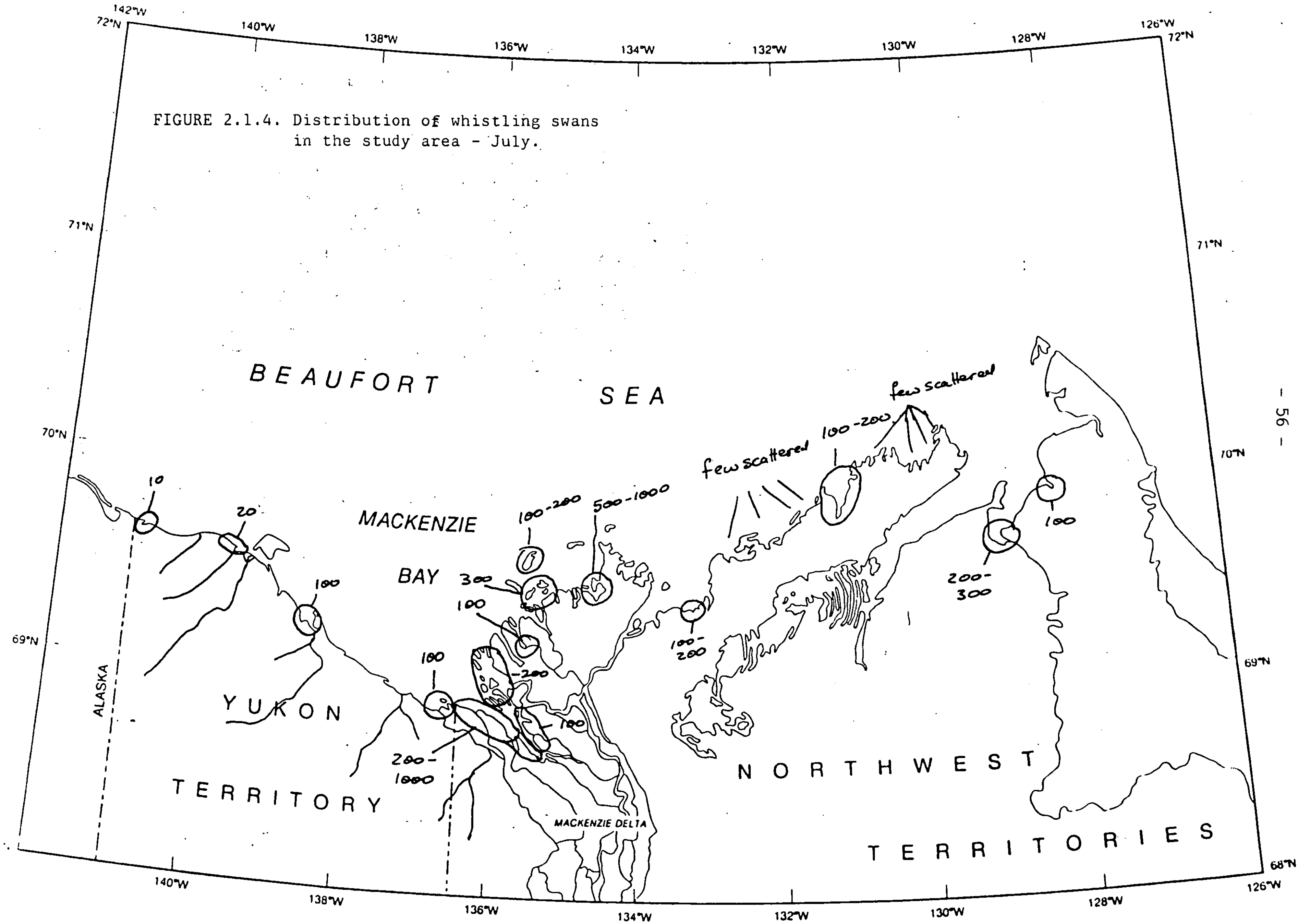


FIGURE 2.1.3. Distribution of whistling swans in the study area - June.

Population Status

North America: 80,000-150,000
Target Population: 5,000-20,000

FIGURE 2.1.4. Distribution of whistling swans
in the study area - July.



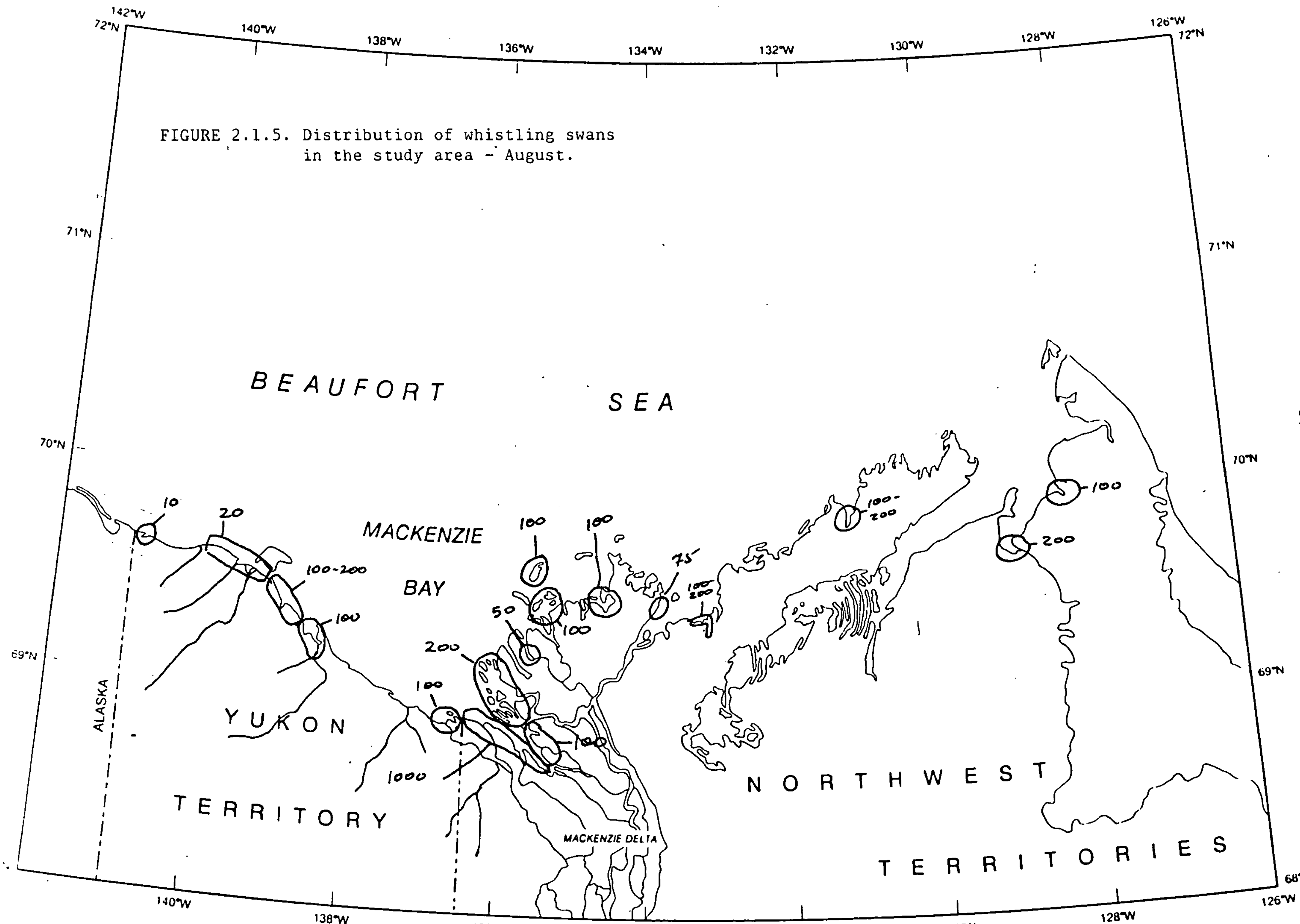


FIGURE 2.1.5. Distribution of whistling swans in the study area - August.

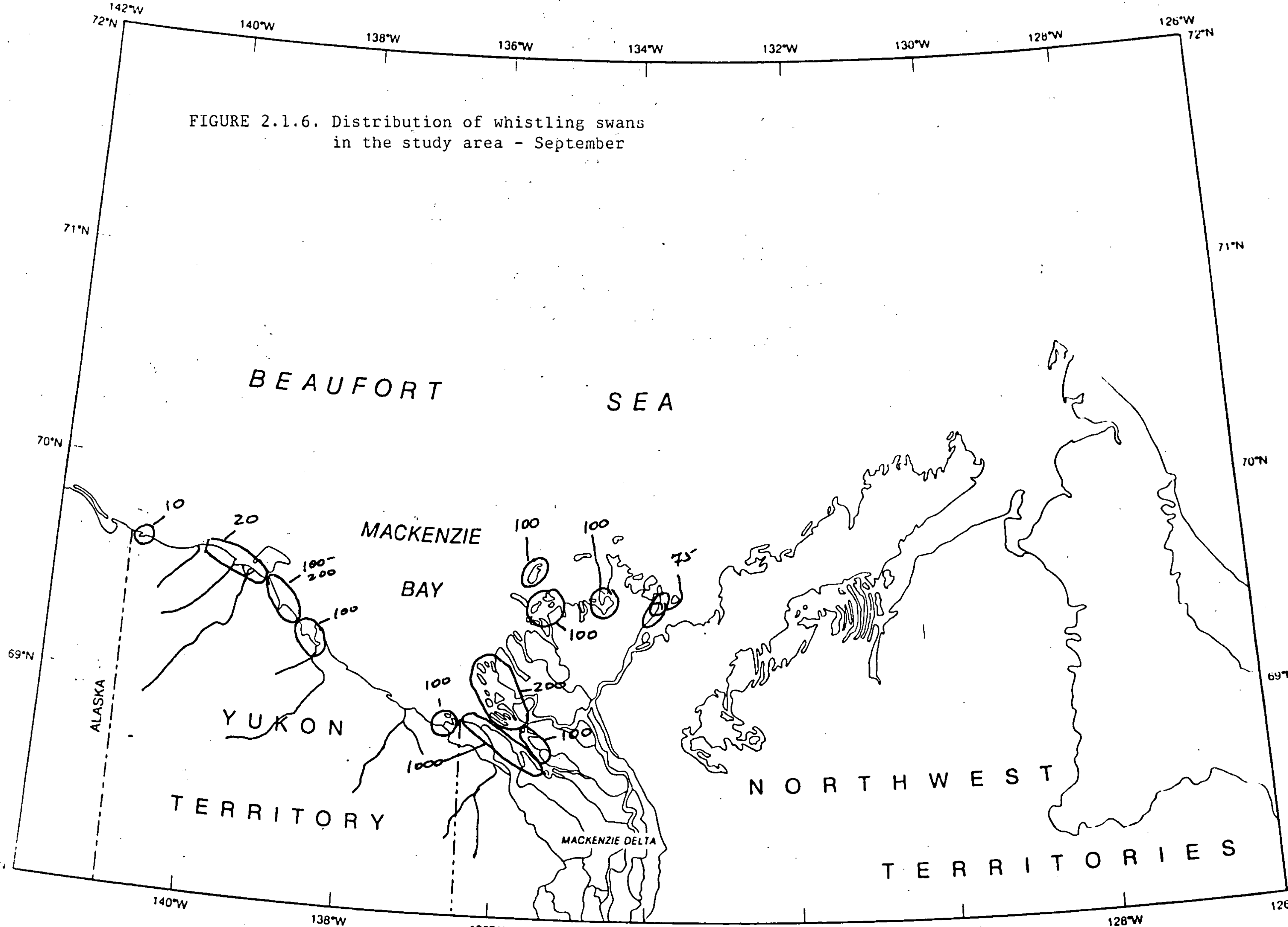


FIGURE 2.1.6. Distribution of whistling swans in the study area - September

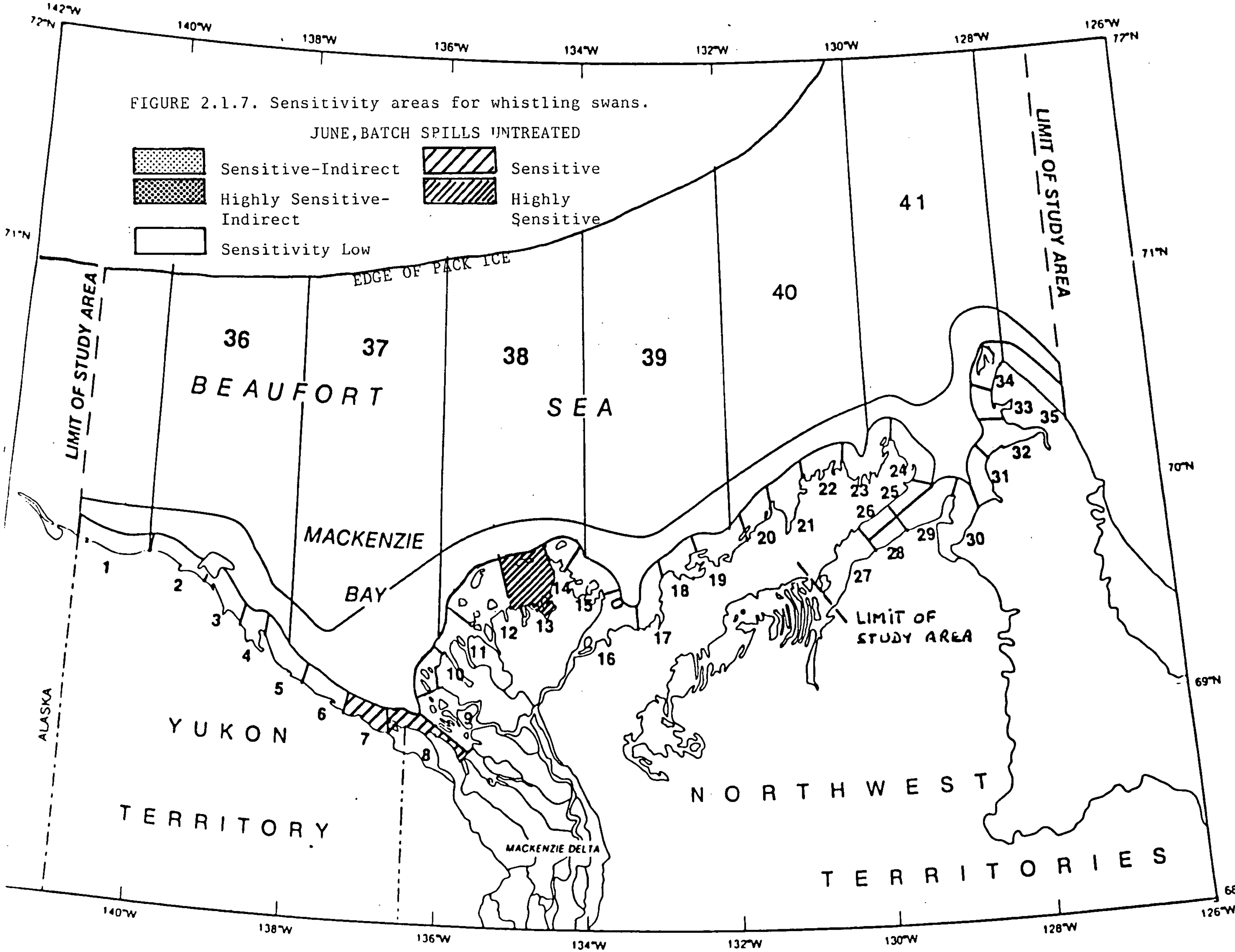


FIGURE 2.1.7. Sensitivity areas for whistling swans.

JUNE, BATCH SPILLS UNTREATED

Sensitive-Indirect

Highly Sensitive-Indirect

Sensitivity Low

Sensitive

Highly Sensitive

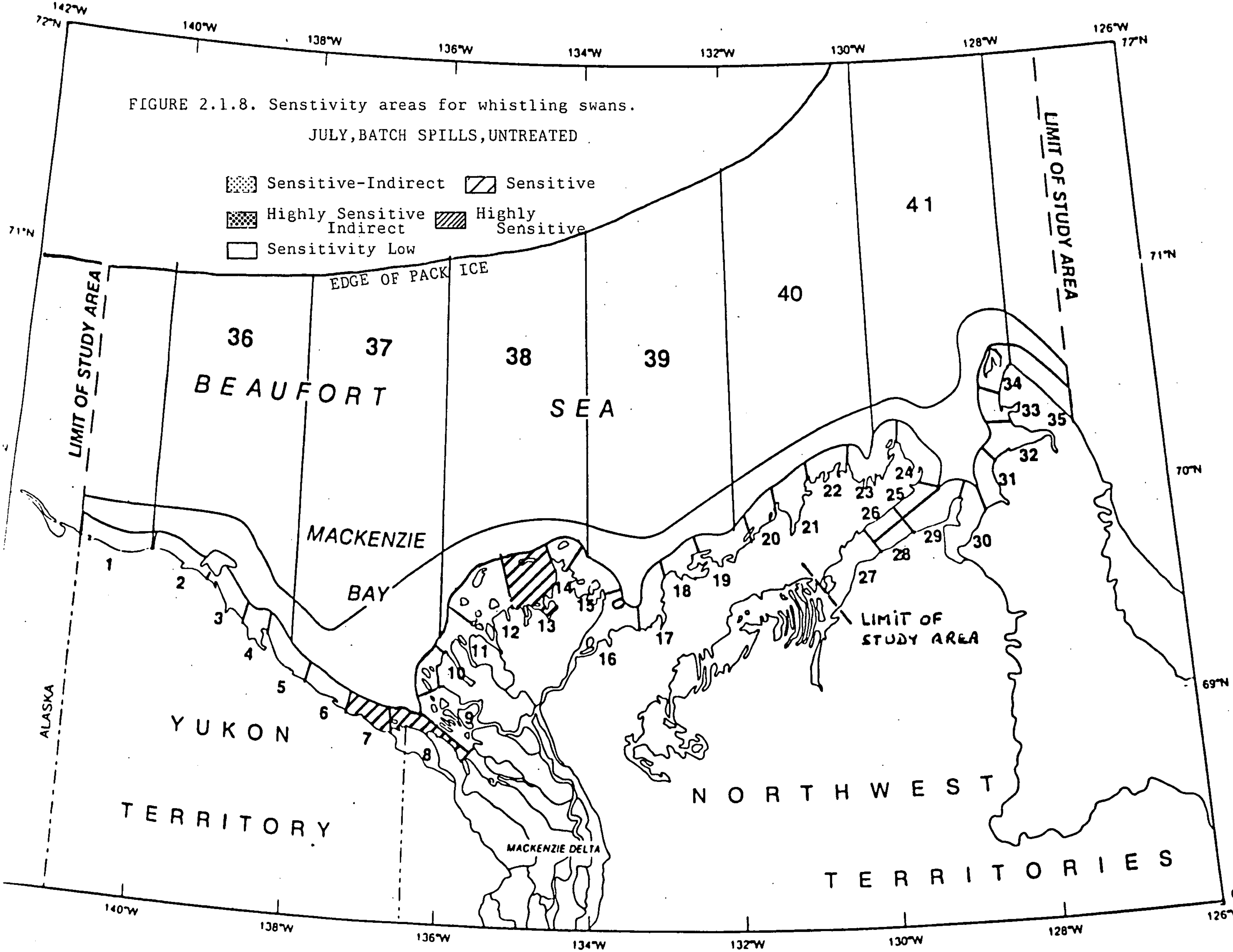


FIGURE 2.1.8. Senstivity areas for whistling swans.

JULY,BATCH SPILLS,UNTREATED

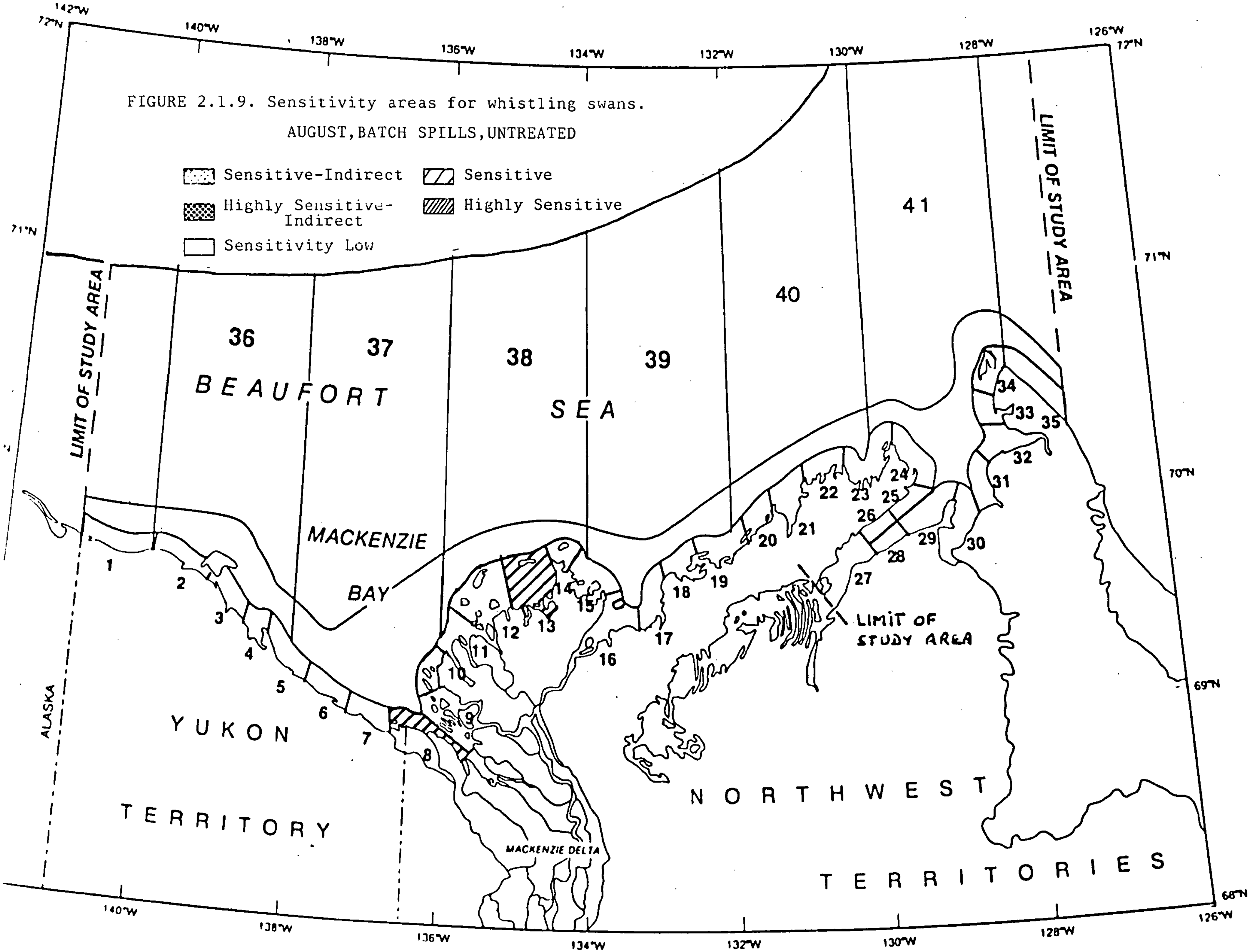
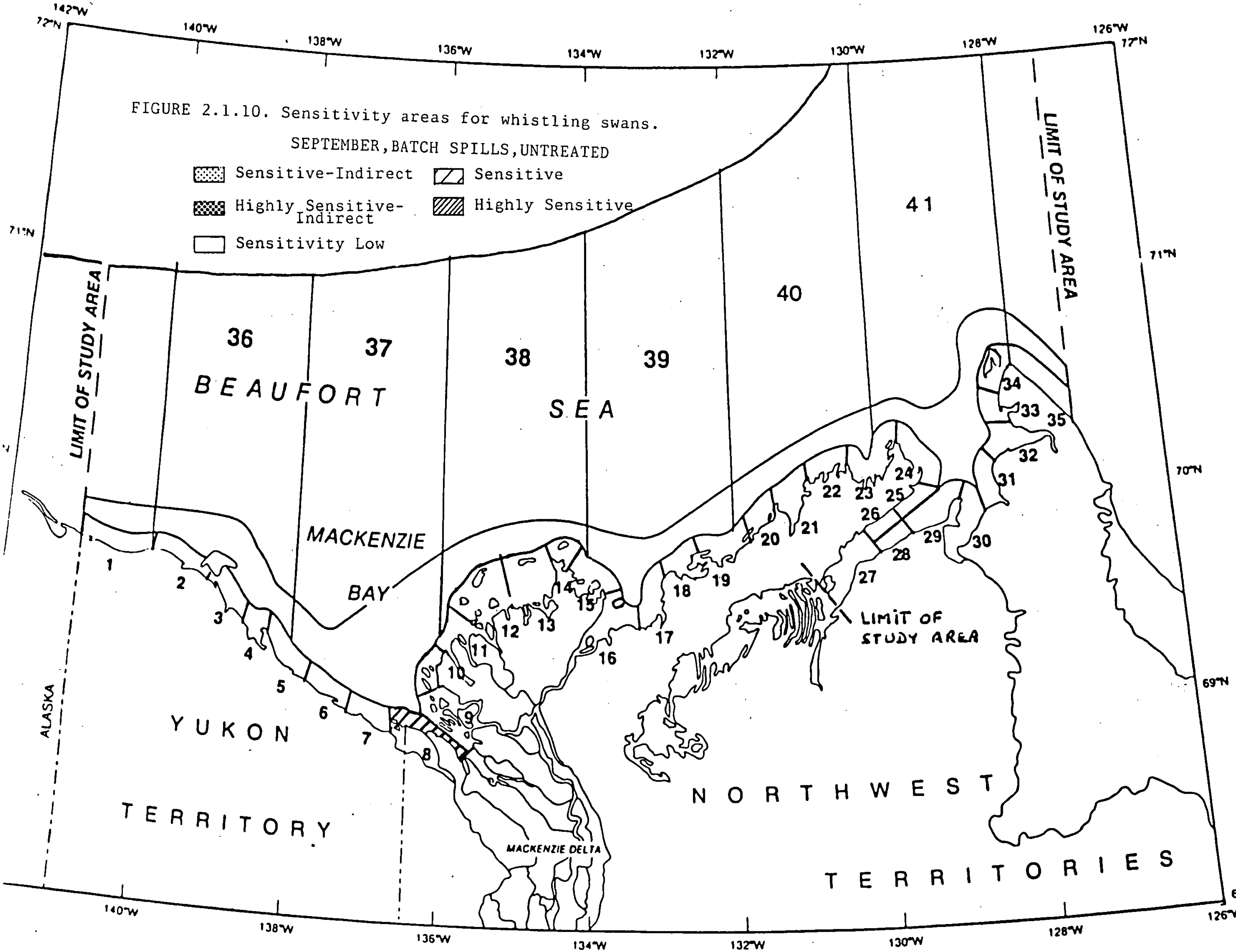


FIGURE 2.1.9. Sensitivity areas for whistling swans.

AUGUST, BATCH SPILLS, UNTREATED

FIGURE 2.1.10. Sensitivity areas for whistling swans.

SEPTEMBER, BATCH SPILLS, UNTREATED



2.2 CANADA GOOSE (*Branta canadensis*)

Canada geese utilize Arctic areas for breeding but though present they are not abundant in the coastal areas of the Canadian southern Beaufort Sea. According to Bellrose et al (1980) the North American population of Canada Geese is made up of eleven sub-species which are sorted into at least 12 stocks. The total number of birds, as of the 1974 census was about 2 to 3 million birds.

2.2.1 Populations Status

Two sub-species, Taverner's Goose (*B.C. taverneri*) of the Alaskan stock and the Lesser Canada Goose (*B.C. parvipes*) of the short grass prairie stock, make up the vast majority of the Canada Geese that utilize the southern Beaufort Sea Area. *B.C. taverneri* breeds throughout Alaska and to some extent along the coast of the Canadian Beaufort Sea as far east as the Queen Maud Gulf. This population numbers in total roughly 100,000 individuals most of which appear to breed in Alaska. *B.C. parvipes* breeds in low densities in coastal areas of the mainland from the Queen Maud Gulf west to the Mackenzie Delta but appears to prefer the inland areas of tundra and open boreal forest as far south as northern Alberta and Saskatchewan. This population appears to number roughly 100,000 individuals. There appears to be little information concerning the numbers of each sub-species that utilize coastal areas of the southern Beaufort Sea but various accounts place the total number of Canada's breeding, moulting, and staging population in the area of several tens of thousands of individuals or no more than 10% of the respective stocks. Of this number, the majority appear to prefer upland areas or the margins of rivers and hence are invulnerable to marine spills. Because of difficulties in separating populations of these two sub-species of Canada Geese they have collectively been considered the target population in this work.

2.2.2 Habits, Movements, and Timing Within the Southern Beaufort Sea Area

Canada geese reach the southern Beaufort Sea area via the Mackenzie Valley and reach the Arctic Coast during the latter part of May and the first weeks of June. In the southern Beaufort Sea Area Canada Geese nest primarily in the interior away from the coast. Eggs are laid in the first two weeks of June and hatching occurs in early July. Goslings are reared within a few miles of the nest site until they are capable of flight in September. Breeding adults begin their moult while the young are half grown and regain fight in three to four weeks in September. When the family groups are capable of flight they disperse to coastal aeas and areas of the Mackenzie Delta in September before departing on their southward migration. There appear to be only two sizeable breeding areas in the southern Beaufort Sea area; in the Anderson River and in western Liverpool Bay but neither area is on the coast. Non-breeders move to specific coastal and inland locations for the moult in July where they form moulting aggregations.

2.2.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

Coastal moulting areas which include the Herschel Island area and Mallik Bay appear to support only low numbers. The areas of greatest concentration in western Liverpool Bay and at the head of Harrowby Bay are inland from the coast where birds are invulnerable to spills. Although several coastal areas are used for staging in August and September, only the area on the north coast of Shallow Bay appears to support a significant number of Canada Geese. Canada Geese may suffer significant effects at the SLIGHT level in the latter area.

In summary, Canada Geese are vulnerable to significant effects of spills only in pre-migratory staging areas in the Shallow Bay area in August and September.

References: Bellrose et al 1980; Searing et al 1975.

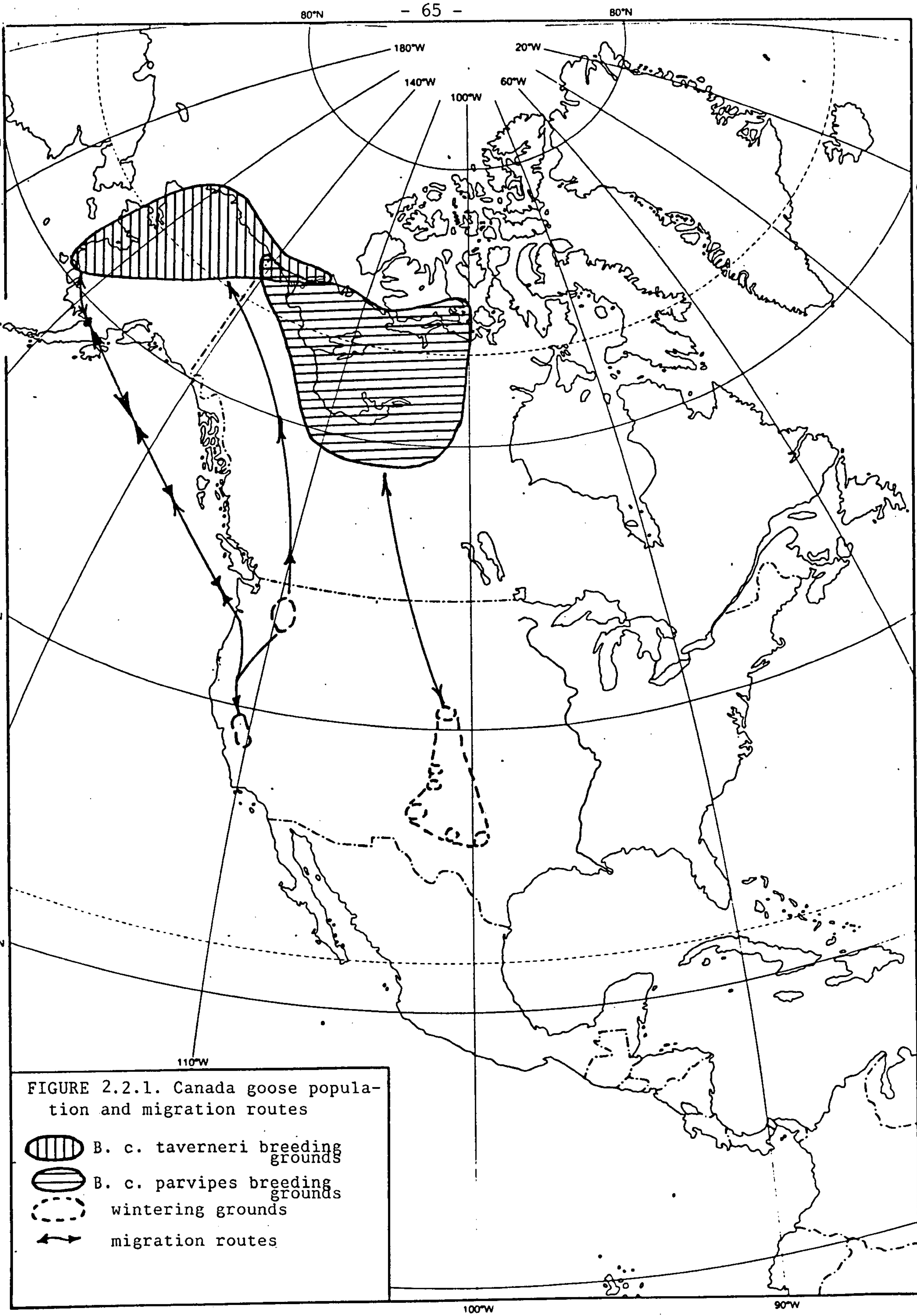
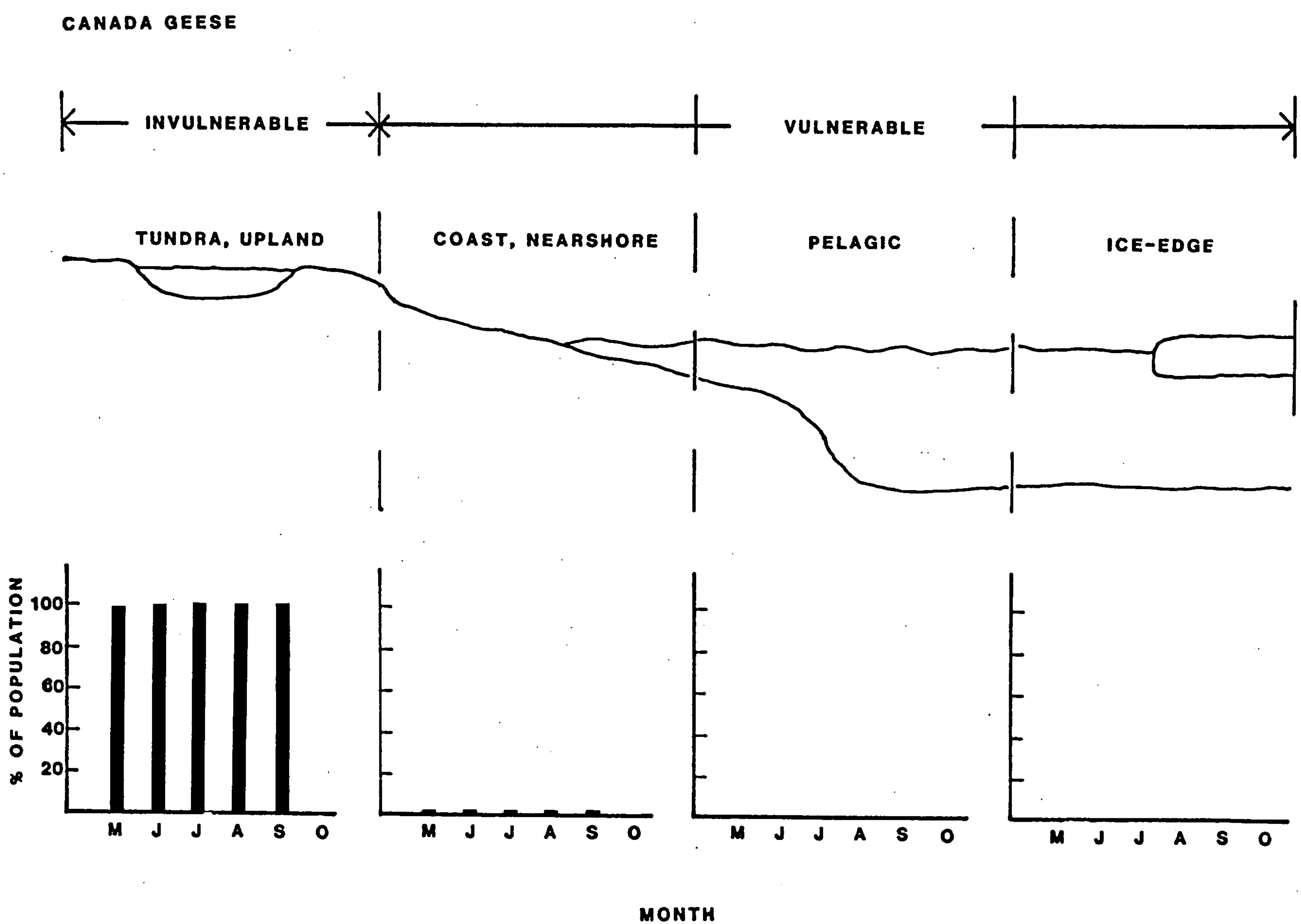


FIGURE 2.2.1. Canada goose population and migration routes

Figure 2.2.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



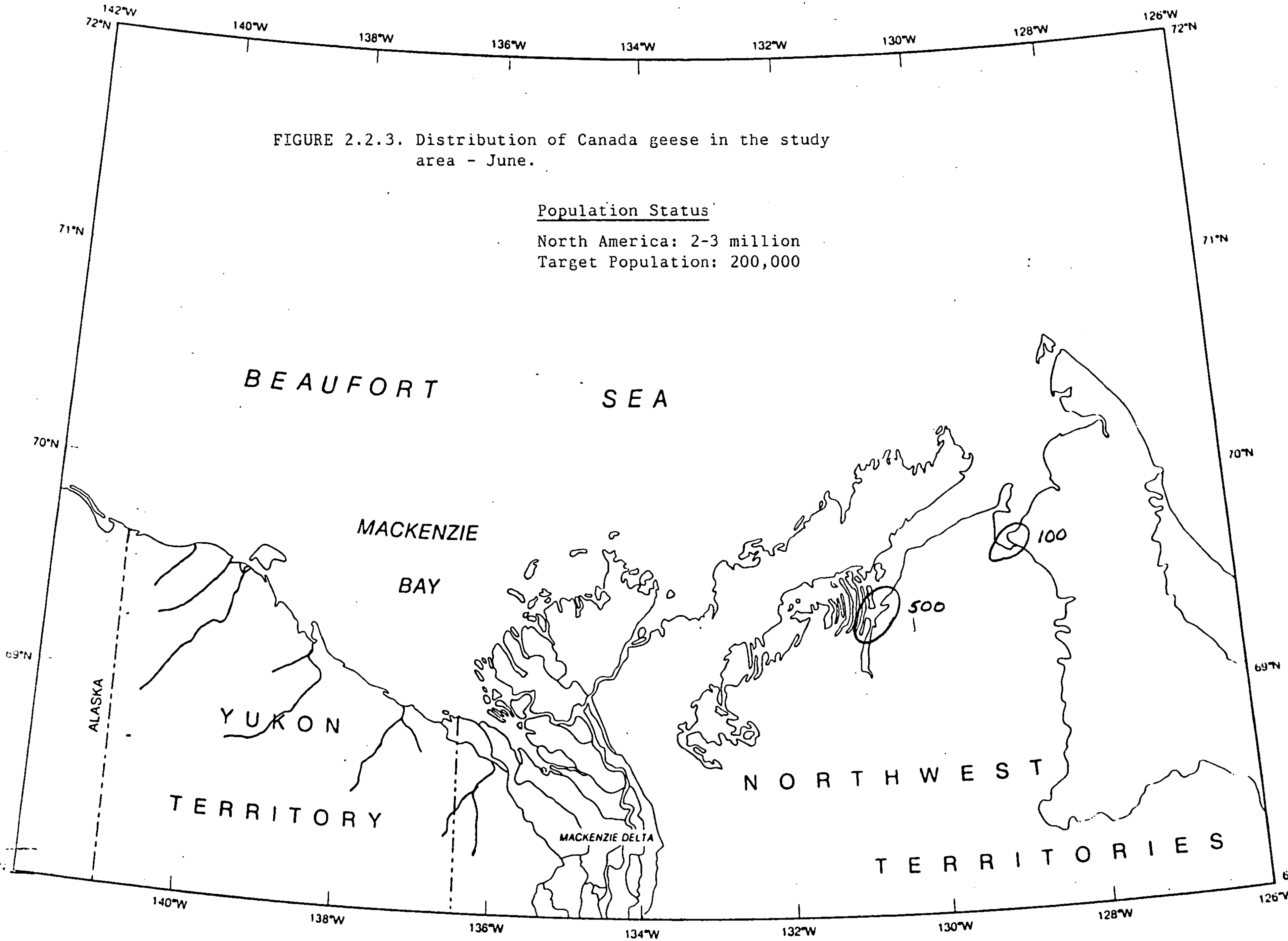


FIGURE 2.2.3. Distribution of Canada geese in the study area - June.

Population Status

North America: 2-3 million
Target Population: 200,000

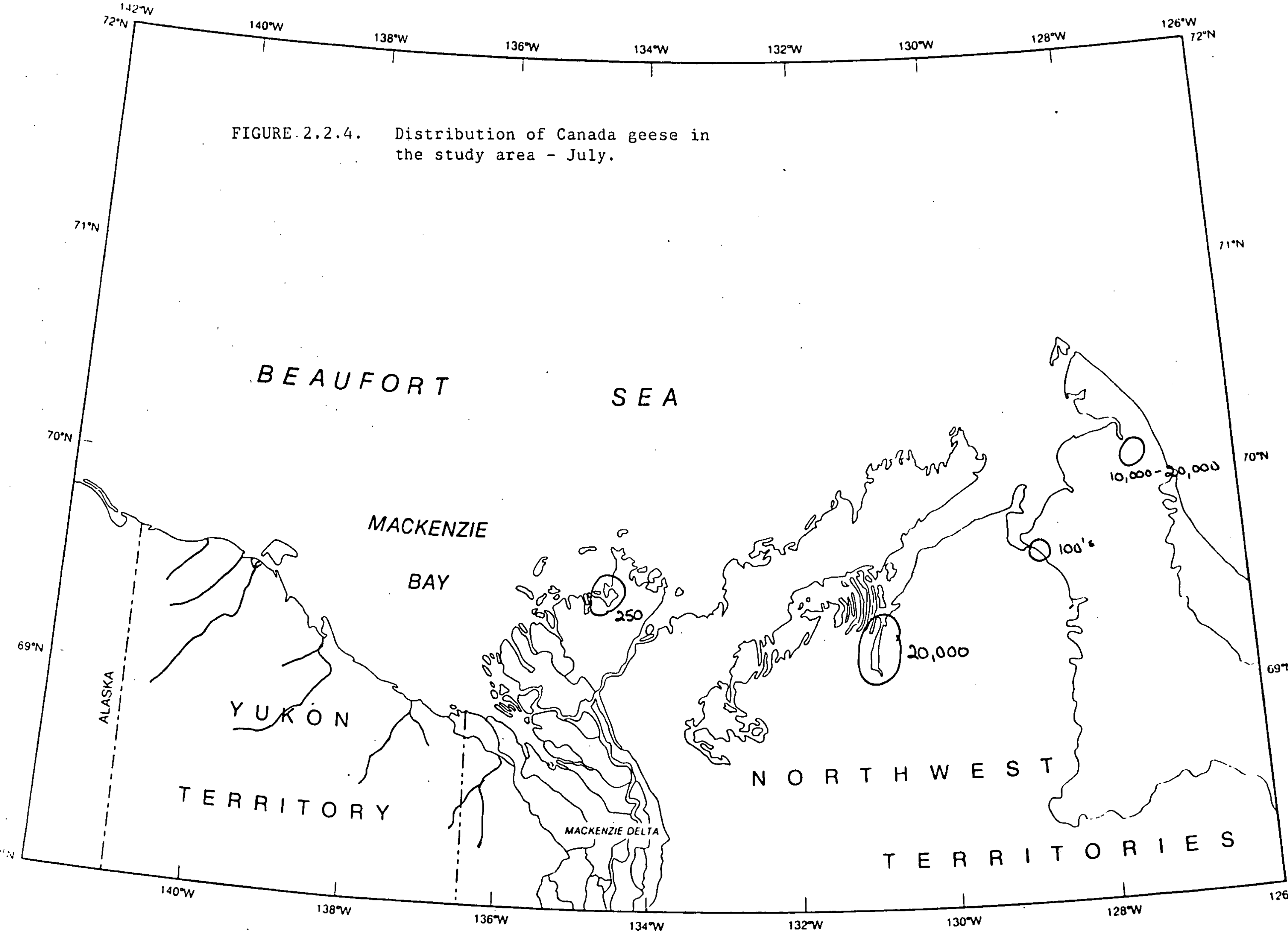


FIGURE 2.2.4. Distribution of Canada geese in the study area - July.

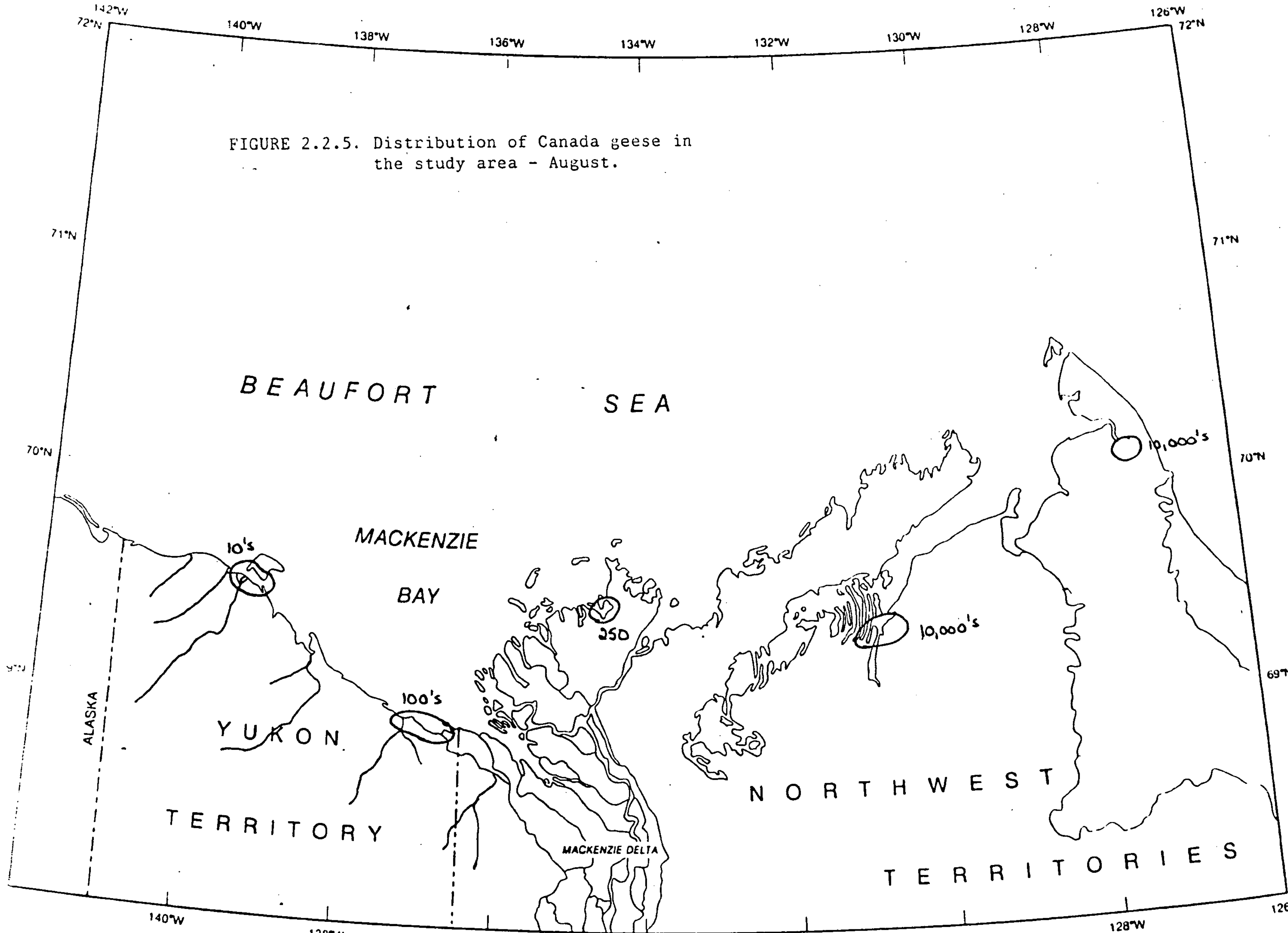


FIGURE 2.2.5. Distribution of Canada geese in the study area - August.

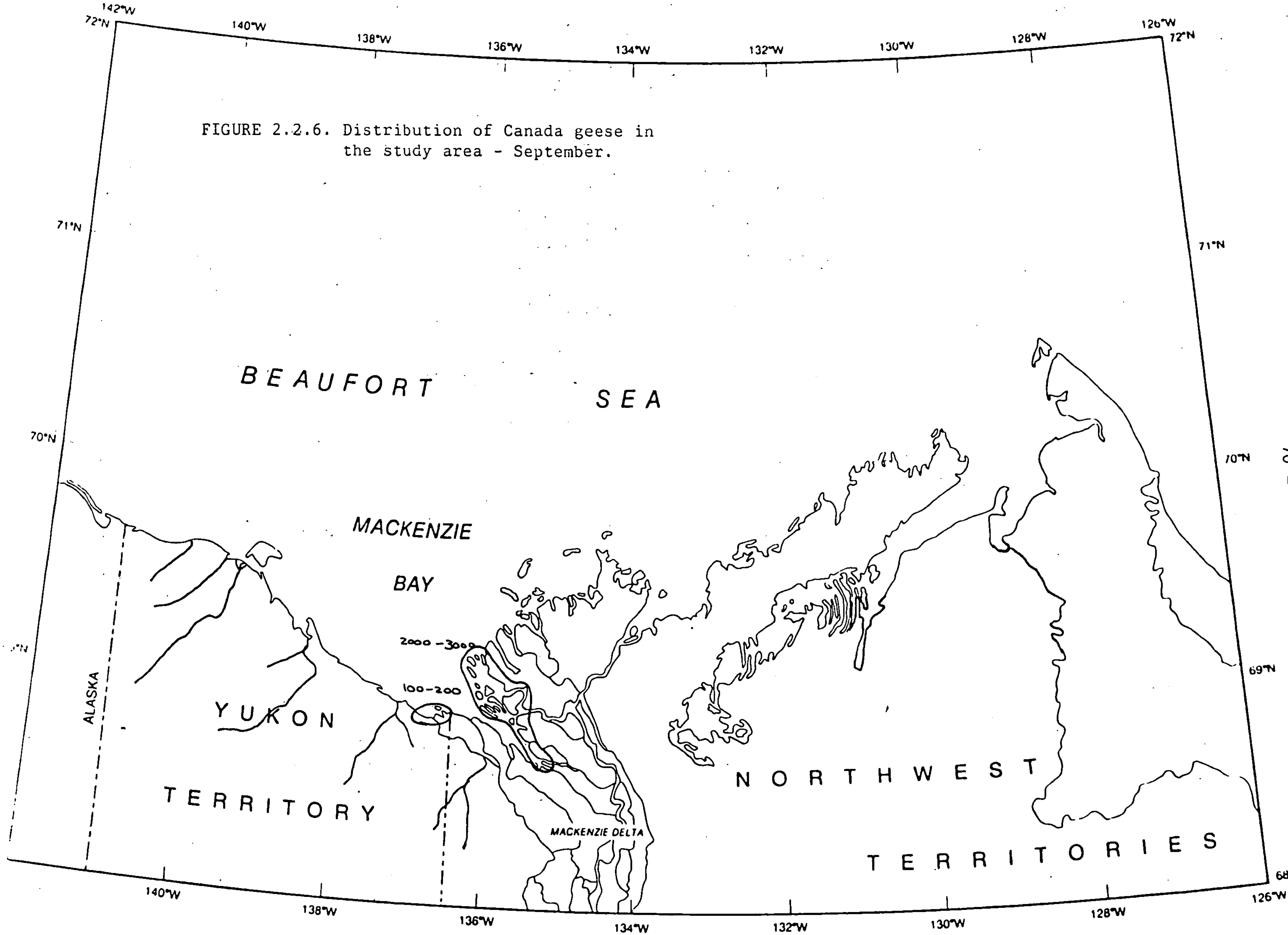


FIGURE 2.2.6. Distribution of Canada geese in the study area - September.

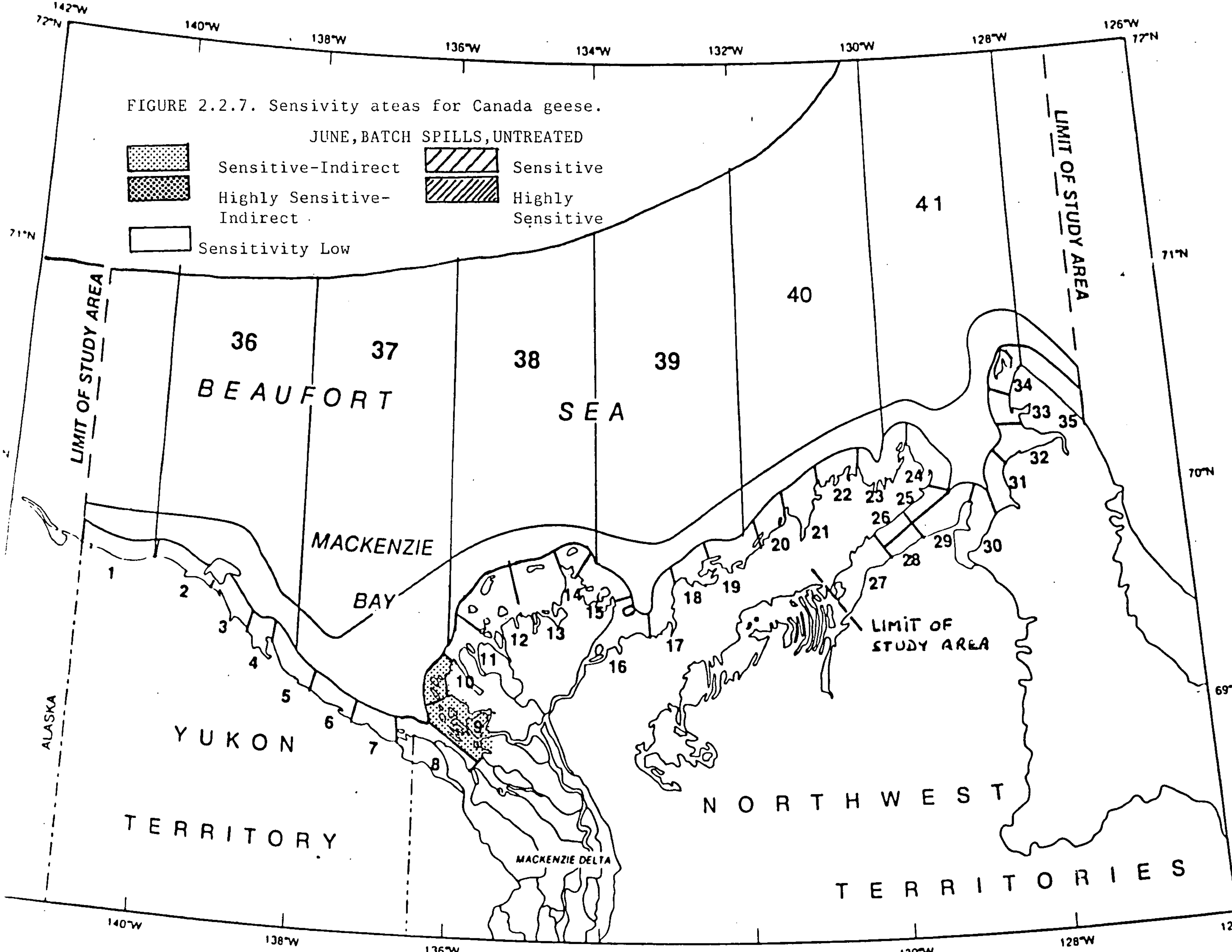


FIGURE 2.2.7. Sensivity ateas for Canada geese.

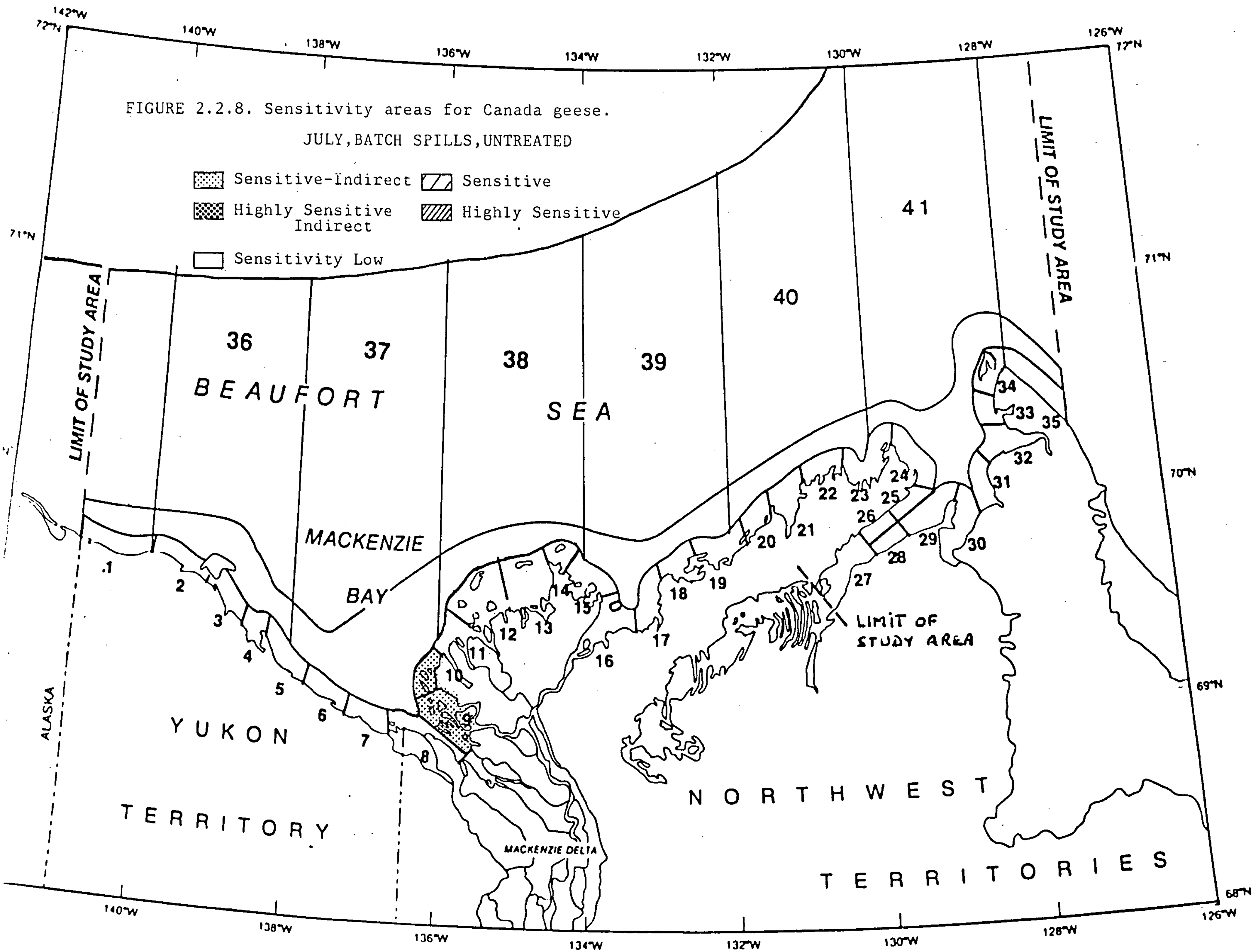


FIGURE 2.2.8. Sensitivity areas for Canada geese.

JULY, BATCH SPILLS, UNTREATED

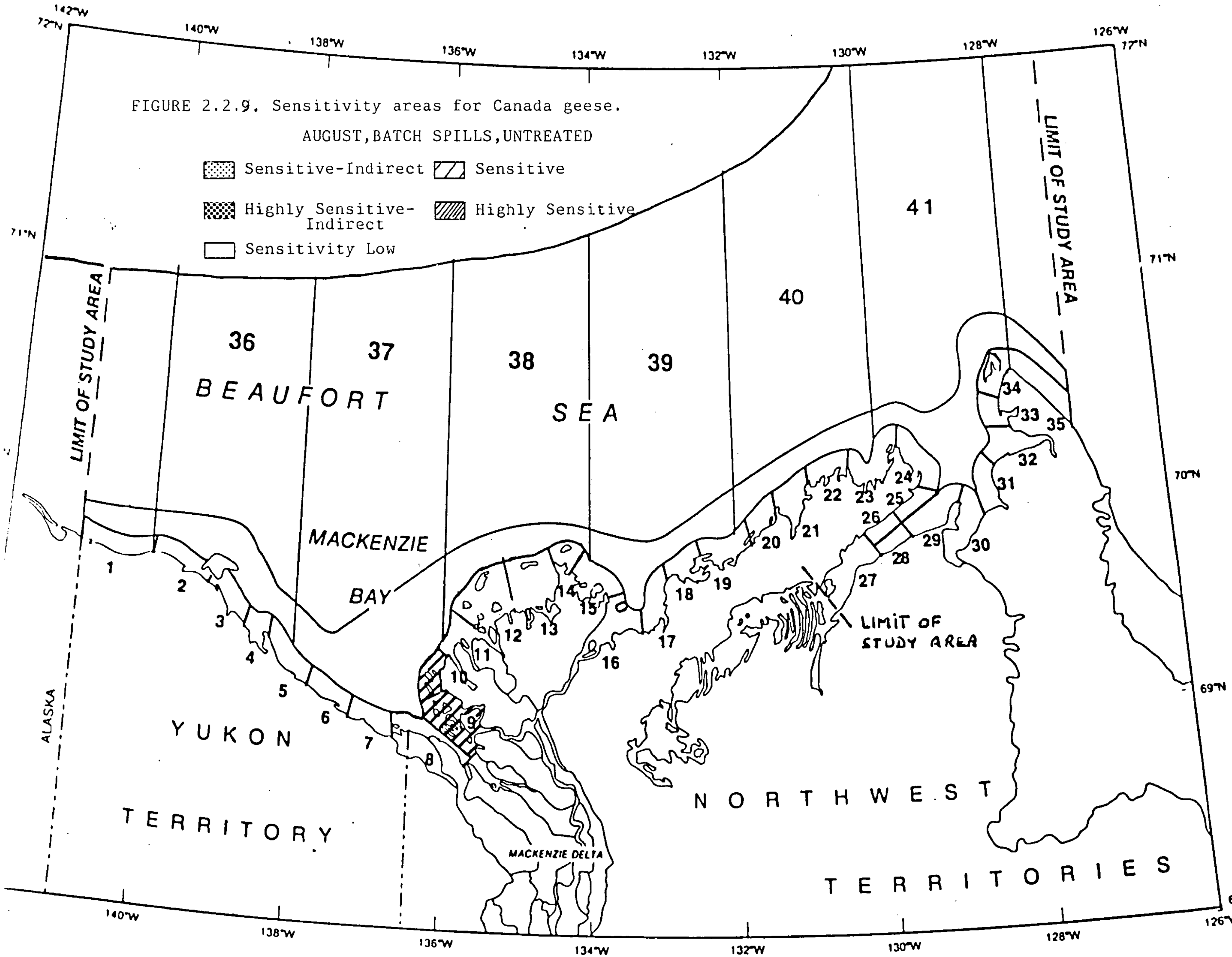


FIGURE 2.2.9. Sensitivity areas for Canada geese.

AUGUST, BATCH SPILLS, UNTREATED

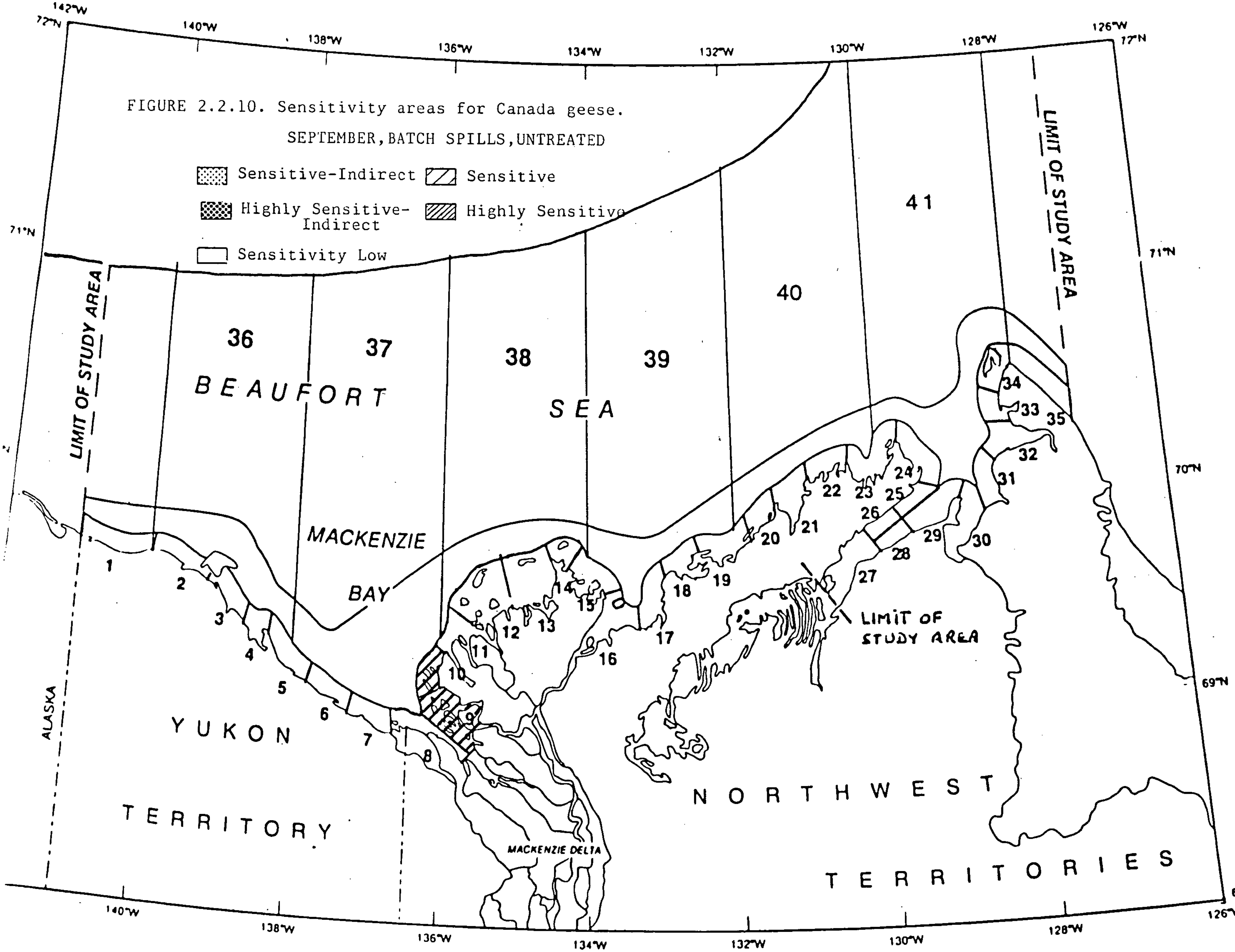


FIGURE 2.2.10. Sensitivity areas for Canada geese.

SEPTEMBER, BATCH SPILLS, UNTREATED

2.3 WHITE-FRONTED GOOSE (*Anser albifrons frontalis*)

White-fronted geese are the most common species of breeding goose in areas of the Alaska North Slope and, although less common in the Canadian Beaufort Sea, they are present in large concentrations in some areas. The North American population which numbers roughly 300,000 individuals, breeds in various locations in the western Arctic and passes the winter in scattered locations in the south western United States.

2.3.1 Population Status

From the work of Bellrose et al (1980), the North American population of white-fronts can be divided into two groups on the basis of their breeding and wintering grounds and the migration path used. One segment of the North American population breeds mostly in the Yukon Delta in Alaska and uses the Pacific flyway. The remaining birds breed in the interior of Alaska, the southern Beaufort Sea Area, and the central Canadian Arctic and use the Central Flyway. Only the birds that breed in the southern Beaufort Sea Area or breed in Alaska and pass through the study area during migration are vulnerable to spills in the study area. This group is composed of a population of some 40,000 to 60,000 birds that breed in the Mackenzie Delta - Liverpool Bay Area. This group also includes an additional 10,000 birds that breed in the Alaskan North Slope but which stop over in the Mackenzie Delta during migration. It is these two groups that are the target population of this work. These birds constitute from 15-20% of the North American population.

2.3.2 Habits, Movements, and Seasonality Within the Southern Beaufort Sea Area

White-fronts utilize the southern Beaufort Sea Area for breeding, moulting and migration. Breeders arrive in the southern Beaufort Sea area in mid to late May. Eggs hatch by late June, the young are fledged by mid-August and are prepared for migration by late August. Adults moult through July and have regained flight in time for migration in late August or early September. Adults moult at the breeding site.

The available information indicates that the non-breeders spend the latter part of May and June in the general area of the breeding site. According to Bellrose et al (1980) these non-breeders gather in large flocks of hundreds or thousands at traditional sites for the moult in early July and remain in these areas until the onset of migration in mid-August.

White-fronts appear to nest near but not necessarily on the sea coast. Johnson et al (1975) observed that along the north coast of Alaska white-fronts "nest primarily within a strip approximately 30 km from the coast". Nesting occurs on tidal flats as well as in upland areas. They breed within 50-100 yards of open water near ponds on the tundra or near rivers, streams and lakes. Breeders remain in these areas for most of the summer season. Non-breeders reside near the breeding sites upon first arriving in the southern Beaufort Sea area but then move to traditional moulting areas. Here they congegrate in large flocks on inland on lakes or along the coast.

The data of Koski (1975) suggests that fall migrants from Alaska utilizing the outer Mackenzie Delta as a stopover site utilize coastal areas to a large extent rather than inland lakes and ponds. Hence these individuals would be highly vulnerable to marine spills.

The vulnerability of white-fronts is generally lower than for many other species for a number of reasons. First, this species does not aggregate into large compact colonies to breed. Rather birds are dispersed throughout the area in the form of small colonies 25-50 pairs or nest singly. Although white-fronts appear to nest near the coast (within 30 kilometres) they utilize areas further inland than brant. They breed on the margins of lakes, ponds, or rivers and make little use of coastal areas while breeding. Hence adults and young are relatively invulnerable to marine oil spills over most of the summer. Non-breeders are similarly invulnerable in May and June when they remain inland near the nest sites but become more vulnerable during the moult when a portion of the population of non-breeders aggregate in flocks in moulting areas on the coast.

2.3.3 Vulnerability Within the Southern Beaufort Sea Area

According to Bellrose et al (1980) roughly 40,000 to 60,000 white-fronts use the southern Beaufort Sea Area at one time or other during the ice free season. Roughly 40,000 birds use the Mackenzie Delta - Liverpool Bay area and an additional 10,000 from the Alaska North Slope birds migrate through the area in the fall stopping over briefly in the waters of the Mackenzie Delta Area.

White-fronts are most abundant in areas of the north eastern part of the Mackenzie Delta, the Tuktoyaktuk Penninsula and Anderson River. During the early part of the breeding season, June, both breeders and non-breeders appear to remain near the breeding site in inland areas. There are, as a result, few individuals in coastal waters. In July the non-breeders move to traditional moulting sites. Some of these areas are coastal while others are inland. Hence a part of the non-breeders population from each of the nesting areas moves to adjacent coastal areas, and these often form large flocks of birds of the order of thousands of birds. This situation persists until late August and early September when these non-breeders begin their fall migration and the population of vulnerable individuals diminishes with the out-migration. It is assumed that the adults and young remain near the inland nesting areas throughout the breeding and rearing period and depart directly for the southern staging areas without visiting coastal areas and hence are invulnerable.

In addition to the birds that breed locally, other birds also use the Outer Mackenzie Delta during migration in August and September. The population of birds that breeds in the Alaskan North Slope appears to stopover briefly in the outer part of the North Western Mackenzie Delta. This population numbers roughly 10,000 birds (Bellrose et al 1980). These migrants explain in part, the appearance of large numbers of birds, numbers in the thousands, in the Shallow Bay area and in the outer margin of the Mackenzie Delta (Koski, 1975).

Even though white-fronts form concentrations of hundreds or thousands of birds in coastal areas, they are seldom vulnerable to effects at greater than the SLIGHT level because adults and a portion of the non-breeders utilize inland habitats over the summer months. The population might suffer SLIGHT effects as a result of contamination of certain sectors in the outer Mackenzie Delta and the Tuktoyaktuk Peninsula in July, August, and September. There is evidence of concentrations of several thousands of white-fronts in the outer Delta from Kendall Island to Mallik Bay in July. Contamination of this area might result in MODERATE levels of effect on the population.

<u>References</u>: Barry (1976); Bellrose et al (1980); Johnson et al (1975); Koski (1975); Searing et al (1975); Smyth et al (1985); Worbets (1979).

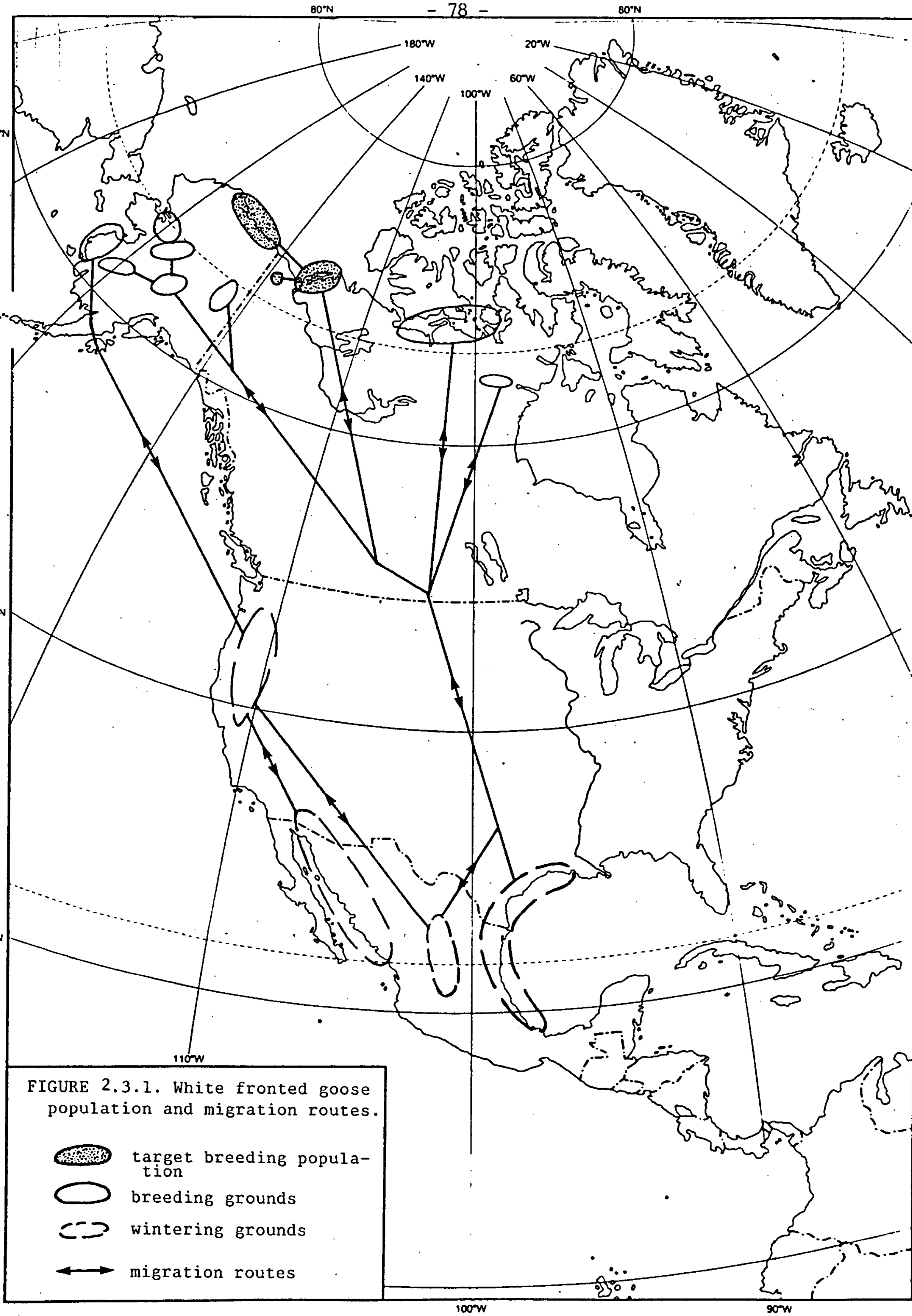


FIGURE 2.3.1. White fronted goose population and migration routes.

Figure 2.3.2. Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.

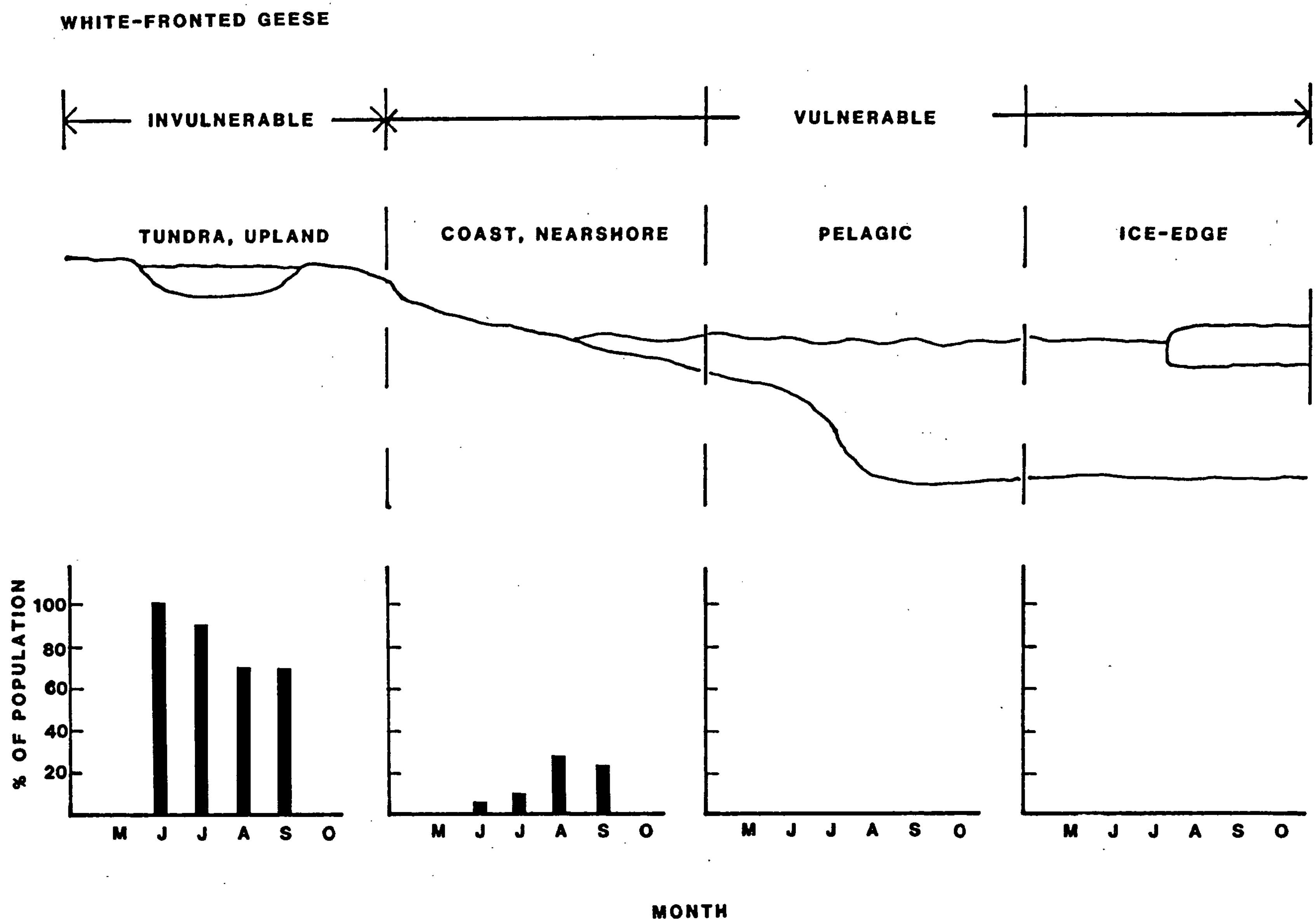
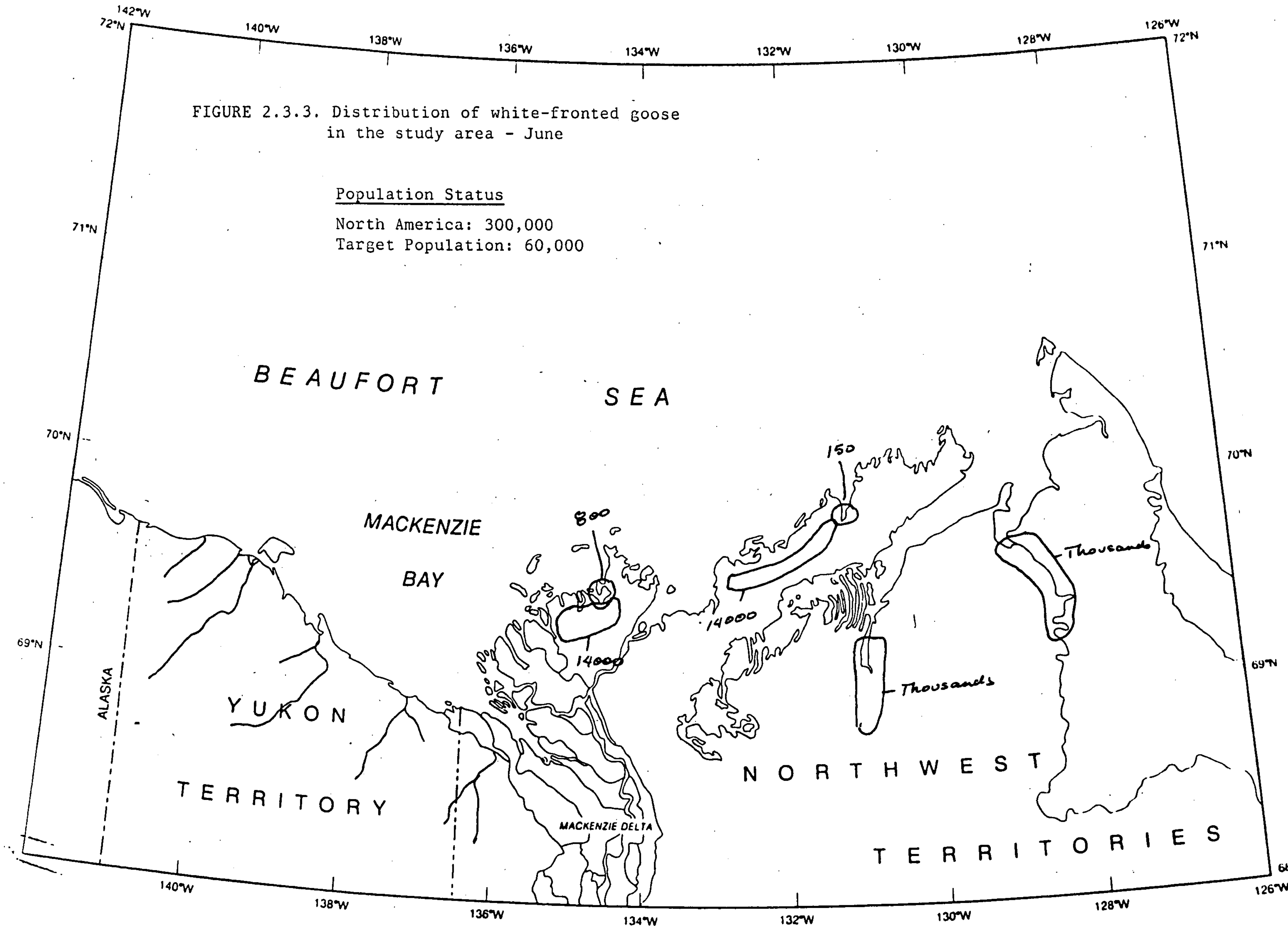


FIGURE 2.3.3. Distribution of white-fronted goose in the study area - June

Population Status

North America: 300,000
Target Population: 60,000



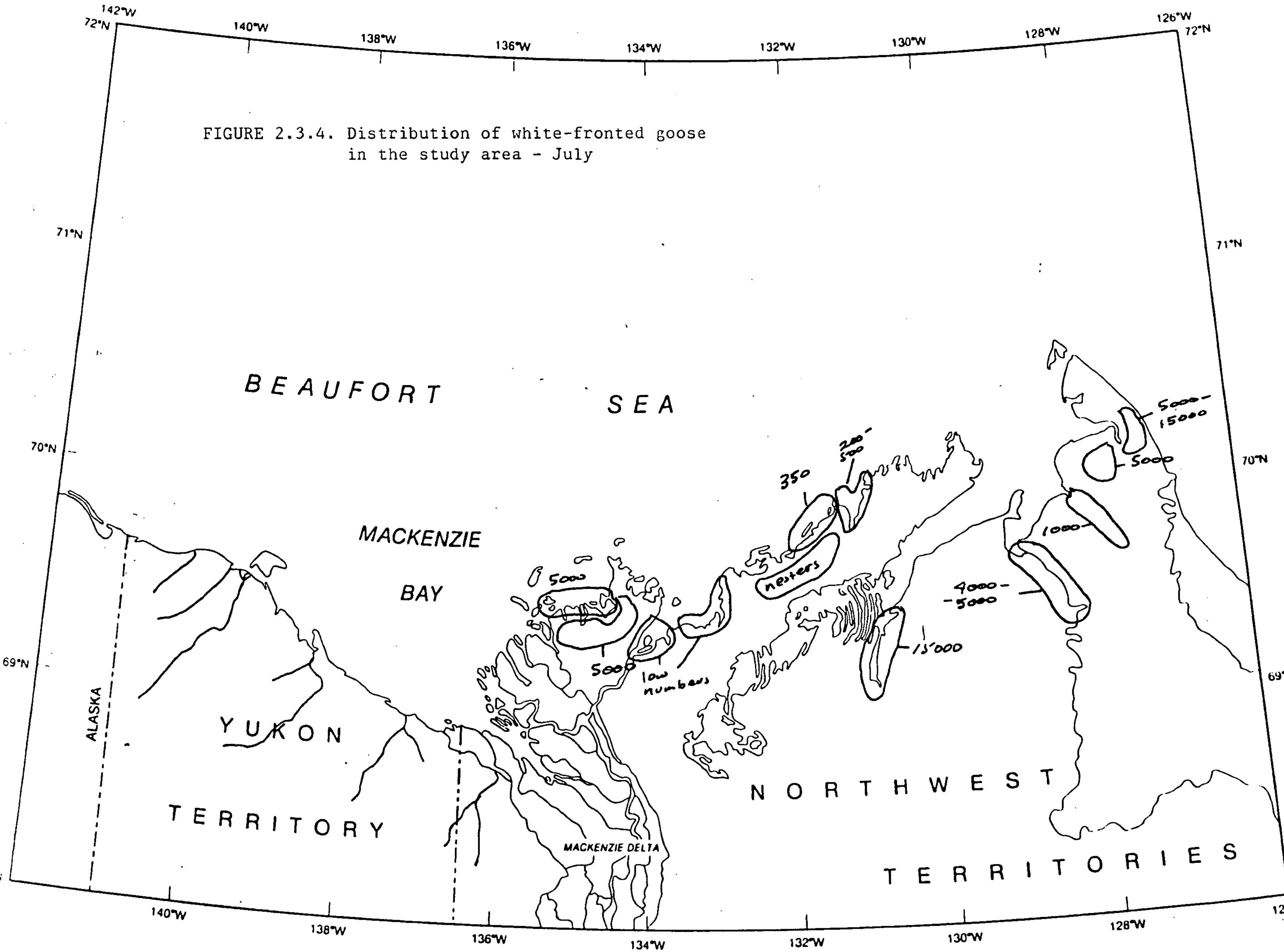


FIGURE 2.3.4. Distribution of white-fronted goose in the study area - July

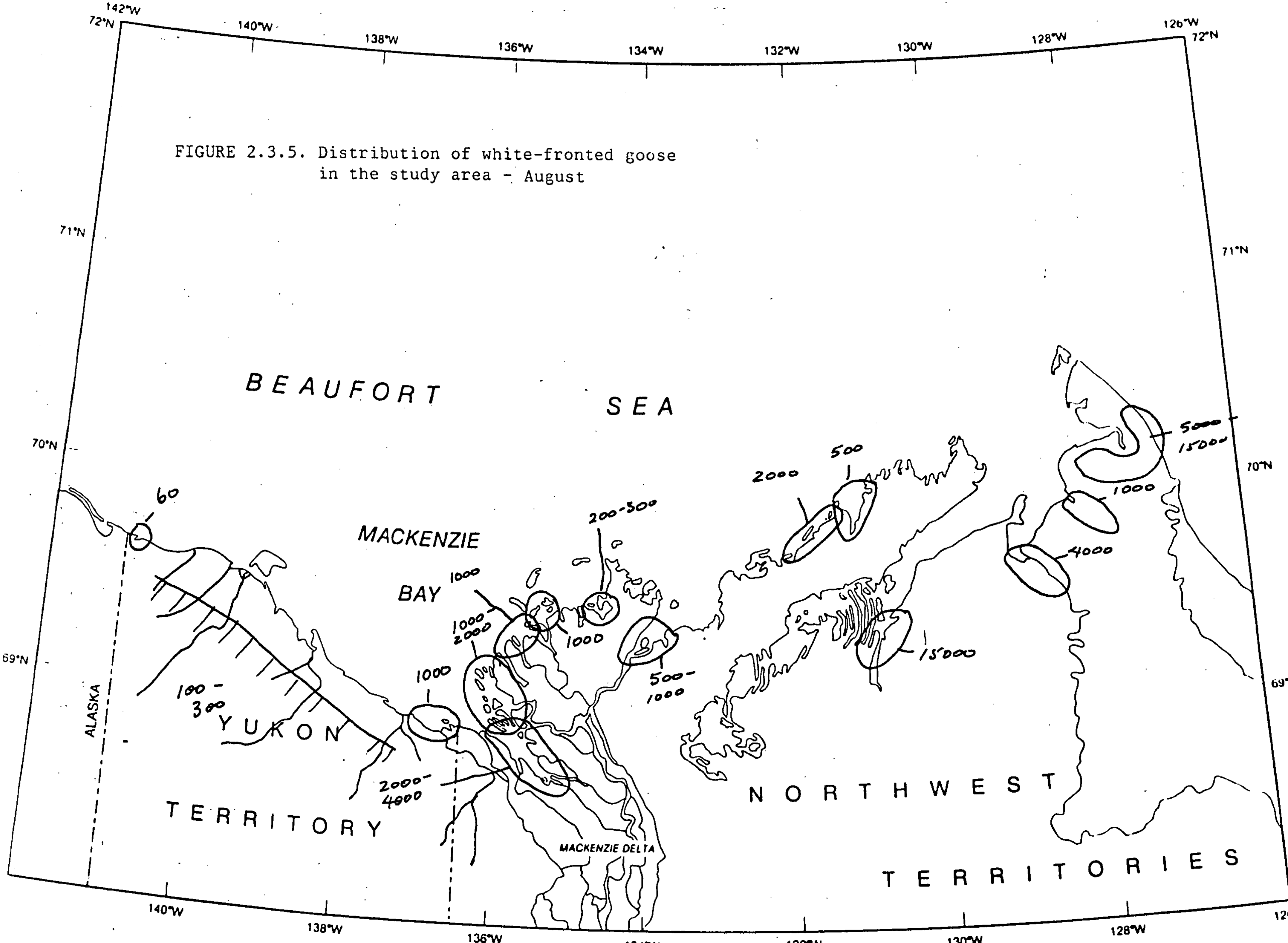


FIGURE 2.3.5. Distribution of white-fronted goose in the study area - August

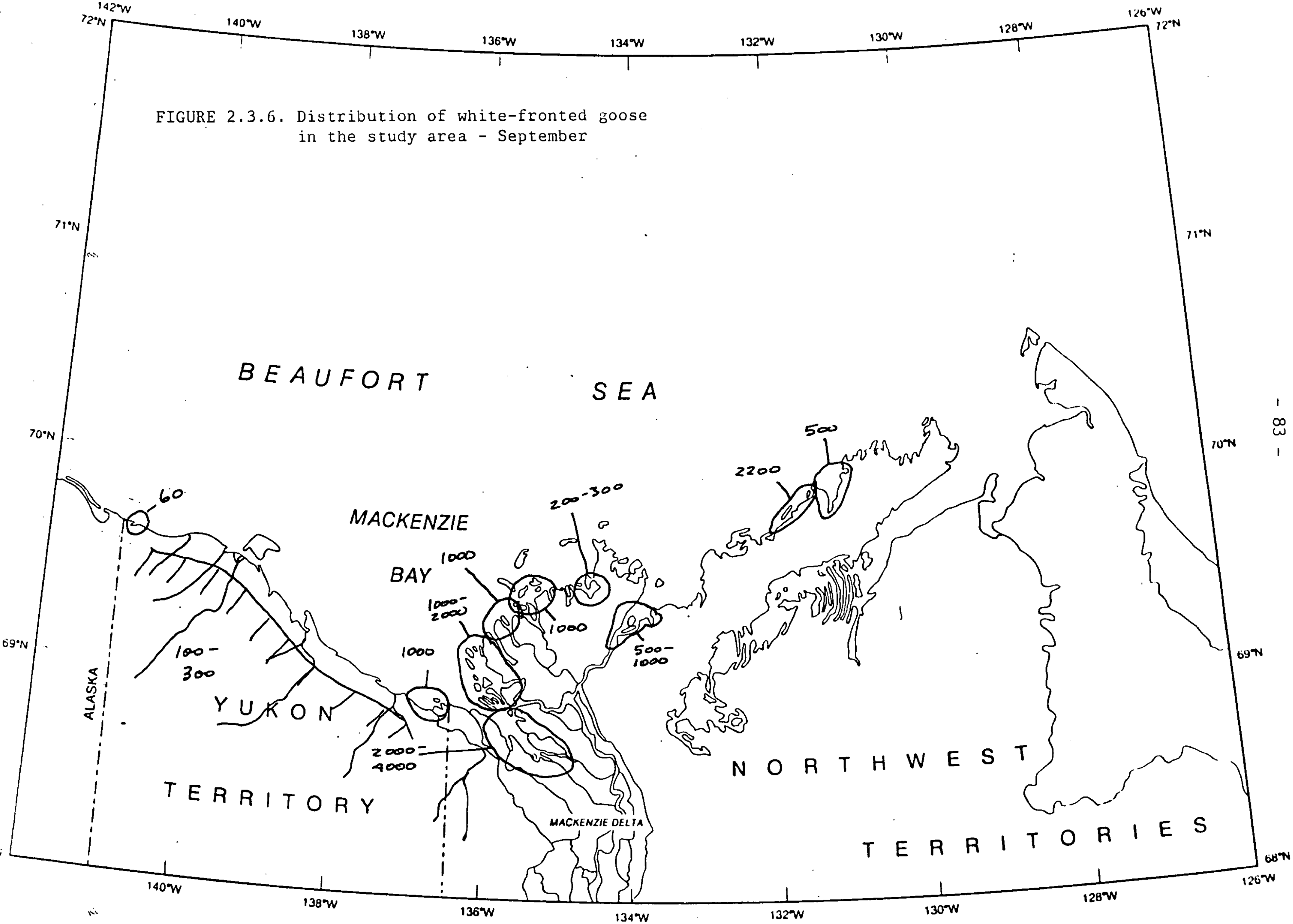


FIGURE 2.3.6. Distribution of white-fronted goose in the study area - September

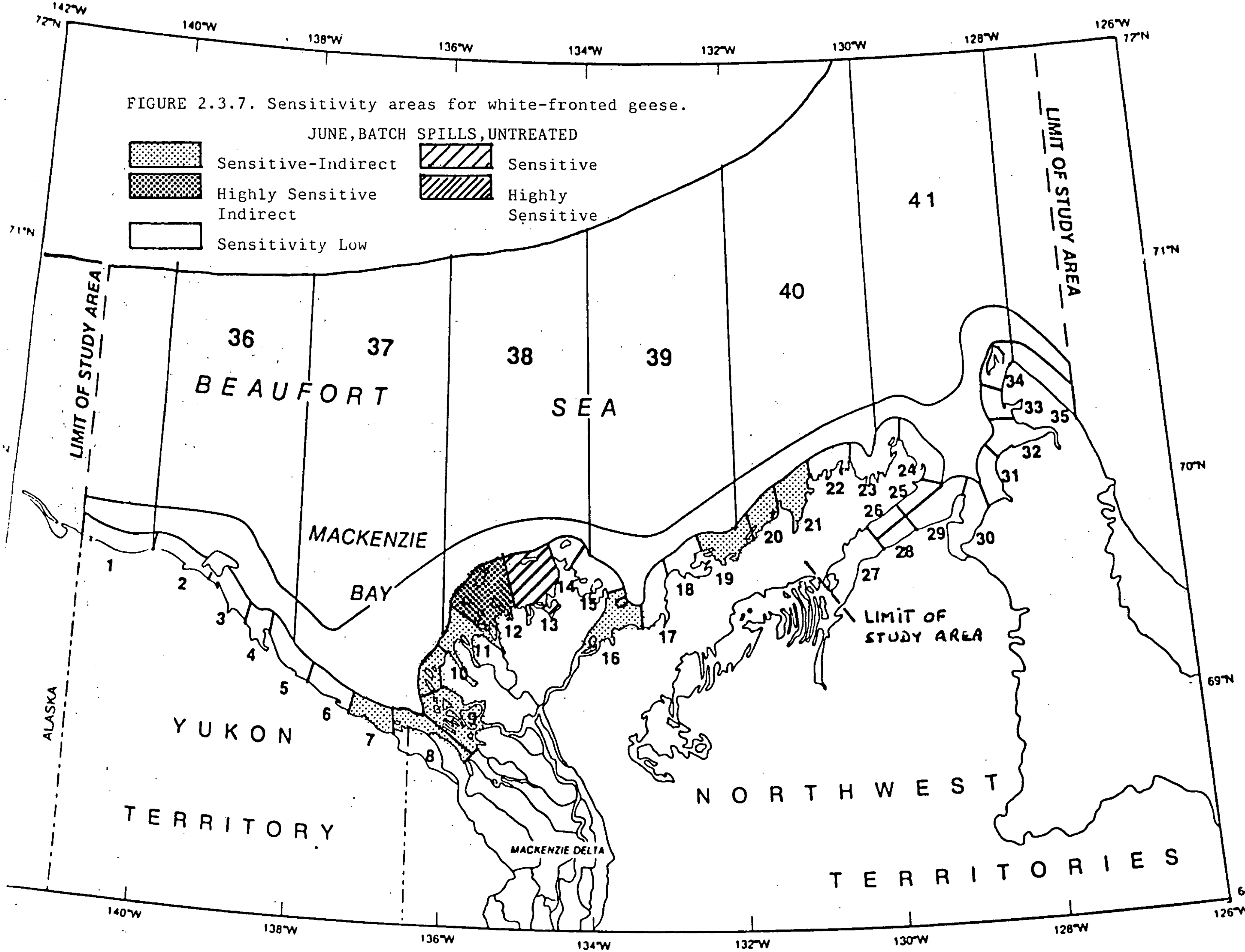


FIGURE 2.3.7. Sensitivity areas for white-fronted geese.

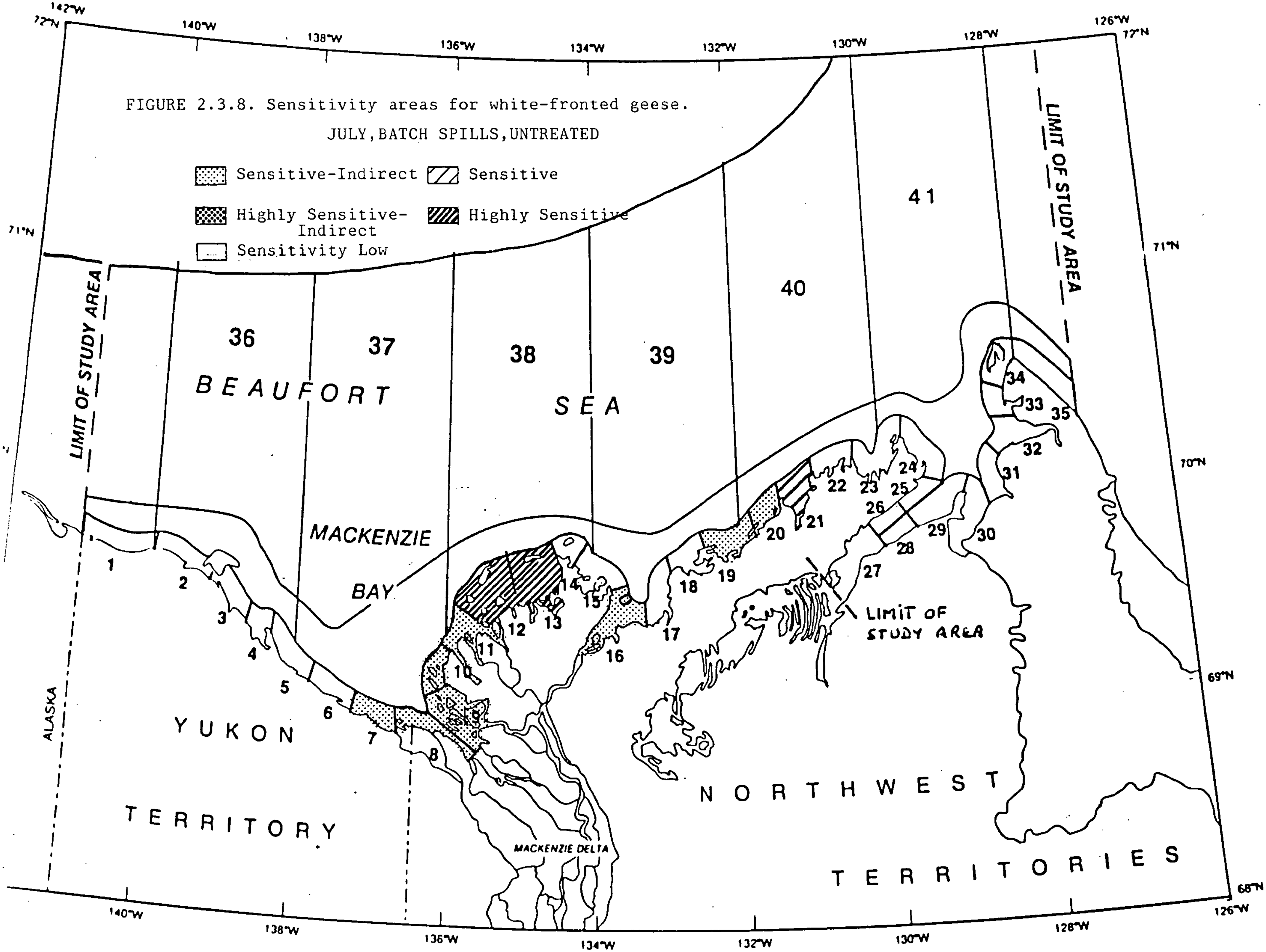


FIGURE 2.3.8. Sensitivity areas for white-fronted geese.
JULY, BATCH SPILLS, UNTREATED

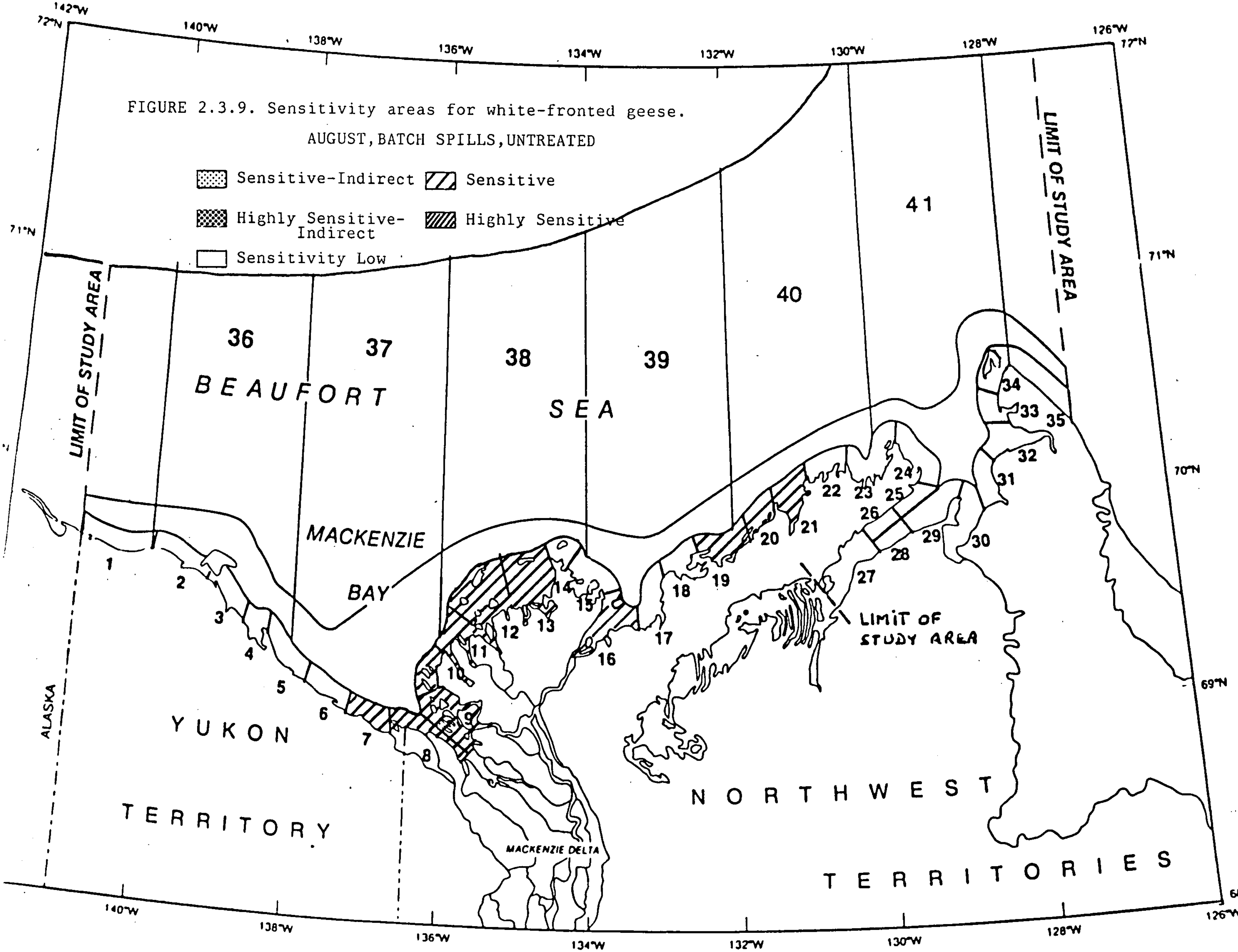


FIGURE 2.3.9. Sensitivity areas for white-fronted geese.
AUGUST, BATCH SPILLS, UNTREATED

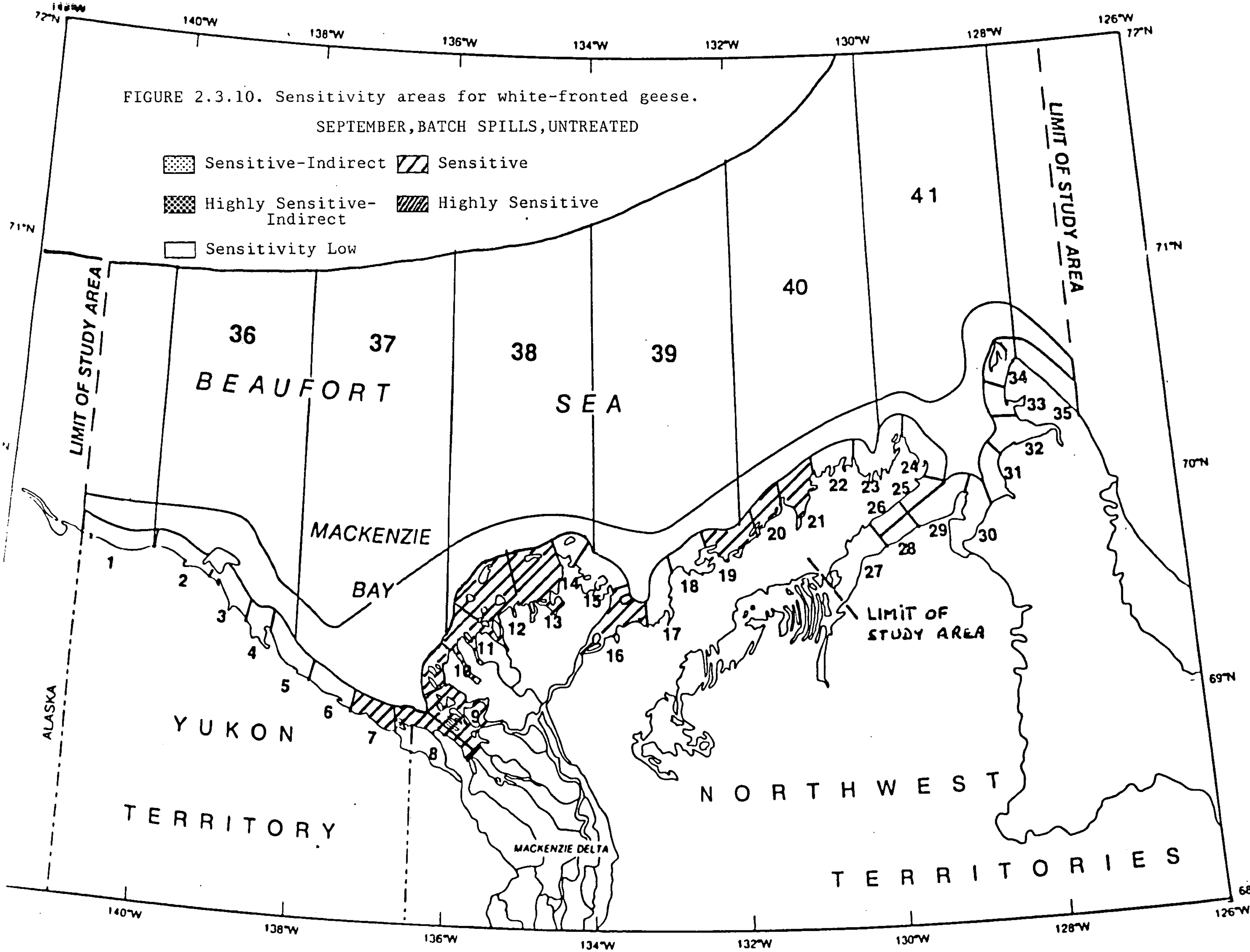


FIGURE 2.3.10. Sensitivity areas for white-fronted geese.
SEPTEMBER, BATCH SPILLS, UNTREATED

2.4 LESSER SNOW GOOSE (Chen caerulescens caerulescens)

Lesser snow geese is one of the more abundant species of geese in the southern Beaufort Sea area. Bellrose et al (1980) suggests that the North American population of Lesser Snow Geese, which numbers some one to two million birds, is divided into two completely independent sub-populations. One part of the population breeds in the eastern Arctic near Hudson Bay, winters on the Gulf of Mexico, and migrates via the Mississippi flyway. This population numbers roughly 1.5 million birds. A second population breeds from the Central Canadian Arctic on the east to Wrangle Island in the west, winters in the western part of the United States and in Mexico, and uses the Central flyway for migration. This population appears to number from 300,000 to 500,000 birds.

2.4.1 Population Status

The lesser snow geese of the southern Beaufort Sea area belong to the population that breeds in the western Arctic and migrates via the Central Flyway. These birds breed, stage and migrate through the Mackenzie Delta. This segment of the western North American population is composed of birds that breed in Banks Island, Anderson River, Kendall Island (in the Mackenzie Delta), and a small number of birds that breed on the Alaskan North slope, and on Wrangel Island (see Figure 2.4.1). This population, excluding young of the year, is composed of roughly 300,000 birds; 200,000 breeders and 100,000 non breeders (Bellrose et al 1980).

2.4.2 Habits, Movements, and Seasonality within the Southern Beaufort Sea

Spring migrants arrive in the Southern Beaufort Sea area via the Mackenzie Valley. Adults arrive during the last two weeks in May and move directly to breeding sites without preliminary stops in the area. Adults appear to be highly nest tenacious, returning to the same nest site year after year. Females begin laying eggs within 1 to 2 weeks of arriving at the nest site, generally during the second week of June. Incubation begins immediately and lasts for 20-23 days. During the incubation period the female seldom leaves the nest. The young are fully fledged within seven weeks to 45 days. Adults lead the young from the nest site within a few days of hatching, apparently in search of food. Adults begin to moult in the second week after the young are hatched. Moulting of breeders appears to take place near the breeding site without pre-moult migration. Adults regain their flight about 24 days after they moult their flight feathers, and are capable of flight a few days before the goslings are able to fly. During normal years the young are strong enough to fly from nesting sites to staging and feeding areas by mid August. Adults and young are prepared to leave the nest sites for feeding and staging areas by late August and early September.

Immature birds arrive in the southern Beaufort Sea area from one to two weeks later than the adults. Since few lesser snows of any age are observed outside of the Kendall Island area in the Mackenzie Delta it appears that these non-breeders pass the summer near the breeding site in Kendall Island, Anderson River, and Banks Island and do not spread themselves out along the coast as is the case with brant. Immatures do not appear to move from breeding areas for the moult, but moulting of immatures begins several weeks before that of breeding adults. Non-breeders are the first to leave their moulting areas for the feeding and staging areas. Non-breeders from Banks Island leave Banks Island by mid-August and fly to the northwest edge of the Mackenzie Delta. Adults and young follow in late August or early September.

Snow Geese move initially to staging and feeding areas on the Bathurst Peninsula, Cape Parry, the Mackenzie Delta and along the Yukon and Alaskan North Slope. Populations then appear to move westward, spreading out along the Yukon North Slope from the Mackenzie Delta to the Canning River in Alaska. The peak of the westward movement occurs in early September. There is a two week hiatus in the westward movement during which the birds rest and feed. Birds normally begin to move eastward again around the second or third week in September. They then appear to move gradually back to the Mackenzie Delta but do not appear to aggregate again in major staging areas prior to departure southward.

As pointed out by Barry et al (1981) snow geese can hardly be considered a marine species since they breed, feed and stage largely inland even though it is within a few kilometres of the coast. There is some evidence, however, that immatures utilize coastal habitats during the summer for moulting and feeding and some adults and young utilize coastal habitats for feeding in preparation for the fall migration. For the most part however, lesser snows use inland areas for nesting, feeding and staging.

2.4.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

Lesser snow geese appear to be largely invulnerable to marine oil spills in June and July since they use inland habitat for breeding and moulting. They become somewhat more vulnerable in August and September as they move through the southern Beaufort Sea area, stopping to feed in various locations, in preparation for the fall migration. Even at this time they use inland areas for feeding and few are vulnerale to marine spills. As a consequence lesser snows appear to be vulnerale to no more than SLIGHT effects of spills in this area. In June and July, only birds from the Kendall Island and Anderson River Delta colonies are vulnerable to spills and hence significant effects will result only from contamination of these two areas. In August and September a portion of the transient group of birds feeding in the outer Mackenzie Delta will be vulnerable to the effects of contamination but these effects should be only at the SLIGHT level.

References: Barry 1976; Barry et al 1981; Bellrose et al 1980; Koski 1975; Searing et al 1975.

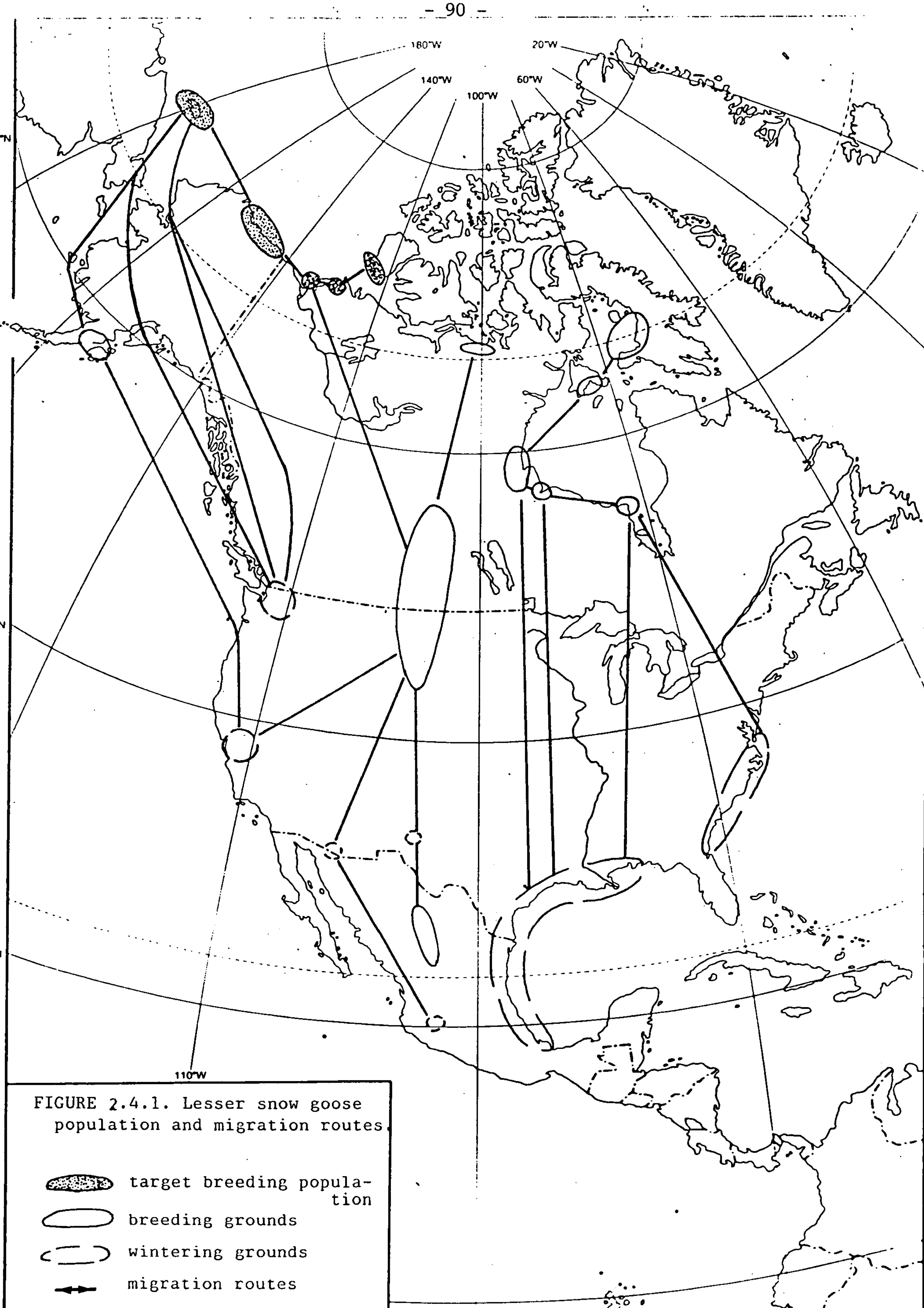


FIGURE 2.4.1. Lesser snow goose population and migration routes.

target breeding population

breeding grounds

wintering grounds

migration routes

Figure 2.4.2. Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.

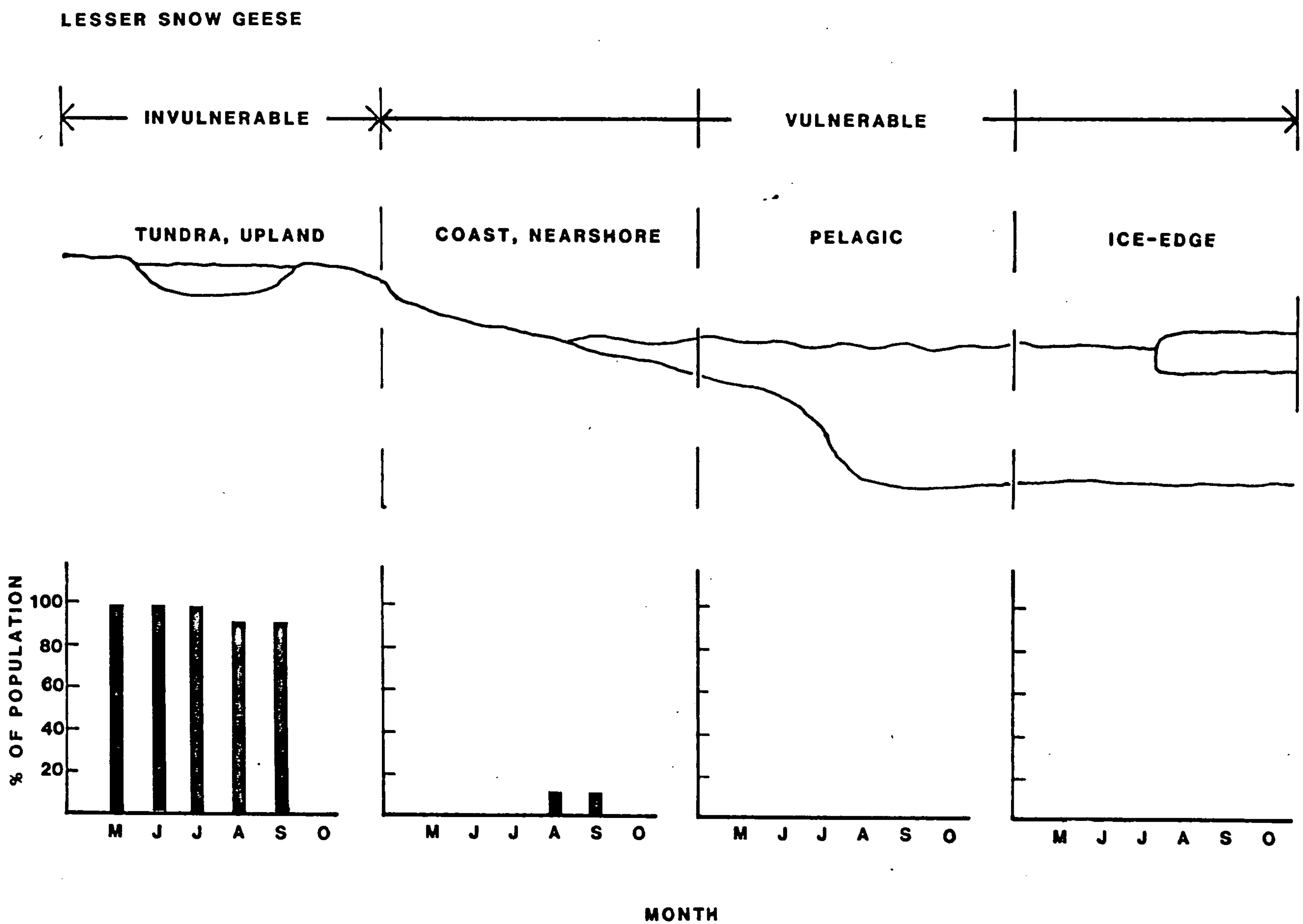


FIGURE 2.4.3. Distribution of lesser snow goose in the study area - June

<u>Population Status</u>

North America: 1-2 million
Target population: 300,000-500,000

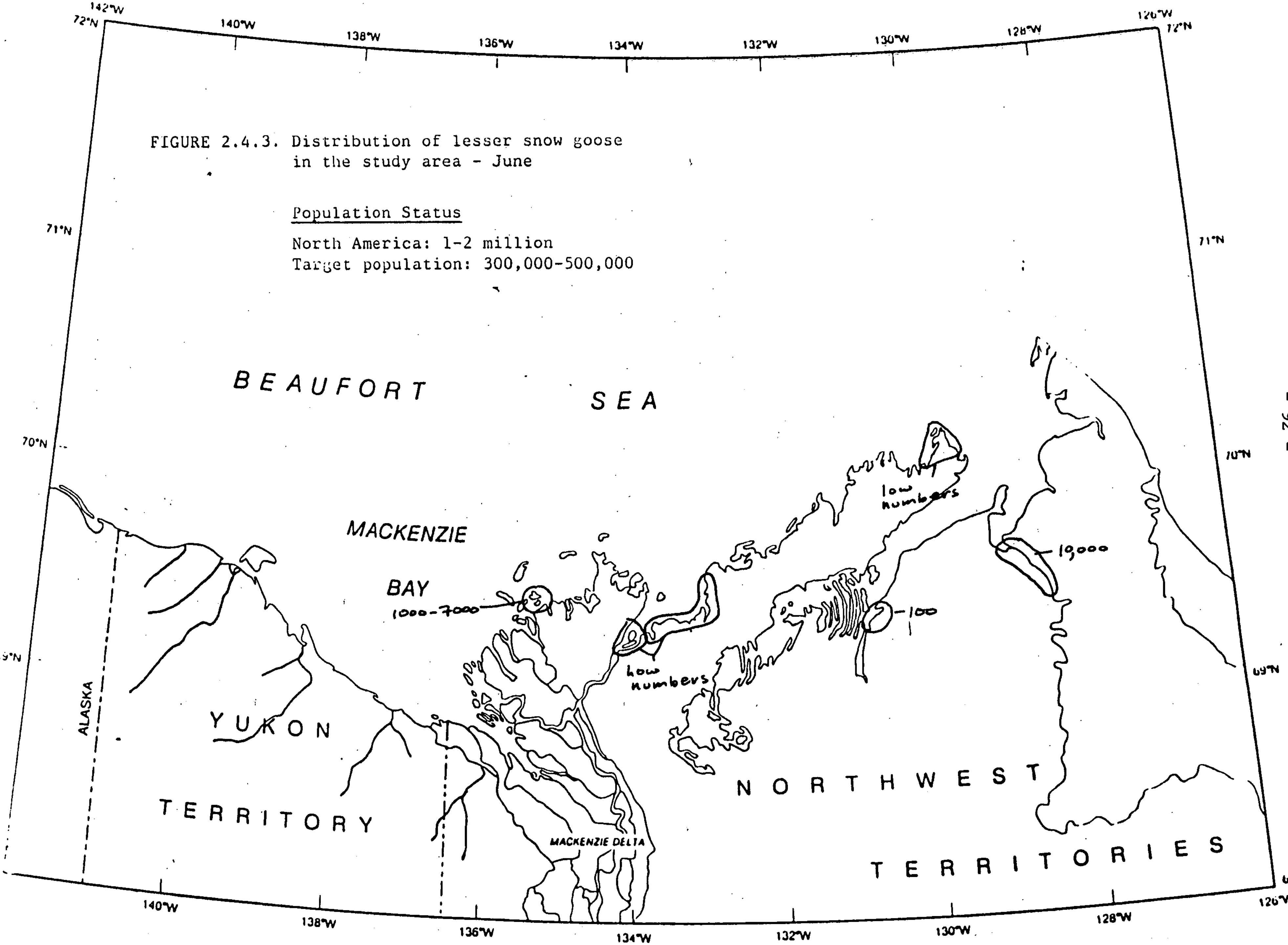
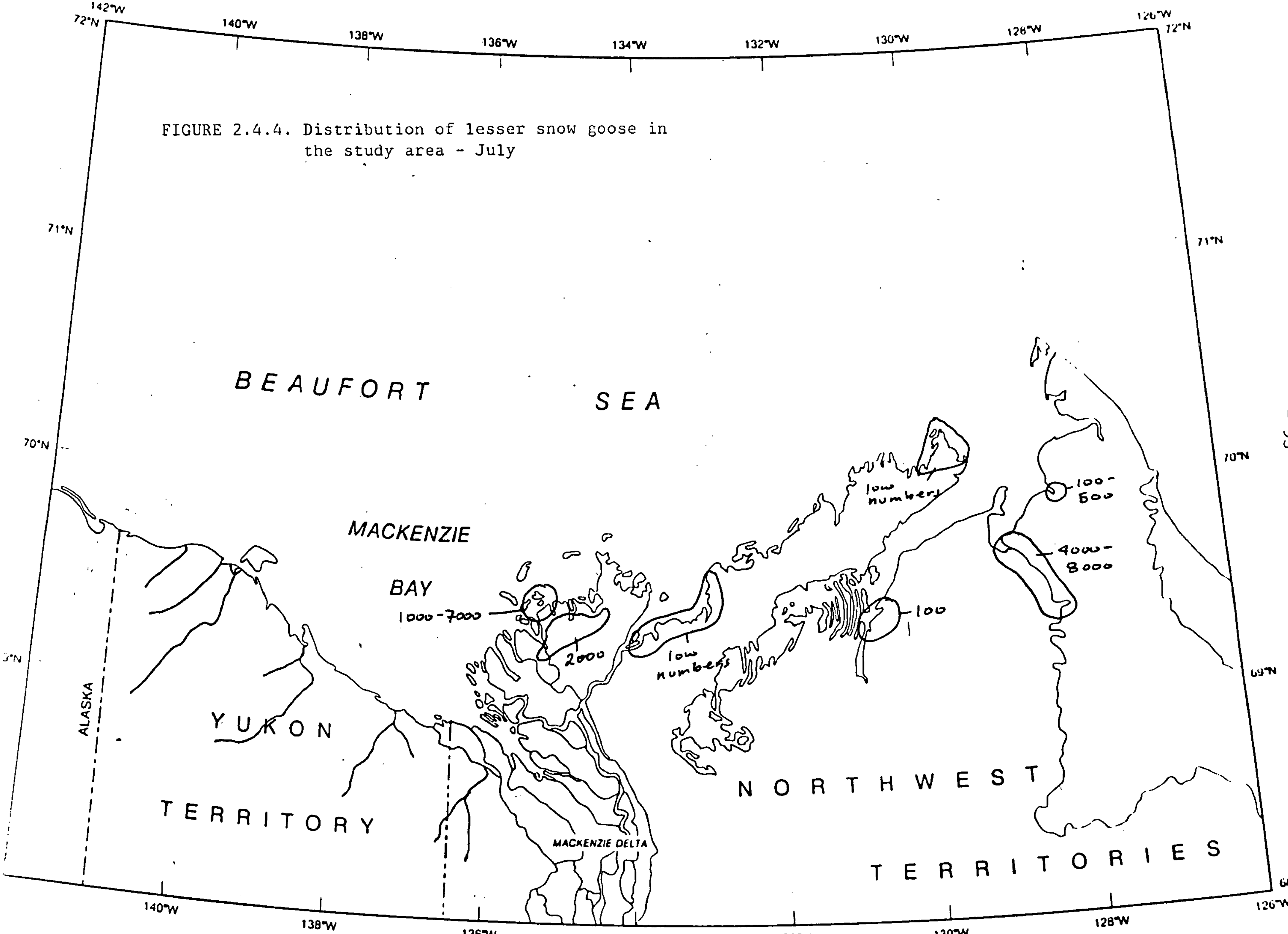


FIGURE 2.4.4. Distribution of lesser snow goose in the study area - July



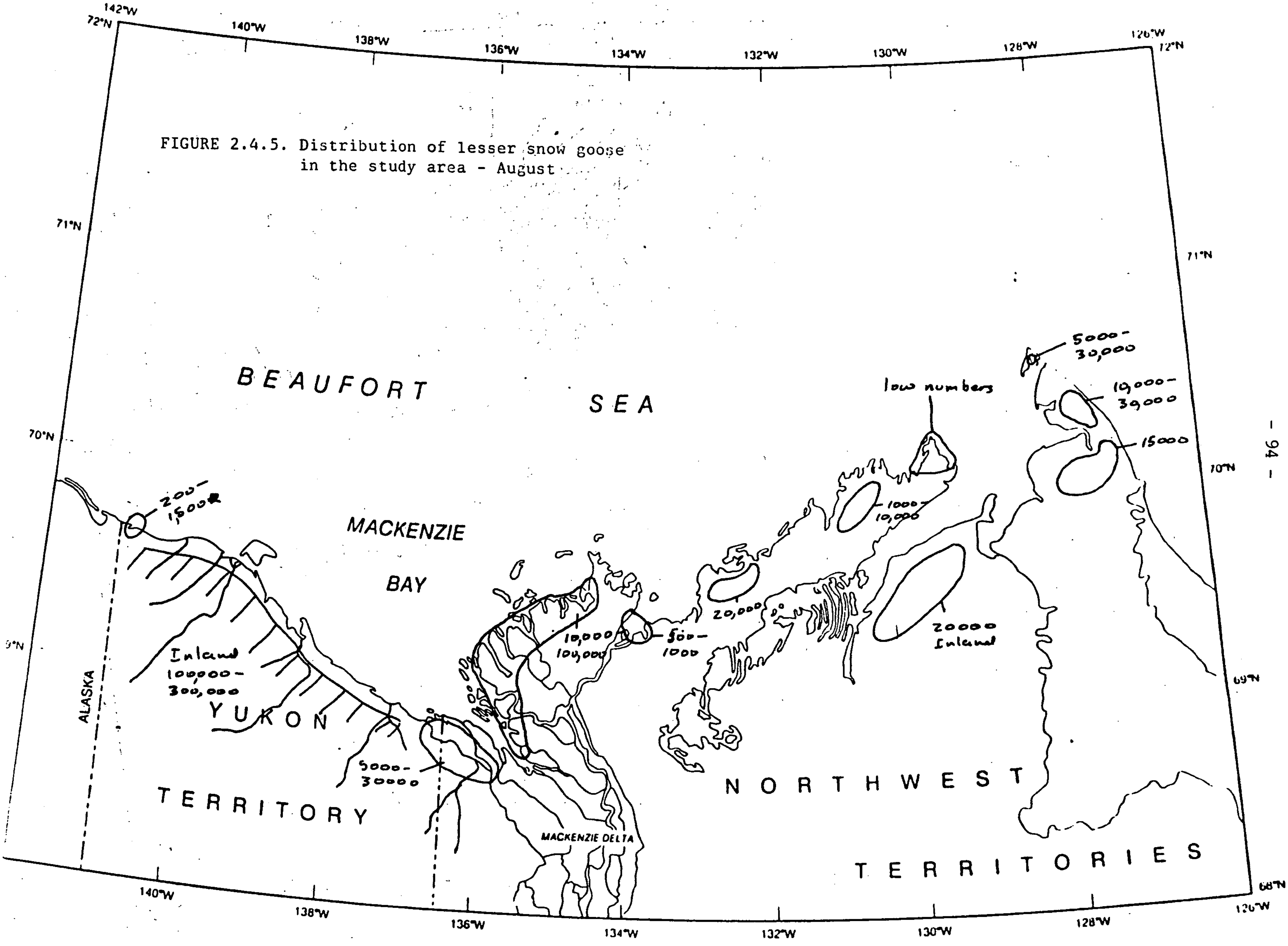
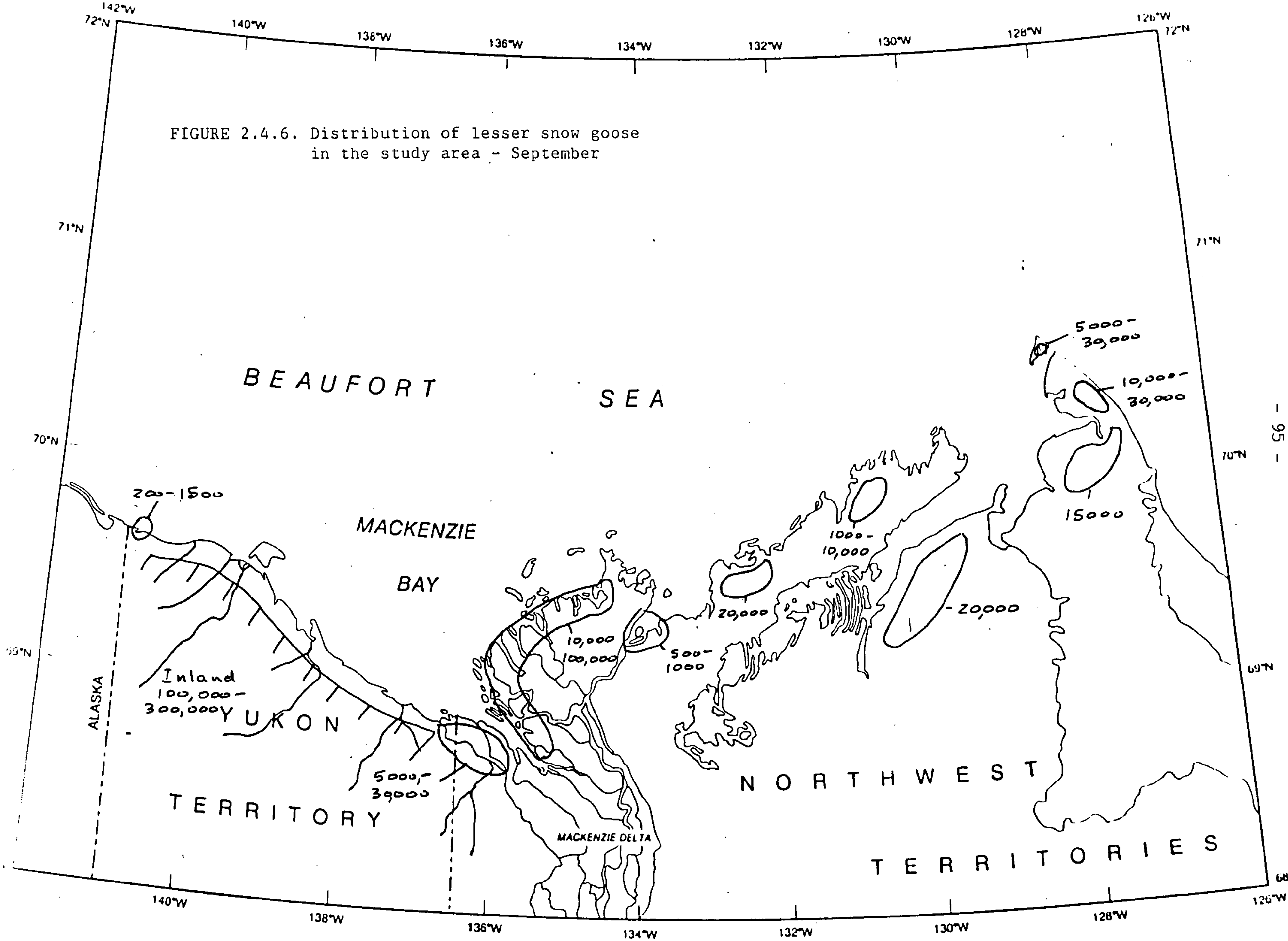


FIGURE 2.4.5. Distribution of lesser snow goose in the study area - August

FIGURE 2.4.6. Distribution of lesser snow goose in the study area - September



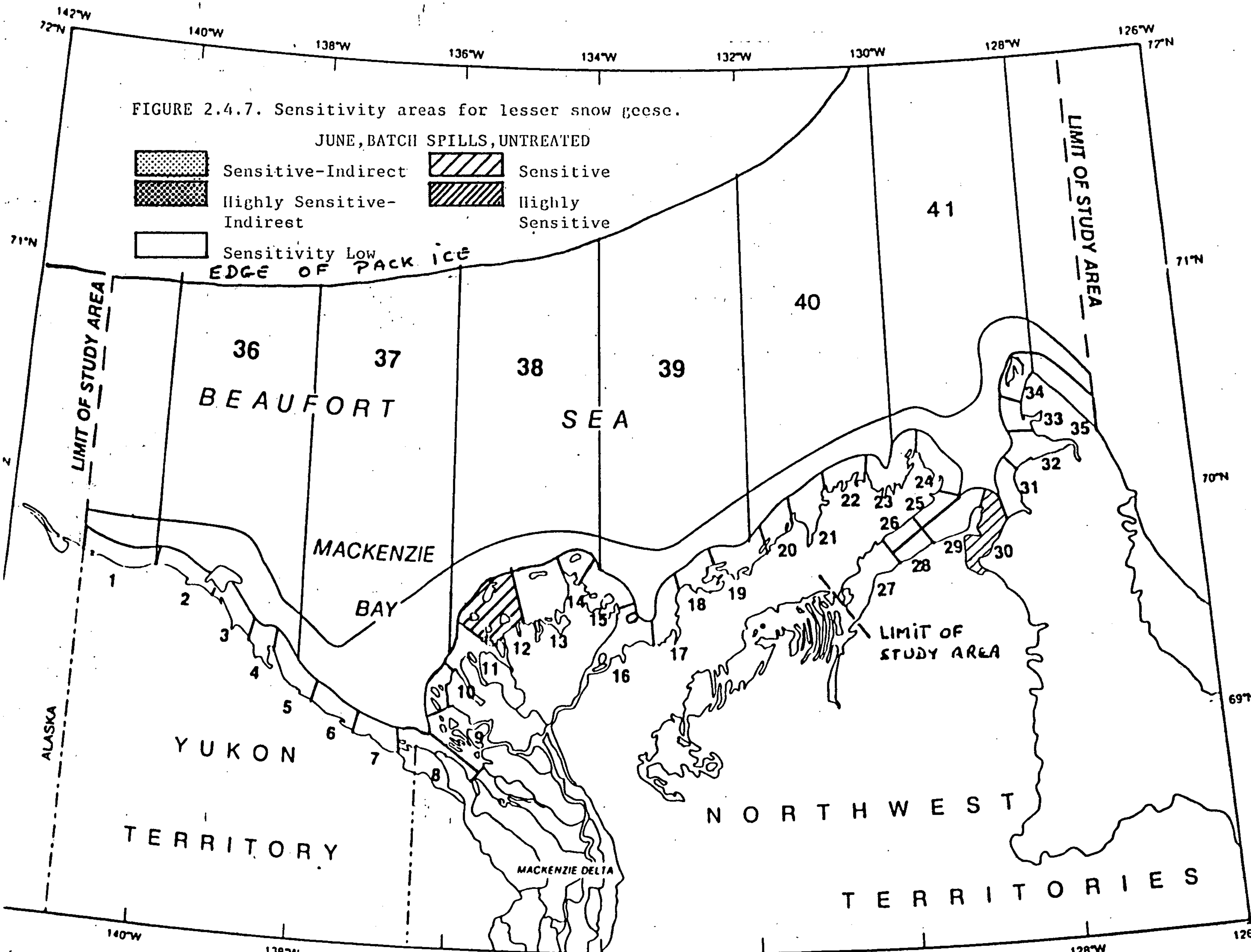


FIGURE 2.4.7. Sensitivity areas for lesser snow geese.

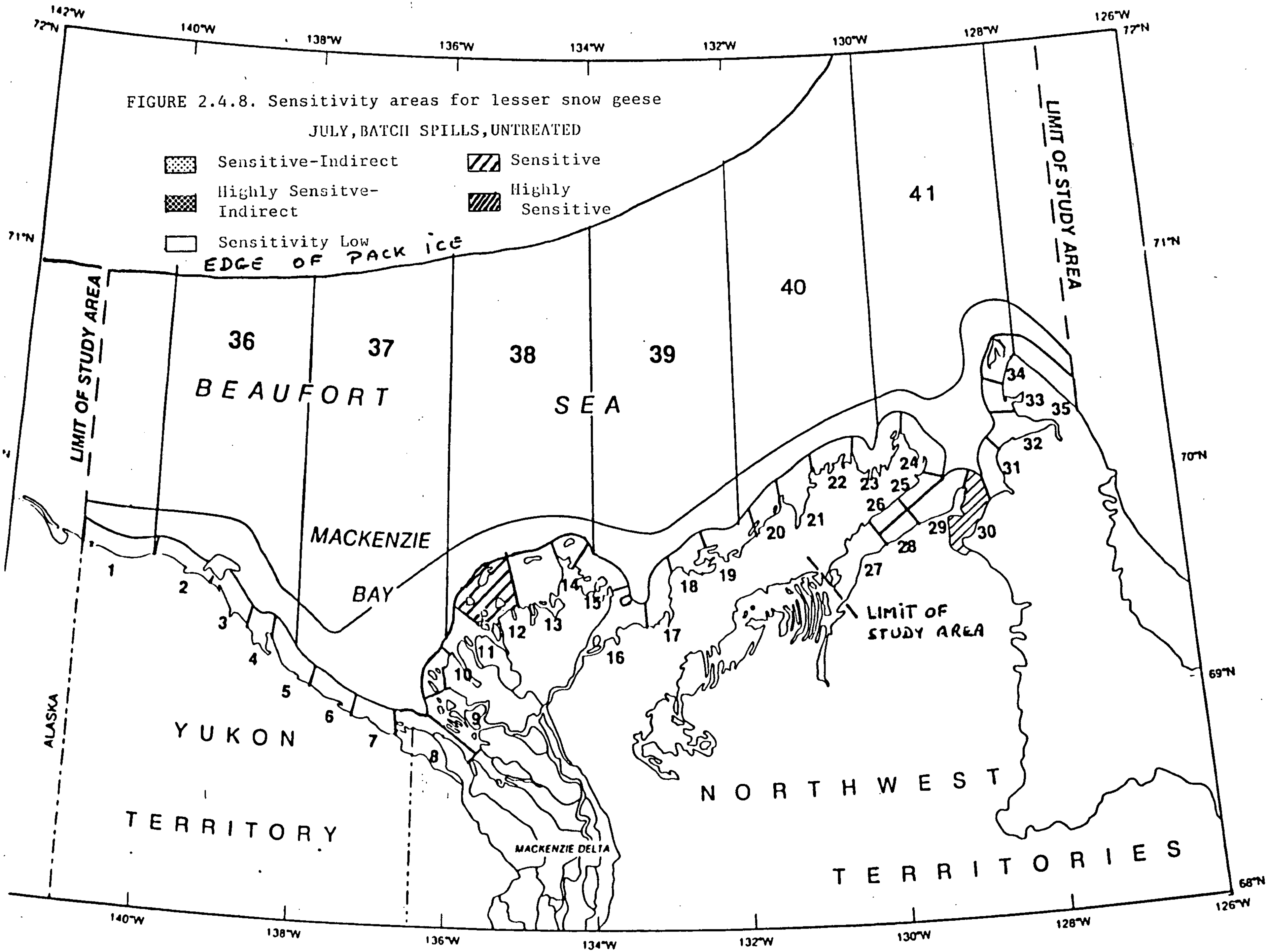


FIGURE 2.4.8. Sensitivity areas for lesser snow geese

JULY, BATCH SPILLS, UNTREATED

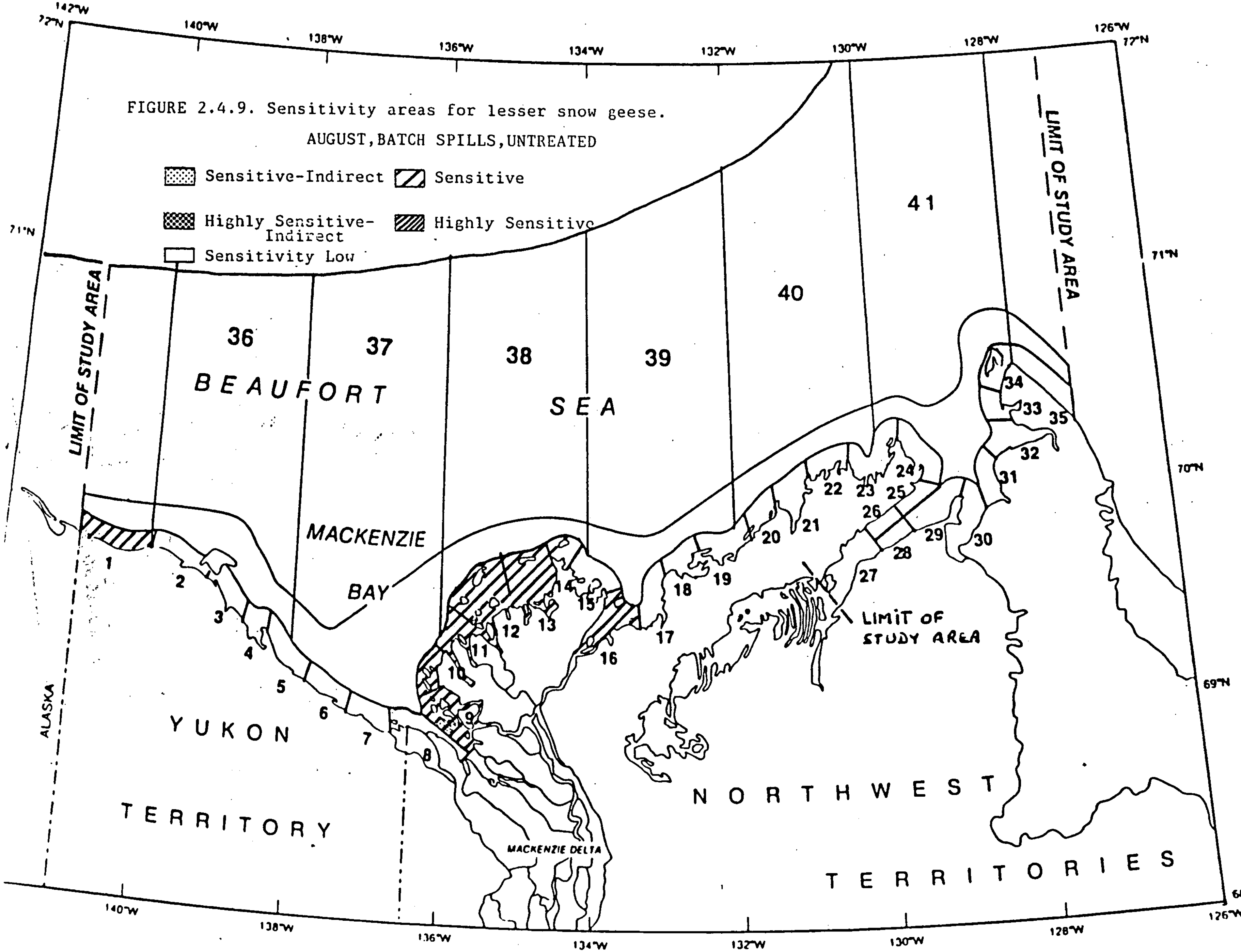


FIGURE 2.4.9. Sensitivity areas for lesser snow geese.

AUGUST, BATCH SPILLS, UNTREATED

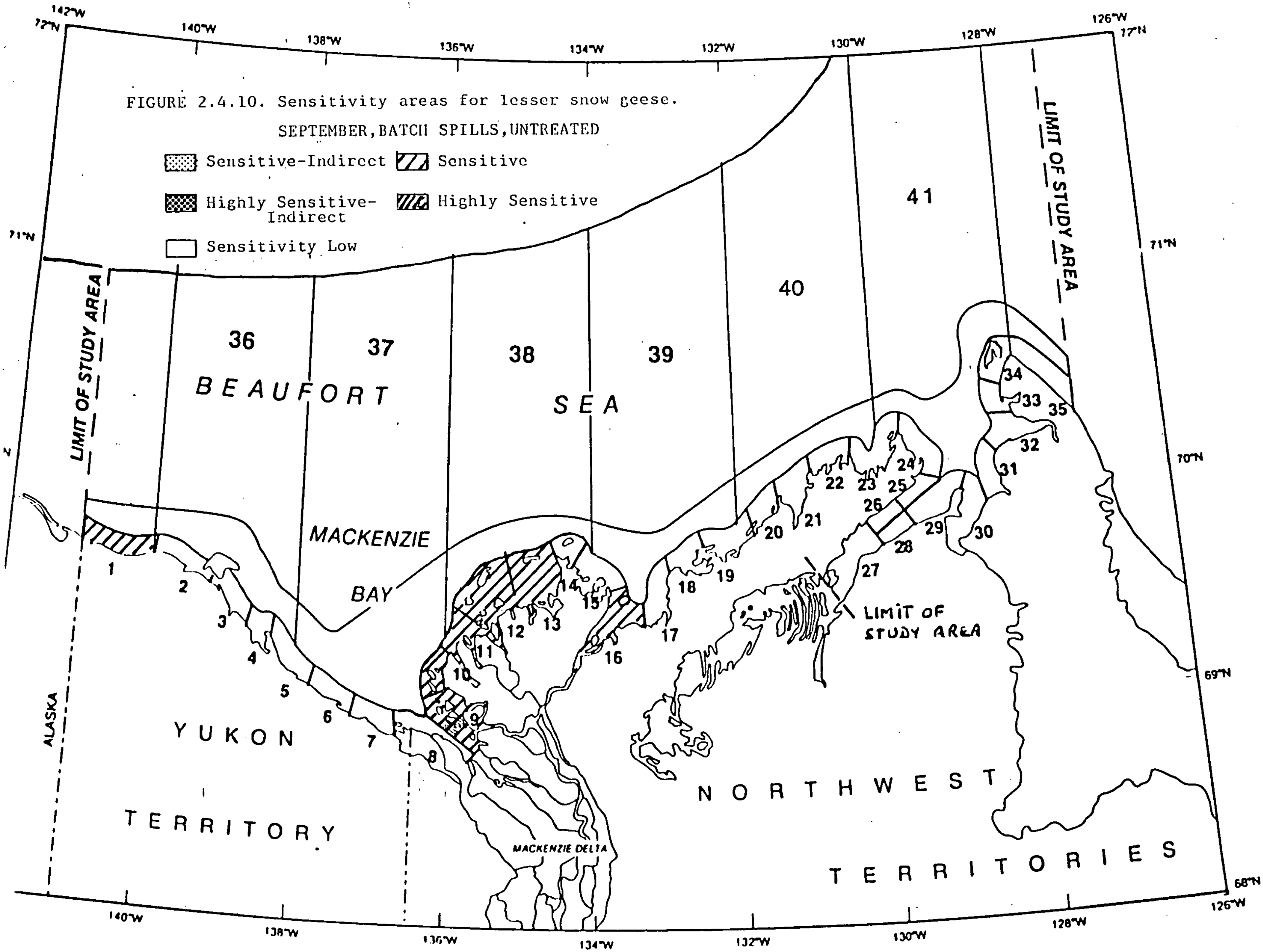


FIGURE 2.4.10. Sensitivity areas for lesser snow geese.
SEPTEMBER, BATCH SPILLS, UNTREATED

2.5 BLACK BRANT (Branta bernicla nigricans)

The Pacific sub-species of black brant is one of the most common nesting geese in the southern Beaufort Sea area. This population winters on the Pacific Coast of North America from the Fraser Estuary, British Columbia to Baja, California and migrate northward in the summer months to breed in several locations in Alaska and in the Western Canadian Arctic (Figure 2.5.1).

According to Smith and Jensen in Bellrose et al (1980), winter surveys indicate that the black brant population is rather stable lying in the range of 100,000 to 150,000 birds. However, Bellrose's summary of breeding sub-populations of brant in northwest North America suggests that the population of non-breeders and breeding adults may be somewhat greater than this (roughly 200,000).

2.5.1 Population Status

For purposes of this work, the target population will be assumed to include groups that breed within the southern Beaufort Sea and in areas to the east of the study area including those from Victoria Island, Prince Albert Peninsula, and on Queen Maude Gulf. This population is vulnerable to oil spills in the southern Beaufort Sea since members of the population use the area for breeding while others migrate through the area in the spring and fall. From the data in Table 2.5.1 this group would appear to number roughly 20,000 birds, or roughly 10% of the total North American population.

2.4.2 Habits, Movement, and Seasonality Within the Southern Beaufort Sea Area

Black brant utilize the S.B.S. area for breeding from May to September. During their spring migration brant leave the wintering grounds and move to the Izembek Bay Region of Alaska before moving further north. The majority of brant follow the coastline in moving around Alaska to their breeding grounds in the western Arctic, moving northward to Point Barrow and then eastward along the coast to the Mackenzie Delta and breeding grounds to the east. There is however, some evidence of brant reaching the southern Beaufort Sea area by traversing the interior of Alaska, following major river valleys and by crossing the Anaktuvuk or other mountain passes.

A number of species of birds follow the Arctic coastline in their migration but Richardson and Johnson (1981) point out that of all species that migrate eastward along the Arctic coastal areas during the spring, only brant appear to concentrate within a few kilometres of the coast. These authors also point out that flocks of brant have also been observed migrating eastward far offshore over the southern Beaufort Sea.

The flocks of brant that migrate into the study area are composed of all age classes of birds; breeding birds, non-breeding adults, and immatures. All of these groups initially aggregate at the sites of the breeding colonies making all age classes equally vulnerble. Brant nest in loose colonies (Barry 1976) near the water on the mainland coast and on offshore islands.

Nesting and laying begin immediately upon arrival in May and young are hatched by late June or early July. The young quickly become self sufficient, walking, swimming, and diving within a few days of hatching and are able to maintain themselves within 10 days without brooding. By the 40-45th day they are capable of flight. Breeding adults moult about 2 weeks after the hatching of young. They are flightless for about 3 weeks, regaining flight a few days before the young are fledged. There is little indication of a pre-moult migration amongst adults.

Non-breeders aggregate at the periphery of the breeding colonies and at various other points along the coast. There is some indication that brant, presumably non-breeders, aggregate at certain coastal sites for moulting. According to Barry (1976) non-breeders aggregate in the littoral marshes of river deltas and bays for the moult. The ratio of breeders to non-breeders in populations is variable.

Brant begin the fall southward migration in late August and early September and appear to retrace their spring migration routes. Brant aggregate in several locations in preparation for the fall migration. According to Barry (1976) some of the areas of aggregation that lie within the study area are the flats of the outer Mackenzie Delta between Richards Island and the Blow River. They begin to gather in late August and remain for much of September before continuing their fall migration.

The habitat preference of black brant makes it one of the more vulnerable of waterfowl species that use the Southern Beaufort Sea area. The entire brant population can be found along the coast of the mainland or on coastal islands. Brant nest almost exclusively within a few feet of high tide mark making both adult and young vulnerable to stranded oil. Non-breeders (immatures and non-breeding adults) remain near the coastline, where they graze on vegetation in the littoral zone. Birds remain in this habitat during the moult and stage for the fall migration in bays and estuaries where marsh vegetation is abundant.

2.5.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

Black Brant are present within the Southern Beaufort Sea area in the months of May to September. There is a very brief peak in late May corresponding to the through migration of birds breeding in areas east of the Southern Beaufort Sea. The number of brant present in June is small, only several thousand birds, most of which are in the Anderson River area. The birds present between the Nunaluk Point and Cape Bathhurst are breeders that form small loose colonies numbering only tens to a few thousands of birds, and non-breeders that form small groups of tens to hundreds of birds near the breeding colonies or in bays and inlets along the coast. At this time the population is vulnerable to SLIGHT effects. The numbers of birds present in coastal areas is greatest from July through September when the populations concentrate at several points within the study area. Birds appear to utilize this area from Nunaluk Point to Phillips Bay in the west, the outer edge of the Mackenzie Delta, and the bays and river mouths of the Tuktoyaktuk Peninsula. In most of these areas, birds form groups numbering several hundreds to several thousands of birds. Barry (1976) reported observing as many as 12,000 Brant staging in the Philips Bay area in September 1980. During this period brant are vulnerable to MODERATE and MAJOR effects at certain locations along the coast.

References: Barry (1976); Barry et al (1981); Bellrose et al (1980); Richardson and Johnson (1981); Searing et al (1975); Smyth et al (1985).

TABLE 3 Population status of black brant

Sub-population	Numbers of individuals: Non-breeders	Breeders	Total
Wrangel Island	10,000[1]	2,000[1]	12,000[1]
Yukon-Kuskoknim Delta, Alaska	75,000[1]	75,000[1]	150,000[1]
North Slope	17,500[2]	17,500[2]	35,000[1]
Mackenzie Delta	100[2]	100[2]	200[1,3]
Liverpool Bay	1,500[2]	1,500[2]	3,000[1,3]
Banks Island	4,500[2]	4,500[2]	9,000[1,3]
Victoria Island and Prince Albert Peninsula	1,500[2]	1,500[2]	3,000[1,3]
Queen Mand Gulf	1,500[2]	1,500[2]	3,000[1,3]
TOTAL			215,200

1. After Bellrose et al 1980
2. Assumes 1:1 ratio of breeders to non-breeders
3. These populations combined are taken to be the "target population" for spills in the Southern Beaufort Sea. The total population size appears to be roughly 20,000 individuals including both breeders and non-breeders.

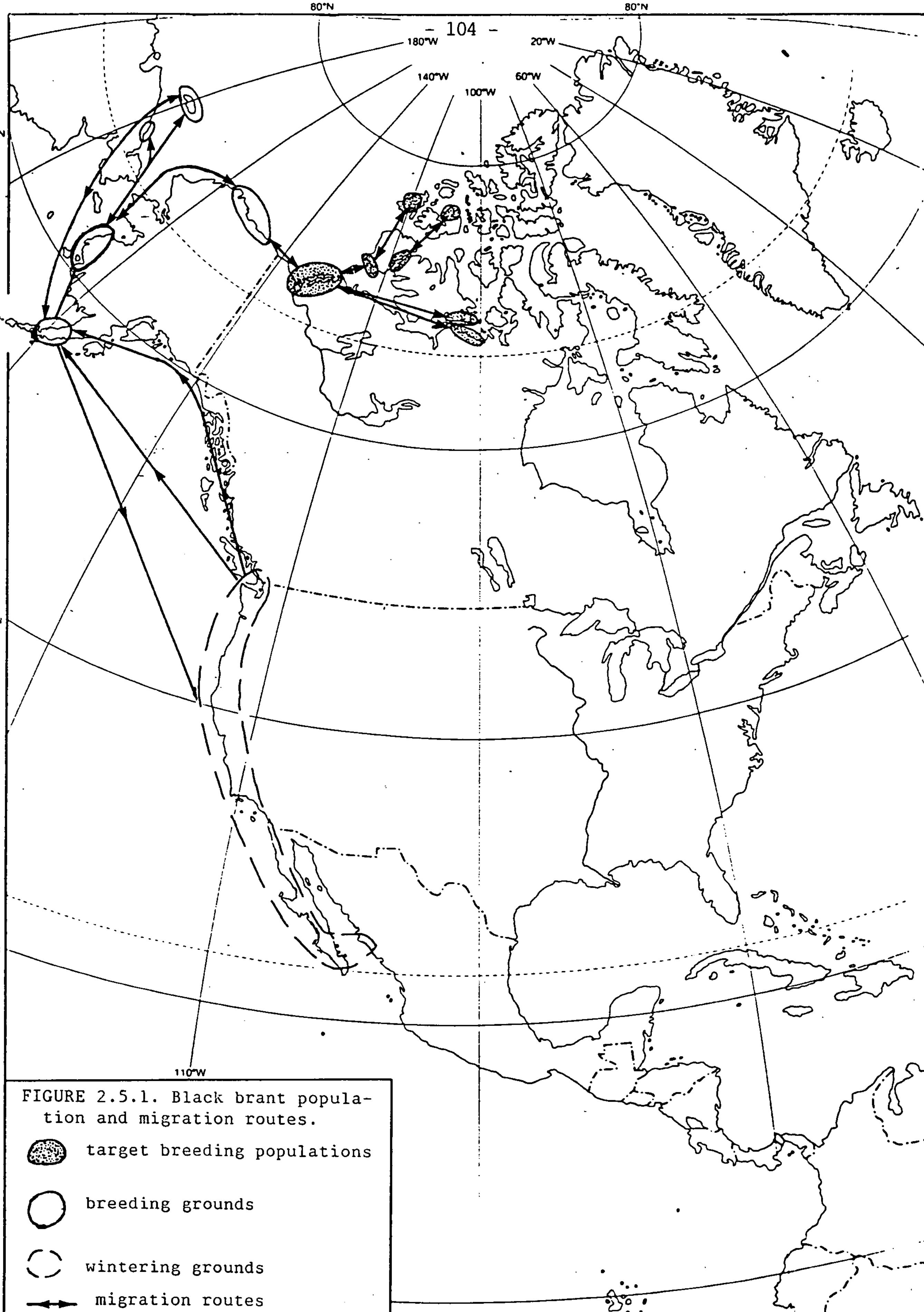
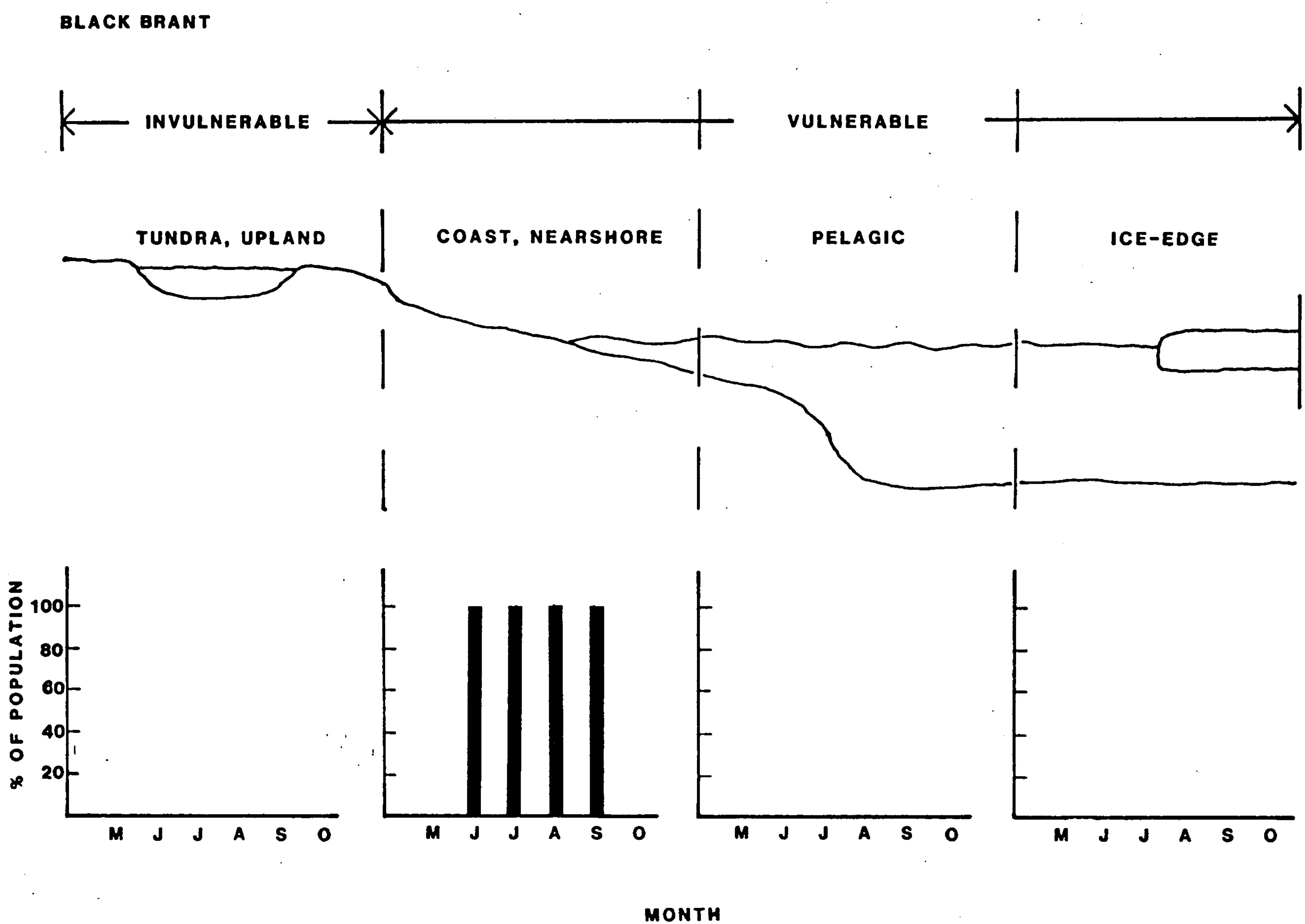


FIGURE 2.5.1. Black brant population and migration routes.

Figure 2.5.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



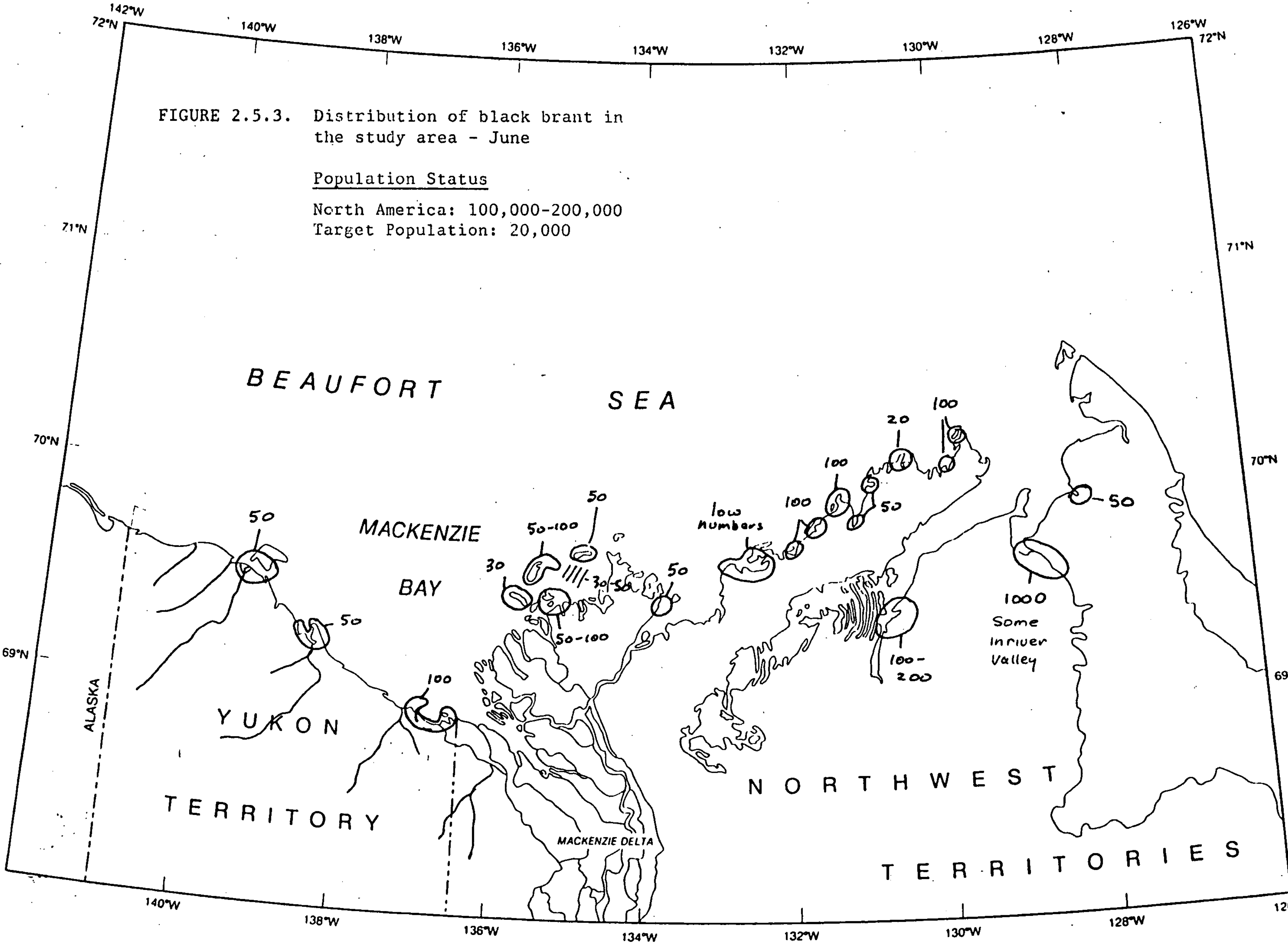


FIGURE 2.5.3. Distribution of black brant in the study area - June

Population Status

North America: 100,000-200,000
Target Population: 20,000

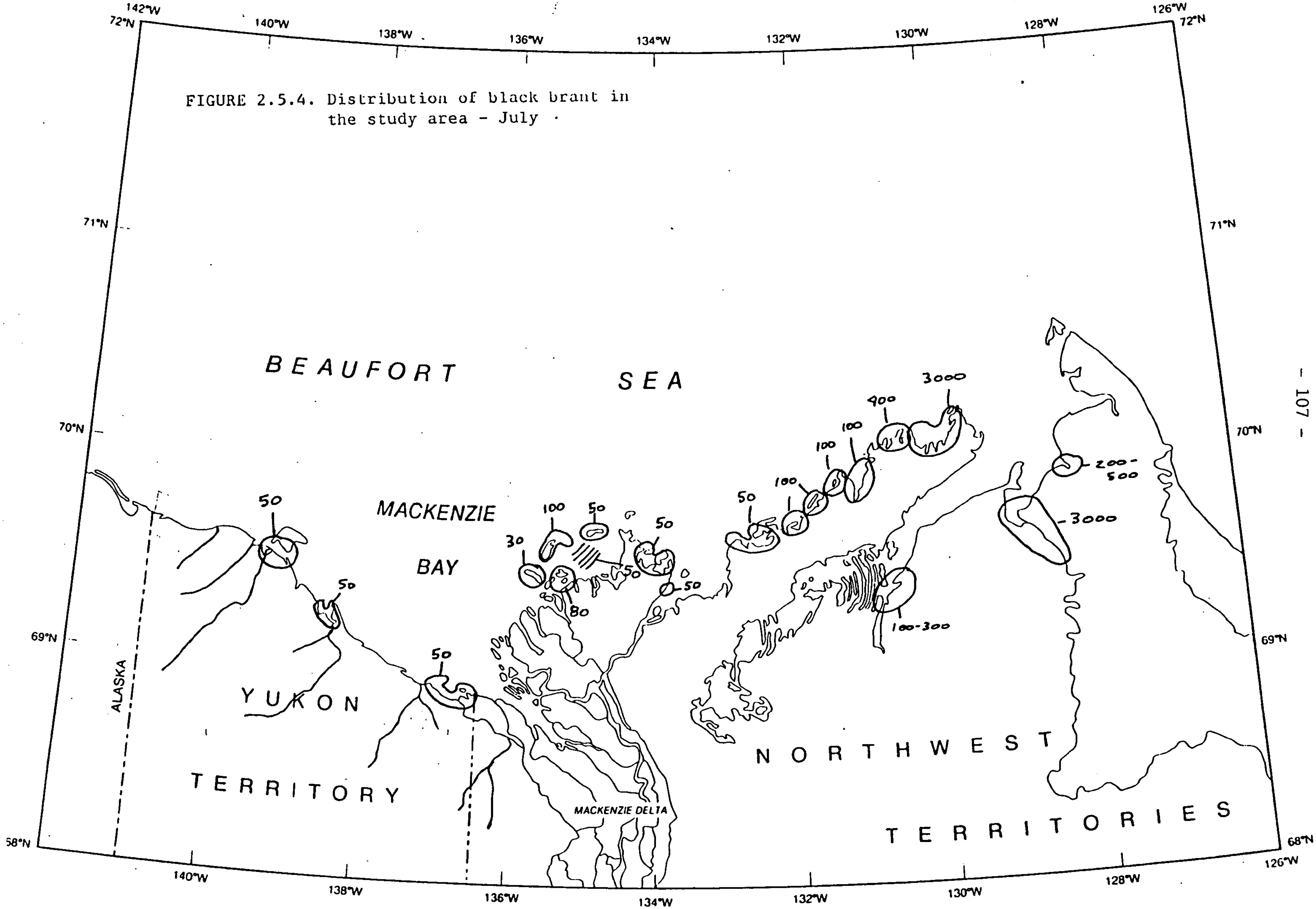


FIGURE 2.5.4. Distribution of black brant in the study area - July

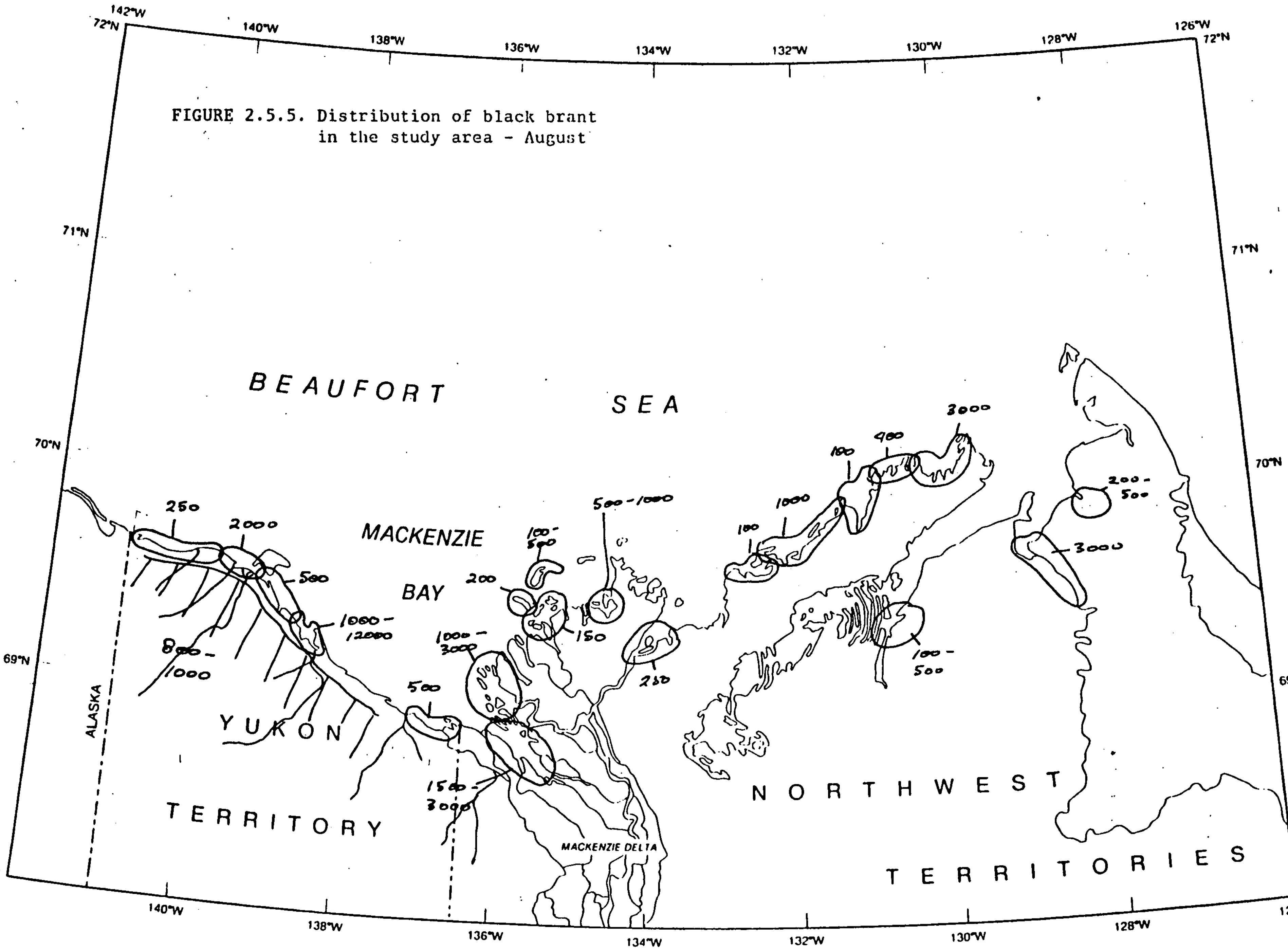


FIGURE 2.5.5. Distribution of black brant in the study area - August

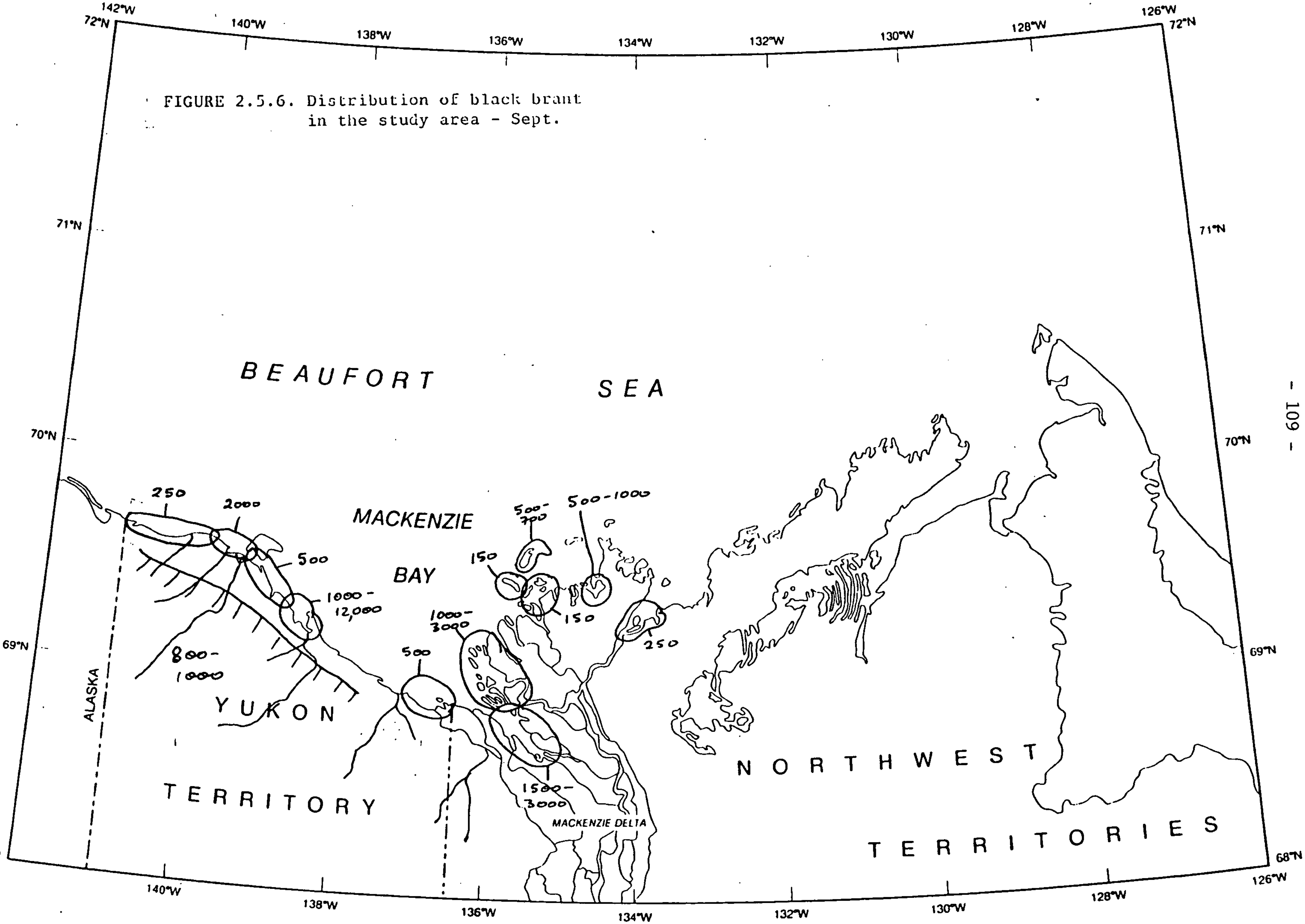


FIGURE 2.5.6. Distribution of black brant in the study area - Sept.

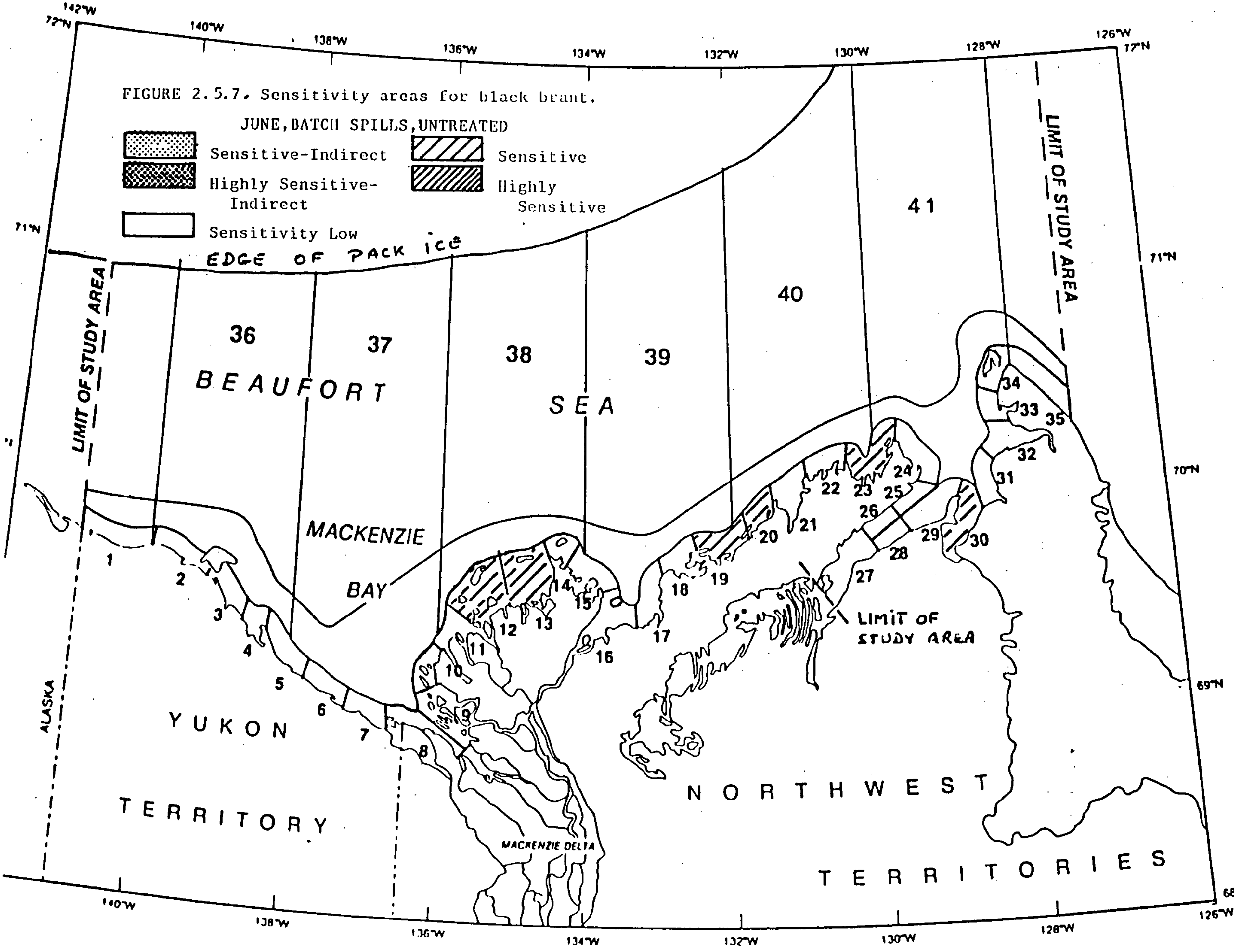


FIGURE 2.5.7. Sensitivity areas for black brant.

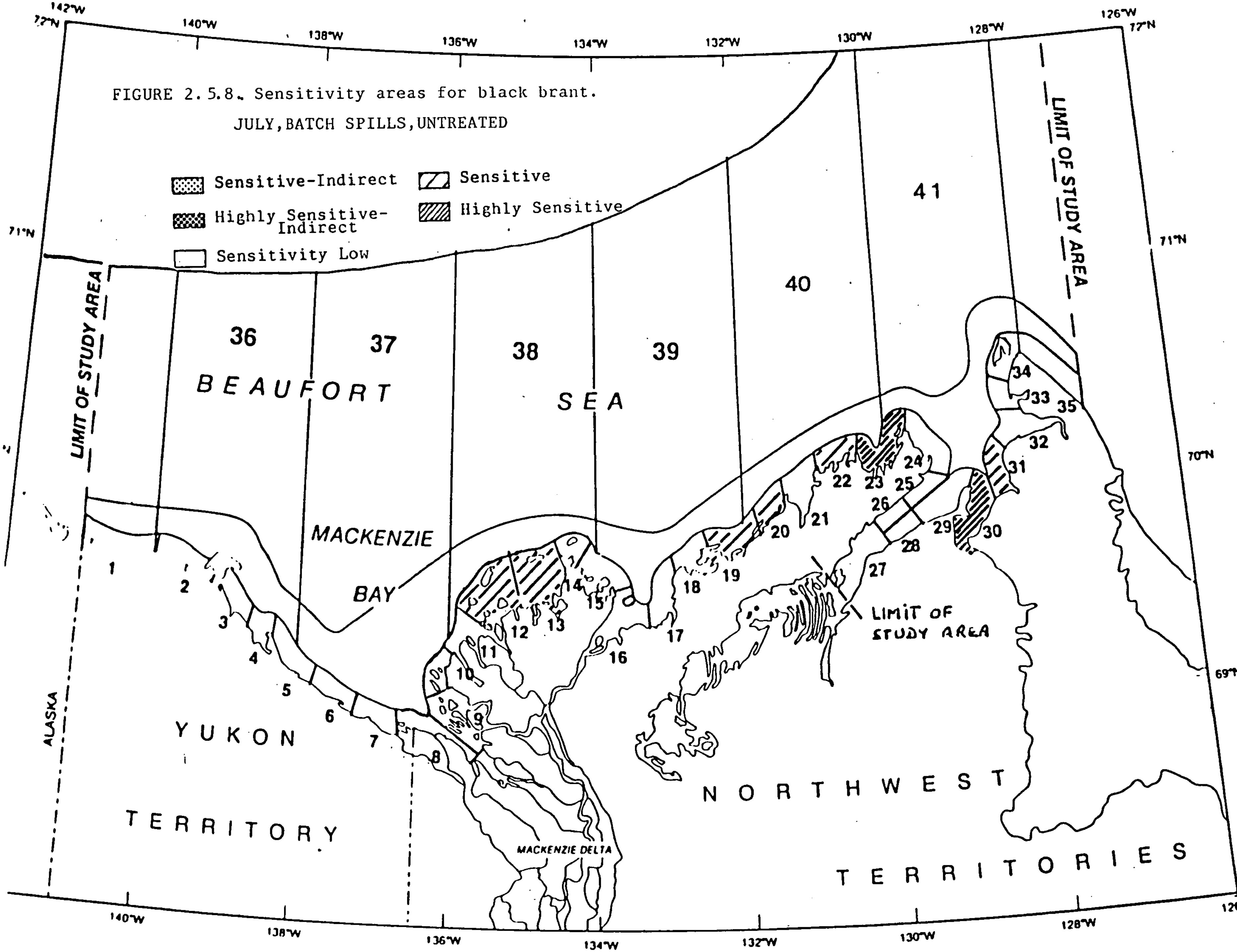
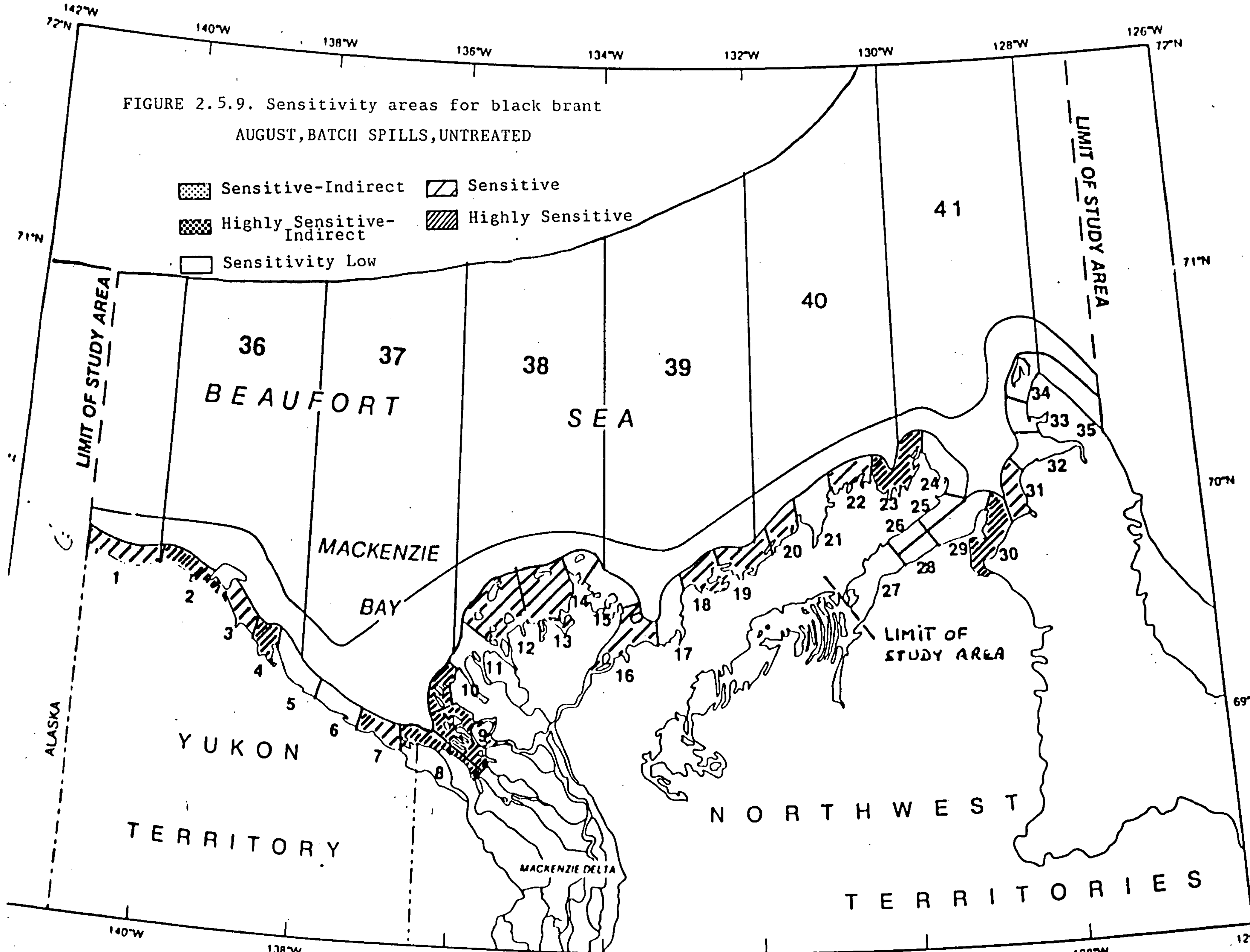


FIGURE 2.5.8. Sensitivity areas for black brant.
JULY, BATCH SPILLS, UNTREATED

FIGURE 2.5.9. Sensitivity areas for black brant
AUGUST, BATCH SPILLS, UNTREATED



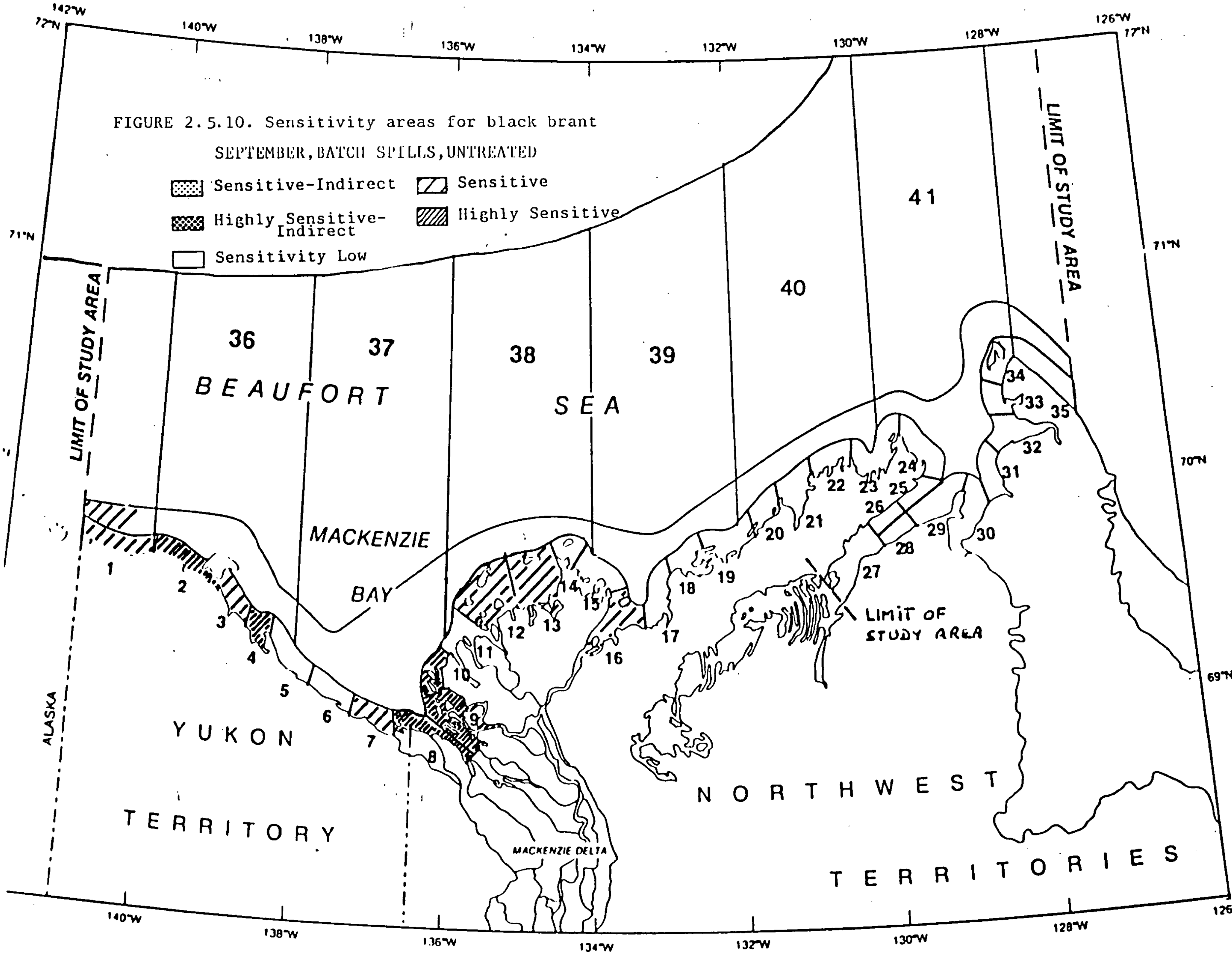


FIGURE 2.5.10. Sensitivity areas for black brant

SEPTEMBER, BATCH SPILLS, UNTREATED

2.6 GREATER SCAUP (Aytha marila mariloides)

Greater Scaup are common in the coastal areas of the southern Beaufort Sea from July to September. The North American population of greater scaup, which numbers roughly 750,000 individuals, breeds in the western Arctic from Hudson Bay to the west coast of Alaska and winters in the Atlantic, Pacific, and Gulf coasts as well as on the Great Lakes.

2.6.1 Population Status

The greater scaup that occur in the southern Beaufort Sea area belong to a population that breed in Canada both in coastal areas of the Beaufort Sea and inland in the tundra and open boreal forest as far south as the 60^{0}N. This population winters on the Atlantic and Gulf coasts and migrates between wintering and summer locations via interior routes. It is this population that is taken to be the target population in this case. According to Bellrose et al (1980) this population appears to number roughly 200,000 of which roughly 50,000 individuals breed in the vicinity of the Mackenzie Valley. However, a rough estimate of the numbers of birds using the coastal areas of the southern Beaufort Sea is only about 20,000 birds or roughly 10% of the target population. Both greater scaup and lesser scaup (Aytha affinis) occur in the southern Beaufort Sea area and frequent accounts of scaup do not distinguish between the two. However, Trauqer (cited in Bellrose et al 1980) report that most scaup in the Mackenzie Delta were greater as the lesser scaup preferred inland habitat.

2.6.2 Habits, Movements, and Timing Within the Sothern Beaufort Sea Area

Greater scaup move into the study area via inland routes arriving in the area in late May and early June. They nest mostly inland on the margins of tundra ponds. Egg laying takes place in Mid to late June. Only females incubate the eggs which hatch in early to mid-July. Young are fledged by early September just prior to the onset of the southward migration. There is no indication from the literature that females with young move to coastal areas for the moult or for pre-migratory staging. Hence females and young are invulnerable to marine spills.

Adult males of the population congregate in coastal areas and inland lakes for pre-moult migration, moulting and pre-moulting staging from early July through mid-September. Males begin to move to moulting areas shortly after females begin to incubate eggs in late June but the peak of the pre-moult migration appears to occur in mid -July. Moulting males have been observed by various authors from late June to mid to late August. Searing et al (1975) reported one group of greaters in the Parlaiyut Bay area which numbered roughly 450 birds in early July but increased to 1000 by late July and numbered over 2000 birds through August and early September. Migratory movements were observed from late August through early September and by late September most scaup had departed from the coastal areas of the southern Beaufort Sea.

2.6.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

Roughly 20,000 greater scaup or roughly 10% of the target population utilize coastal areas for moulting and staging during the open-water season. Hence, this population is not vulnerable to MODERATE or MAJOR effects in this area. In June few scaup have been observed in coastal areas. In July, August and September concentrations of several hundreds to several thousands of birds are observed. Concentrations have been observed on the Yukon coast of Housen Harbour, the Tuktoyaktuk Peninsula, and in eastern Liverpool Bay. Oil contamination in these areas would result in significant effects at the SLIGHT level.

References: Barry 1976; Johnson et al 1975; Bellrose et al 1980; Searing et al 1975.

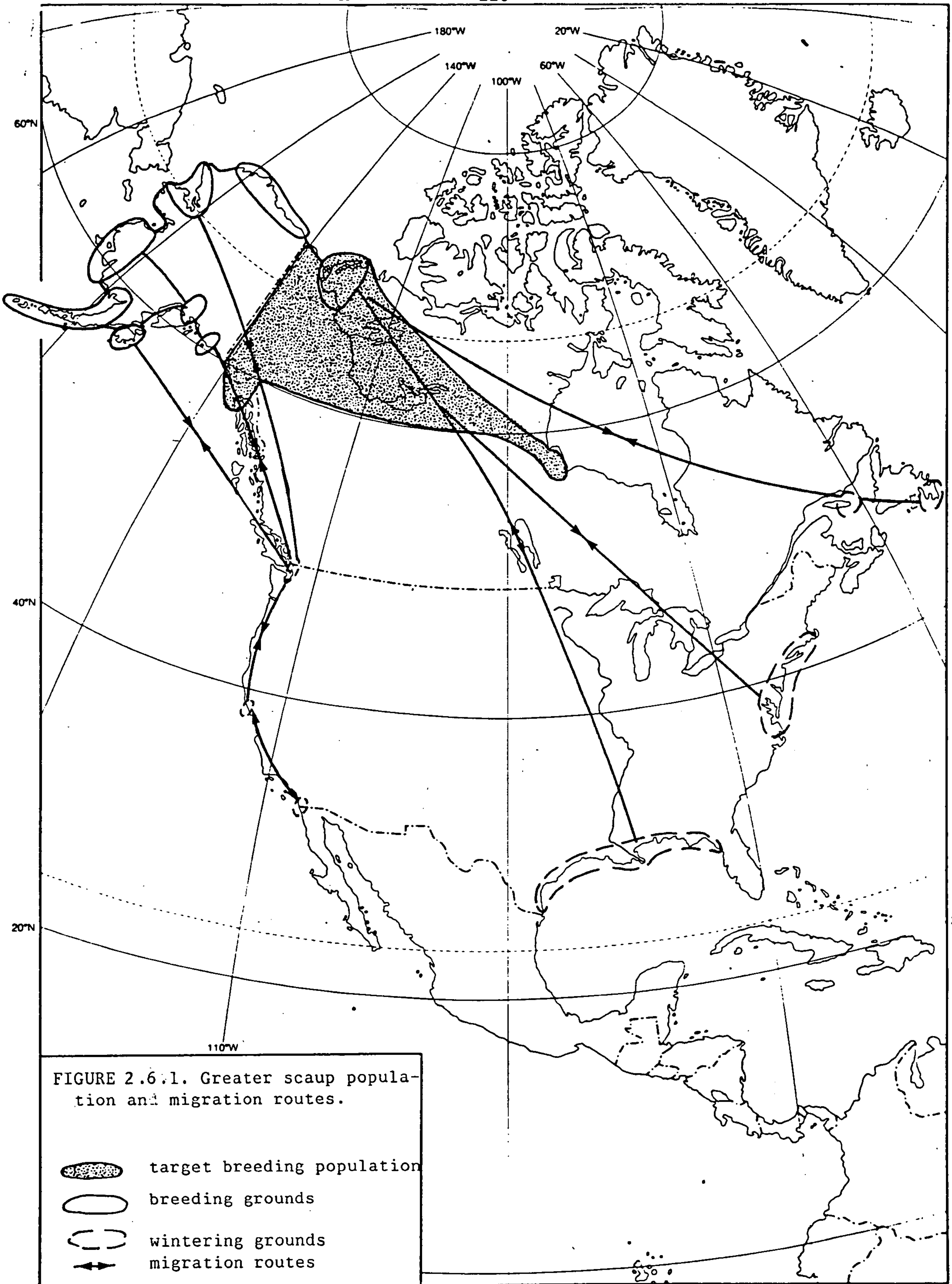
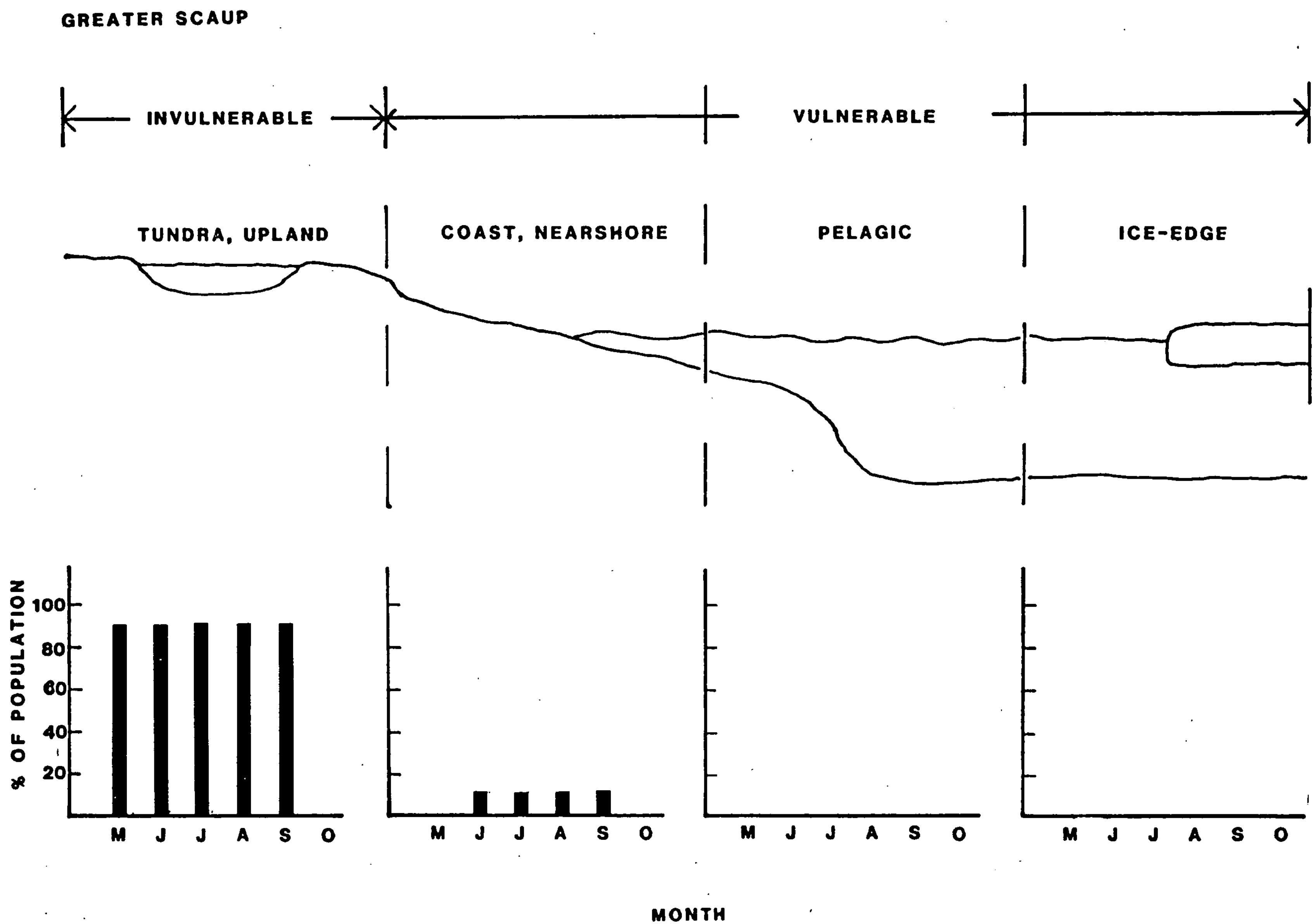


FIGURE 2.6.1. Greater scaup population and migration routes.

Figure 2.6.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



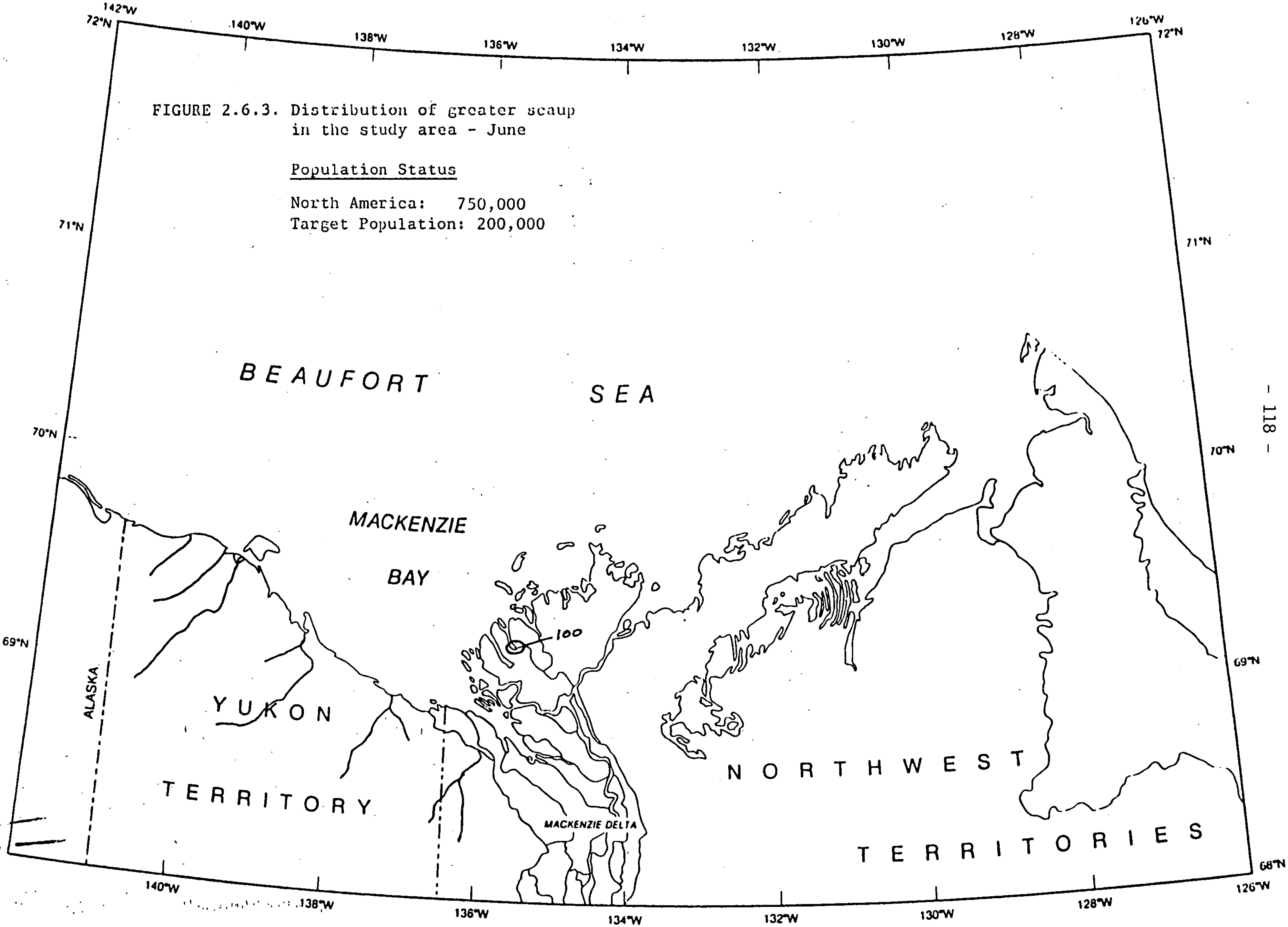


FIGURE 2.6.3. Distribution of greater scaup in the study area - June

Population Status

North America: 750,000
Target Population: 200,000

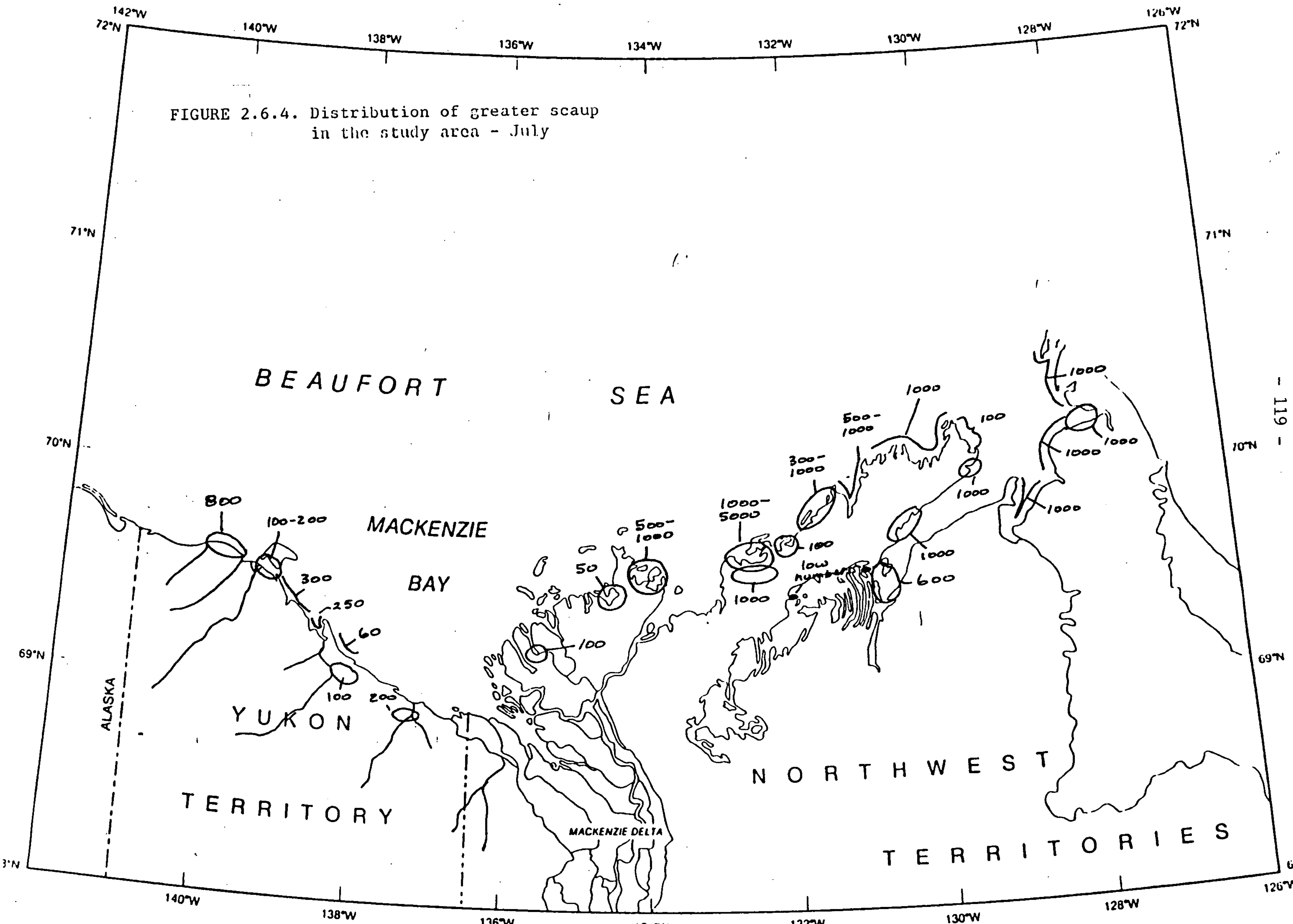
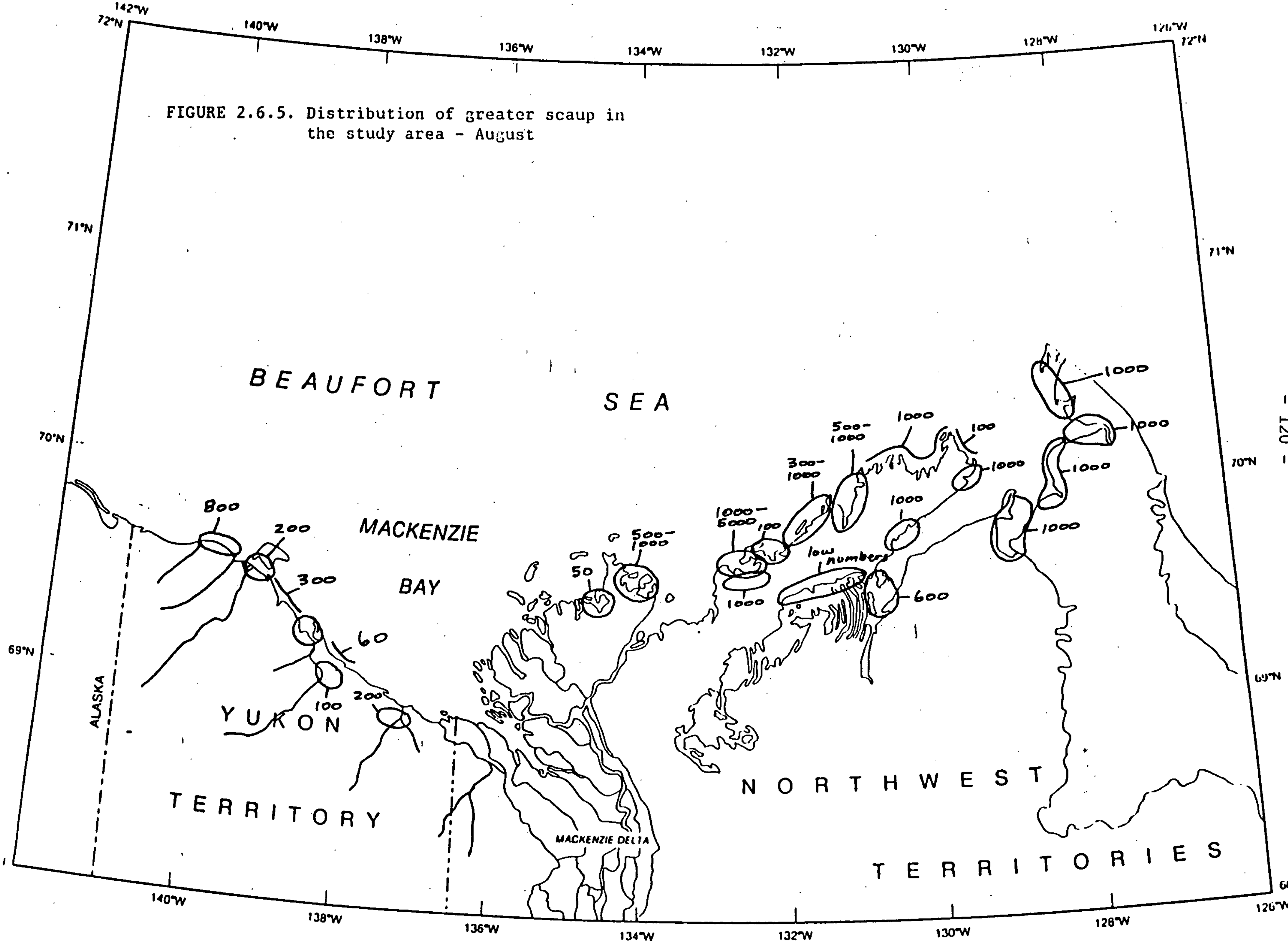


FIGURE 2.6.4. Distribution of greater scaup in the study area - July

FIGURE 2.6.5. Distribution of greater scaup in the study area - August



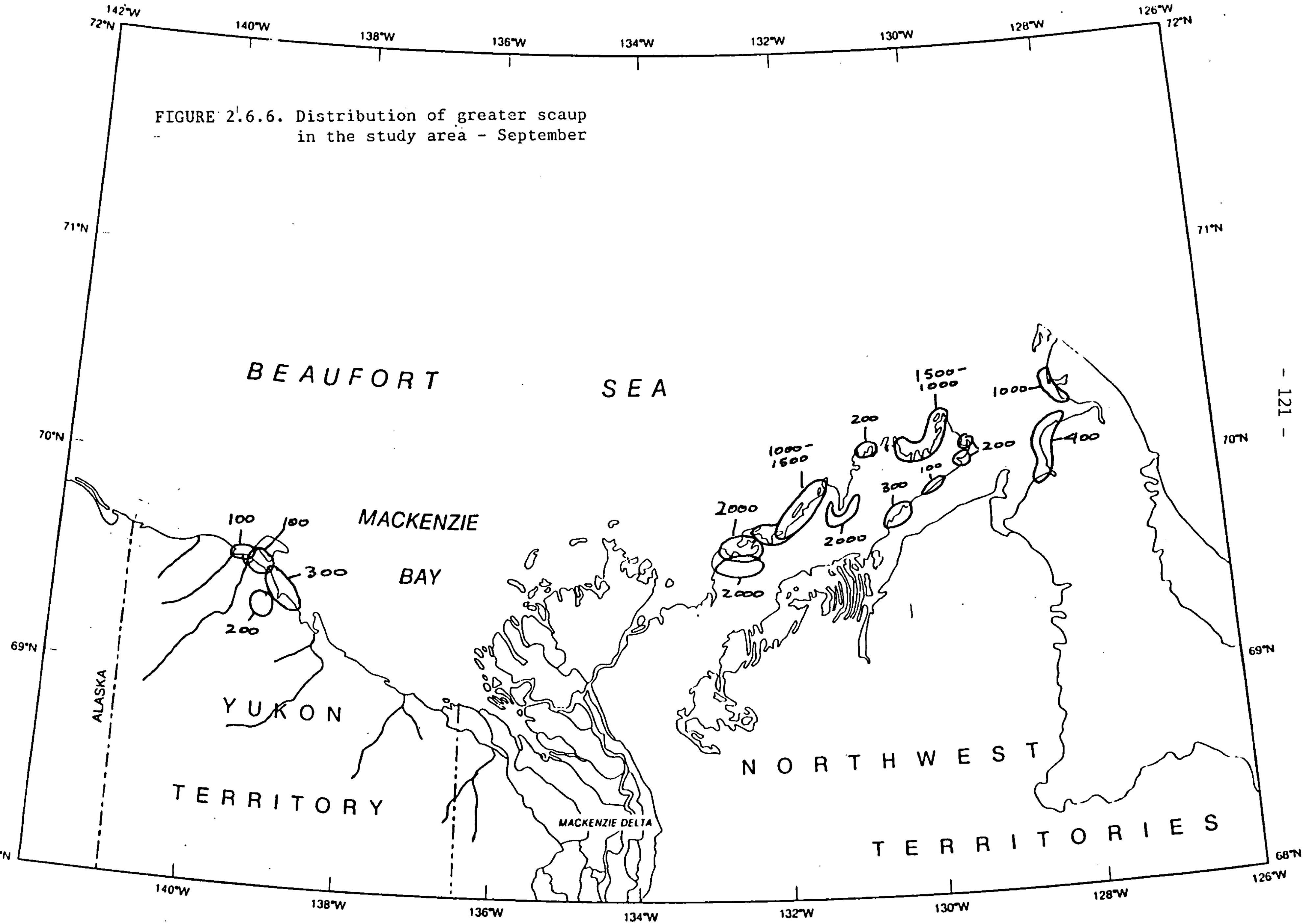


FIGURE 2.6.6. Distribution of greater scaup in the study area - September

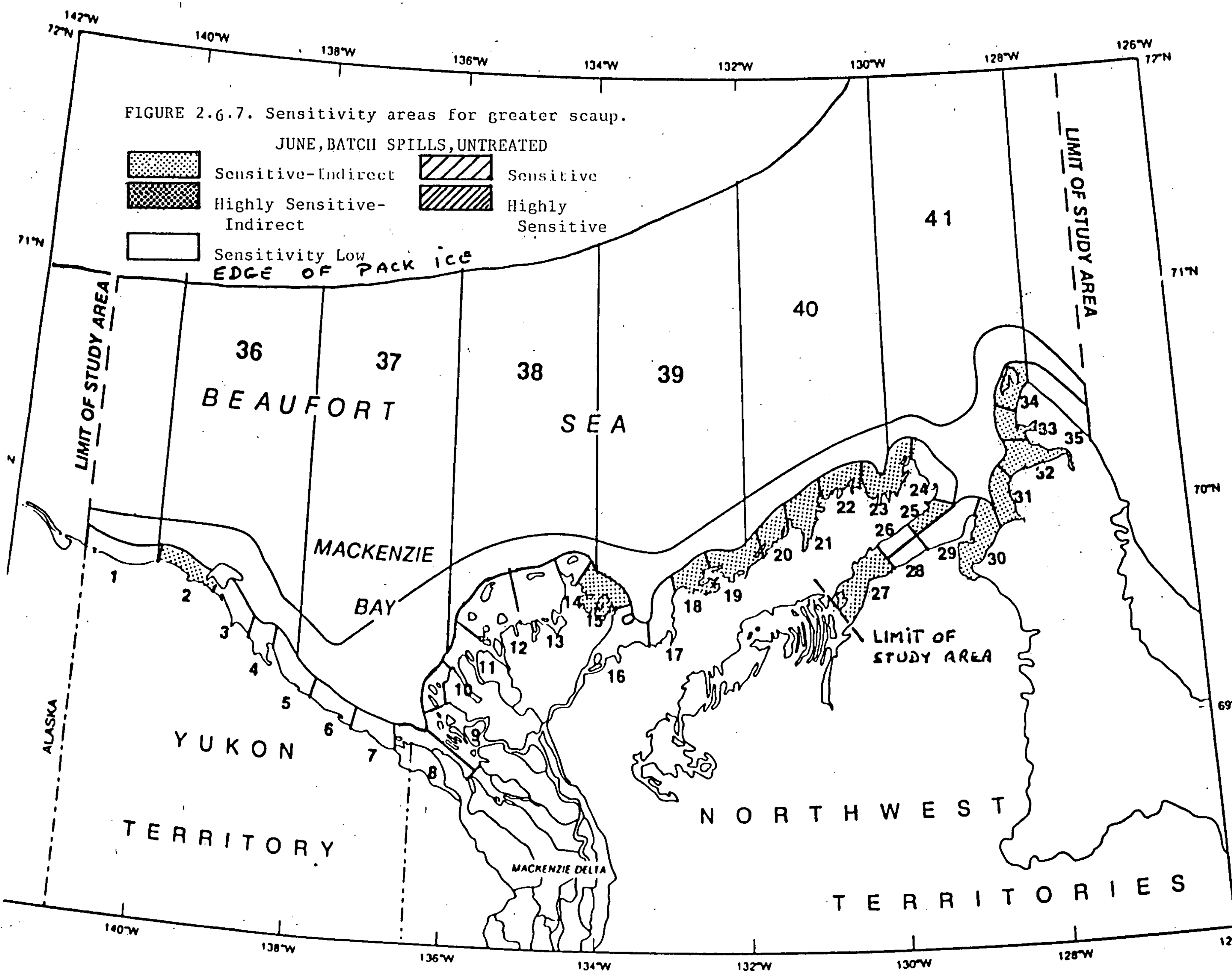


FIGURE 2.6.7. Sensitivity areas for greater scaup.

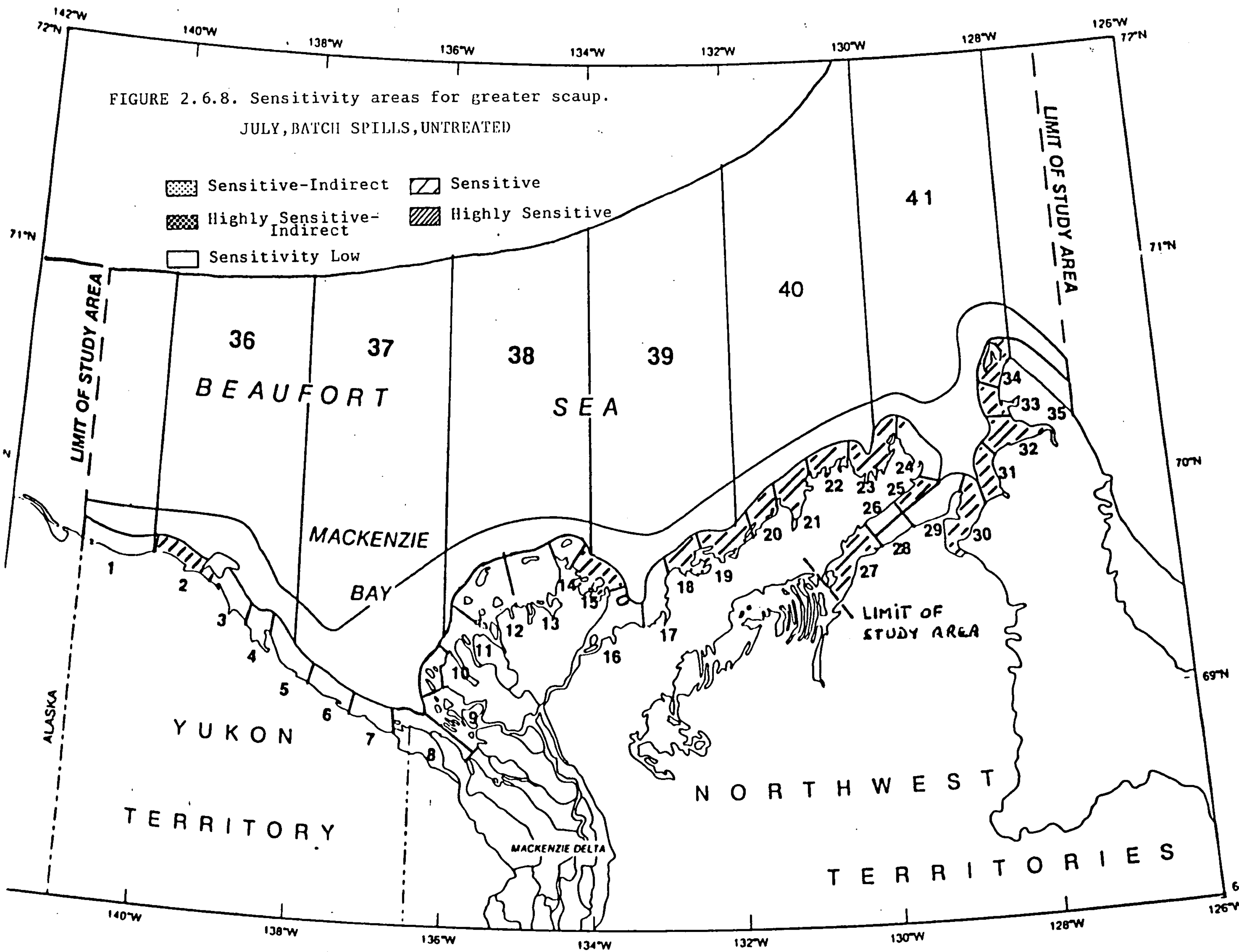


FIGURE 2.6.8. Sensitivity areas for greater scaup.

JULY, BATCH SPILLS, UNTREATED

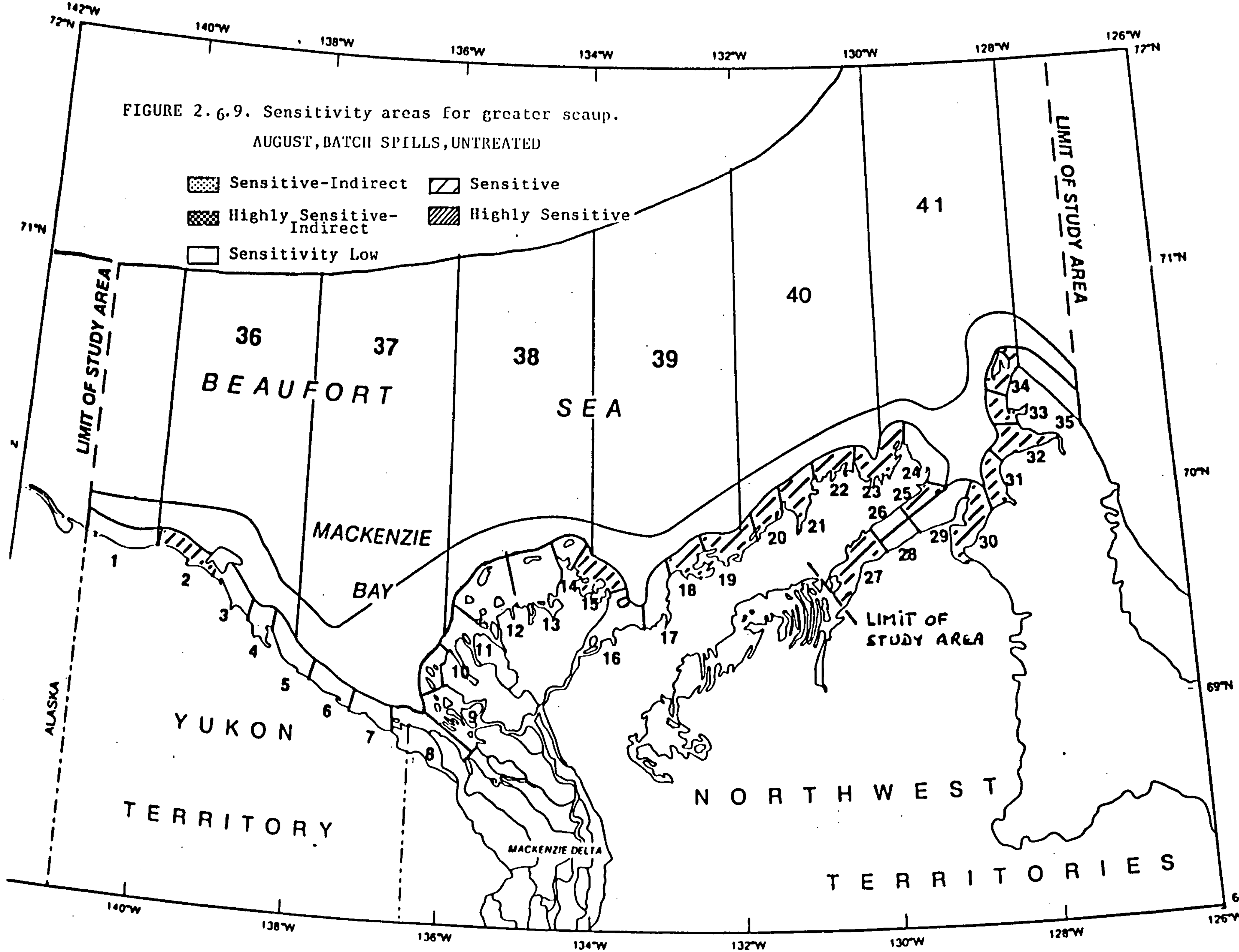


FIGURE 2.6.9. Sensitivity areas for greater scaup.
AUGUST, BATCH SPILLS, UNTREATED

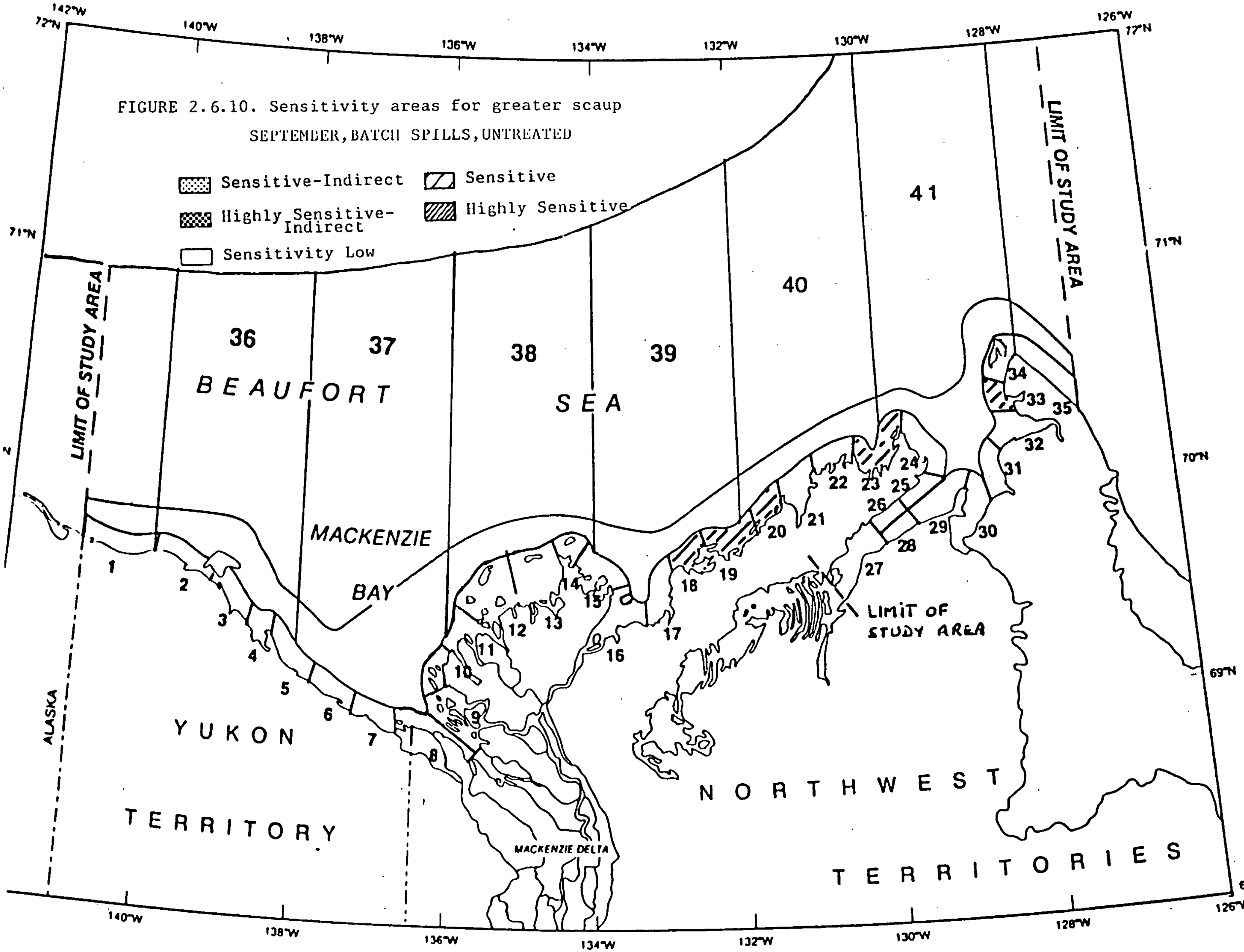


FIGURE 2.6.10. Sensitivity areas for greater scaup
SEPTEMBER, BATCH SPILLS, UNTREATED

2.7 SURF SCOTER (Melanitta perspicillata)

The surf scoter is one of the more common waterfowl species in the southern Beaufort Sea area although only a few birds actually nest in the area. Rather the species nest further south in the open boreal forest and move to the coast during the moulting season. The North American population breeds in the boreal forest of Canada and Alaska and passes the winter in the nearshore and offshore waters of both Pacific and Atlantic coasts. Migration between wintering and breeding areas is via inland routes. According to Bellrose et al (1980) estimates of the population size are imprecise, varying from year to year. Numbers of breeding surf scoter lie in the range of 250,000 to 750,000 birds.

2.7.1 Population Status

Unlike most other waterfowl species that are abundant in the southern Beaufort Sea area, the biology of surf scoter is rather poorly understood and it is not possible to identify unique sub-populations within the North American population on the basis of breeding sites and migration routes. In the absence of any data that would permit the identification of sub-populations, it has been necessary to treat the whole North American population as a single stock. Based on an analysis of works by Barry et al (1981), Searing et al (1975), and Smyth et al (1985), it appears that the peak numbers of surf scoters that use this area is roughly 10,000 to 25,000 individuals, representing much less than 10% of the total North American population.

2.7.2 Habitats, Movements, and Timing in the Southern Beaufort Sea Area

Surf scoter migrate into the southern Beaufort Sea area via inland routes following the Mackenzie Valleys as well as other river valleys and mountain passes in central Alaska, arriving by early June.

For the most part surf scoters breed in inland wooded habitat rather than on or near the coast. Indeed breeding females appear to shun coastal habitats completely nesting in inland areas rearing their young near their nest sites, and depart directly from the nesting site for wintering grounds along with their offspring without visiting the coastal areas of the southern Beaufort Sea. Hence females and young-of-the-year are invulnerable to the effects of marine spills.

Males and non-breeders, on the other hand, make extensive use of coastal areas. These individuals move to the inland breeding sites with the breeding females in late May or early June. Males begin to abandon their mates and move to coastal areas with non-breeders by mid-June to moult. Peak aggregations occur from mid-July to early August. Birds undertake a moult migration which takes them to barrier islands, spits and lagoons along the coast. The number of birds involved in this coastal moult migration may exceed the number of birds breeding in the areas near the coast, as these birds might be joined by migrants arriving from breeding sites in the interior south of the Mackenzie Delta. During this time the male and non-breeding population of surf scoter are vulnerable to coastal oil spills.

The fall migration of male and non-breeding surf scoters begins in late August, and by the latter part of September few migrants remain.

2.7.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

As mentioned above, surf scoters migrate from the wintering areas to their breeding areas via inland routes. This species nests inland in wooded habitat, and females depart this habitat directly to begin their fall southward migration without moving to the coast for moulting or staging.

On the other hand, males and non-breeders depart the nest areas soon after incubation begins and move to large lakes and to coastal areas where they moult and stage in preparation for the fall migration. Hence, only a portion of the local population is vulnerable to marine spills and vulnerability is greatest in July through September. In addition, since the target population for the species is the total North American population of several hundreds of thousands of birds, of which only 10,000 to 25,000 occur in the area of overall vulnerability, rating of this species is low.

In late June, July and early August, when males and non-breeders are loafing, moulting, and staging in coastal areas, the numbers of birds in coastal areas (and hence the number of birds vulnerable to marine oil spills) is much greater than in June. Although surf scoter are distributed throughout the study area there are several areas of concentration. In the west, several thousand surf scoter aggregate in the area of Workboat Passage and Nunaluk Spit. Several thousands of birds make use of the bays and breached lakes of the north coast of the Tuktoyaktuk Pensinsula from Toker Point to Cape Dalhousie. Several hundreds of individuals appear to make use of the coastal area of western and northern Liverpool Bay. Several thousands of individuals occupy the coastal area stretching from Wood Bay to the tip of Cape Bathurst, including the coastal areas of Cape Wolki and Harrowby Bay.

Hence in July and August surf scoter are vulnerable at the SLIGHT level to the effects of spills in the Hershel Island-Phillips Bay area, along the Tuktoyaktuk Peninsula and in Wood and Harrowby Bays.

By late August and September many scoter have departed levaing only a few thousand individuals in the study area. Concentrations of several thousands of birds occur in the western part of the study area where sills may result in effects at the SLIGHT level. However in the remainder of the study area only low numbers of birds occur.

References: Barry et al 1981; Bellrose et al 1980; Johnson et al 1975; Searing et al 1975; Smyth et al 1985.

TABLE 4 Approximate numbers of surf scoter at coastal locations in the southern Beaufort Sea in July and early August

Location	Minimum Estimate	Maximum Estimate
Clarence Lagoon	50	50
Nunaluk Spit	1000	3000
Workboat Passage	1000	5000
Phillips Bay	50	100
Babbage Bight	100	300
Outer Mackenzie Delta	100	500
Hansen Harbour		
Mason Bay	100	500
Token Point		
Atkinson Point	500	2000
Hutchison Bay	4400	8900
McKinley Bay	800	8100
Philips Island to Cape Dalhousie	1000	2000
Shore of Western Liverpool Bay	1000	2000
Cape Wolki	1000	1000
Harronby Bay	1000	1000
West Cape Bathurst	500	1000
TOTAL	12600	35450

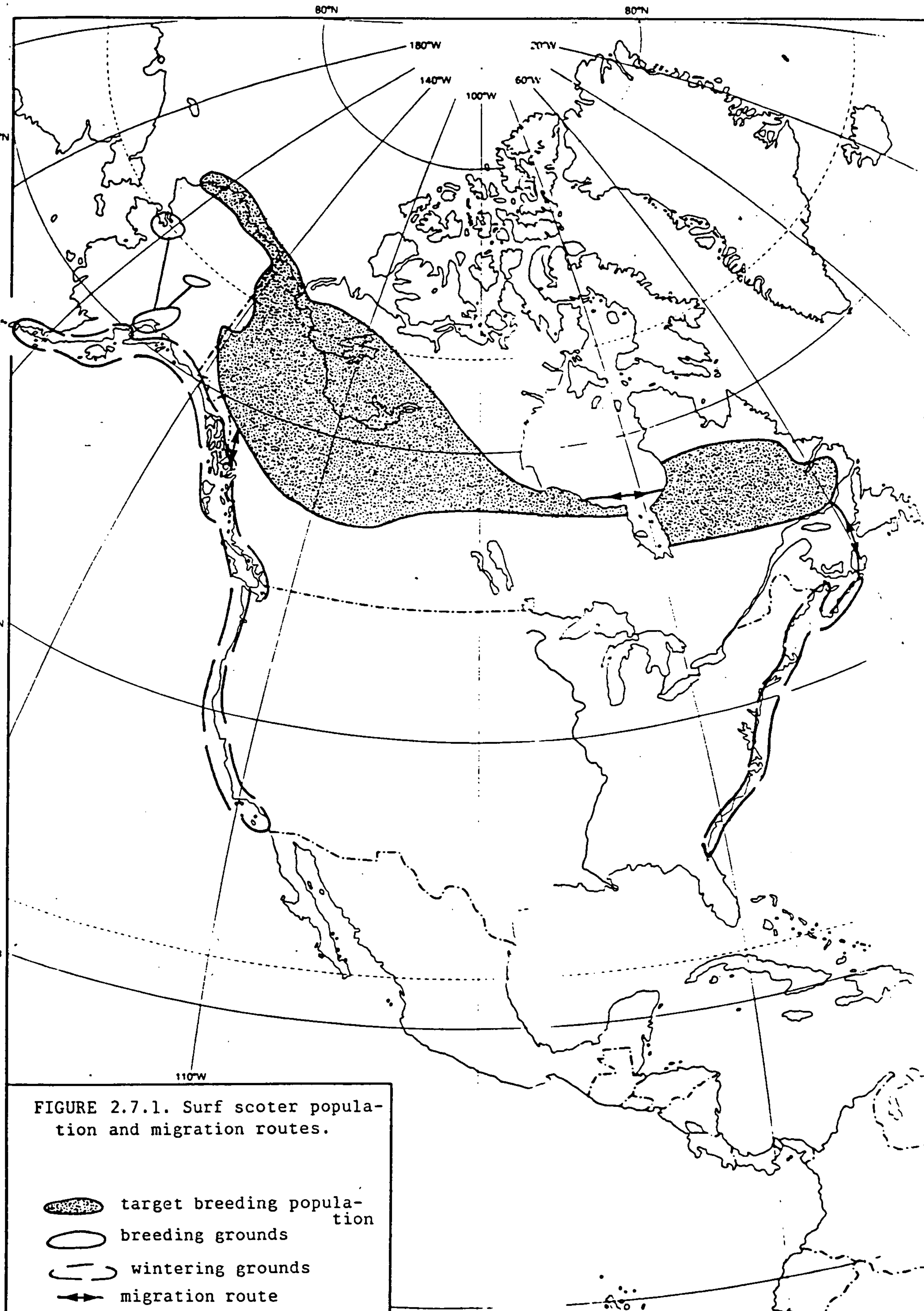
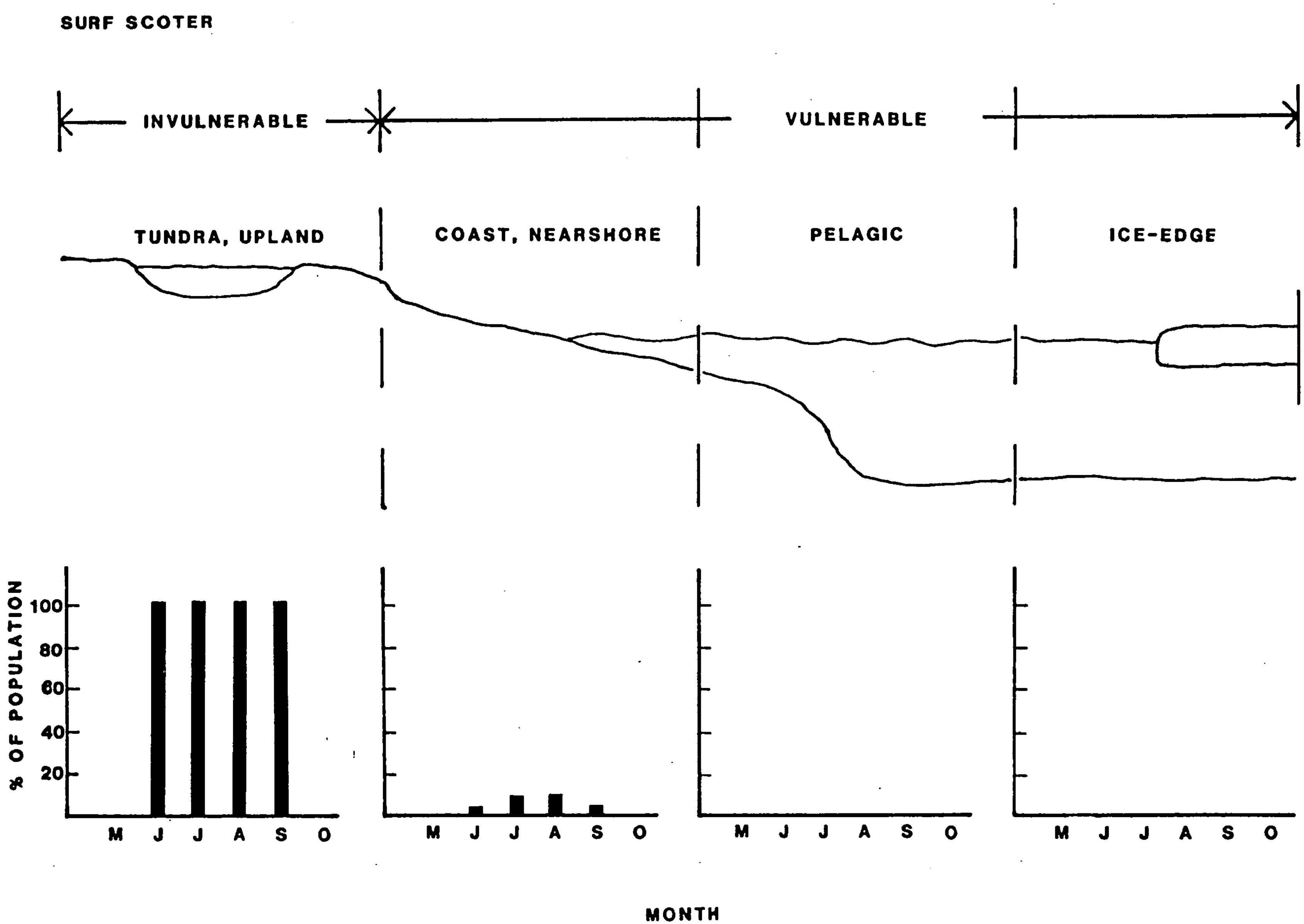


FIGURE 2.7.1. Surf scoter population and migration routes.

Figure 2.7.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



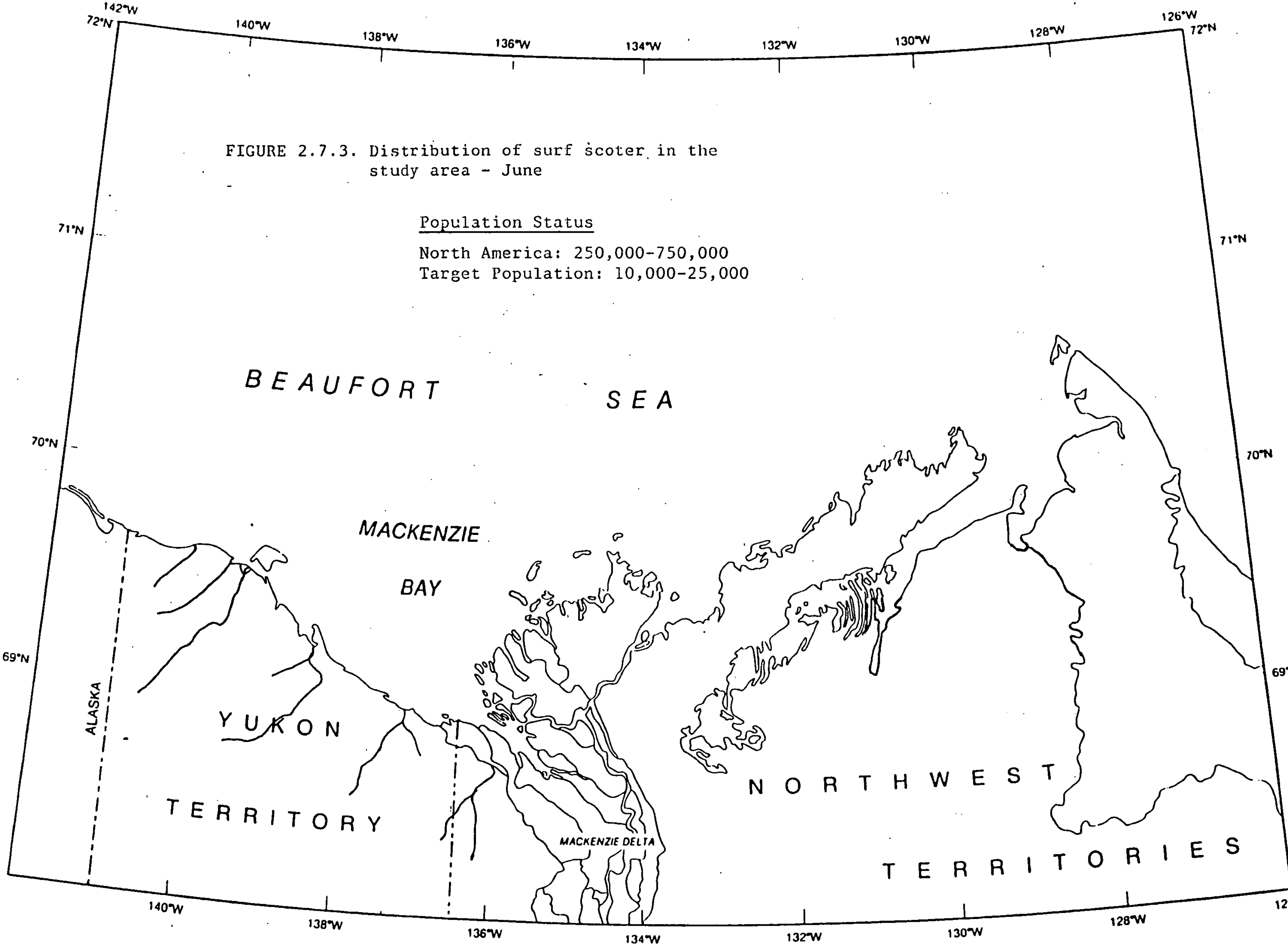
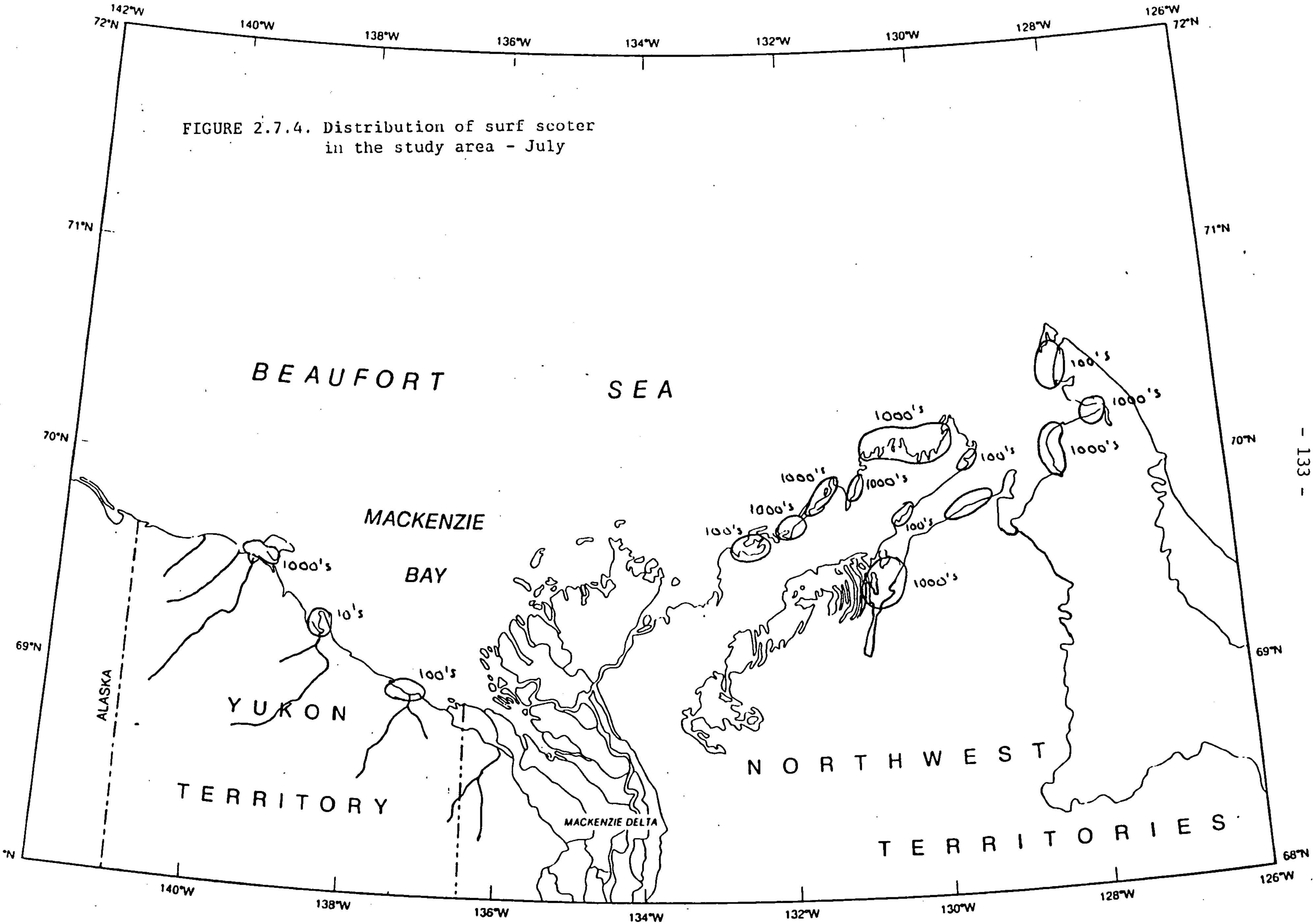


FIGURE 2.7.3. Distribution of surf scoter in the study area - June

Population Status

North America: 250,000-750,000
Target Population: 10,000-25,000

FIGURE 2.7.4. Distribution of surf scoter
in the study area - July



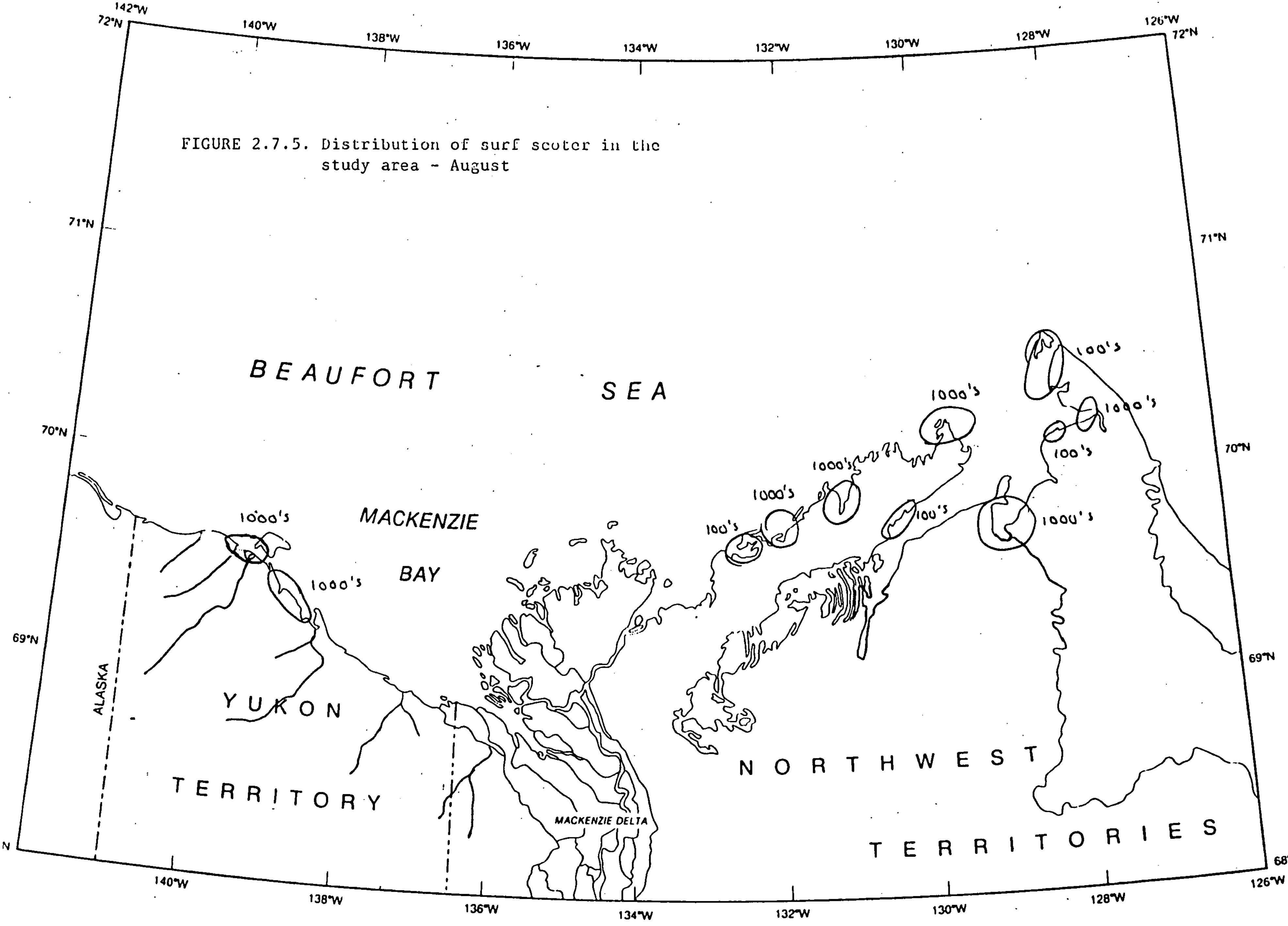


FIGURE 2.7.5. Distribution of surf scoter in the study area - August

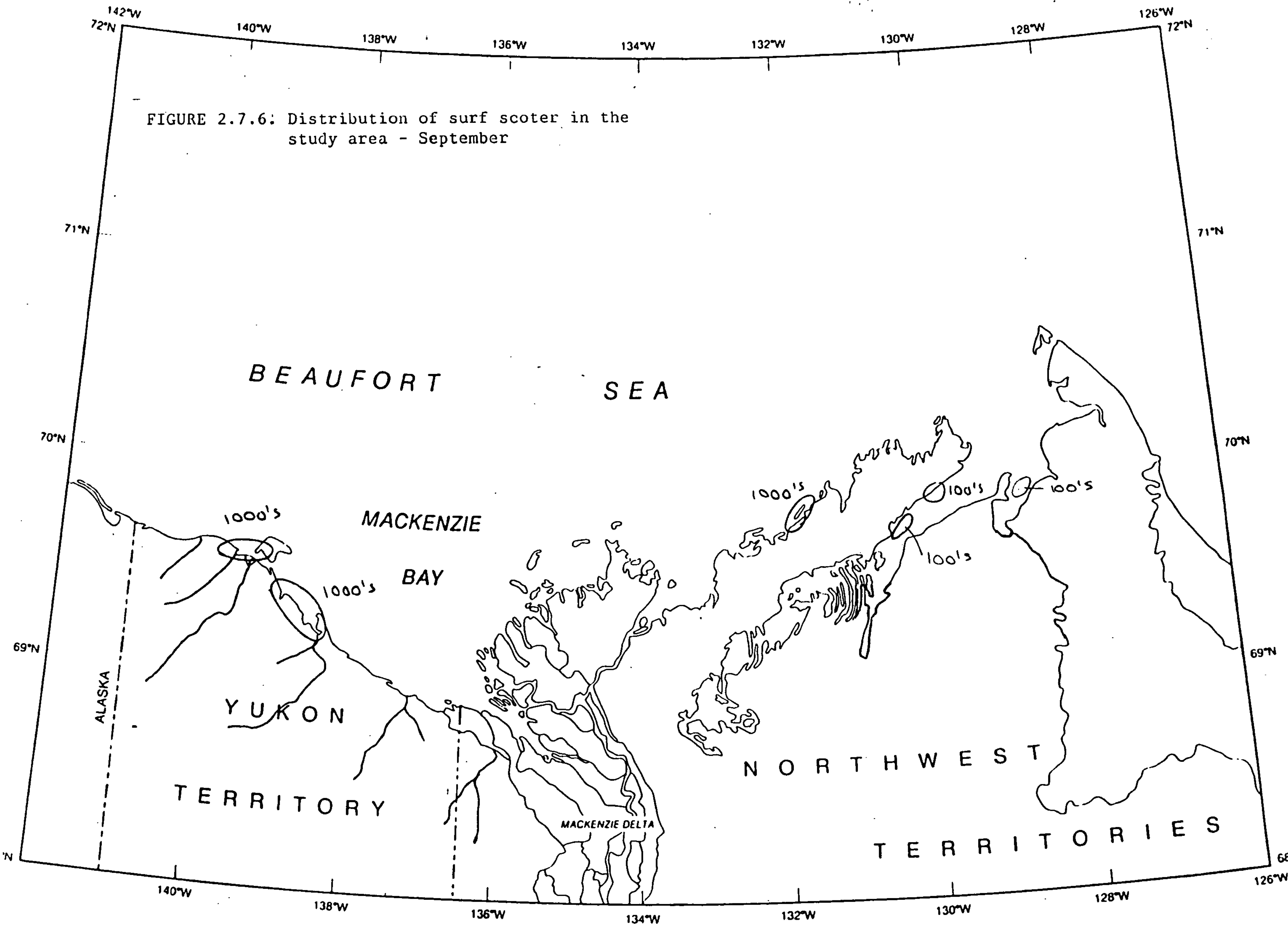


FIGURE 2.7.6: Distribution of surf scoter in the study area - September

FIGURE 2.7.7. Sensitivity areas for surf scoter.

JUNE, BATCH SPILLS, UNTREATED

Sensitive Indirect
Highly Sensitive-Indirect
Sensitivity Low
Sensitive
Highly Sensitive

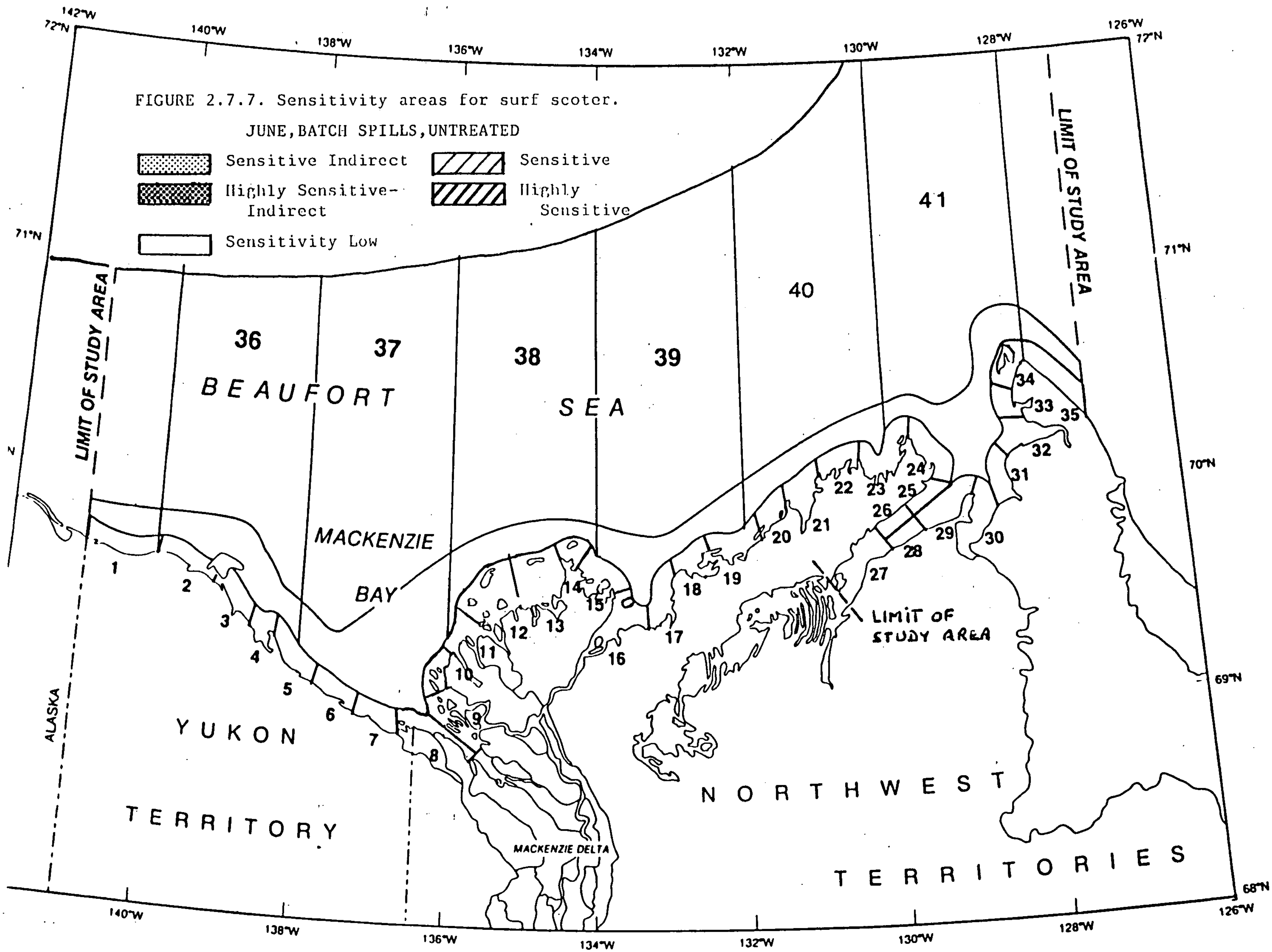
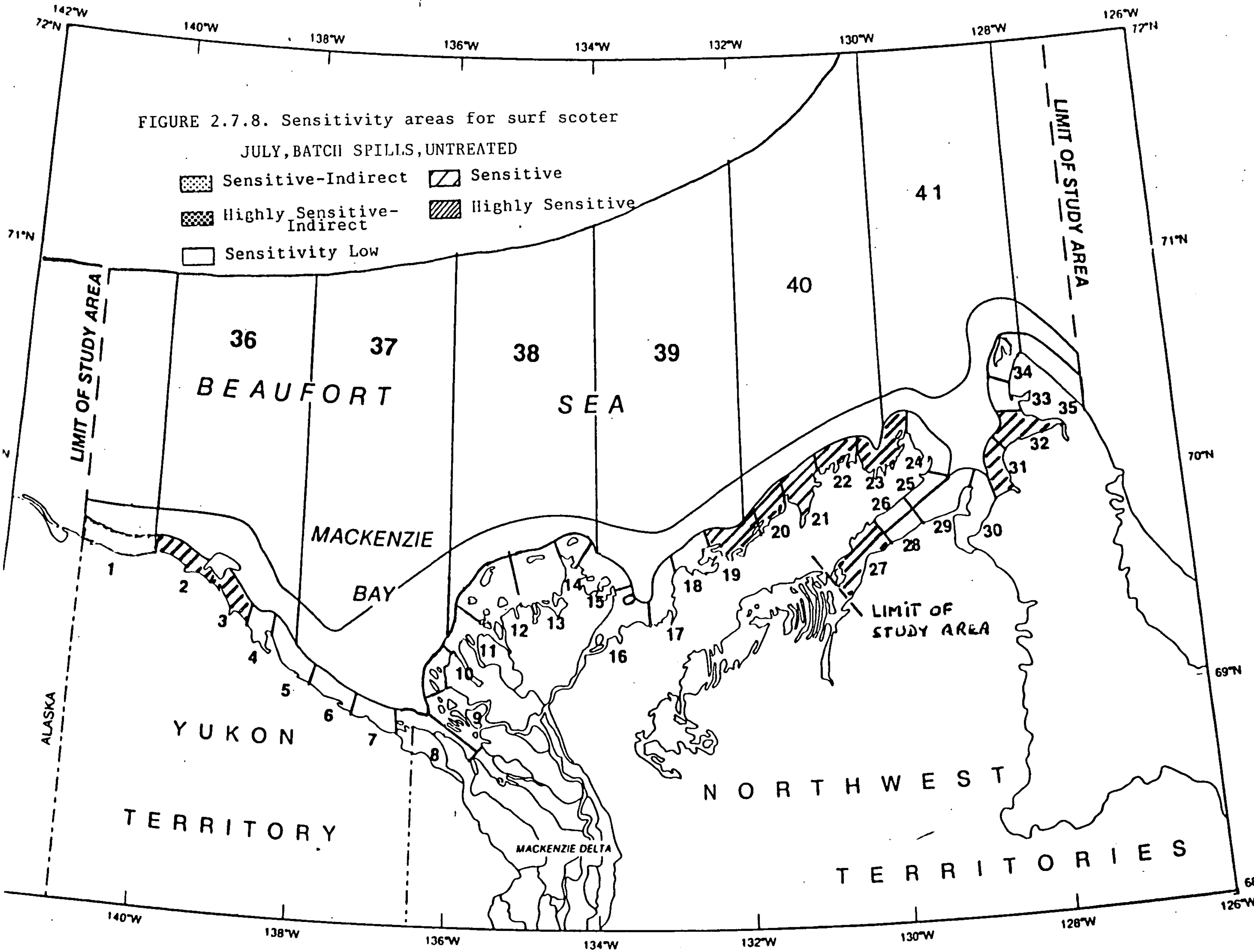


FIGURE 2.7.8. Sensitivity areas for surf scoter

JULY, BATCH SPILLS, UNTREATED



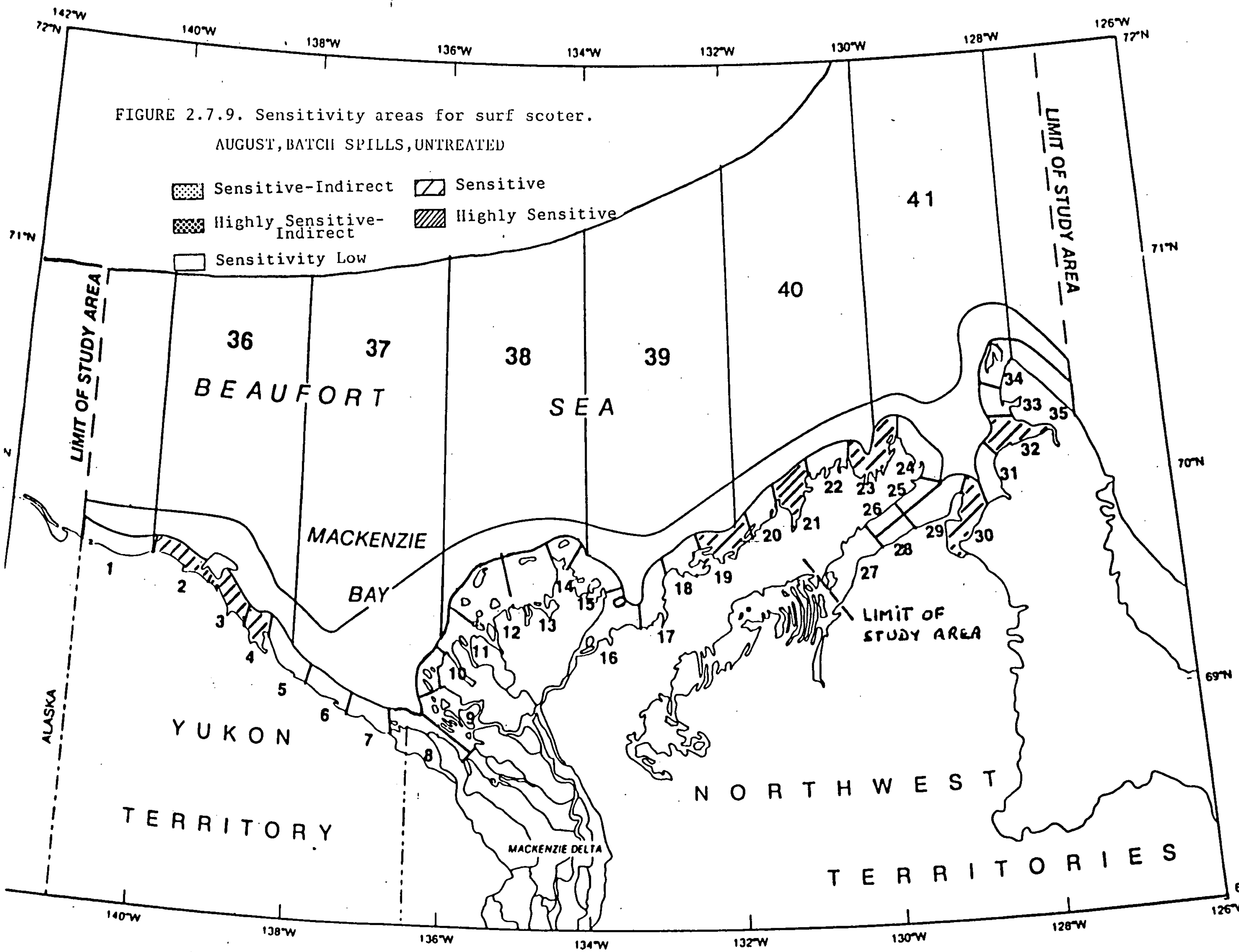


FIGURE 2.7.9. Sensitivity areas for surf scoter.
AUGUST, BATCH SPILLS, UNTREATED

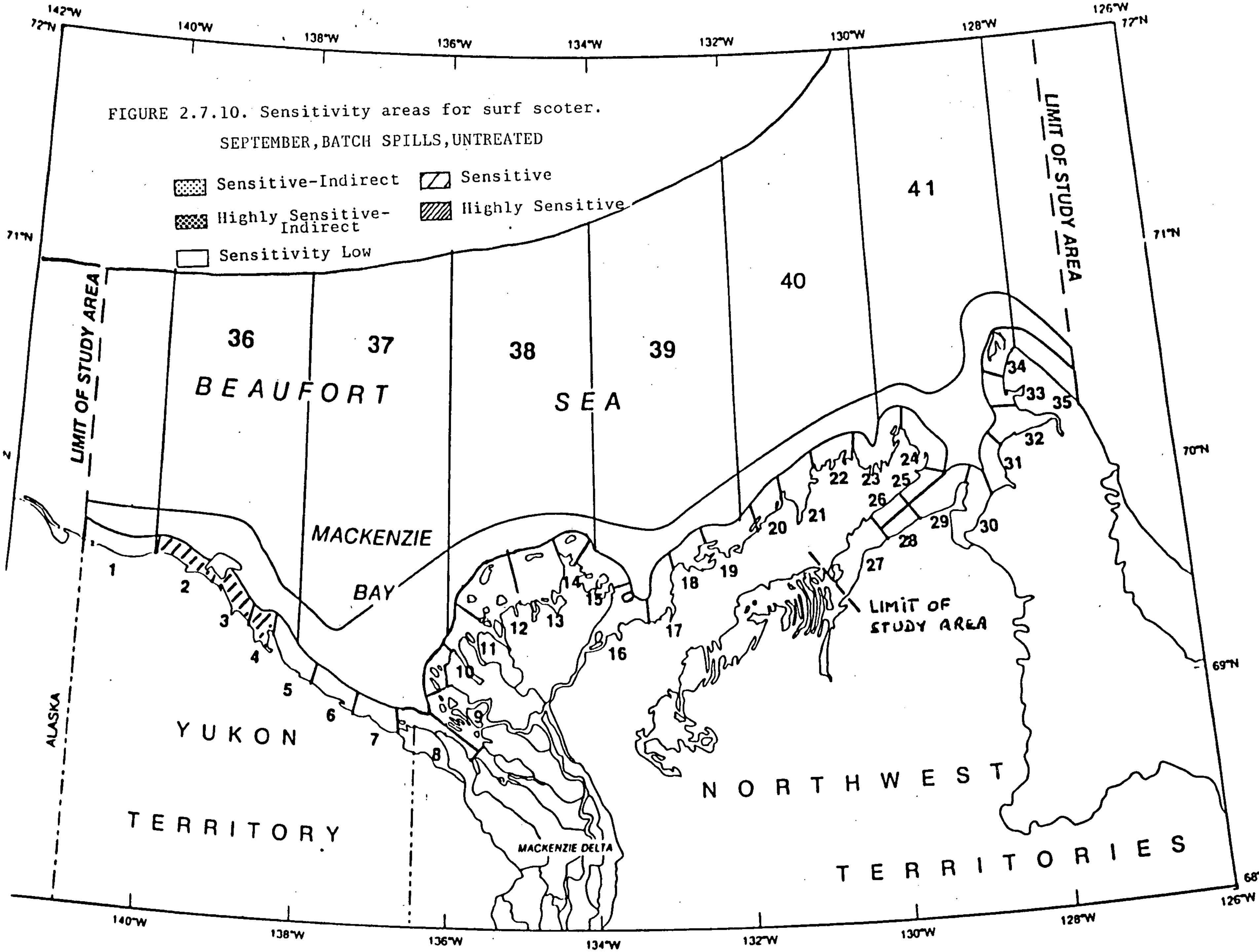


FIGURE 2.7.10. Sensitivity areas for surf scoter.
SEPTEMBER, BATCH SPILLS, UNTREATED

2.8 OLDSQUAW (Clangula hyemalis)

Oldsquaw ducks are reported by several sources to be the most common breeding duck species in the southern Beaufort Sea area. Oldsquaws are circumpolar in their breeding distribution and in North America they are almost continuous in their distribution from Alaska to Labrador. They breed both in coastal and inland areas from the southern limits of the tundra to well north into the arctic islands. The species winters on both Pacific and Atlantic coasts and migrates between breeding and wintering areas using both coastal and inland routes. Bellrose et al (1980) estimates the North American population of oldsquaw to be from three to four million birds.

2.8.1 Population Status

The oldsquaws that occur in the southern Beaufort Sea area use the area for breeding and for migration between wintering areas on the Pacific coast and breeding sites to the east. A portion of these birds winter on the Pacific Coast and migrate into the area via the coastal migration route around Alaska, or through the interior of Alaska following major river systems. It appears that a portion of the population winters in the east on the Great Lakes and reaches the area overland through the Mackenzie Valley. For the present work the target population was defined as those birds that breed within the study area as well as those that breed to the east of the study area as far east as Queen Maud Gulf and migrate through the southern Beaufort Sea. There appears to be some lack of agreement over the size of the population. Bellrose et al (1980) reports that the aerial surveys of the U.S. Fish and Wildlife Service estimate a population of some 200,000 oldsquaws in the Mackenzie Delta - Liverpool Bay area, while Barry (1976) reports only some 40,000 birds in the western and cental Canadian Arctic, many of which occur to the east of the study area. A rough estimate of the number of oldsquaws within the study area based on the works of Barry et al (1981), Searing et al (1975), and Smyth et al (1985) places their numbers at least in the range of 20,000 to 30,000 birds. This value, coupled with estimates of numbers of birds in breeding areas to the east of the study area reported in Bellrose et al (1980) (Banks Island, 6000-10,000; Victoria Island and Prince Albert Peninsula, 20,000; Queen Maud Gulf, 12,000) yield an estimate of roughly 100,000 individuals from the population that breeds or migrates through the study area. This was the value used as the size of the target population in this work.

2.8.2 Habits, Movement and Timing in the Southern Beaufort Sea Area

As mentioned, the oldsquaws that breed in or migrate through the S.B.S. area reach this area arriving in the area in late May or early June. Oldsquaws nest in clusters or colonies, on islands, in coastal locations, or in inland areas near tundra lakes or ponds. Eggs are laid in mid June and hatching occurs in mid to late July.

Females incubate alone, with males and non-breeders leaving the nest sites as soon as incubation begins. Females lead their young to the nearest water soon after hatching. Females moult during the last stages of development of the ducklings and both females and young are able to fly by September.

In late June, males and non-breeders leave the nest site and move westward to coastal areas forming large moulting flocks. These birds gather in bays, lagoons and behind barrier islands along the coast of the Northwest Territories, Yukon, and Alaska. The premoult migration is completed by mid-July when the moult occurs. These birds remain in these areas through July and August, and begin their fall migration to wintering areas in late August, prior to the commencement of migration by adult females and young.

The peak of fall migration occurs in Alaska in September when females and young begin to pass observation sites in coastal Alaska. Apparently fall migrants follow the same migration routes as they do in the spring.

Oldsquaw are therefore vulnerable to marine spills in May during the spring migration when they occur in flocks of several thousands of birds in offshore areas. Significant numbers of migrants are present in offshore areas in June but the majority of the population appears to be in inland areas at their breeding sites at this time. In July through September a major proportion of the population is in coastal areas moulting and staging for the fall migration where they are vulnerable to the effects of spills.

2.8.3 Distribution and Vulnerability Within the Southern Beaufort Sea Area

The available data suggest that significant proportions of the Oldsquaw population (sub population) are present in offshore areas, coastal habitats, as well as in inland areas from June to September or early October.

In offshore areas, the greatest densities of migrating oldsquaws occur in leads in the ice wihin 50 km of Cape Dalhousie and Baillie Islands. These assemblages can be as large as 1000 to 5000 birds. In June, flocks of 100's to 1000's of birds have been observed up to 50 km offshore, across the full width of the study area. Barry (1976) observed the largest flocks off the northwest Mackenzie Delta, off eastern Tuktoyaktuk Peninsula, and off Liverpool Bay, with smaller flocks in the western part of the study area and off Kugmallit Bay. There are no data regarding changes from day to day or from year to year so it must be assumed that flocks in the 100's to 1000's range may occur at any location in the near offshore during June. A similar pattern appears to be true in July, with the possible qualifier that birds have moved into coastal areas for moulting and feeding. Barry (1976) observed much smaller numbers of birds in the offshore in August and September with only a few small (100 birds) flocks noted. Hence, offshore spills in

June and July pose a significant risk at the SLIGHT level to birds in the offshore, while spills in August and September pose little threat.

Many thousands of birds, a highly significant proportion of the oldsquaw population, make use of the coastal zone in the study area for breeding, moulting, and staging from late June to September.

In June the data suggest that only low numbers of oldsquaw are present in coastal areas and hence their vulnerability is low. In July and August large numbers occur in coastal areas in concentrations of a few hundreds of birds to as high as 8,000 to 10,000 birds. Major concentrations of birds occur in the western part of the study area near Herschel Island, along the Tuktoyaktuk Peninsula, in Liverpool Bay and from Wood Bay to Cape Bathurst. Contamination of coastal habitat in these areas would result in effects at the SLIGHT level. In September large concentrations have been observed in many of the areas that are highly sensitive in July and August but the overall numbers of birds in coastal areas is lower and the large concentrations of birds are confined to only a few sites near Herschel Island, Hutchison Bay, Western Liverpool Bay and Wood Bay.

<u>References</u>: Barry 1976; Barry et al 1981; Bellrose et al 1980; Johnson et al 1975; Searing et al 1975; Smyth et al 1985.

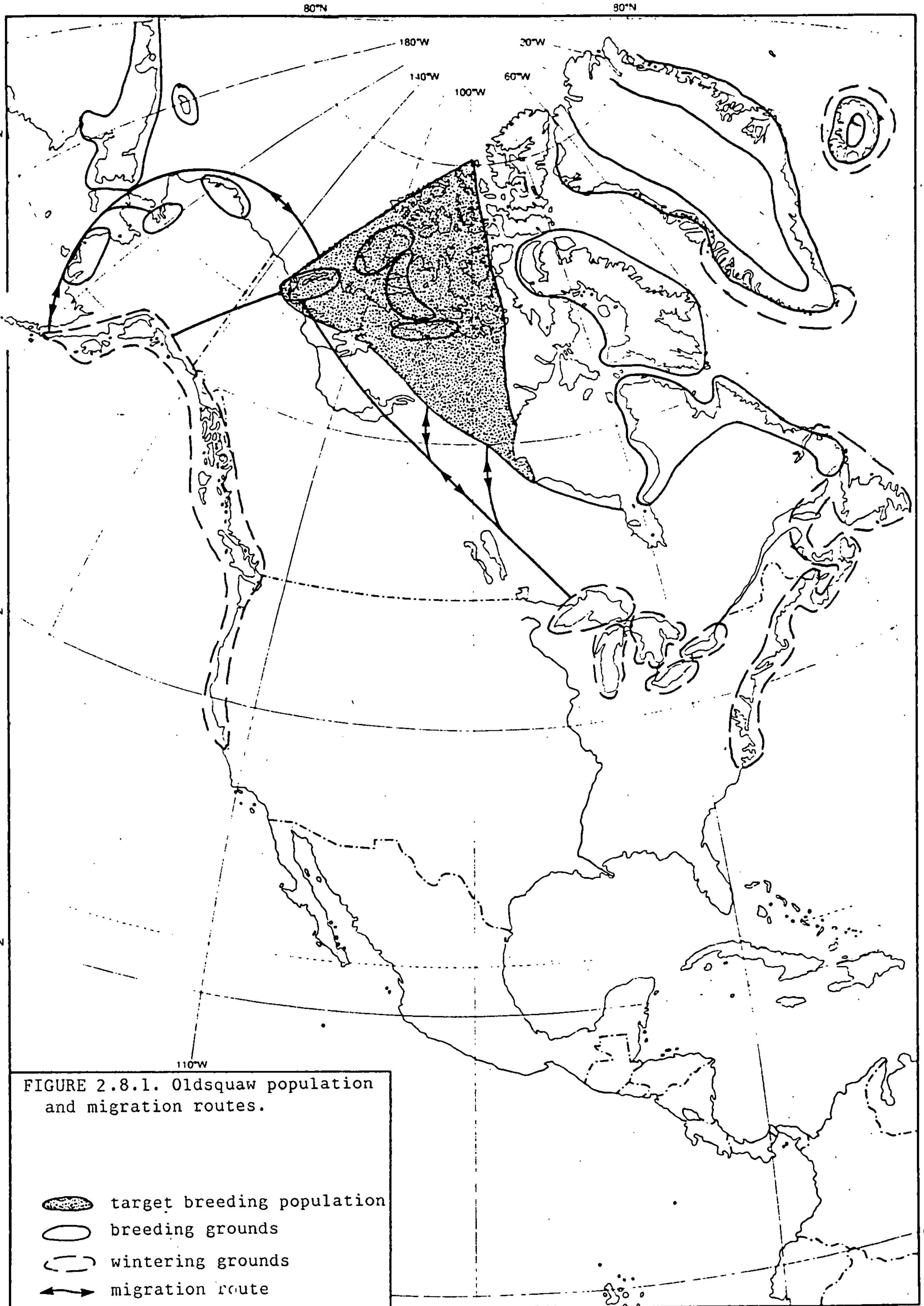


FIGURE 2.8.1. Oldsquaw population and migration routes.

Figure 2.8.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.

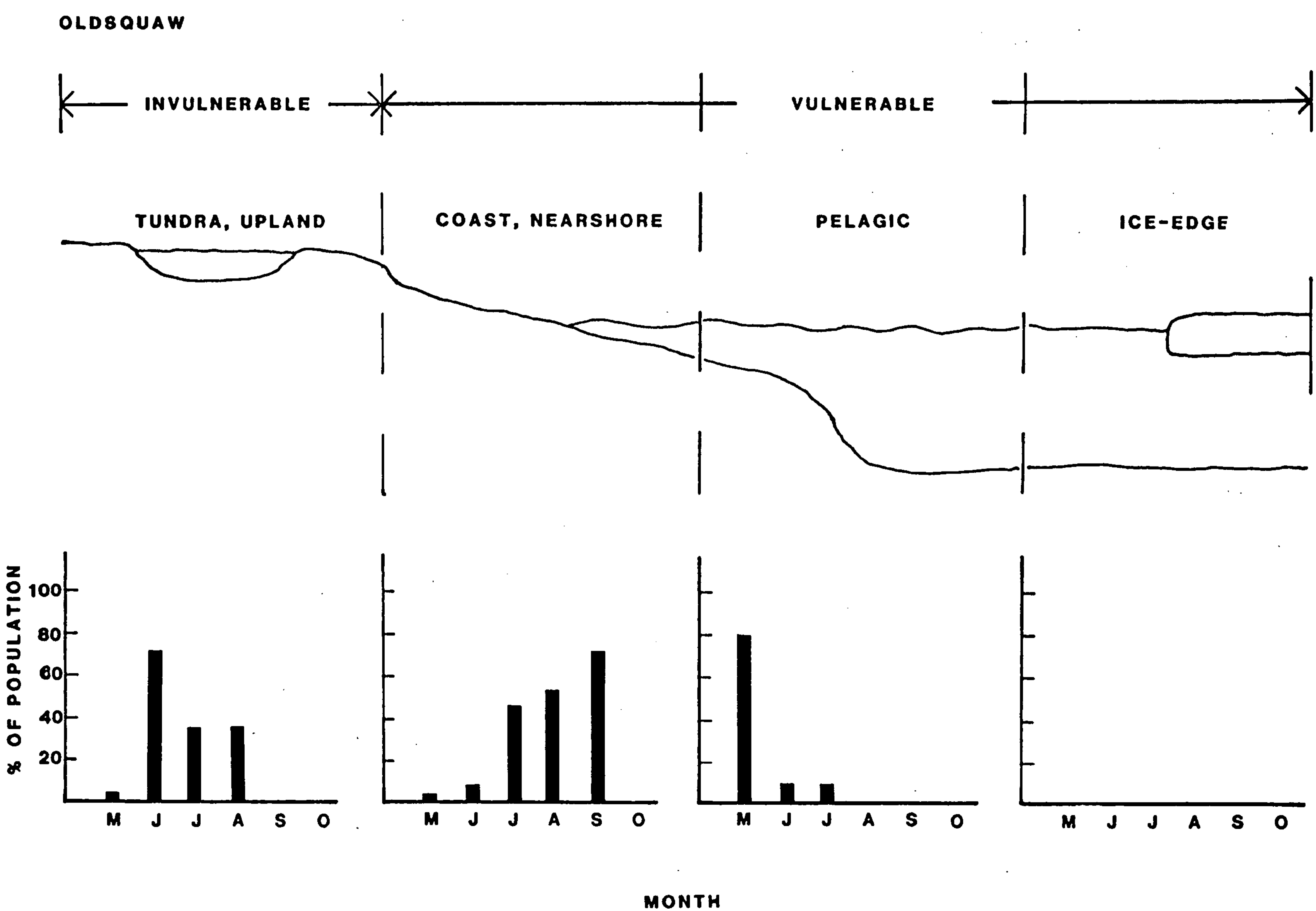
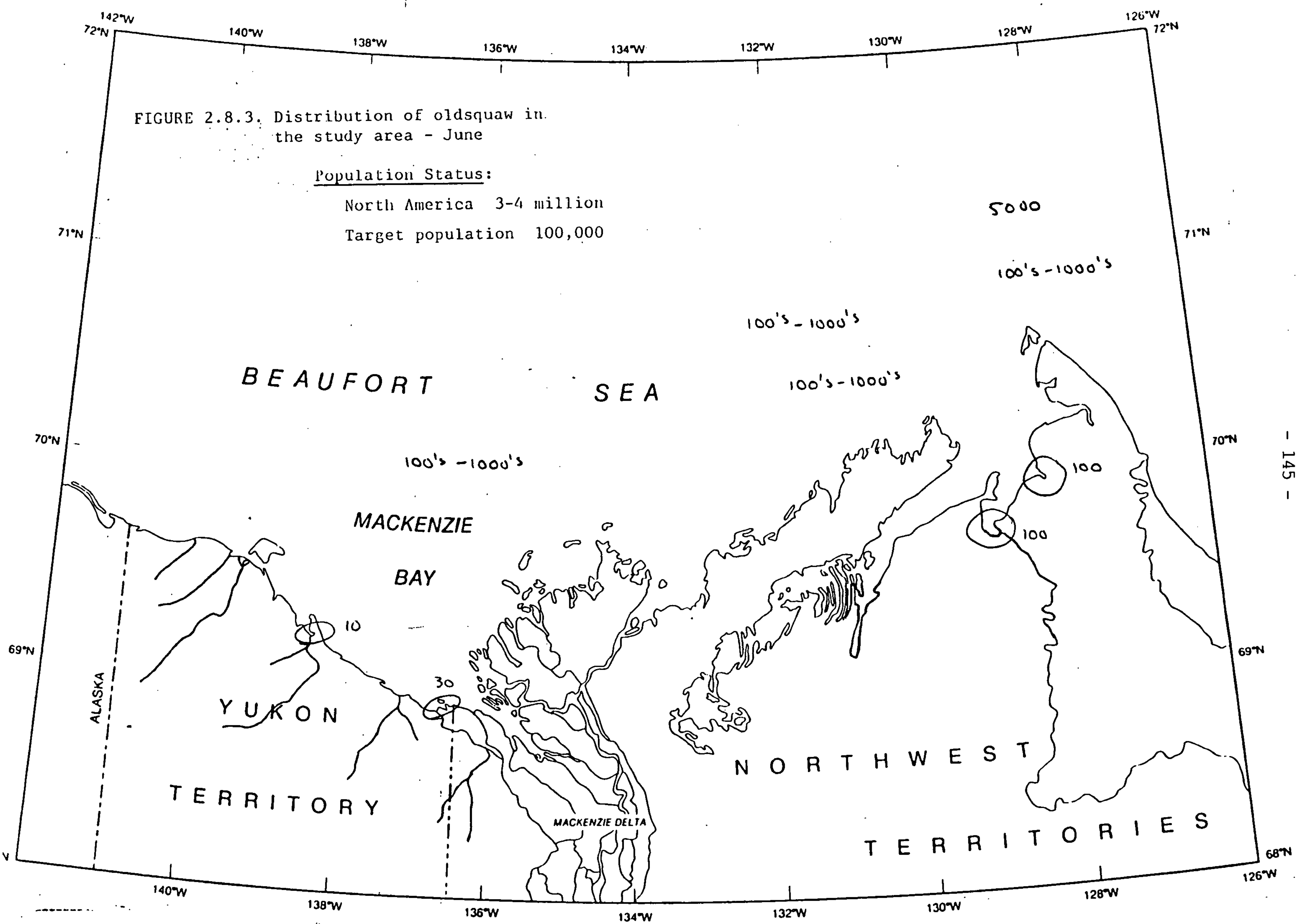


FIGURE 2.8.3. Distribution of oldsquaw in the study area - June

Population Status:

North America 3-4 million

Target population 100,000



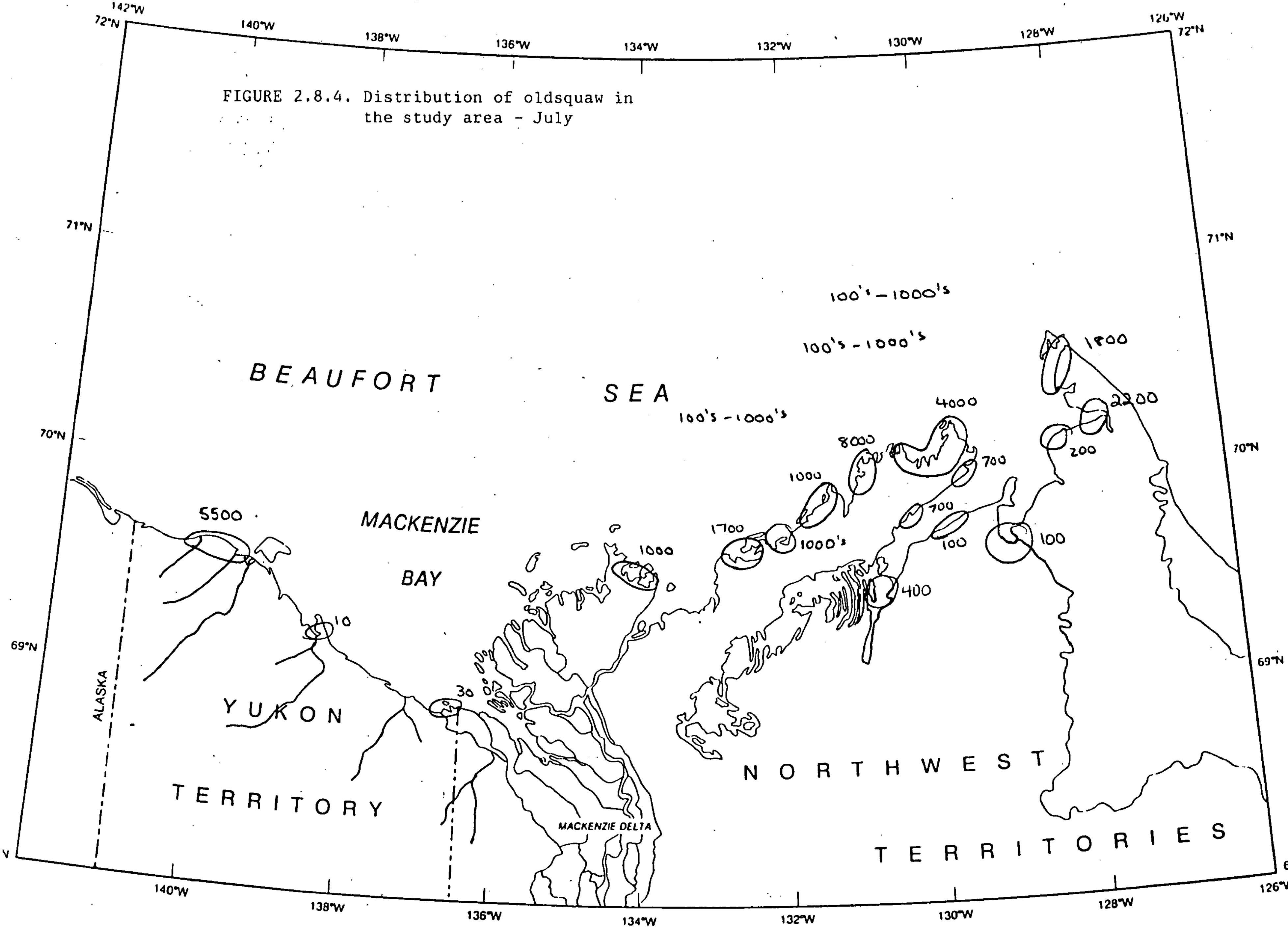


FIGURE 2.8.4. Distribution of oldsquaw in the study area - July

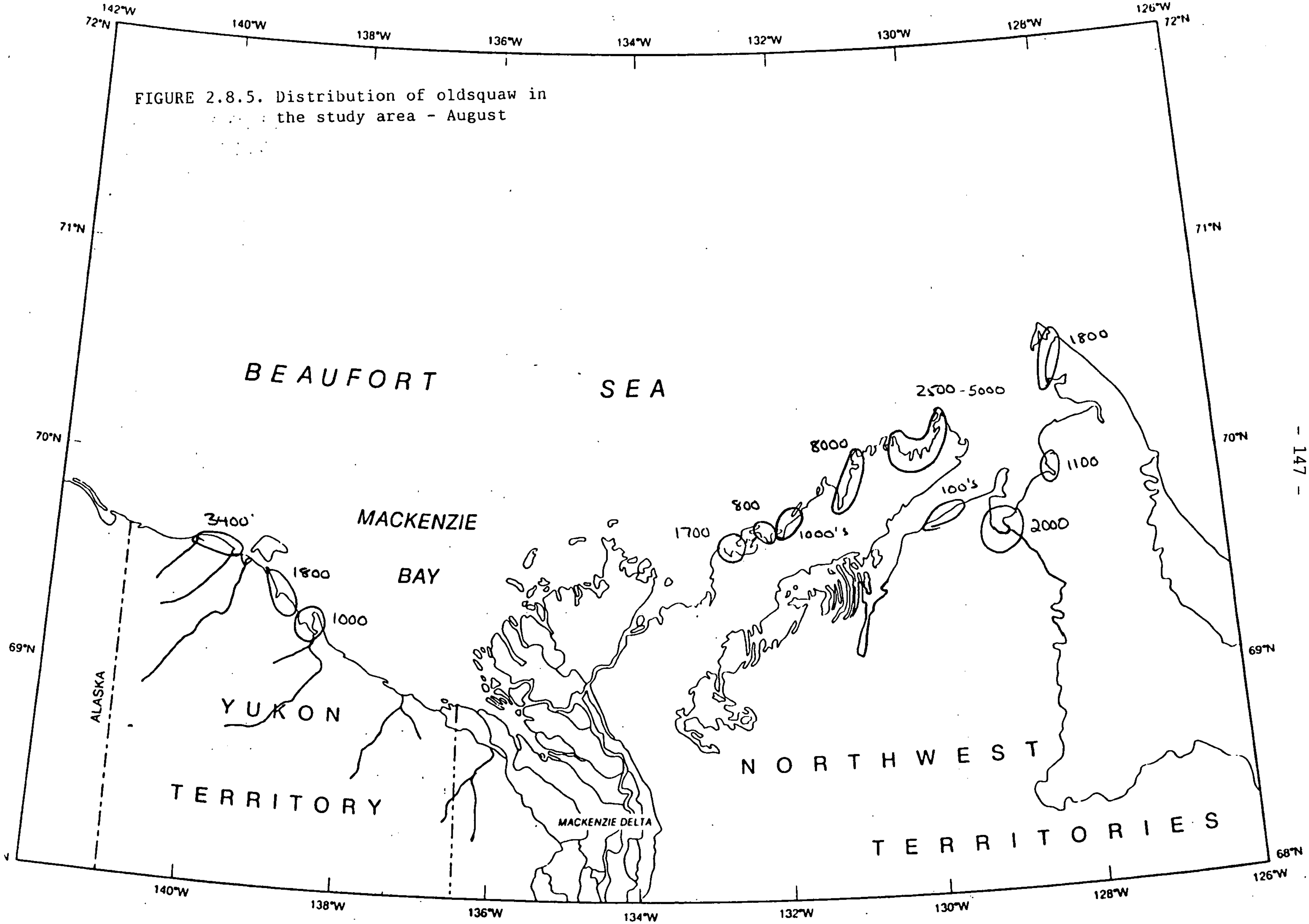


FIGURE 2.8.5. Distribution of oldsquaw in the study area - August

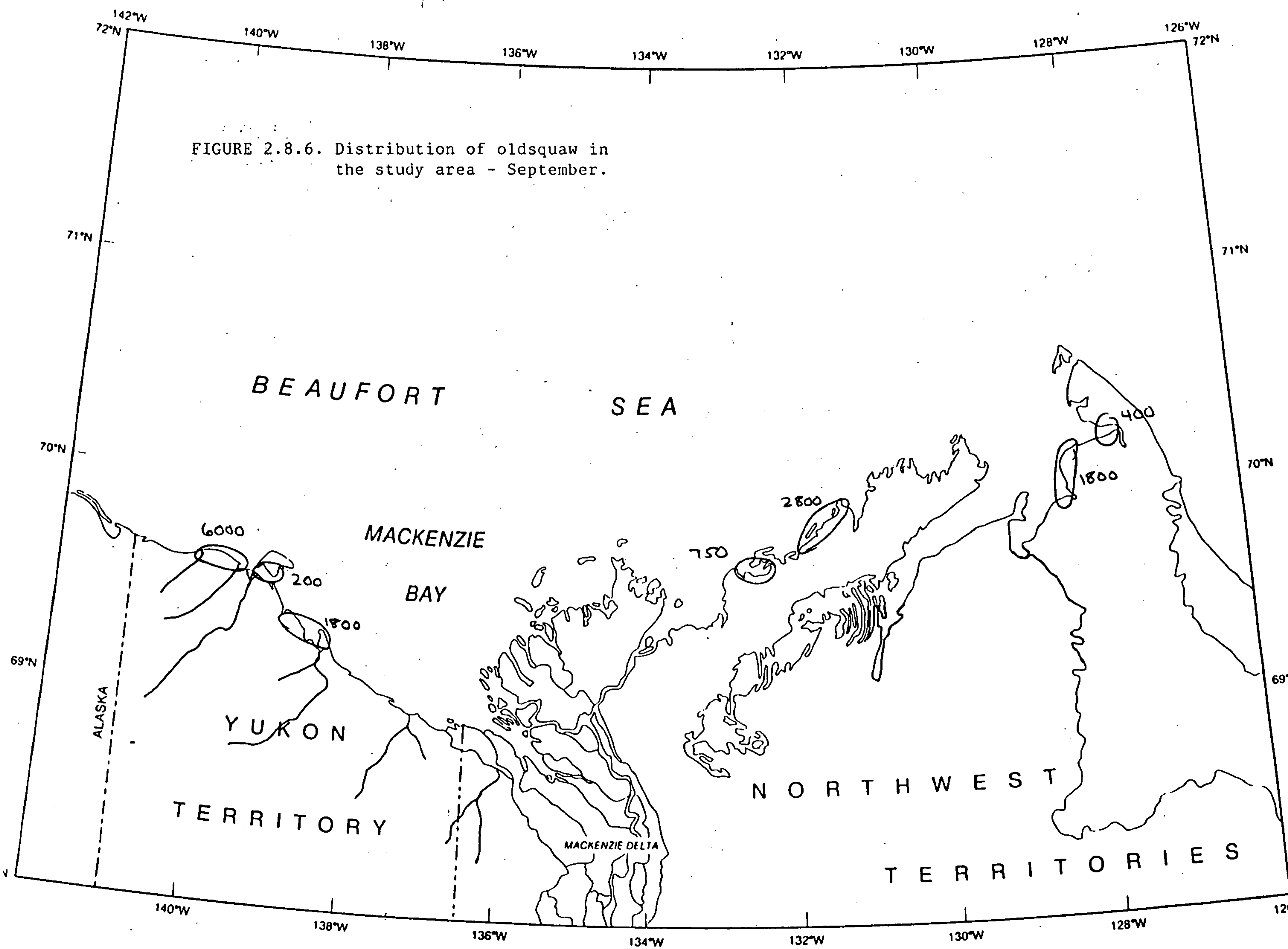


FIGURE 2.8.6. Distribution of oldsquaw in the study area - September.

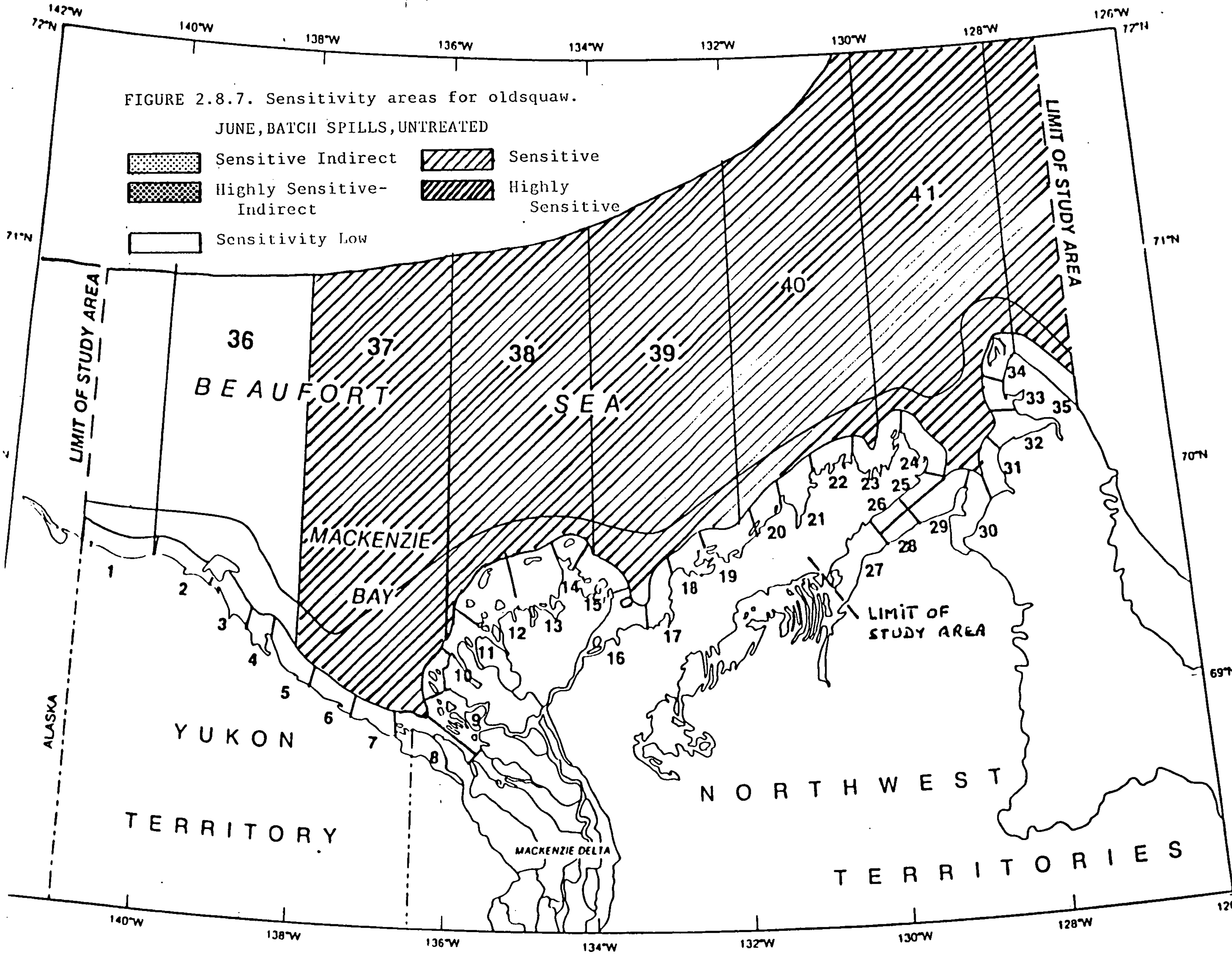


FIGURE 2.8.7. Sensitivity areas for oldsquaw.

JUNE, BATCH SPILLS, UNTREATED

Sensitive Indirect

Highly Sensitive-Indirect

Sensitivity Low

Sensitive

Highly Sensitive

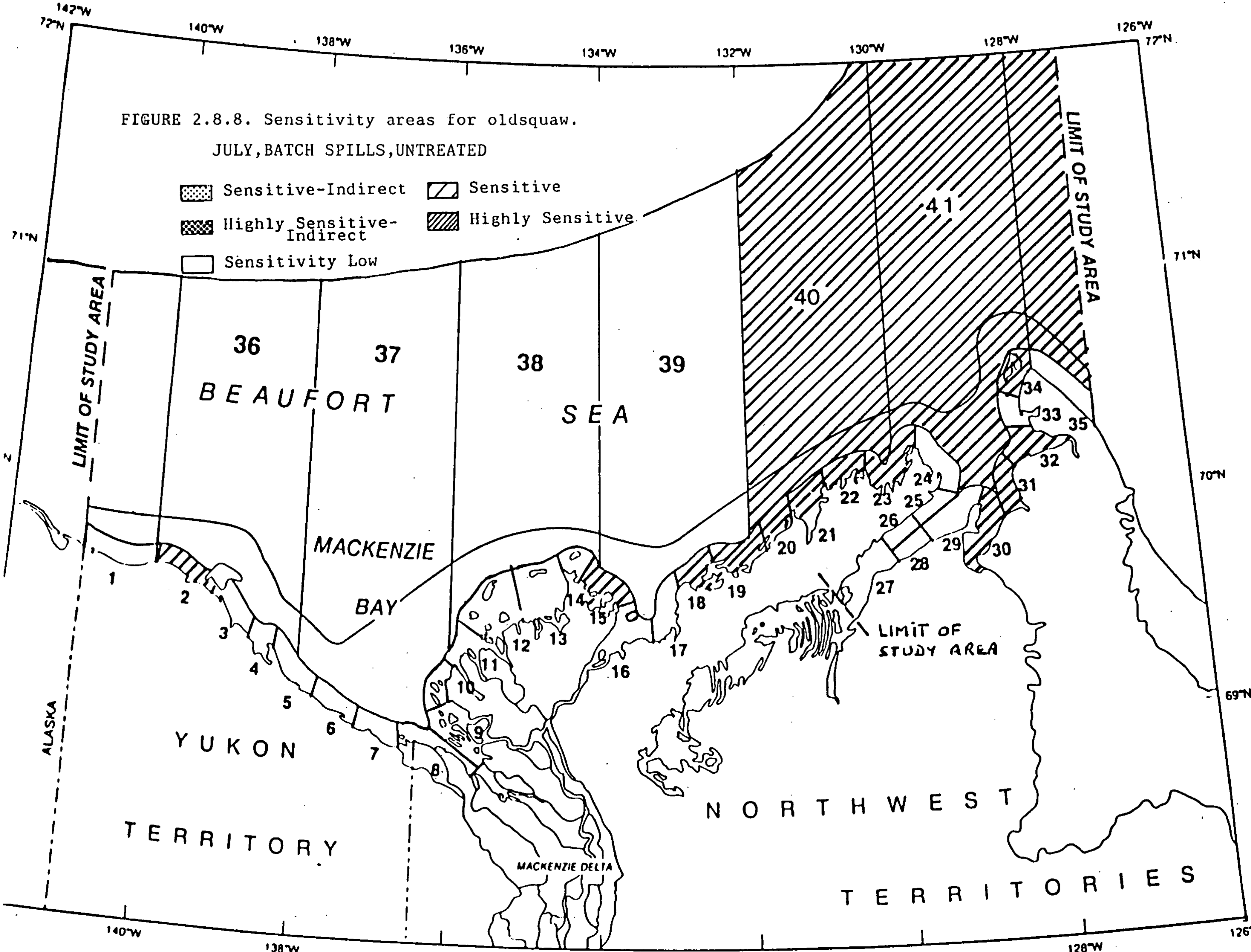


FIGURE 2.8.8. Sensitivity areas for oldsquaw.

JULY, BATCH SPILLS, UNTREATED

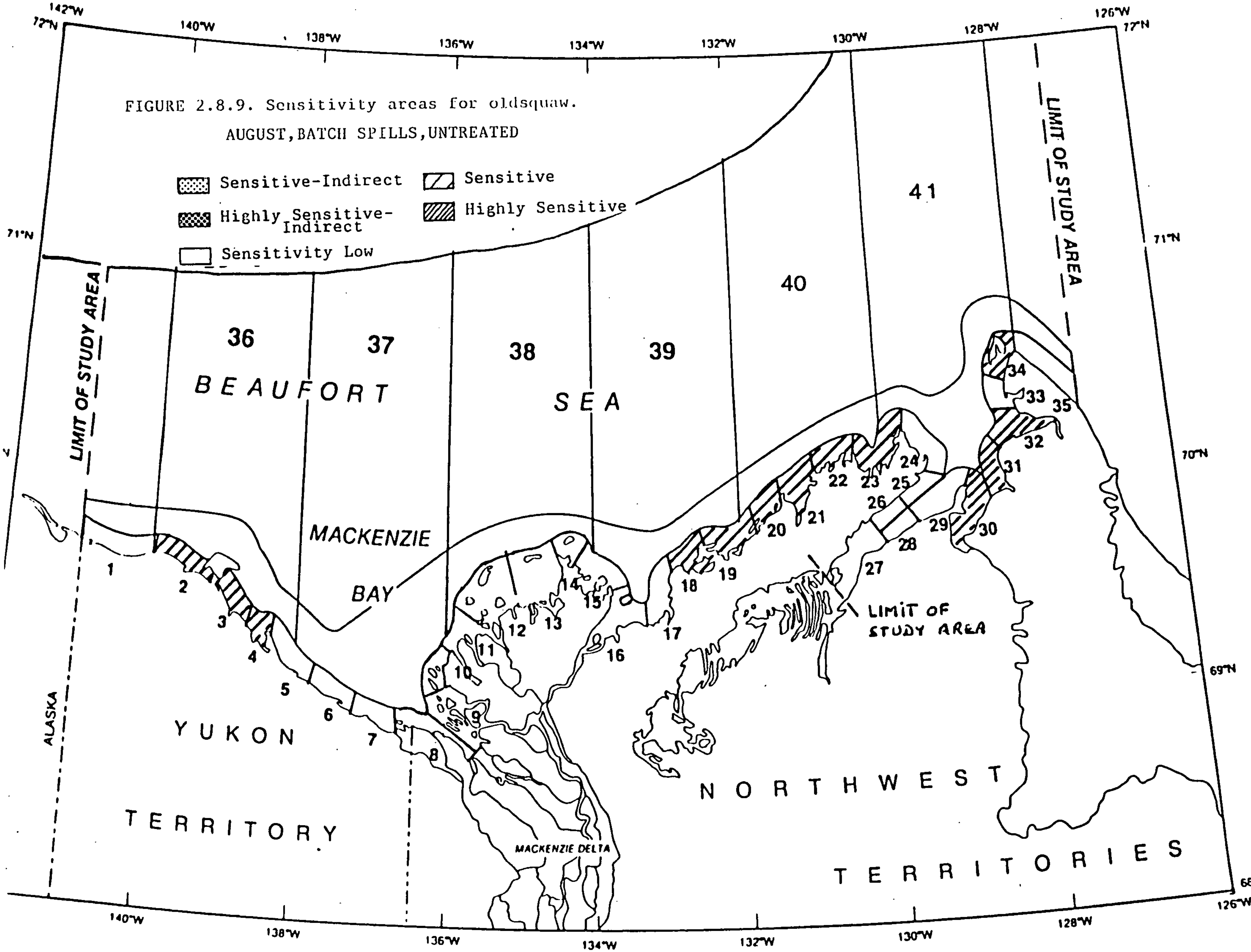
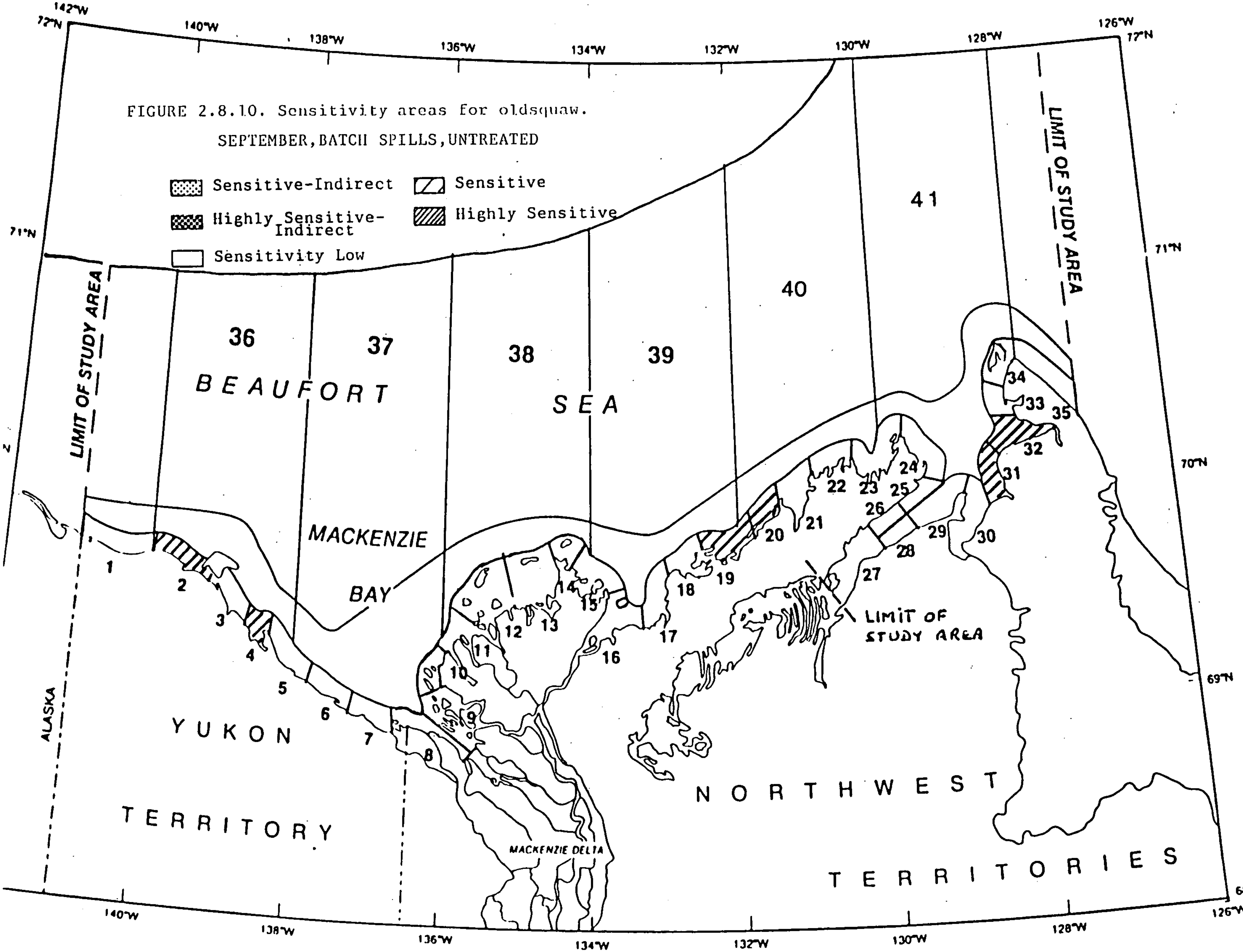


FIGURE 2.8.9. Sensitivity areas for oldsquaw.
AUGUST, BATCH SPILLS, UNTREATED

FIGURE 2.8.10. Sensitivity areas for oldsquaw.
SEPTEMBER, BATCH SPILLS, UNTREATED



2.9 COMMON EIDER (Somateria mollissima)

There appear to be five sub-species of common eiders that breed in North America, but of these sub-species only the Pacific Eider (S.m. v-nigra) occurs in the S.B.S. Area. According to Bellrose et al (1980) this species breeds in coastal regions of Alaska and the southern Beaufort Sea area, from the extreme southwestern parts of Alaska, as far east as the southwest Victoria Island and the Kent Peninsula (Figure 2.9.1). Most of these birds winter in the Bering Sea area along the coast of Alaska and Northern British Columbia. Eider migrate between wintering areas and breeding grounds via a coastal migration route and open water ice leads around the coast of Alaska.

2.9.1 Population Status

There is an important discrepancy between accounts of the numbers of common eiders that inhabit the southern Beaufort Sea area. Several accounts place the number of birds migrating through the southern Beaufort Sea at between 250,000 and 500,000 birds. Surveys of nesting areas including Banks Island, Victoria Island, King William Island, and the present study area can account for only a fraction of this number, Barry (1986) estimating the number at about 80,000. Barry (1986) also estimated the number migrating past Point Barrow in spring to be 50,000 - 100,000. As a conservative approach taken in order to not underestimate the sensitivity of this species, the 100,000 figure will be taken as the number using the study area.

For this species the entire western Pacific race has been taken as the target population. This population numbers between 300,000 and 500,000 individuals. Apparently only a small proportion, perhaps 25% use the southern Beaufort Sea area for breeding or a migration route to and from breeding sites further east. Only a very small fraction of these (probably no more than 1000 birds), nest within the study area.

2.9.2 Habits, Movements and Timing Within the Southern Beaufort Sea Area

Common eiders are coastal migrants and the timing of their migration into the southern Beaufort Sea is determined by the availability of patches of open water along the North Slope of Alaska and along offshore migration routes. Hence, common eiders appear in the southern Beaufort Sea area only in late May and early June. Nesting activities are initiated in mid to late June. Incubation lasts for roughly 30 days, with hatching taking place in mid to late July. Males abandon their females as soon as incubation begins in late June and move to traditional coastal moulting areas along with non-breeders. Many of these moulting areas lie outside the Southern Beaufort Sea area, so a portion of the common eider population vacates the Southern Beaufort Sea area and ceases to be vulnerable to oil spills from this time onward.

As soon as the hatch takes place in mid to late July, females lead the young directly to nearby bodies of water, either tidal pools, lagoons, bays or the open sea, where they remain until they are fledged (roughly eight weeks) in late September. Females enter their post-nuptial moult when the young have reached a certain stage of development, and regain flight at roughly the time the offspring are fledged.

Eiders are sea ducks and their habits and habitat preference renders them highly vulnerable to marine oil spills. As mentioned above, eider follow coastal or offshore migration routes in both the spring and fall. In the spring, eiders make use of leads, making them specially susceptible to spills if these become contaminated with oil. Eiders are coastal nesters and since non-breeders gather at the nest sites or in nearby coastal waters, the entire population is vulnerable to oil spills during the nesting and laying period. Males and non-breeders perform a moult migration and the moulting areas are along the coast where moulting birds remain vulnerable to spills. Although breeding females remain on their nests throughout the 30 day incubation period in July and are invulnerable at that time, they lead their young to coastal water bodies after hatching and adults and young are vulnerable from hatching until the young are fledged and migration begins.

2.9.3 <u>Distribution and Vulnerability Within the Southern Beaufort Sea Are</u>

Peak numbers of eider occur in the study area in May and June. These birds are in offshore areas and are no doubt migrants moving through the area to nesting sites further east. In the western and central offshore areas, bird numbers in the 10's to 100's are common, while greater numbers in the 1000's to 5000's occur in the east north of Cape Bathurst and Cape Dalhousie. Inshore near nesting areas birds appear to be present in lower numbers. In the western and central part of the study area (Nunaluk Spit, the Tuktoyaktuk Peninsula and Western Liverpool Bay) birds are present in the 10's to 100's range, while the eastern shore of Liverpool Bay appears to support slightly larger numbers in the 100's to 500's range.

In July, the numbers of birds in offshore areas is much reduced. In the inshore areas, bird numbers distribution appears to be similar to that in June. The situation in August and September is no doubt similar to that of July with the exception that males and non-breeders will have departed westward for the fall migration, leaving only the females and young in coastal areas.

Since the number of common eider using coastal areas if the study area is low, contamination of these areas will not result in significant effects on the population. However, significant numbers of common eider occur in offshore areas in June when either batch spills or blowouts may result in population effects at the SLIGHT level.

<u>References</u>: Barry 1976; Bellrose et al 1980; Johnson et al 1975; Searing et al 1975; Smyth et al 1985.

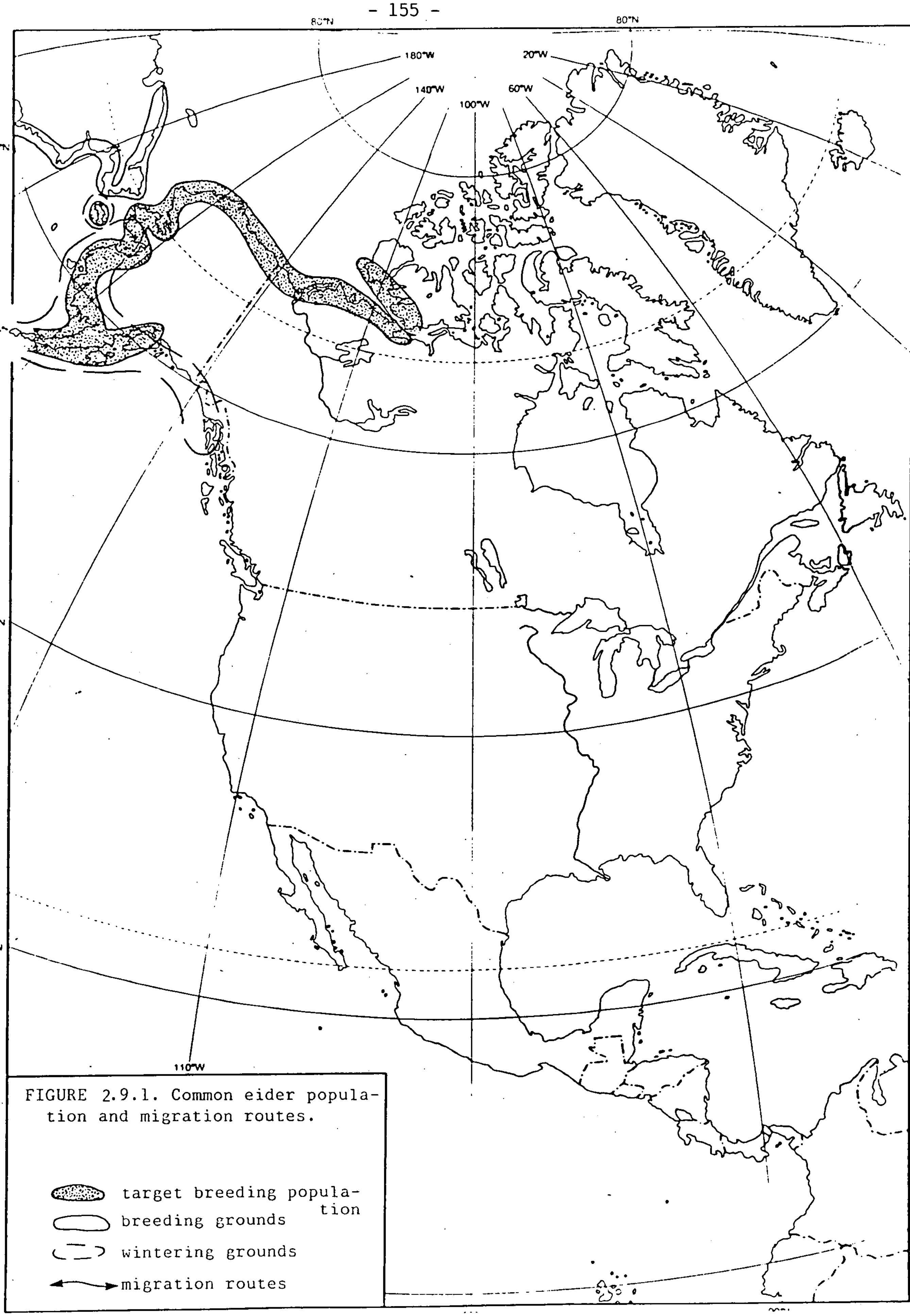
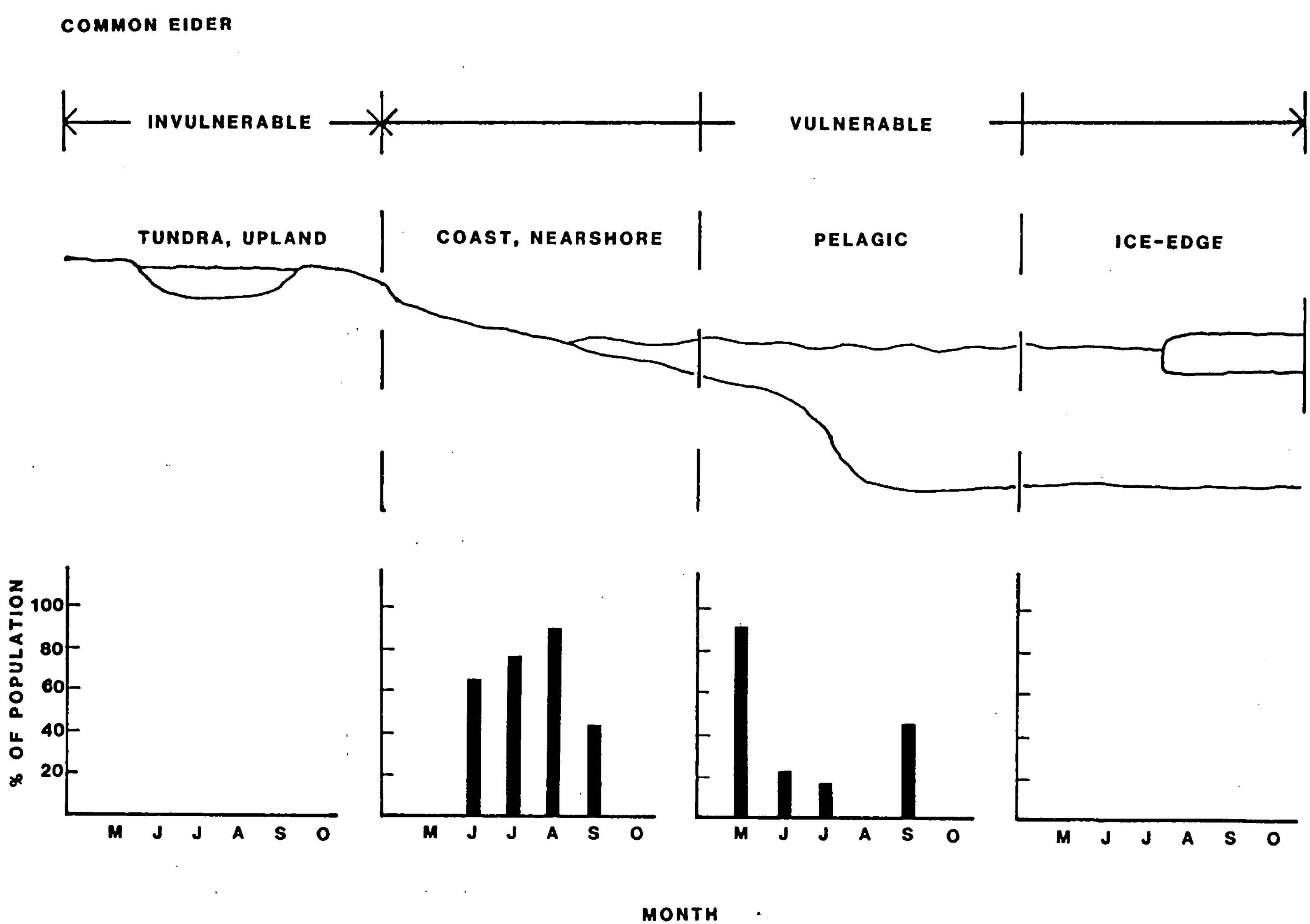


FIGURE 2.9.1. Common eider population and migration routes.

Figure 2.9.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



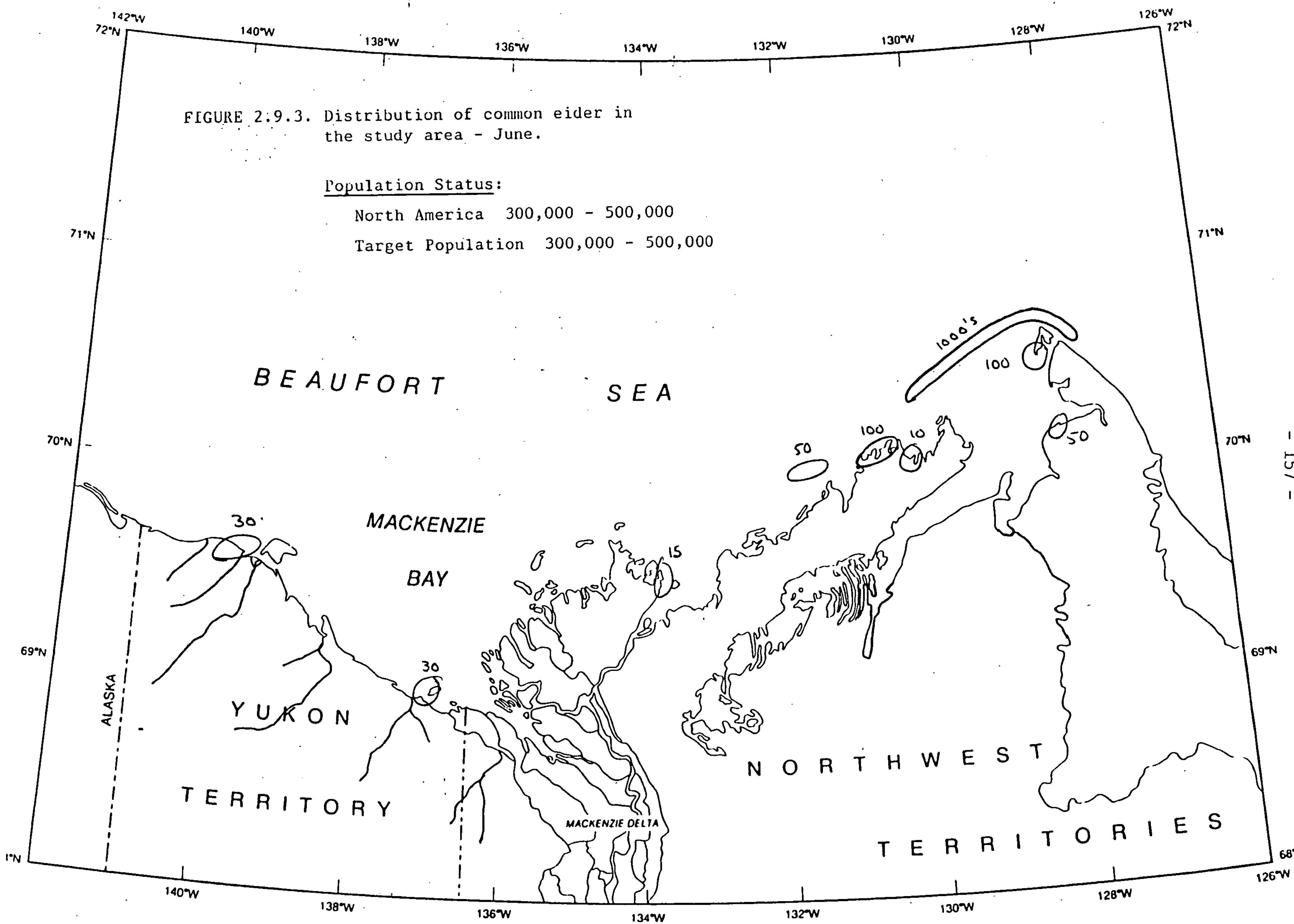


FIGURE 2.9.3. Distribution of common eider in the study area - June.

Population Status:

North America 300,000 - 500,000

Target Population 300,000 - 500,000

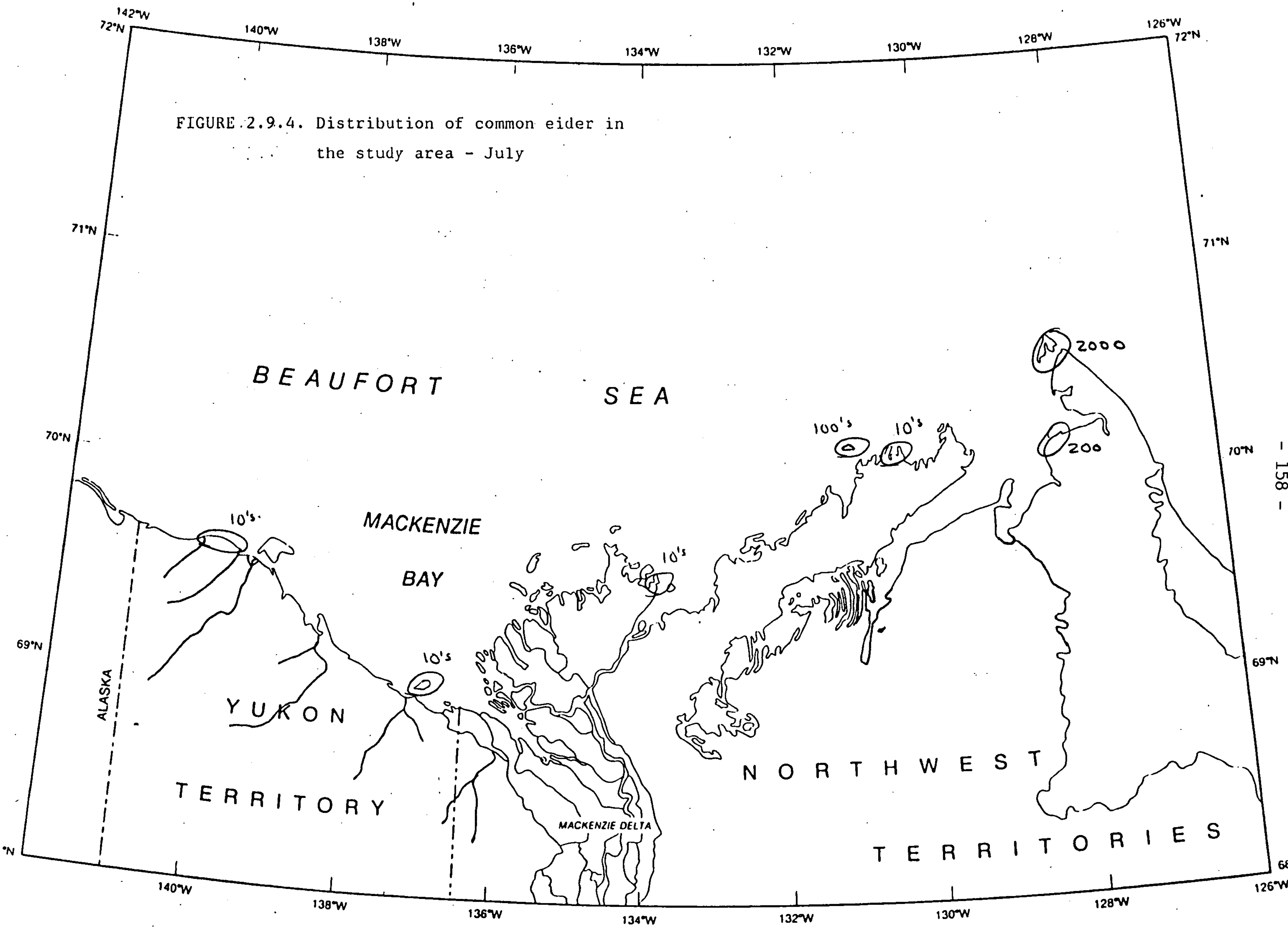


FIGURE 2.9.4. Distribution of common eider in the study area - July

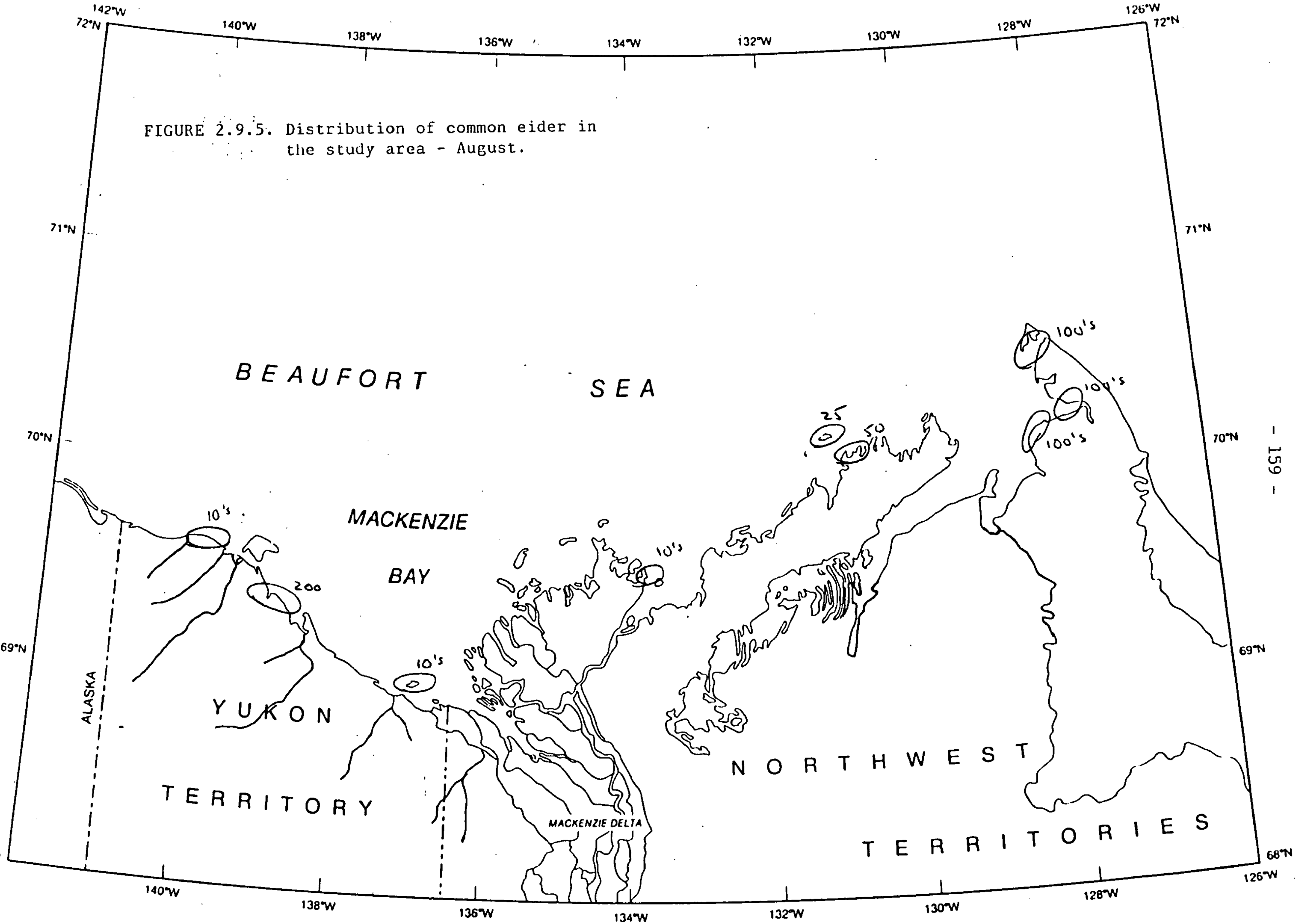


FIGURE 2.9.5. Distribution of common eider in the study area - August.

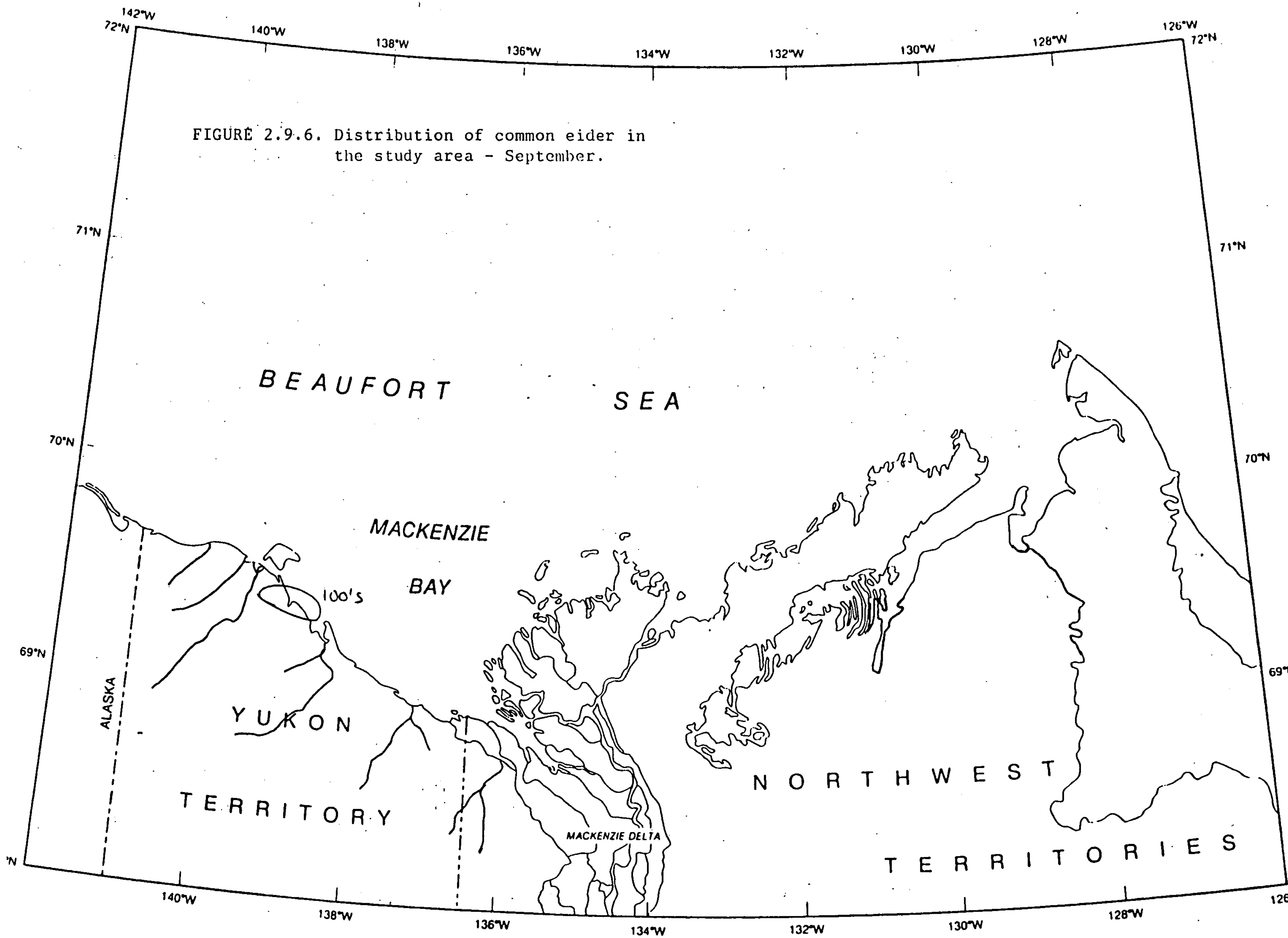


FIGURE 2.9.6. Distribution of common eider in the study area - September.

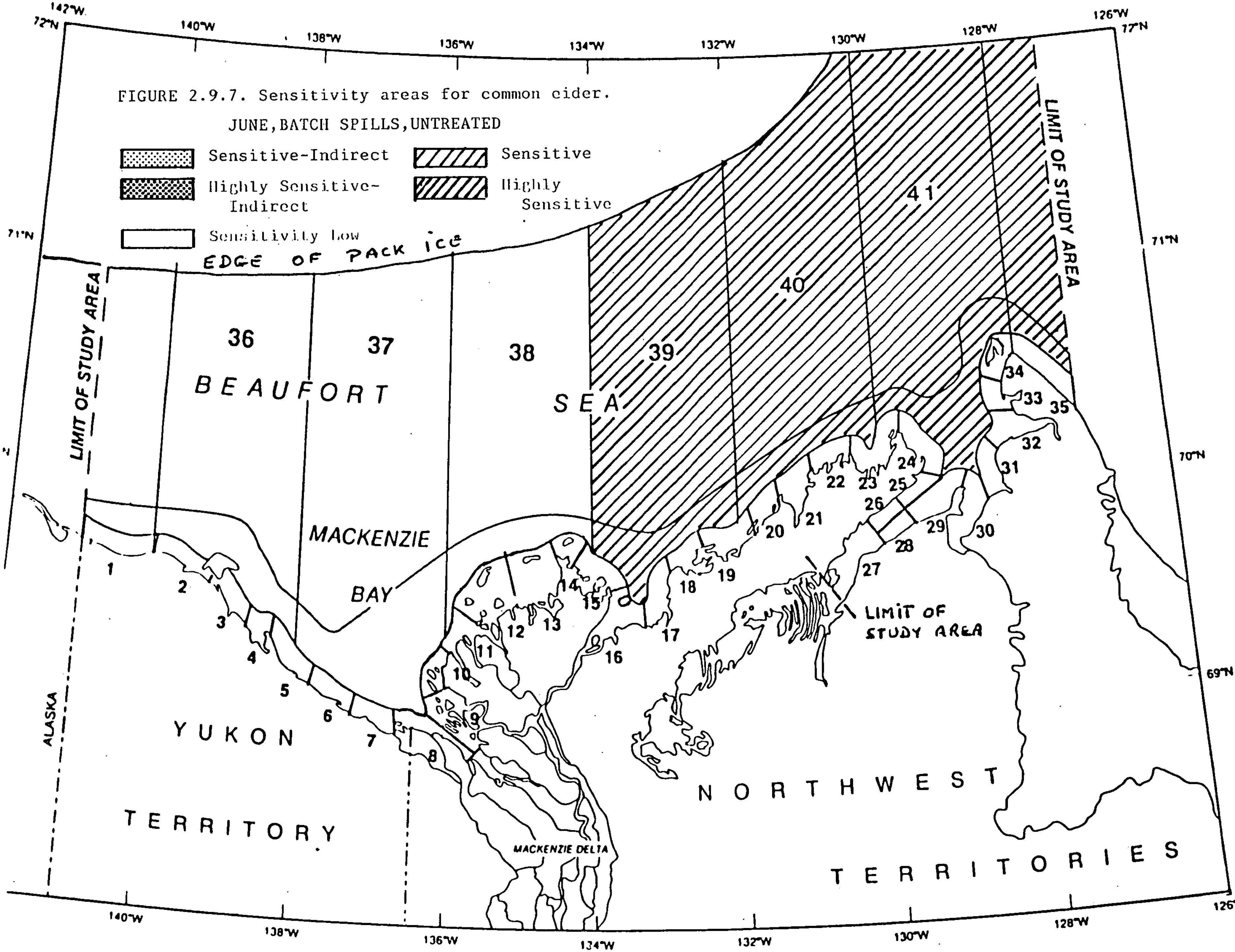


FIGURE 2.9.7. Sensitivity areas for common eider.

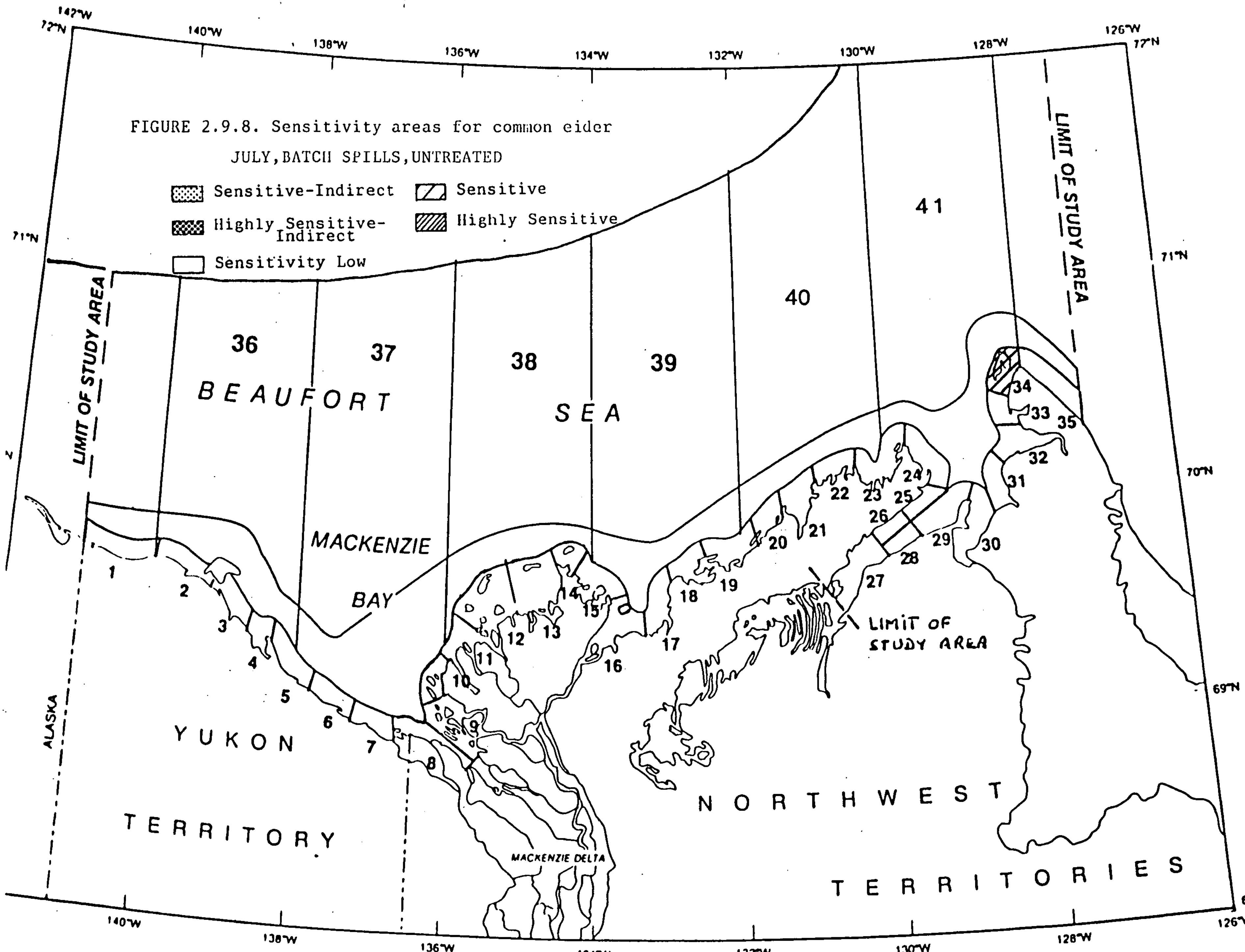


FIGURE 2.9.8. Sensitivity areas for common eider
JULY, BATCH SPILLS, UNTREATED

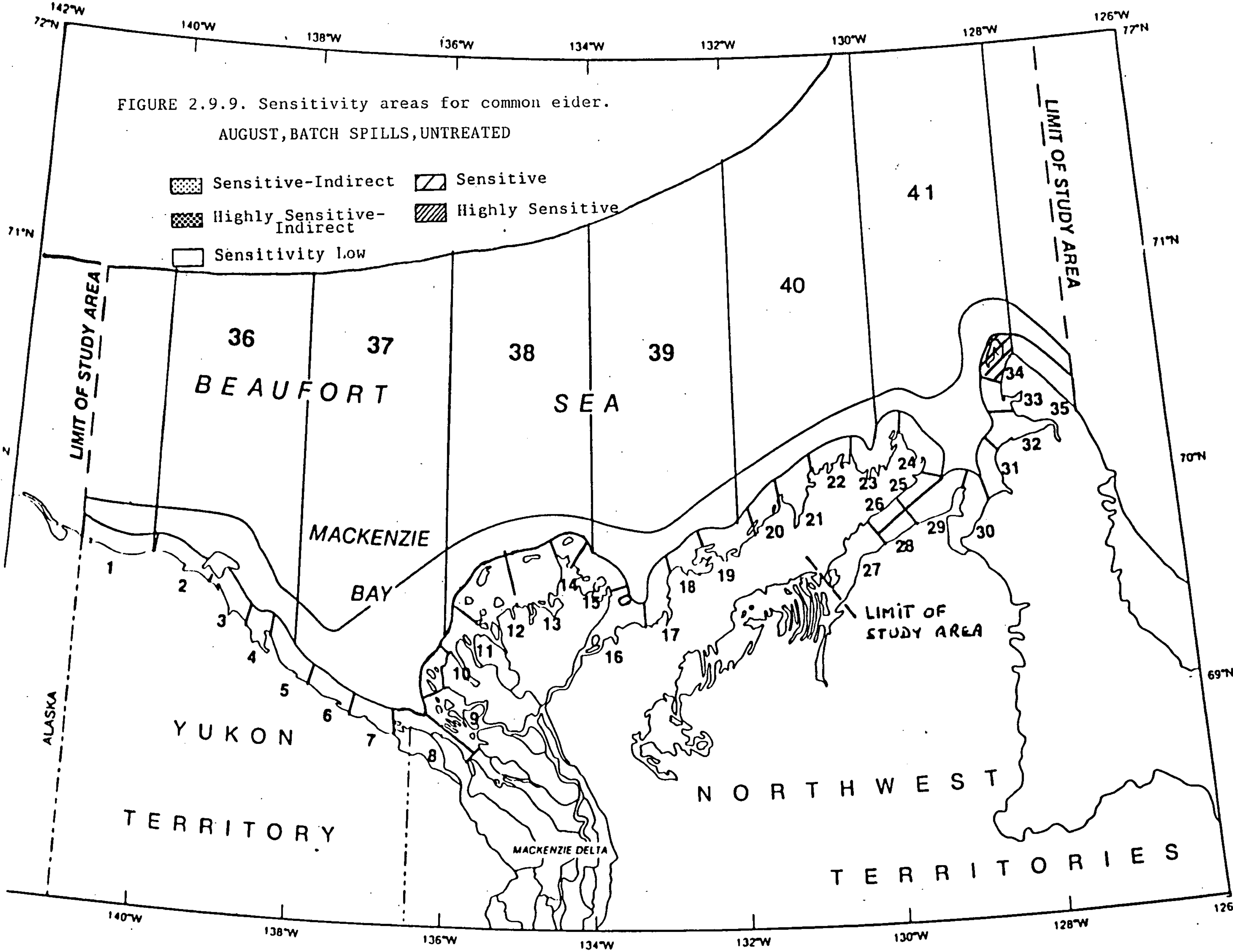


FIGURE 2.9.9. Sensitivity areas for common eider.

AUGUST, BATCH SPILLS, UNTREATED

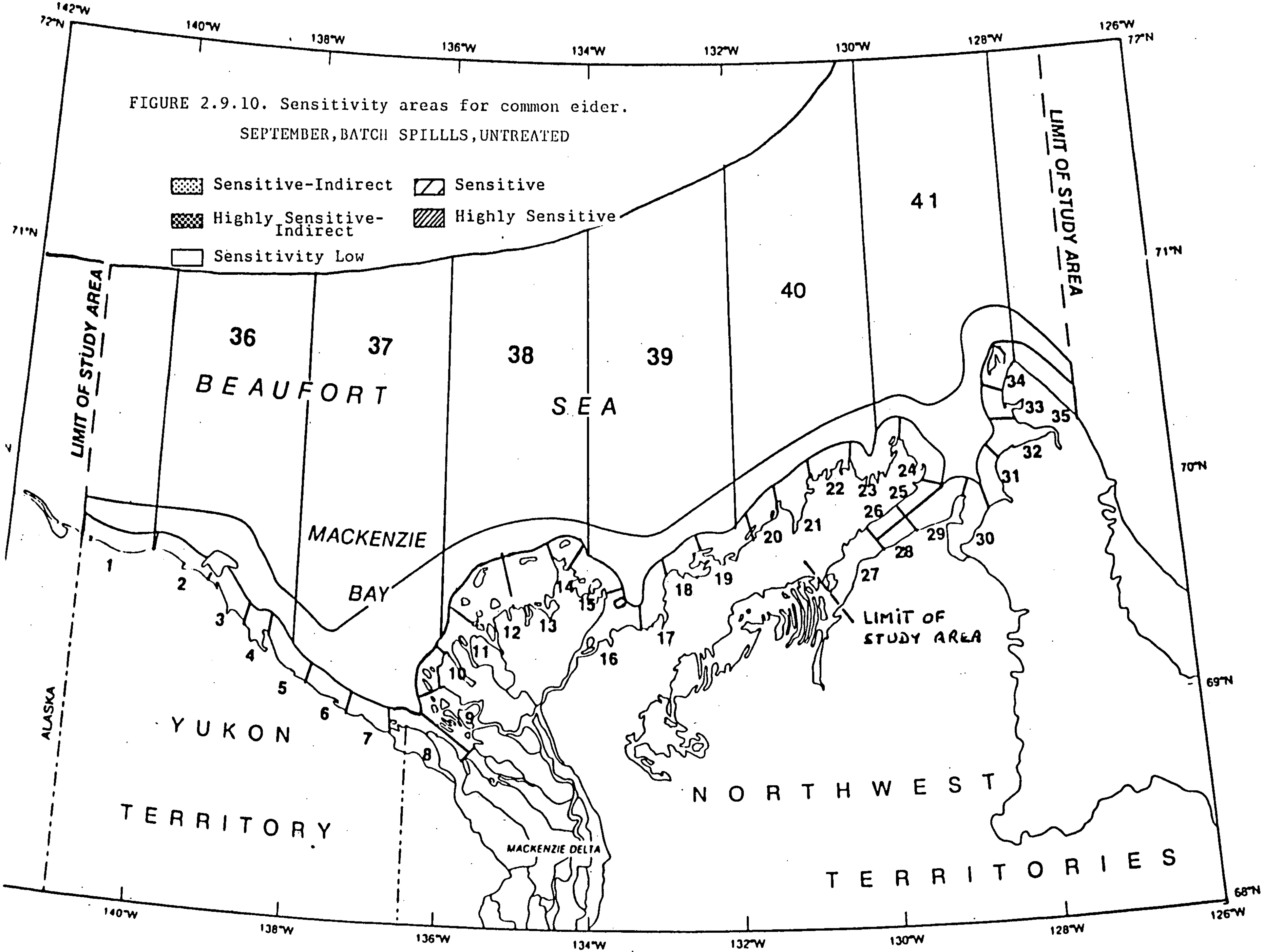


FIGURE 2.9.10. Sensitivity areas for common eider.

SEPTEMBER, BATCH SPILLLS, UNTREATED

2.10 KING EIDER (Somateria spectabilis)

The North American population of king eider number some 1.0 to 1.5 million birds, which inhabit both east and west coasts in winter but do not appear to be specifically segregated on the summer breeding grounds. All king eider which migrate into or through the Beaufort Sea originate on the west coast, and number roughly 800,000 birds. This group winters mainly in the Bering Sea as far north as there is open water. Migration takes the king eider along the Alaskan coast, both to and from the southern Beaufort Sea.

2.10.1 Population Status

It appears that few king eider actually breed on the mainland in the southern Beaufort Sea area. Most use the southern Beaufort Sea area as a migration route to and from breeding areas to the east of the study region. Few birds are seen migrating along the coast, most sightings occurring at least 30 km offshore. During the spring migration, king eider make extensive use of open leads, both at sea and to a lesser extent near shore. Favoured breeding grounds are not included in the study area, these being in the eastern Beaufort Sea (Banks Island) and in the Amundsen Gulf (Victoria Island).

2.10.2 Habits, Movements, and Timing Within the Southern Beaufort Sea

Spring migration from the Bering Sea begins in late April, with the males preceding the females by 2 or 3 weeks. Broad fronts of migration occur around the coast of Alaska to Cape Barrow, where the eider take an east-northeast direction accross the Beaufort Sea. The eider first appear in the southern Beaufort Sea area in mid-May, and continue arriving through late June. During spring migration, their main contact with the marine environment is along the edge of landfast ice, where they stop to rest on the ice and feed in the shallow waters.

Nesting begins in mid-June, most commonly in the interiors of large islands such as Banks Island. The males remain with the females during egg-laying, but then abandon the females to almost immediatley congregate at sea for a moult migration westward across the southern Beaufort Sea. This migration takes place from mid-June through mid-July with the moult itself taking place at some point west of Cape Barrow, Alaska.

Young are hatched in the latter half of July, and within two weeks led to freshwater ponds for brooding. From these ponds they move to marine bays, where the young king eider congregate in groups numbering from a few to 100's. The females leave the young and begin their own fall migration in mid-August continuing through September. The young fledge towards the end of August and begin migrating west across the Beaufort Sea. They continue leaving the breeding ground until early October. The migration of females and young-of-the-year does not occur in concentrated waves, as is the case for males, however they do appear to follow the same route.

Staging and migration of king eider appears to take place mostly in far offshore areas of the southern Beaufort Sea, throughout the open water season. For breeding purposes, they prefer inland areas, and are commonly associated with freshwater ponds.

The male king eider spends all but a few weeks migrating to and from the breeding grounds. Females and young remain in the breeding areas much longer, mostly inland on tundra ponds.

The above habits render the eider population vulnerable to oil spills through virtually the entire open water season, across the entire offshore area.

2.10.4 Distribution and Vulnerability Within the Southern Beaufort Sea Area

King eider do not appear to use or remain in southern Beaufort Sea coastal areas for any appreciable length of time. Migration routes are primarily in the offshore, and moulting and breeding sites are outside the study area. Their behaviour, movements, abundance, and residence time in the offshore are not well documented, however they do appear to use this area extensively throughout the open water season. Searing et al (1975) observed flocks of hundreds or thousands of eiders, many of which were no doubt King eiders in offshore areas north of the Tuktoyaktuk Peninsula. Either batch spills or blowouts in this offshore area might have significant effects on the king eider population at the SLIGHT level.

References: Bellrose et al 1980; Johnson et al 1975.

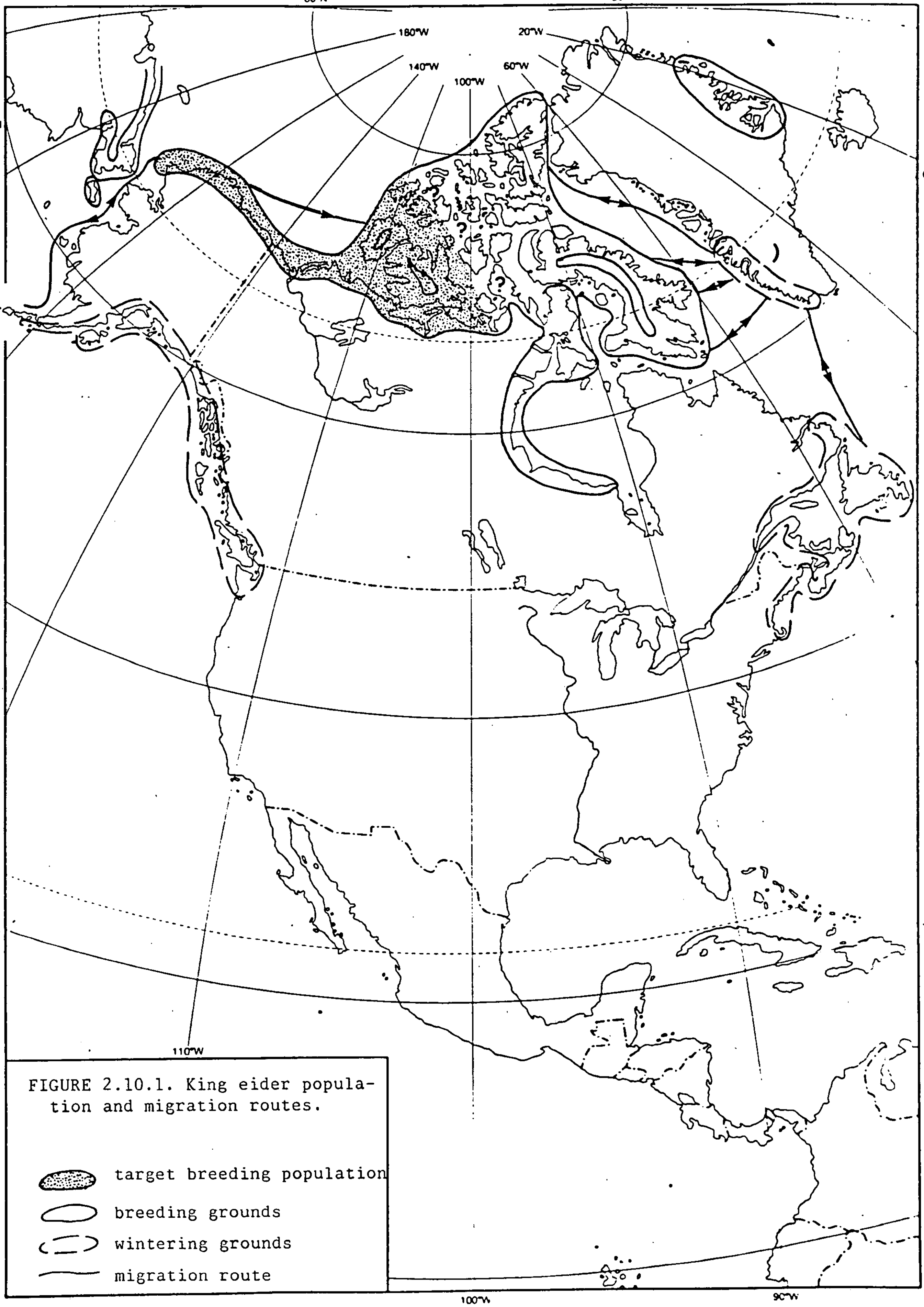
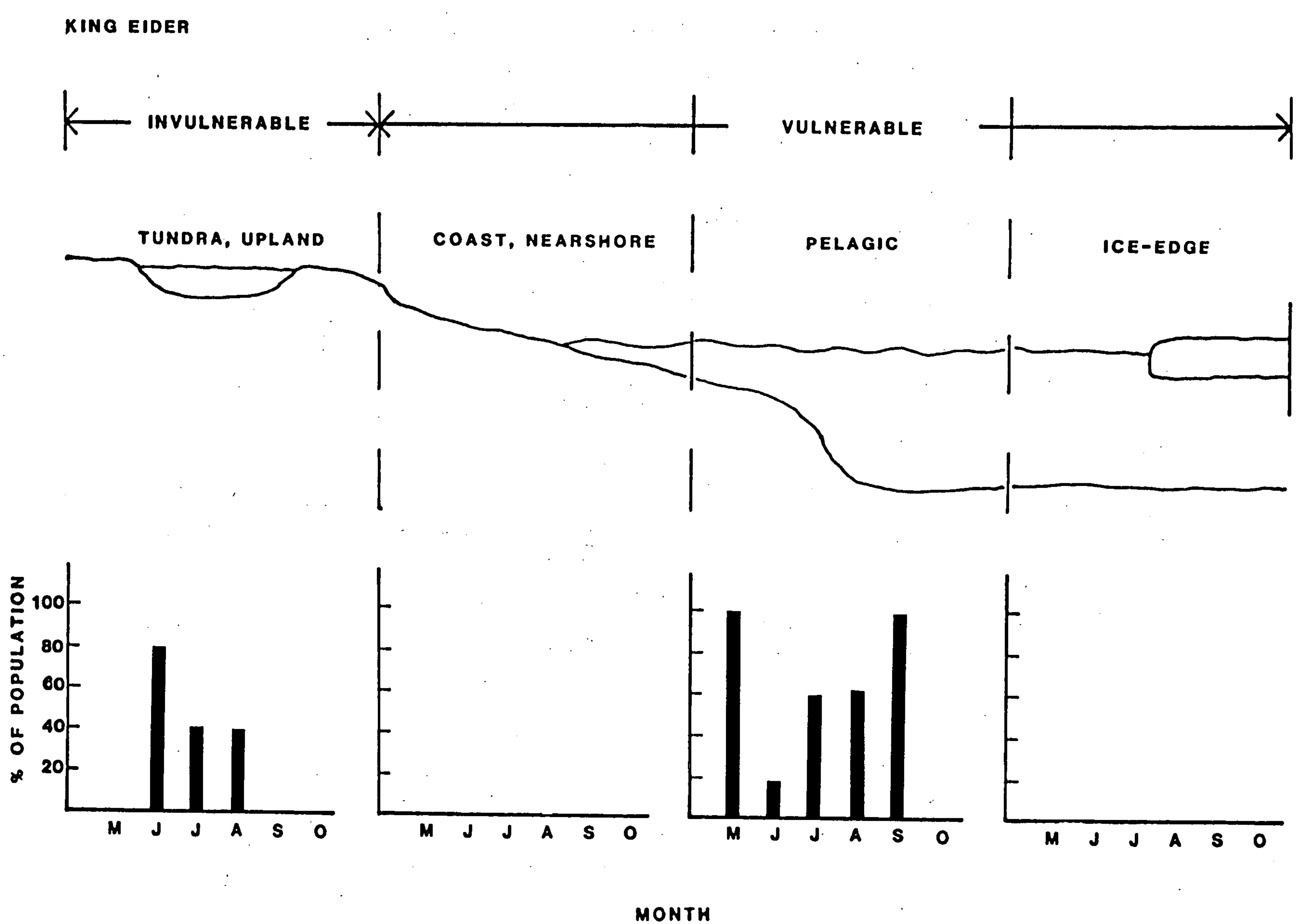


FIGURE 2.10.1. King eider population and migration routes.

Figure 2.10.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.



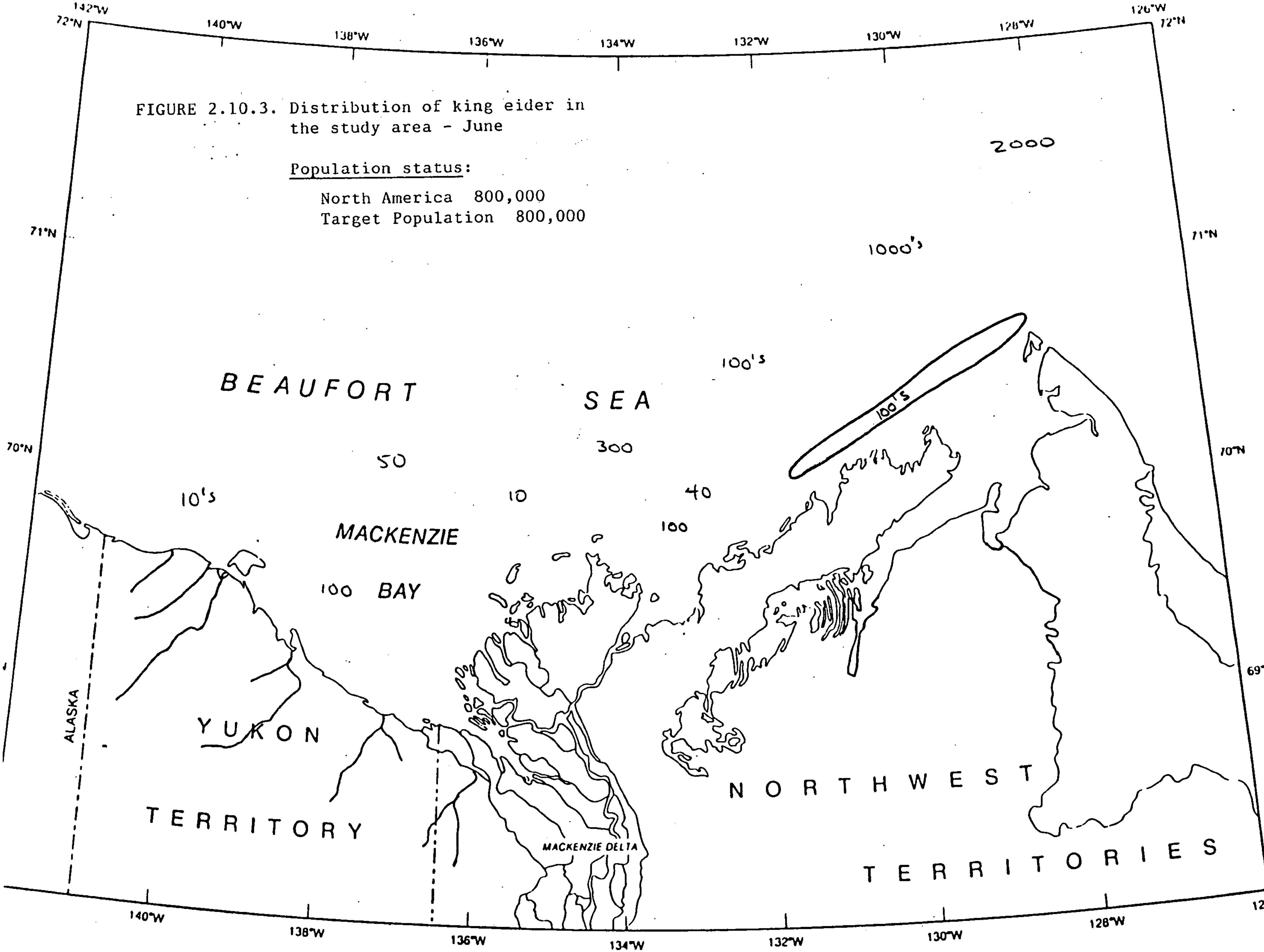


FIGURE 2.10.3. Distribution of king eider in the study area - June

Population status:

North America 800,000
Target Population 800,000

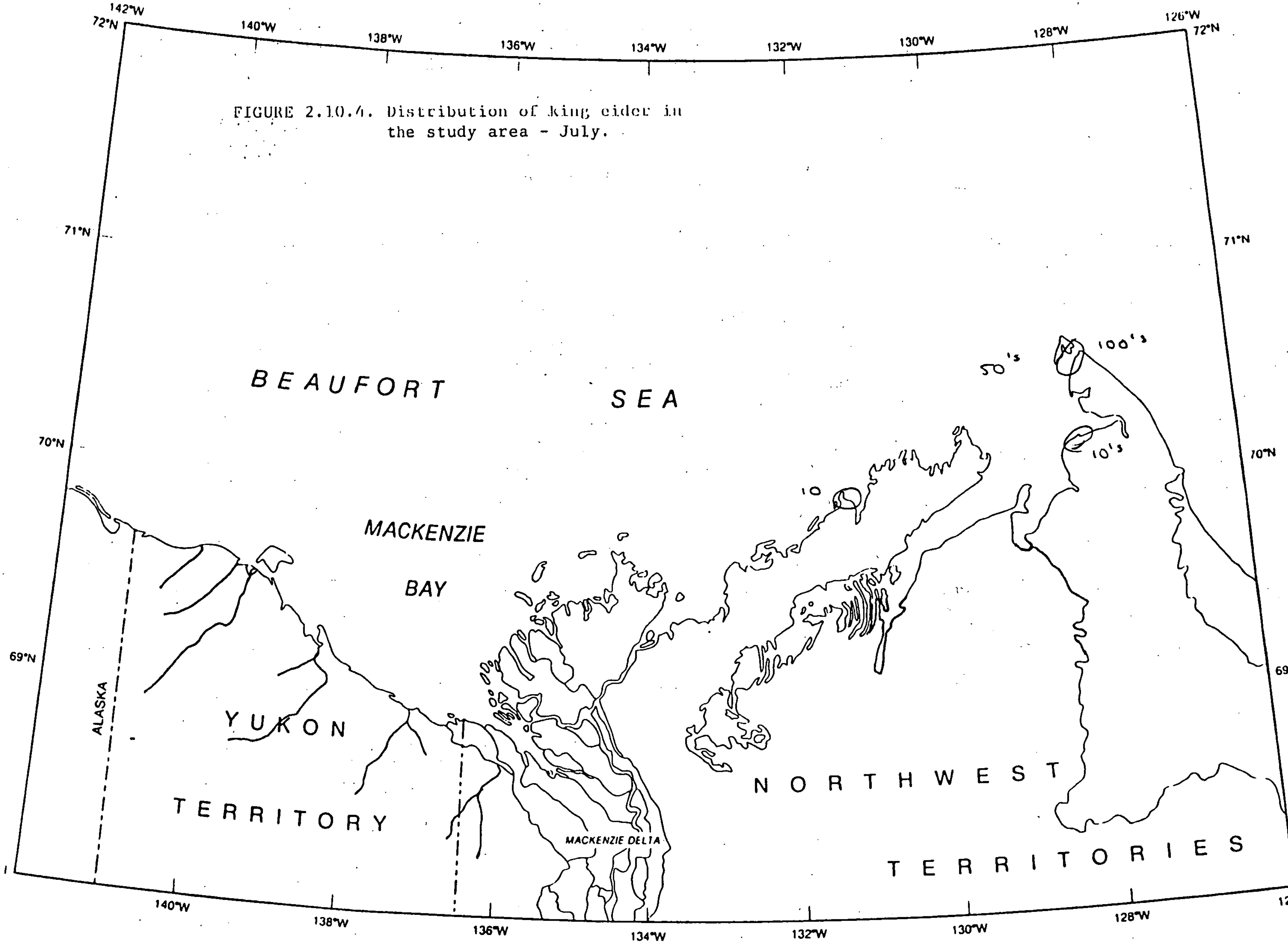


FIGURE 2.10.4. Distribution of king eider in the study area - July.

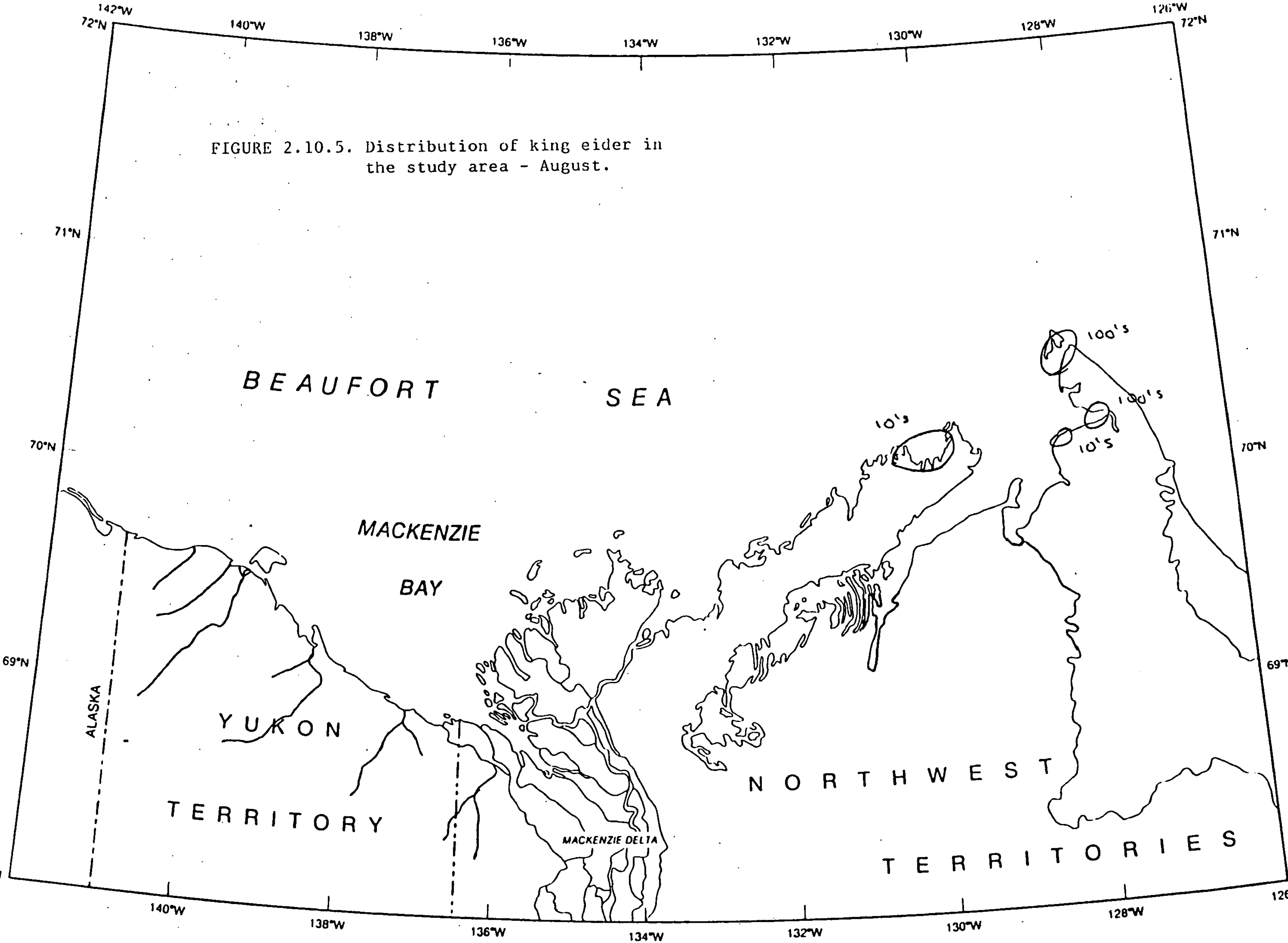


FIGURE 2.10.5. Distribution of king eider in the study area - August.

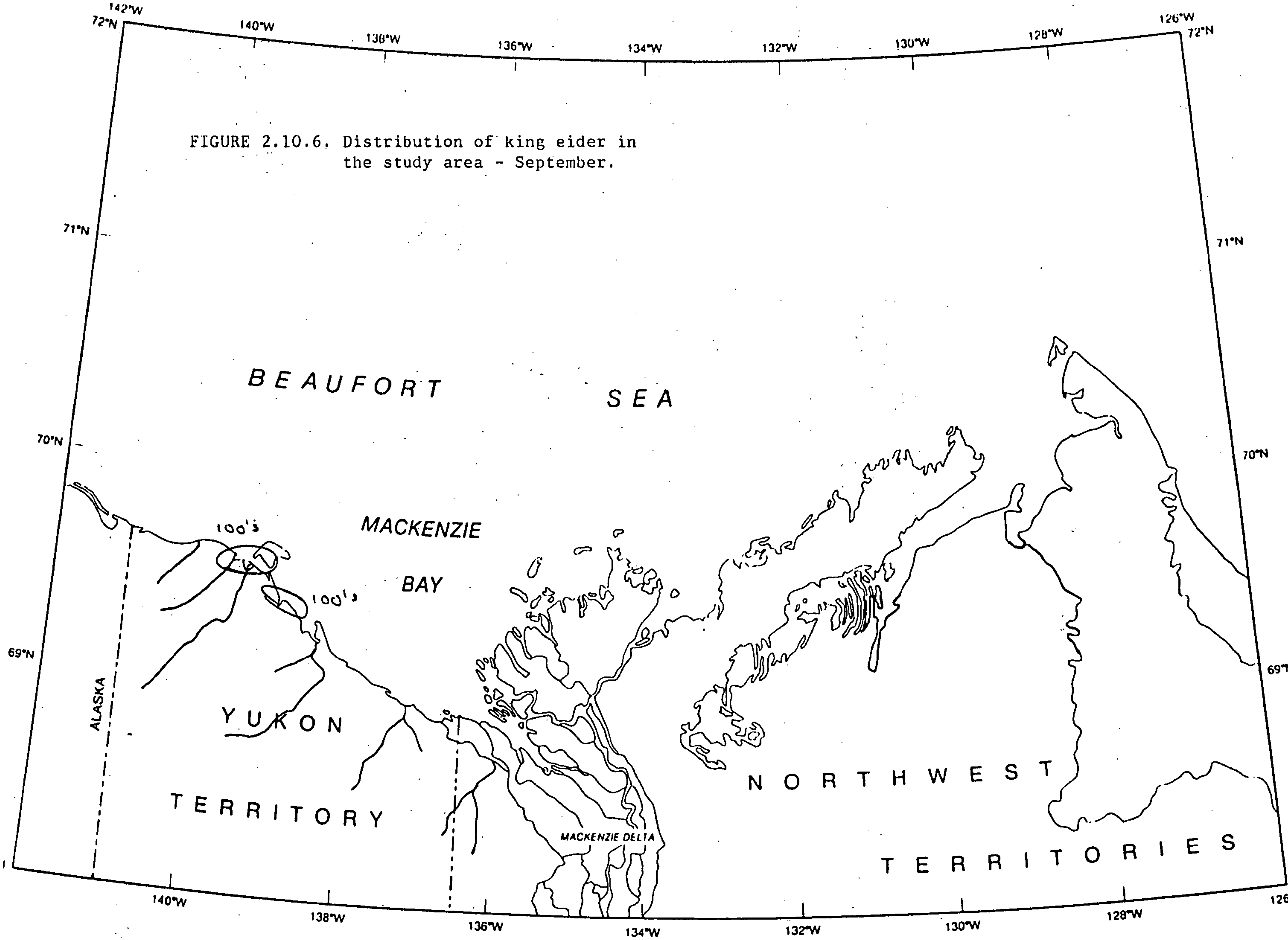


FIGURE 2.10.6. Distribution of king eider in the study area - September.

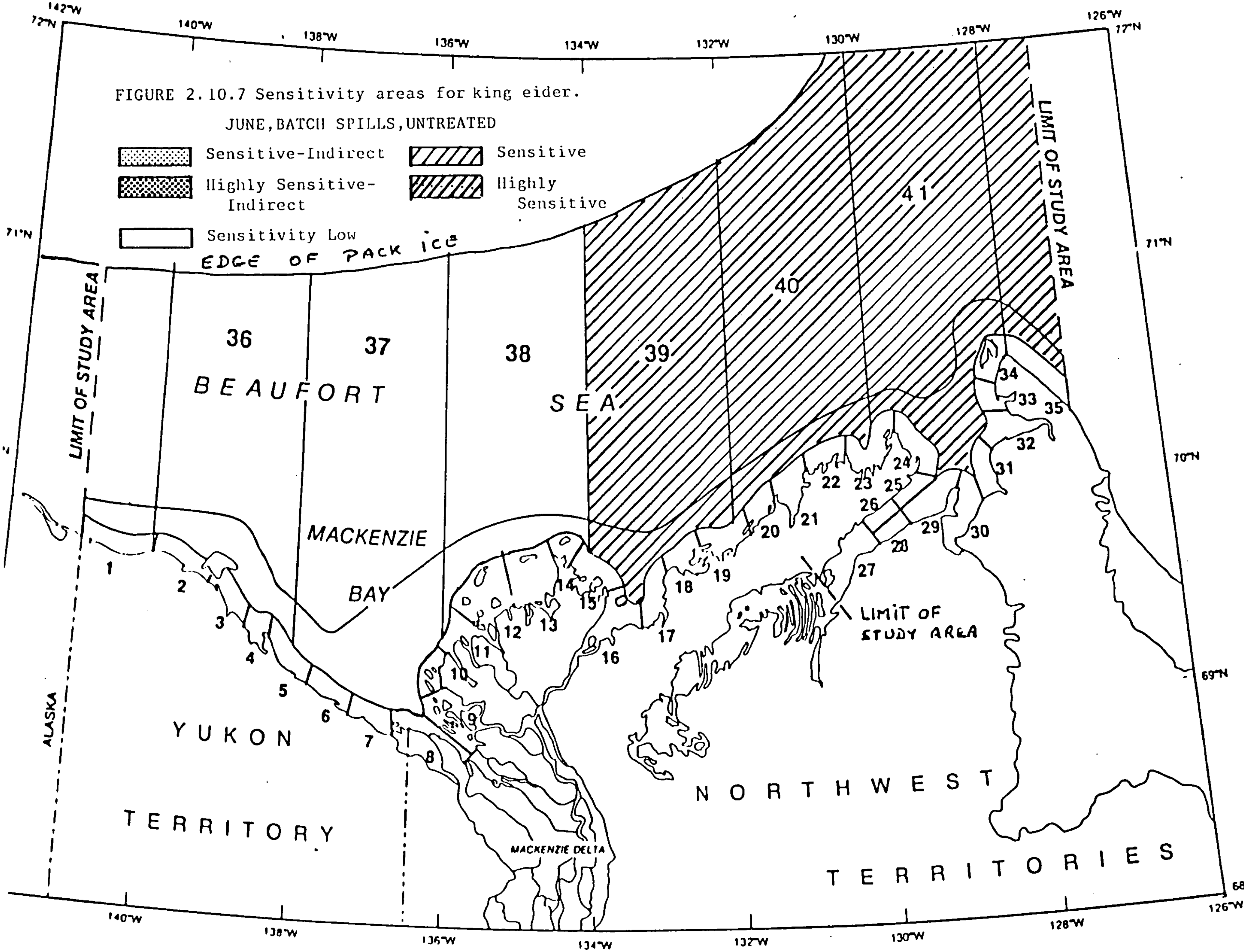


FIGURE 2.10.7 Sensitivity areas for king eider.

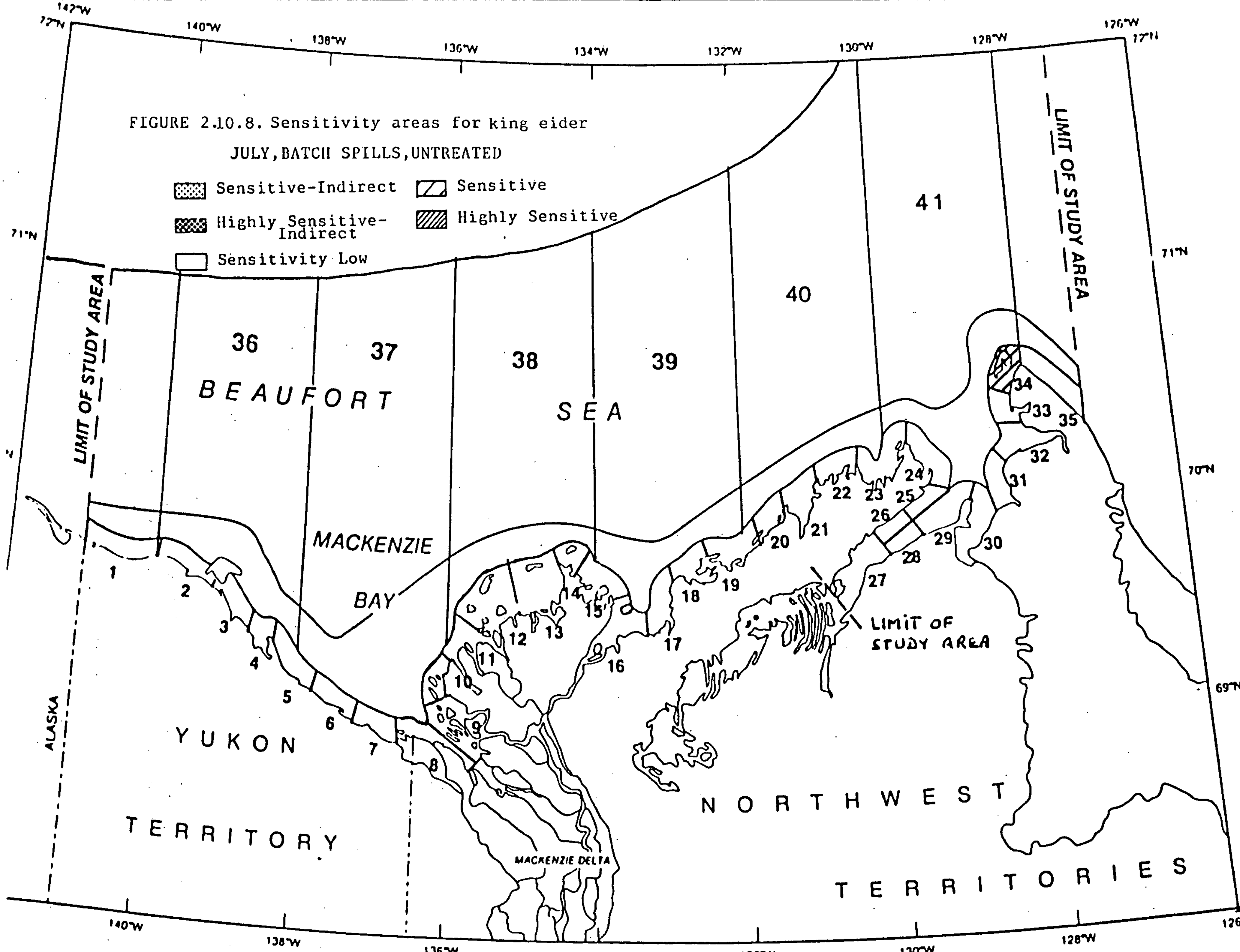


FIGURE 2.10.8. Sensitivity areas for king eider

JULY, BATCH SPILLS, UNTREATED

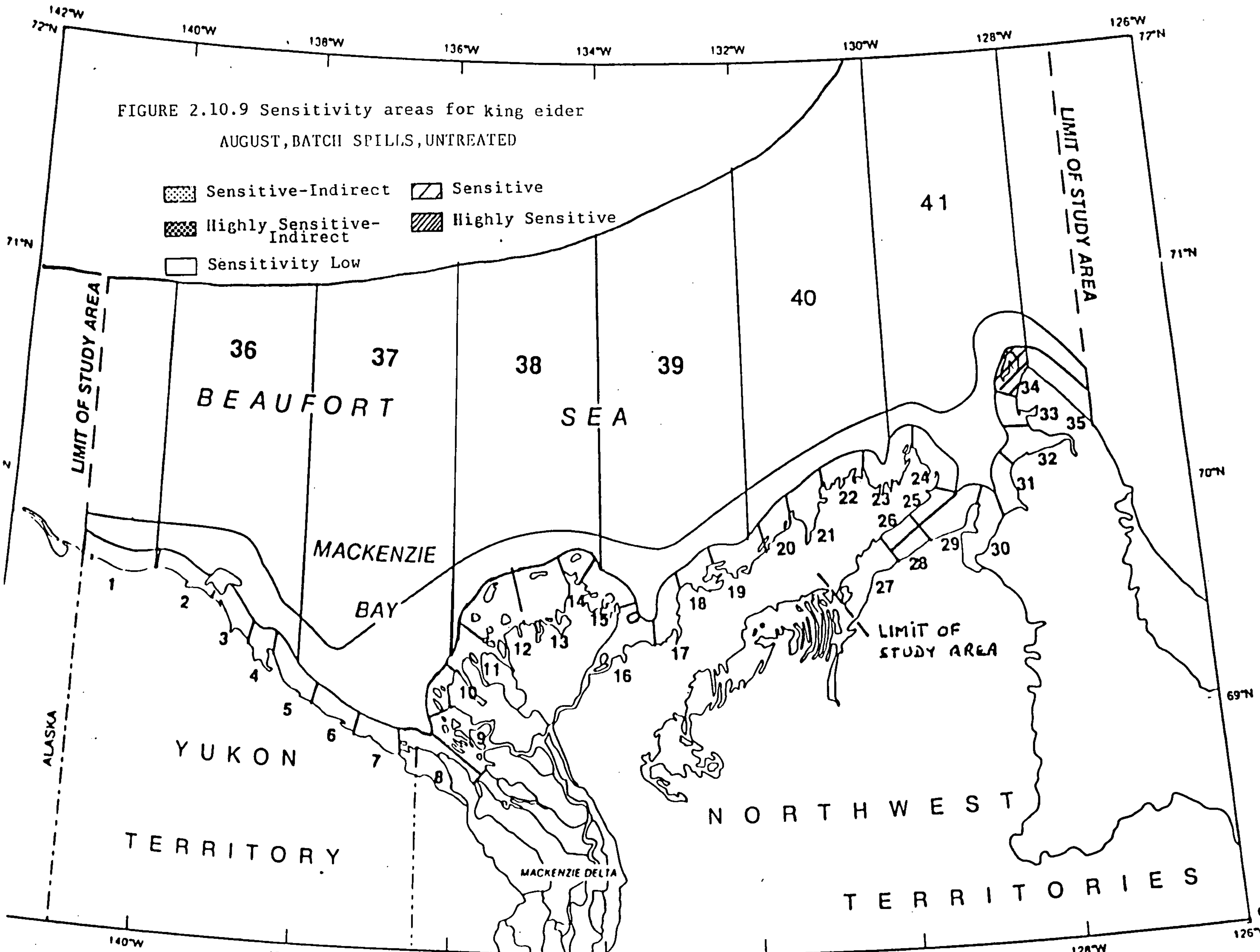


FIGURE 2.10.9 Sensitivity areas for king eider

AUGUST, BATCH SPILLS, UNTREATED

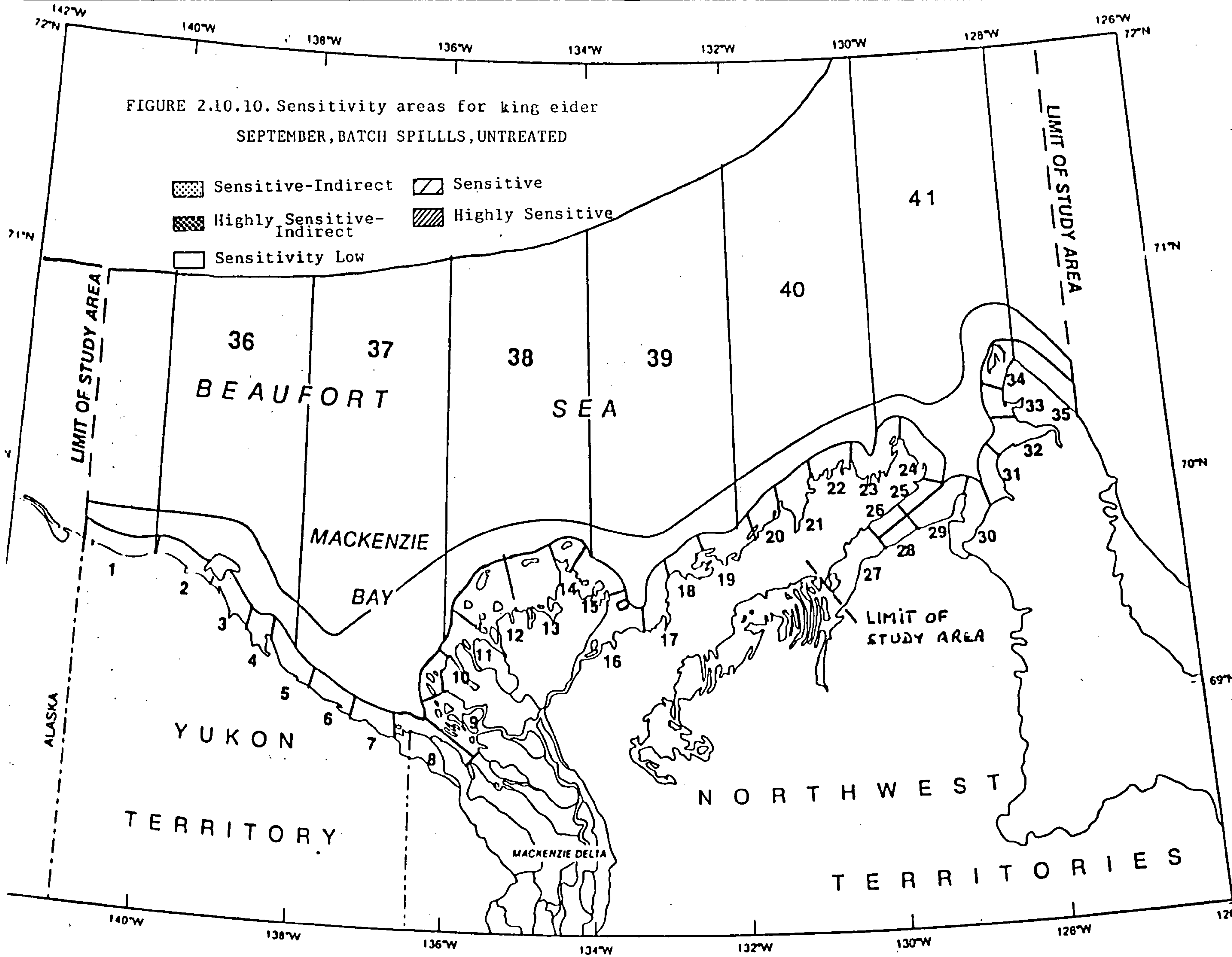


FIGURE 2.10.10. Sensitivity areas for king eider
SEPTEMBER, BATCH SPILLLS, UNTREATED

2.11 RED PHALAROPE (*Phalaropus fulicarius*) RED-NECKED (NORTHERN) PHALAROPE (*Phalaropus lobatus*)

These birds are not well studied with regards to population size, but are known to be very similar in habit, especially with regard to vulnerability to oil. As such they will be treated together here, differences being noted when appropriate.

These phalaropes have circumpolar breeding ranges and breed in large numbers in the Canadian Arctic. They migrate through the southern Beaufort Sea area to and from breeding grounds, and may be present in large numbers during autumn staging. They winter at sea in both the Atlantic and Pacific Oceans in the northern and southern hemispheres. Both phalaropes migrate over the open ocean, with the red-necked also using routes along the coast, and to a lesser extent, inland (Godfrey 1966). The only systematic population estimates of phalarope are for red-neck during east coast fall migration and indicate an eastern population of about 1 million birds regarded as being similar in number to the west coast (Mercier and Gaston 1985). In the absence of more accurate information, a western North American population of 1 million birds is taken as the target population.

2.11.1 Population Status

Phalaropes spend most of the breeding season away from the coast and are only vulnerable to oil spills during fall staging and migration. Both spring and fall migration routes are poorly known, but generally considered to be broad-front and offshore (Barry pers. comm.). The only systematic breeding population survey in the north indicated a population of 35,000 red phalarope on Banks Island (Manning et al. 1956). Other counts are incidental in nature.

2.11.2 Habits, Movements, and Timing Within the Southern Beaufort Sea

Phalaropes arrive in the study area in late May on their way to nesting areas. For red phalaropes, these areas lie to the east, predominantly Banks and Victoria Islands. For red-necks, the breeding grounds are largely on the mainland. For both species, nesting site preference is for tundra bordering on ponds and small lakes. Females abandon the nest shortly following hatch, gather in flocks on the tundra, and leave for wintering grounds by late July. Males incubate the eggs and remain at the nest till young are fledged. They then gather in large feeding flocks just off coastal surf zones and depart south by late August. Young-of-the-year flock with the males, and are largely gone by the end of August. These feeding flocks can be very large, ranging up to 20,000 (Barry pers. comm.; LGL and ESL 1982).

2.11.3 Distribution and Vulnerability in the Study Area

Phalaropes appear to be vulnerable to oil only during the time in which they form large feeding congregations along the coast from Herschel Island to Demarcation Point. Due to the paucity of information concerning this species especially concerning identifiable sub-populations in the western arctic, we must take the estimated 1 million western North American population as the target population. Thus, the greatest effects experienced would be at the SLIGHT level in August on the western Yukon coast.

References: Barry pers. comm.; ESL and LGL 1982; Godfrey 1966; Johnson et al. 1975; Manning et al. 1956; Mercier and Gaston 1985.

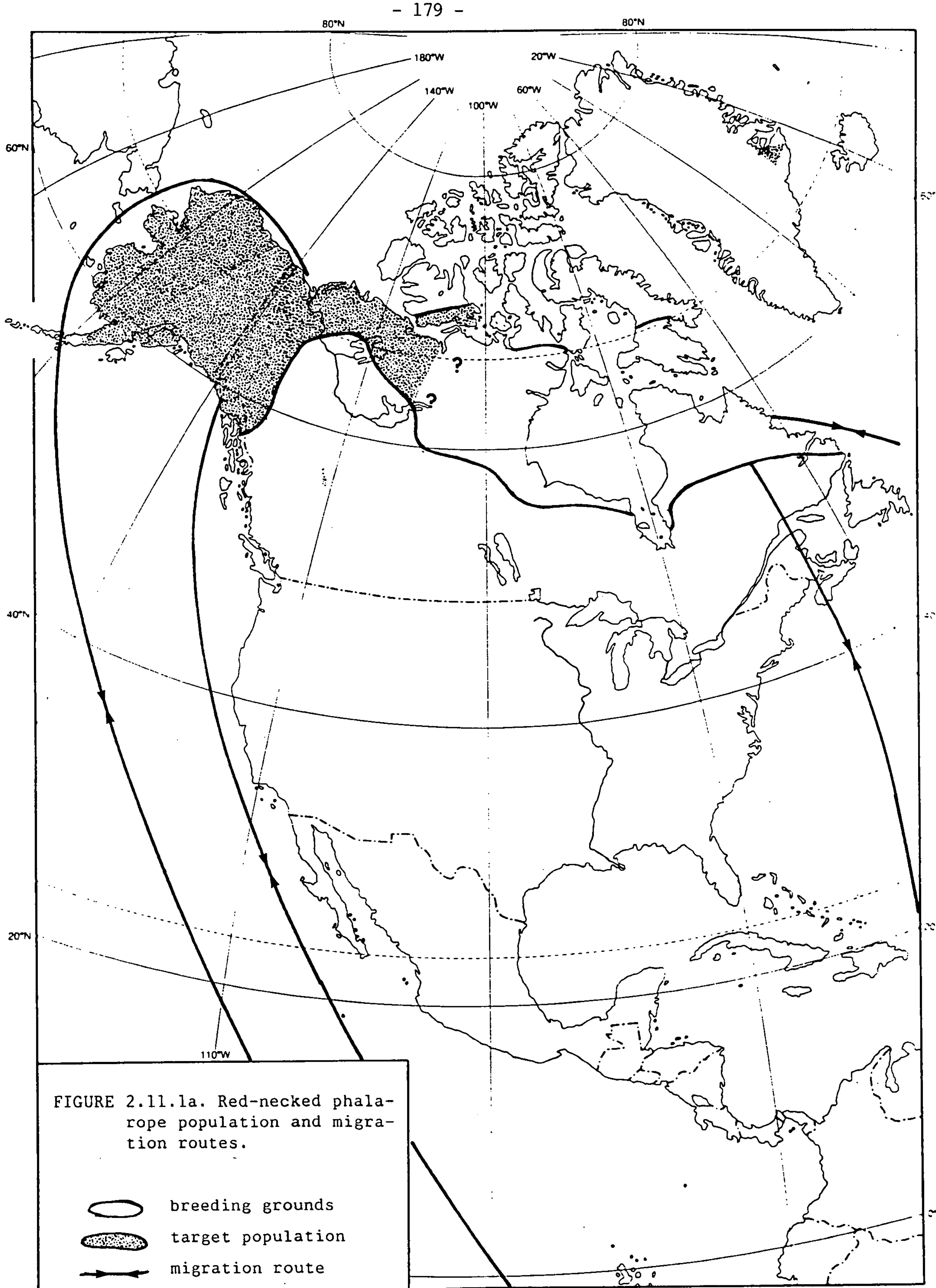


FIGURE 2.11.1a. Red-necked phalarope population and migration routes.

breeding grounds
target population
migration route

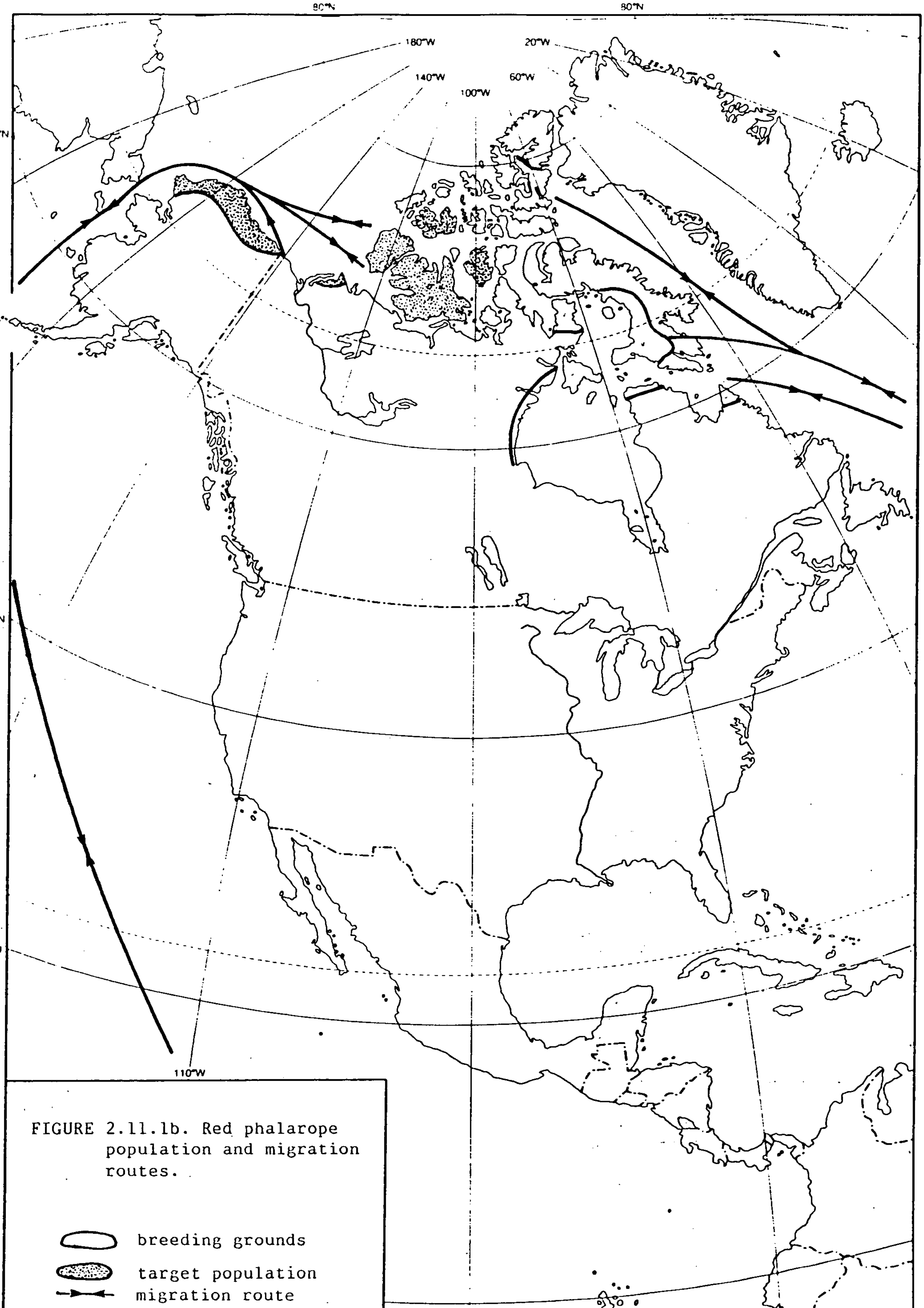
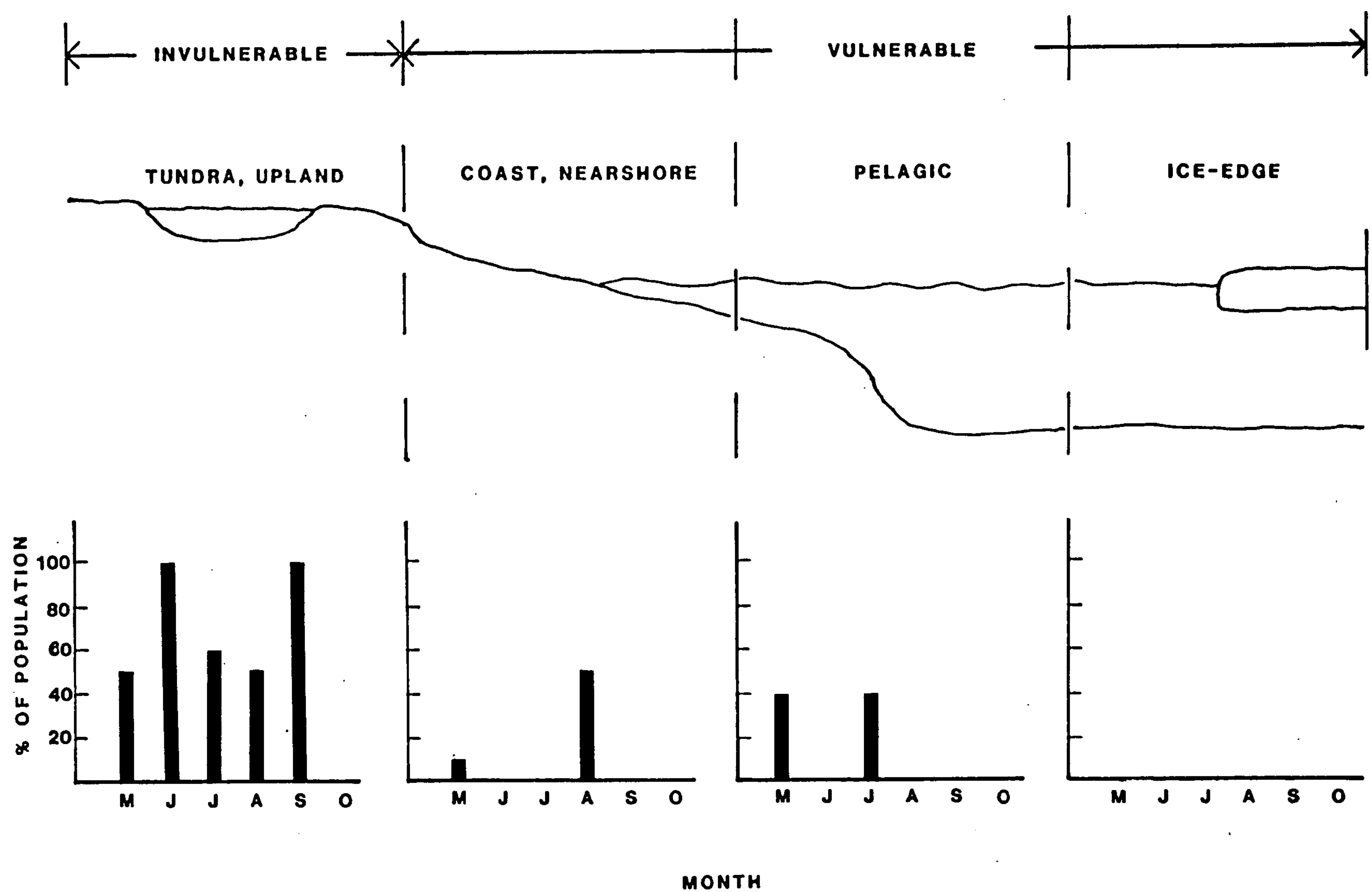


FIGURE 2.11.1b. Red phalarope population and migration routes.

Figure 2.11.2 Habitat utilization and vulnerability of wildlife species during the open-water season in the southern Beaufort Sea area.

RED AND RED-NECKED PHALAROPE



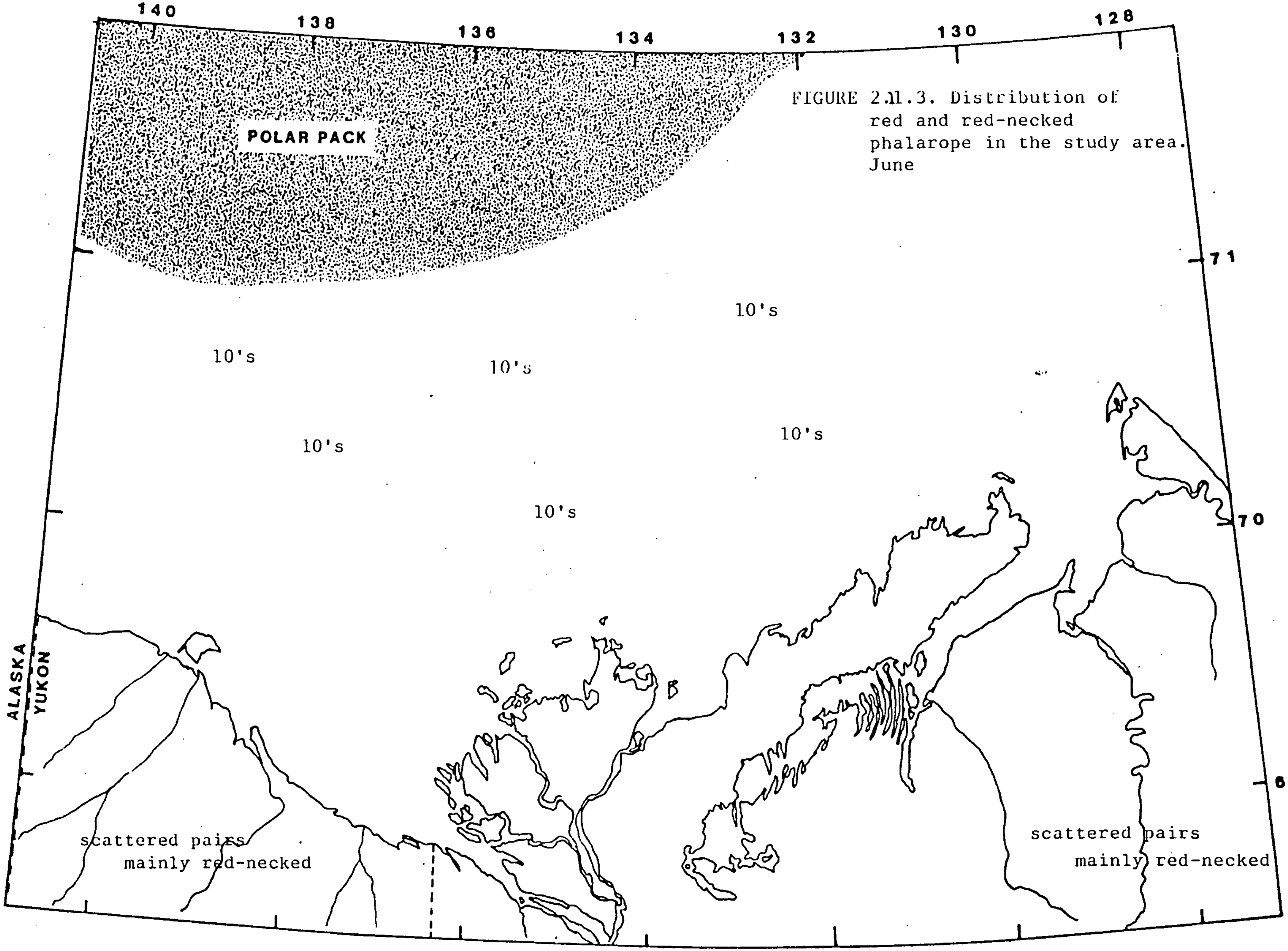


FIGURE 2.11.3. Distribution of red and red-necked phalarope in the study area. June

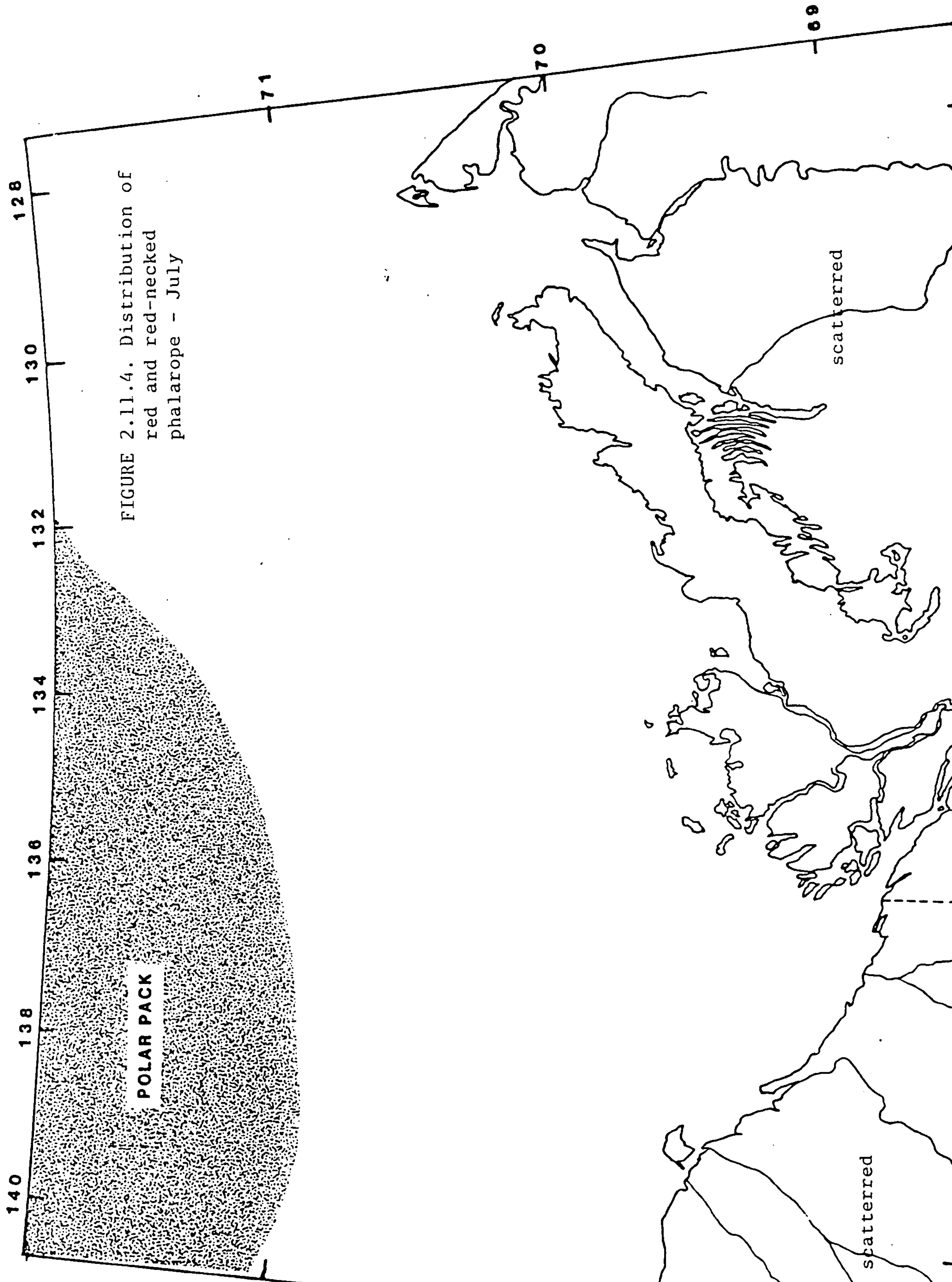


FIGURE 2.11.4. Distribution of red and red-necked phalarope - July

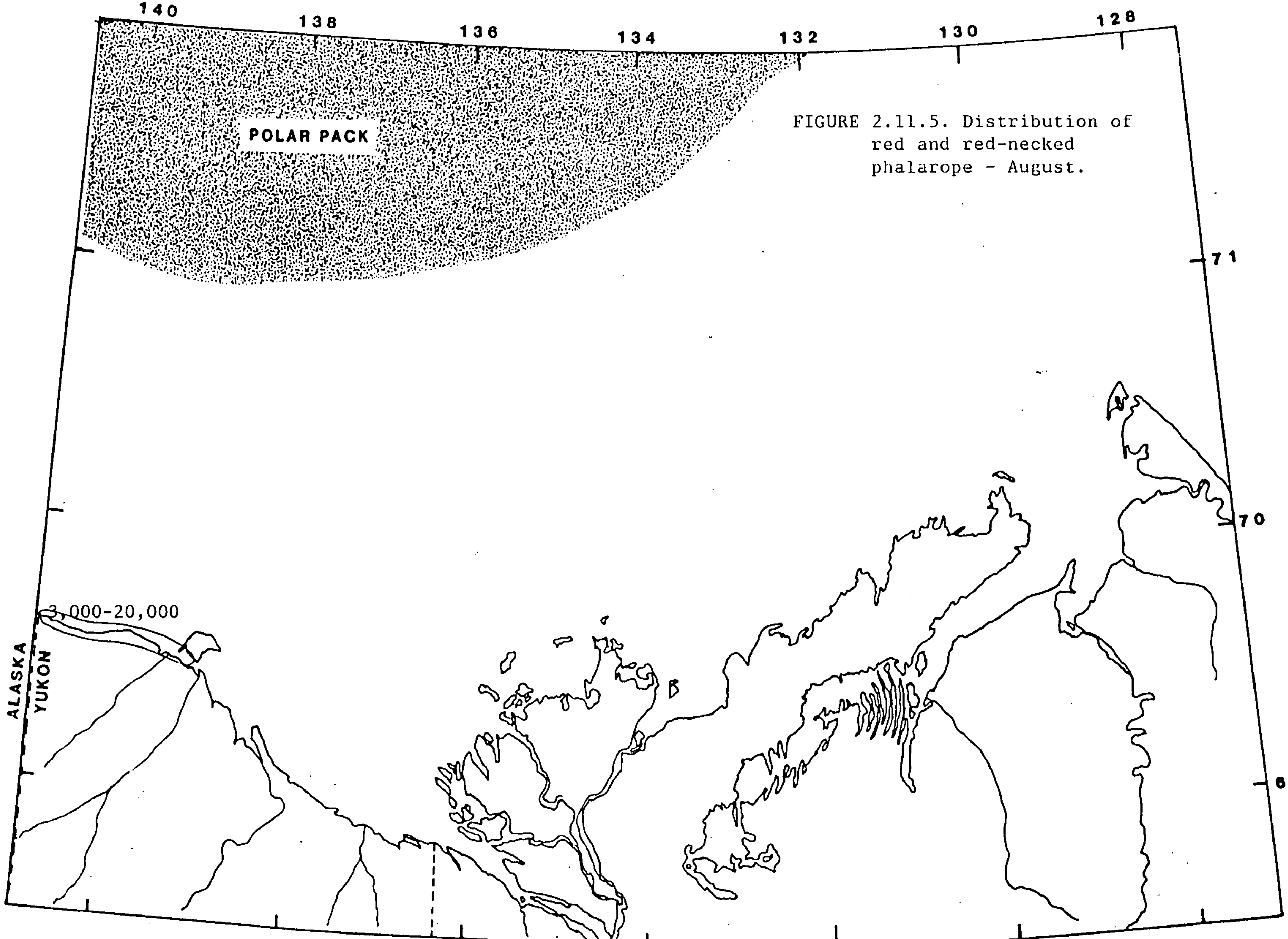


FIGURE 2.11.5. Distribution of red and red-necked phalarope - August.

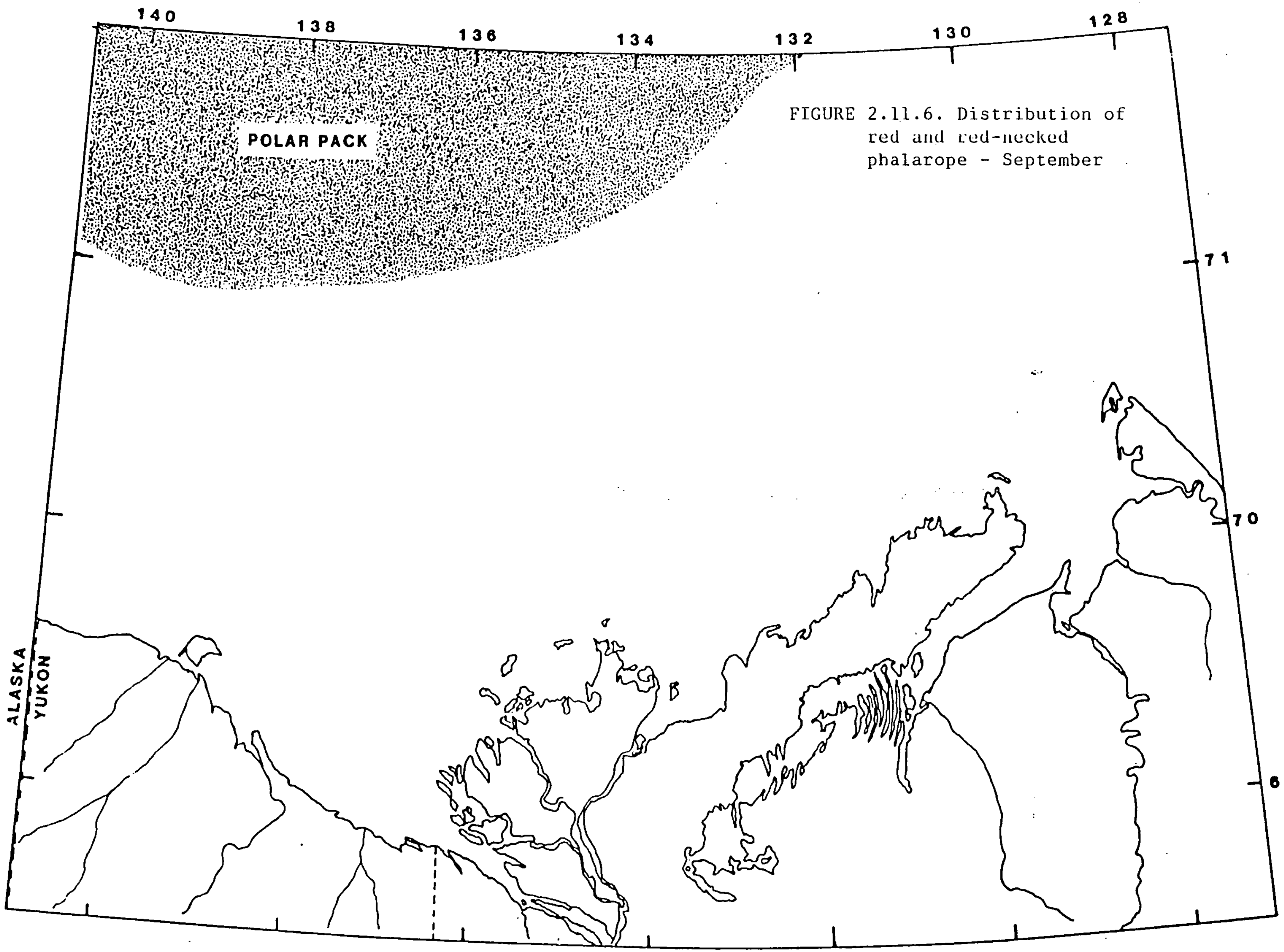


FIGURE 2.11.6. Distribution of red and red-necked phalarope - September

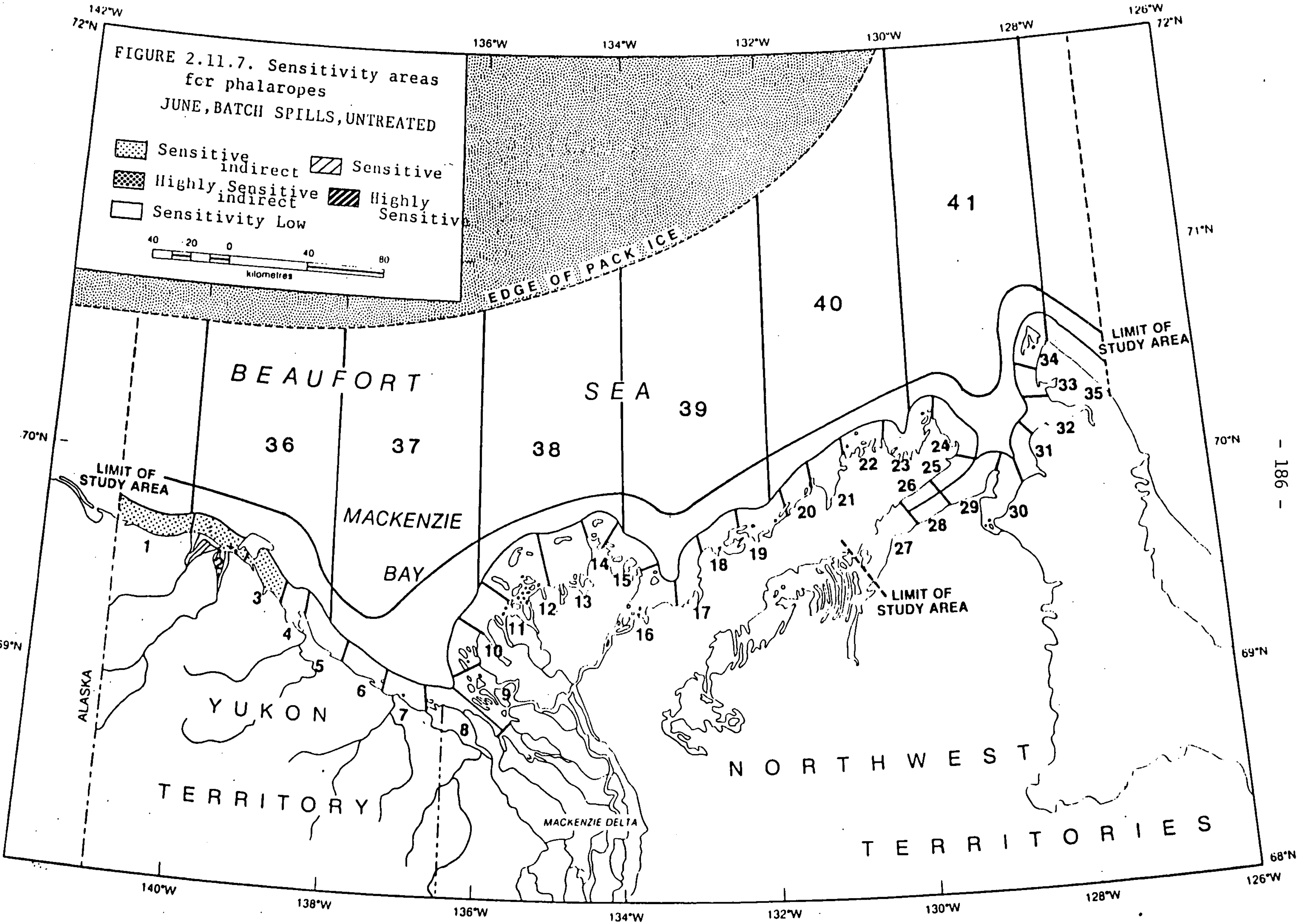


FIGURE 2.11.7. Sensitivity areas for phalaropes
JUNE, BATCH SPILLS, UNTREATED

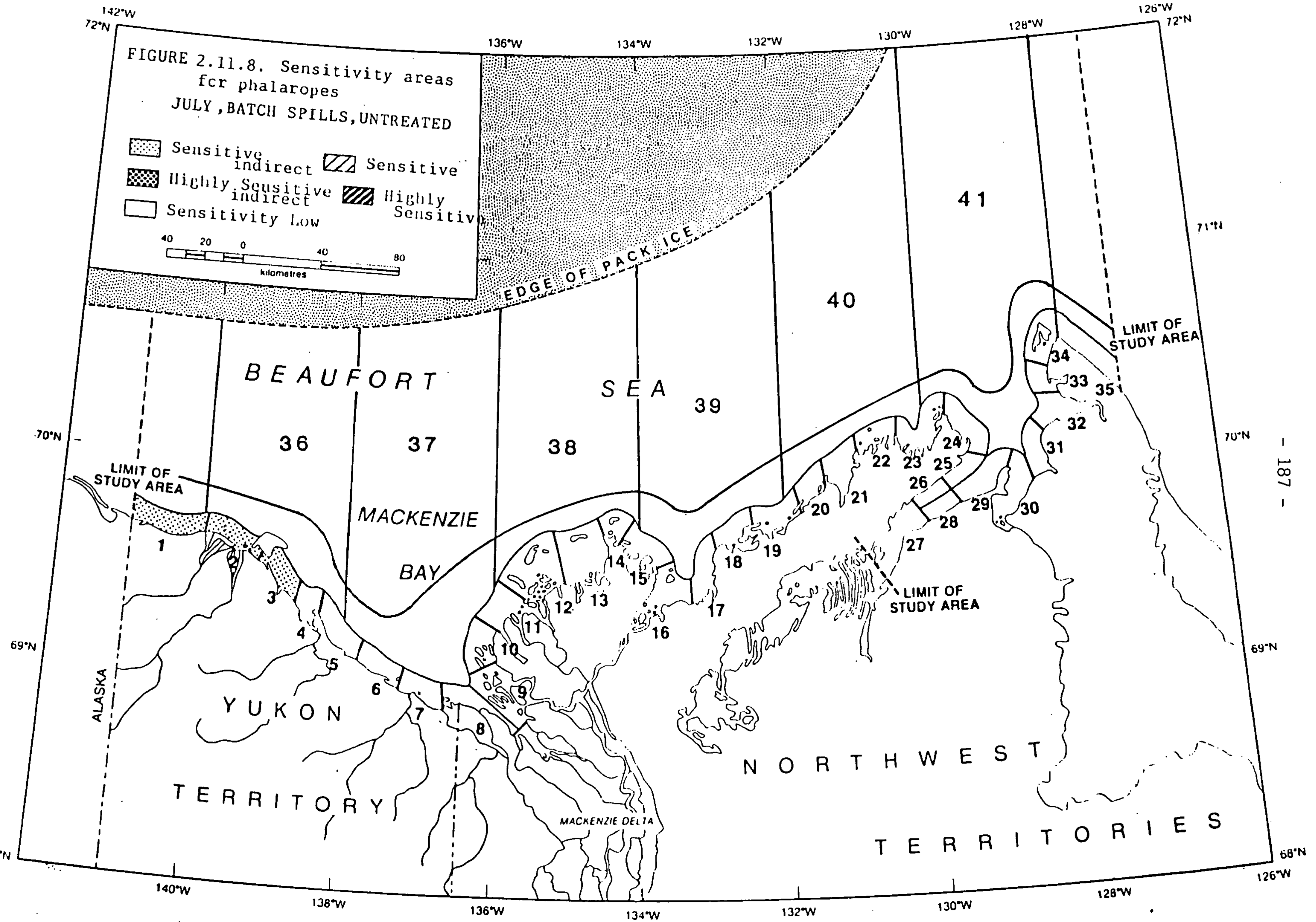


FIGURE 2.11.8. Sensitivity areas for phalaropes
JULY, BATCH SPILLS, UNTREATED

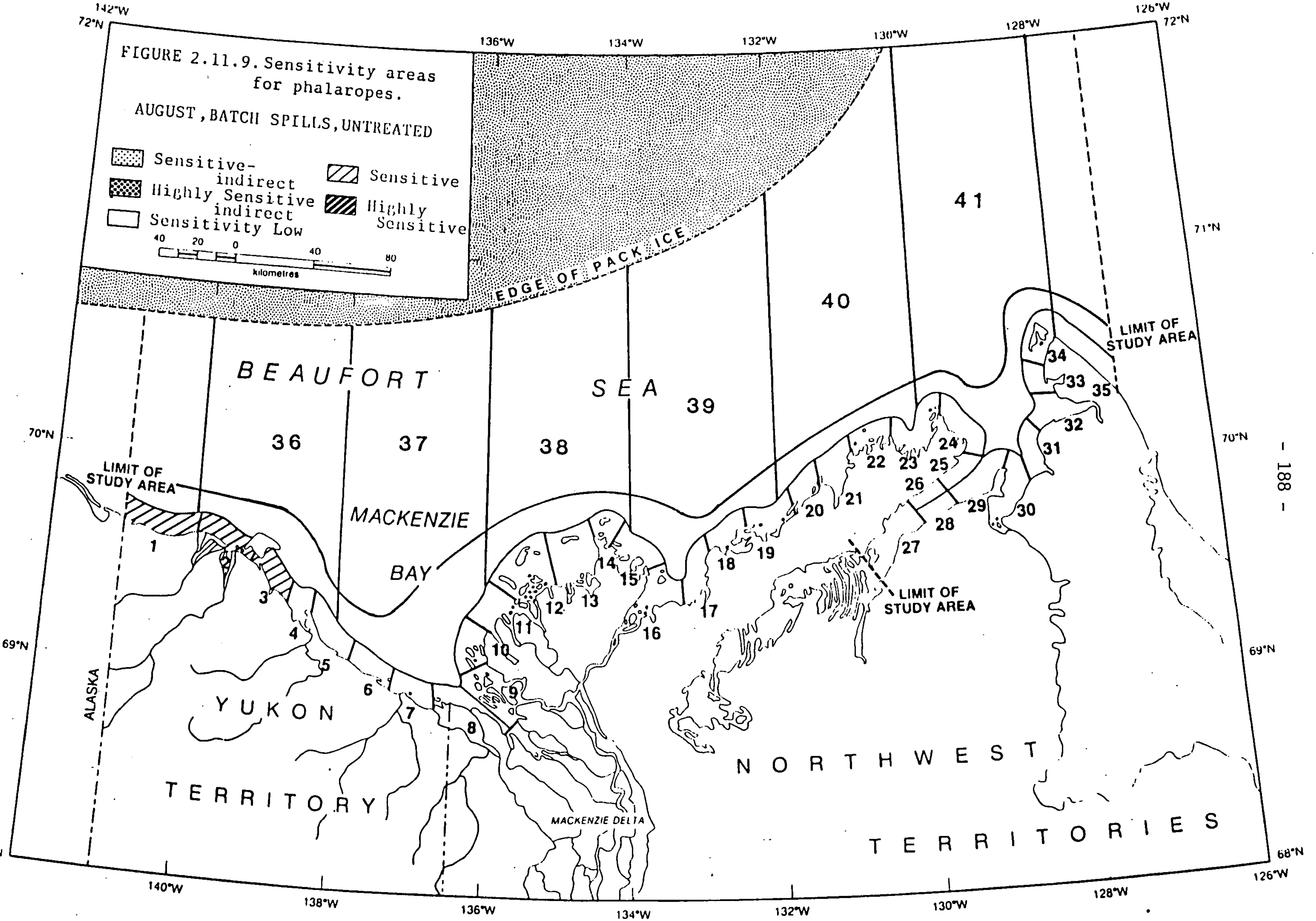


FIGURE 2.11.9. Sensitivity areas for phalaropes.

AUGUST, BATCH SPILLS, UNTREATED

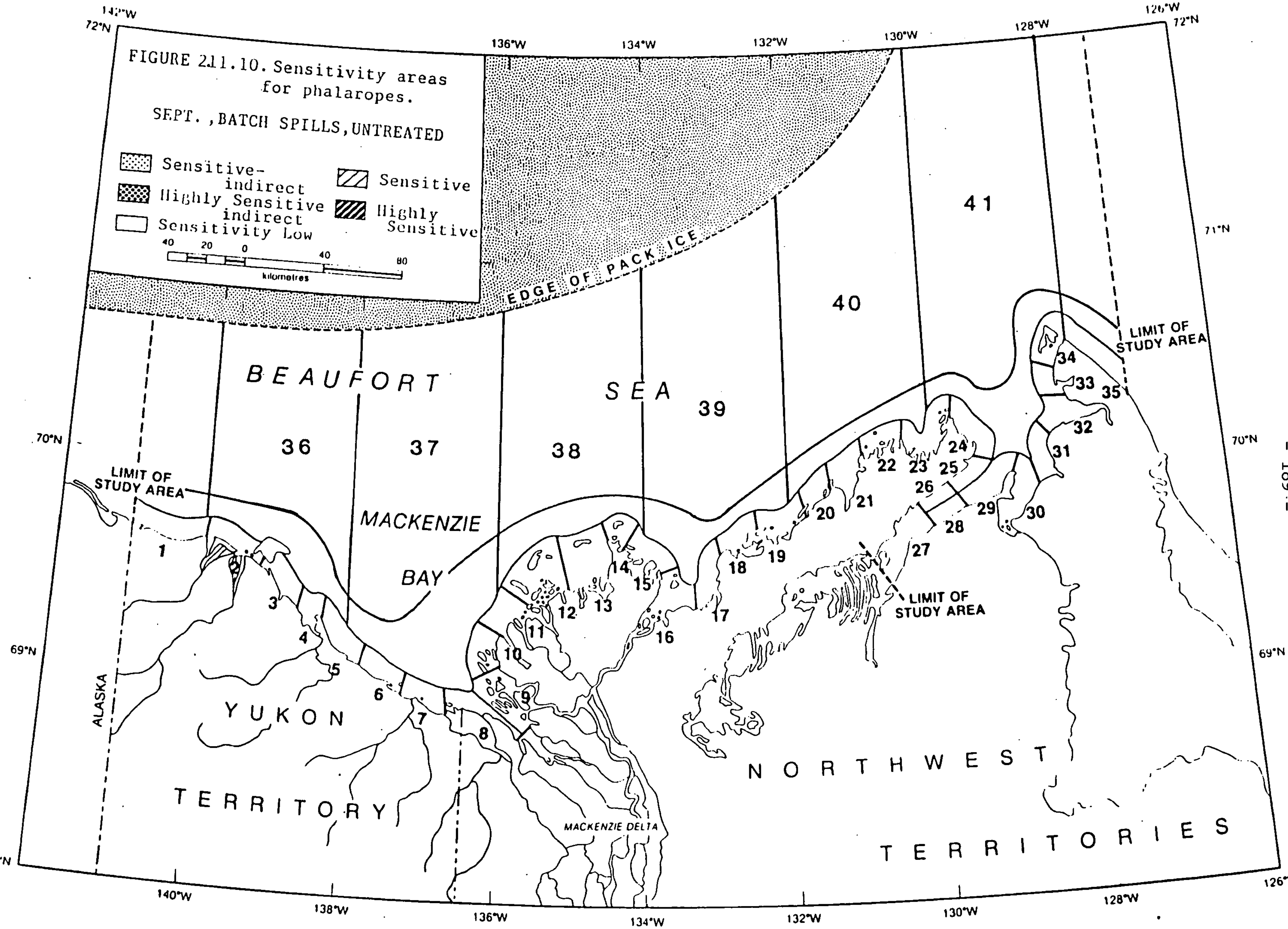


FIGURE 2.1.10. Sensitivity areas for phalaropes.

SEPT., BATCH SPILLS, UNTREATED

3.0 MARINE MAMMALS

3.1 BOWHEAD WHALE (*Balaena mysticetus*)

The bowhead whale is an important component of the marine faunal community of the western Arctic and is considered an endangered species both in Canada and internationally. The stock of bowhead whales found in the Beaufort Sea, often referred to as the Western Arctic Stock, is one of five recognized stocks of the species and the largest one remaining today. All stocks have been severely reduced by commercial whaling. The Western Arctic Stock now numbers approximately 4400 whales (IWC 1985) while the other stocks have become extinct or contain only several hundred individuals. Prior to commercial whaling, the Western Arctic Stock is estimated to have numbered between 14,000 and 26,000 bowheads (Breiwick et al. 1981).

3.1.1 Habits, Movements and Timing Within the Southern Beaufort Sea Area

Bowhead whales of the Western Arctic Stock winter in or near the southern margins of the ice pack in the Bering Sea, and summer in the southeastern Beaufort Sea and Amundsen Gulf. Their spring migration to the Beaufort Sea area begins in late March, with the bulk of the population having entered the Beaufort Sea by mid-June.

The migration from the Bering Sea follows the fast-ice edge along the Chukchi Sea coast of Alaska to Point Barrow. From there migrants follow an offshore route in an easterly direction across the Beaufort Sea, making use of leads in the pack ice. Bowheads intercept the major lead west of Banks Island and move from there to Amundsen Gulf and the waters off Cape Bathurst, where they are found during the early summer. Late migrants may follw a more southerly route across the Beaufort Sea to the Amundsen Gulf, depending upon the ice conditions (LGL and ESL 1982).

Bowheads have been sighted throughout the Beaufort Study area and the Amundsen Gulf during the entire open water season, but historical records and surveys of recent years indicate that there is a general pattern to their seasonal distribution and movements. In June and July, bowheads are present in Amundsen Gulf and in the far eastern and offshore areas of the Beaufort Sea, with few sightings reported in the southern Beaufort Sea west of Cape Dalhousie. In early to mid-August, bowheads move into the southern Canadian Beaufort, with concentrations often occurring along the Yukon coast, in west Mackenzie Bay and off the eastern Tuktoyaktuk Peninsula. In late August or early September, bowheads begin to move into the eastern westward migration toward their wintering areas and appear to be distributed across the entire study area. By early October, most bowheads have departed the Canadian Beaufort. After leaving the study area, bowheads migrate westward through the Alaskan Beaufort and across the Chukchi Sea (Ljungblad et al. 1983; Harwood and Borstad 1985; Davis et al. 1982).

Although bowheads are widely distributed throughout their summer range, they are known to concentrate in certain areas in August and early September. The areas of concentration vary from year to year and are thought to be heavily influenced by oceanographic and ice conditions. Known concentration areas include the Yukon coast, west Mackenzie Bay, the offshore area of the eastern Tuk Peninsula and the Cape Bathurst area (Harwood and Borstad 1985; Thomson et al. 1986).

Recent studies of the effects of oil on whales provide strong evidence that cetacean skin is particularly resistant to the effects of contact with oil. Oil fouling of baleen, if it occurred, would cause only a minor reduction in the filtering efficiency of baleen and would be reversed within 24 to 48 hours. Inhalation of toxic vapours from spilled oil is unlikely, and ingestion of sufficient quantities of oil to harm a whale is also unlikely (Braithwaite 1981; Geraci and St. Aubin 1982, 1985).

Although the bowhead is an endangered species and would have a long recovery time following significant mortality, the species is not considered to be especially vulnerable to the effects of oil spills.

Vulnerability would be significant only when bowheads are confined to leads i.e., during the spring migration (Percy and Wells 1984; Engelhardt 1985).

3.1.2 Distribution and Vulnerability

By June, bowheads have essentially completed their spring migration, and are foraging in the eastern Beaufort and Amundsen Gulf where they remain through July. Beginning in early August, bowheads begin moving westward, into the southern Beaufort, with known concentration point noted above. Bowhead continue to move westward through August and September and have vacated the Canadian Beaufort by early October, on their way to wintering grounds in the Bering Sea. Because of the relative insensitivity of bowheads to oil, and since they are no longer using leads during the study period (where they would be vulnerable), effects of any oil spill from June to September would be NEGLIGIBLE.

3.1.3 Resource Use

The harvest of bowheads is prohibited in Canadian waters, but a small subsistence hunt of this species is carried out in Alaska.

Referrences: Braithwaite 1981; Breiwick et al. 1981; Davis et al. 1982; Engelhardt 1985; Geraci and St. Aubin 1982, 1985; Harwood and Borstad 1985; IWC 1985; LGL and ESL 1982; Ljungblad et al. 1983; Percy and Wells 1984; Thompson et al. 1986.

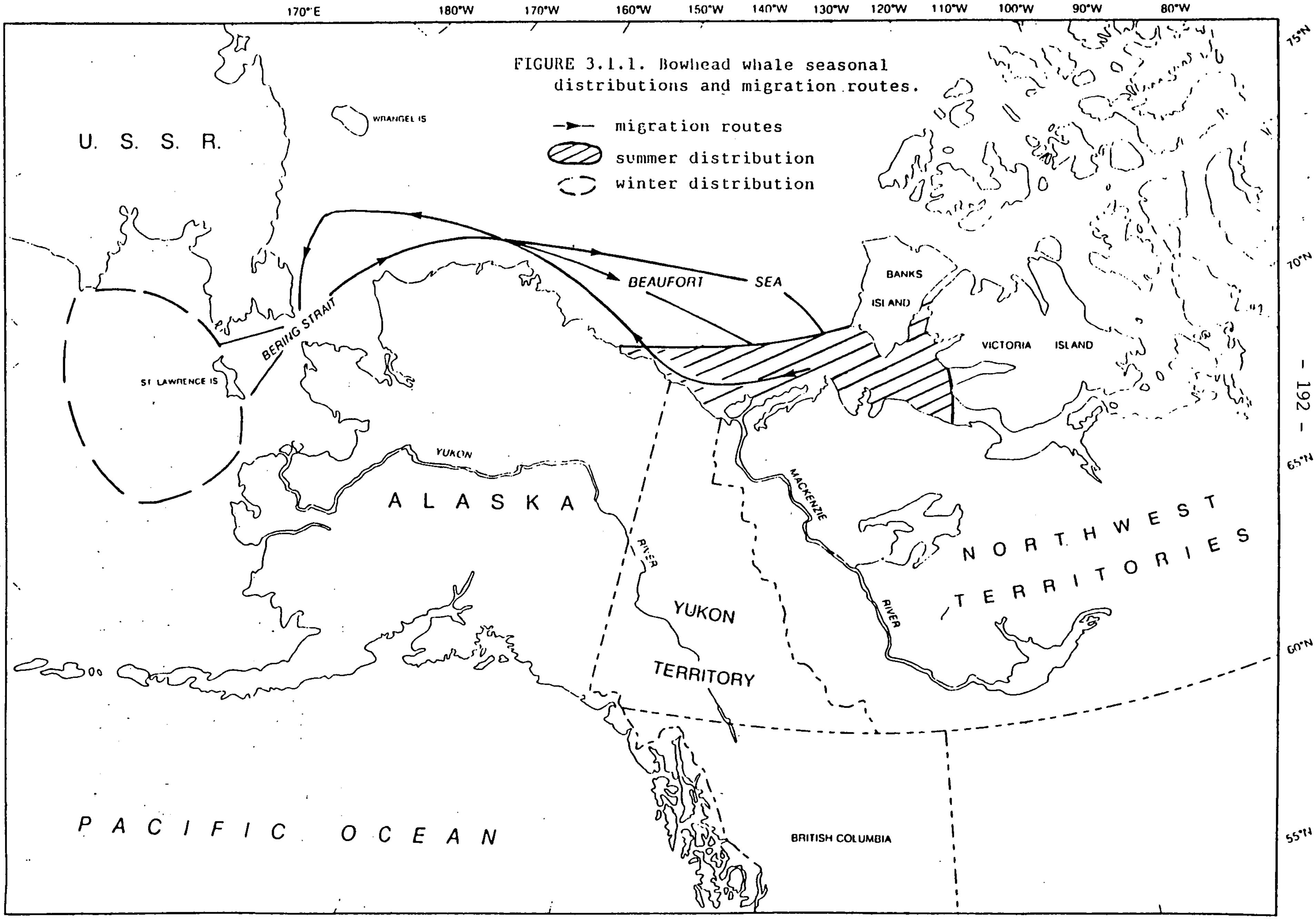


FIGURE 3.1.1. Bowhead whale seasonal distributions and migration routes.

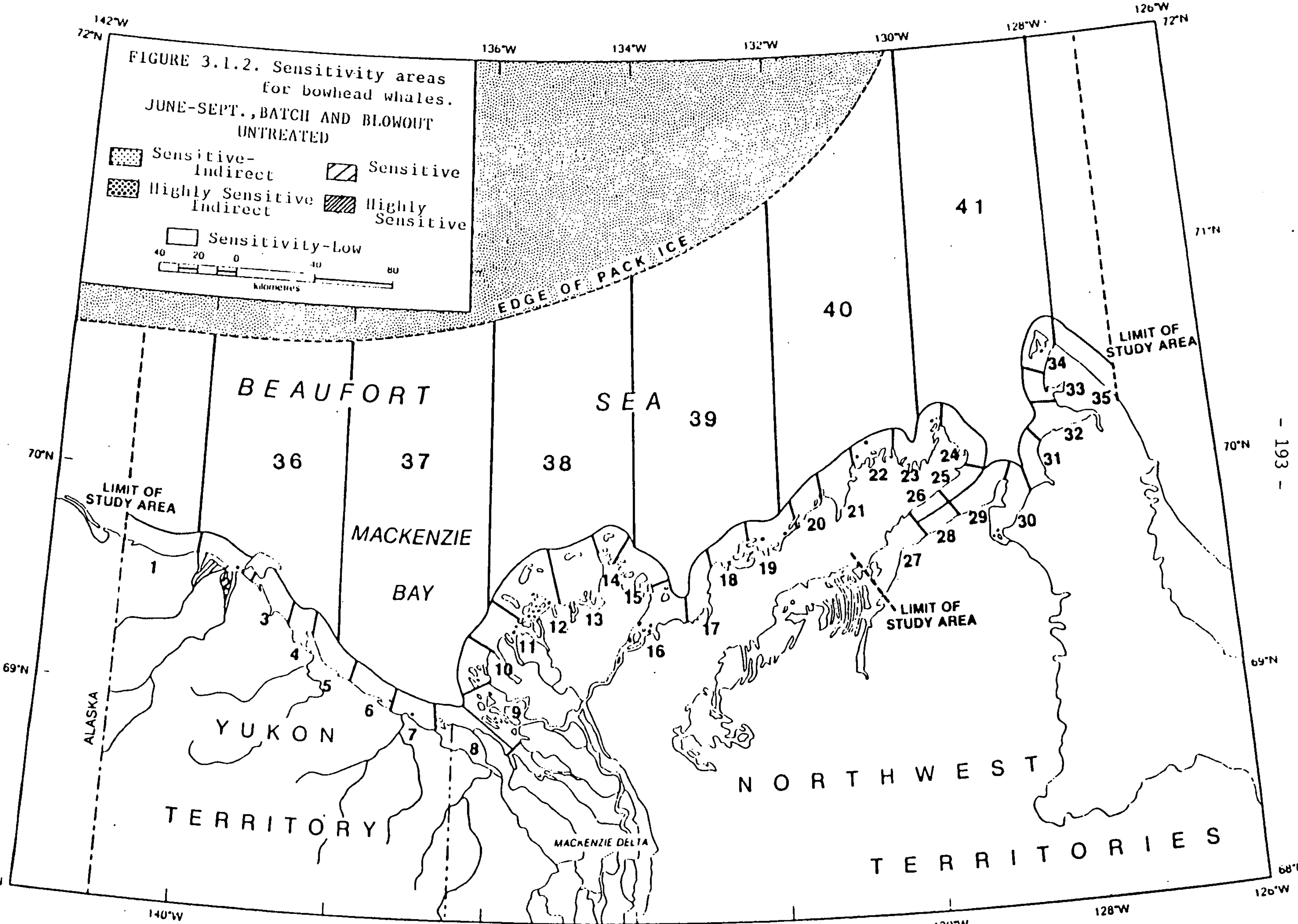


FIGURE 3.1.2. Sensitivity areas for bowhead whales. JUNE-SEPT., BATCH AND BLOWOUT UNTREATED

3.2 WHITE (BELUGA) WHALE (Delphinapterus leucas)

The white whale is an important component of the marine faunal community of the southern Beaufort Sea area and it supports an important whale fishery in the area. The white whales in the southern Beaufort Sea area are all part of a single population that winters in the Bering Sea and summers in the eastern and central Beaufort. The Beaufort Sea stock is the most westerly of the five distinct stocks which occur in Canadian Arctic waters (Davis et al. 1980). The others occur in Lancaster Sound, Cumberland Sound, Ungava Bay, and Hudson Bay. The southern Beaufort Sea stock has been estimated to number at least 11,500 whales (Davis and Evans 1982) constituting about 30 percent of the total population of white whales in Canadian Arctic waters. The Beaufort Sea stock of white whales supports an important domestic fishery in the Mackenzie Delta area in July and August.

3.2.1 Habits, Movements and Timing within the Southern Beaufort Sea Area

The Beaufort Sea population of white whales winters in and along the edge of the pack ice in the Bering Sea area from October to March. They migrate from this area beginning in March and April. In the Beaufort area east of Point Barrow Alaska, the early migrants follow an offshore route using offshore leads to reach Banks Island and the Amundsen Gulf in the eastern Beaufort. They arrive in the eastern Beaufort in May depending upon the ice conditions. Later migrants make use of leads closer to the coast and move either to the eastern Beaufort or to the Mackenzie estuary.

White whales spend from four to six weeks in the eastern Beaufort before moving westward towards the Mackenzie estuary in late June and early July. Fraker (1977) reports that this westward migration follows a narrow corridor along the edge of the landfast ice along the Tuktoyaktuk Peninsula, across northern Kugmallit Bay and along the outer edge of the Mackenzie Delta (Figure 3.2.1).

The population concentrates in the Mackenzie estuary from late June to August (Figure 3.2.1). The greatest concentrations (3,000 - 4,000 individuals) occur in the Shallow Bay area, with lesser concentrations (500 - 1,000 individuals) in east Mackenzie Bay near the Kendall-Courny-Pelby Island area, and in Kugmallit Bay near Hendrickson Island. In addition to these areas, large concentrations (1,000 - 2,000 individuals) of white whales make use of so-called "intermittent-use" areas immediately offshore of these concentration areas in Mackenzie Bay. There is some evidence that occasional use is made of the offshore areas at the edge of the pack ice but by far the greatest concentration of white whales occur in nearshore areas.

In late July and early August concentrations in the Mackenzie estuary decline as some white whales disperse eastward along the coast. During this period white whales occur in relatively low numbers in the Mackenzie estuary, along the coast of the Tuktoyaktuk Peninsula, in the Liverpool Bay- Eskimo Lakes area and in the Amundsen Gulf.

During late August and September white whales begin to leave the Beaufort Sea area. From the limited data available it appears that they follow offshore migration routes in their westward migration although a few white whales have been observed in nearshore areas in September (LGL and ESL 1983).

3.2.2 Distribution and Vulnerability

In June, August and September, white whales are widely distributed in the southern Beaufort Sea area. Because they are relatively insensitive to oil, the effects of any oil spills during these months would be NEGLIGIBLE. In July, white whales are concentrated in the Mackenzie estuary. At this time they may be subject to SLIGHT effects from a blowout, but due to their relative insensitivity to oil, would not be at risk from batch spills.

3.2.3 Resource Use

During the period of concentration of white whales in the Mackenzie estuary (July and August) Inuit from Tuktoyaktuk, Inuvik, and Aklavik harvest whales. Approximately 130 whales are taken each year. The bulk of this harvest occurs in the three concentration areas in Shallow Bay, Kendall-Garry-Pelly Island, and in Kugmallit Bay near Hendrickson Island. Fraker (1977) has suggested that the cultural and social value of the hunt may be even more important to the Inuit than the value of the white whales as a food source. Spills in these areas in June, July and August could seriously hamper this whaling activity because of the clean-up activities, oil fouling of boats and harvested whales, and avoidance by whales of areas with oil slicks.

References: Frost and Lowry 1984; McLaren and Davis 1985.
Davis and Evans 1982; LGL and ESL 1983.
Davis et al. 1980; Fraker 1977.

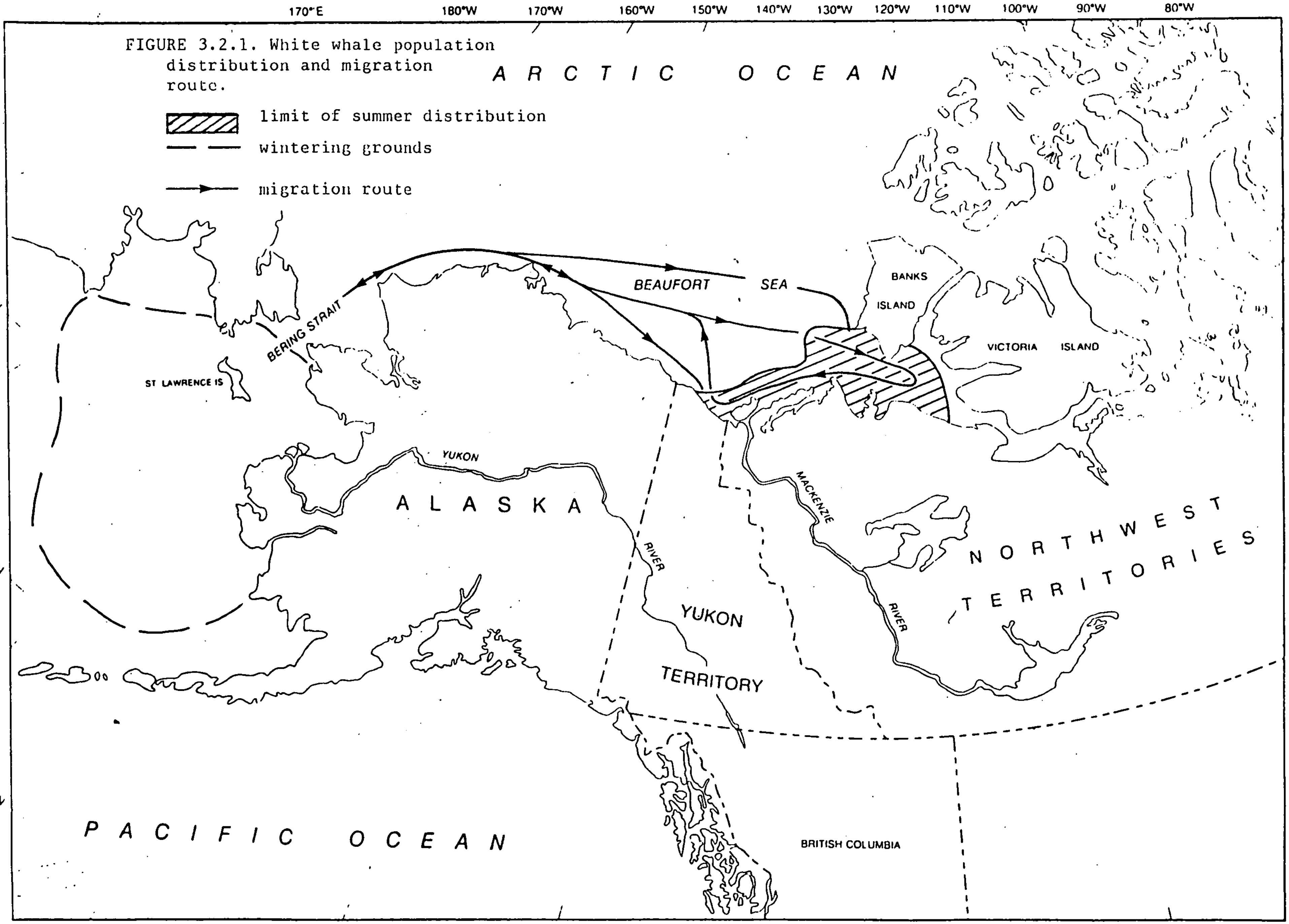


FIGURE 3.2.1. White whale population distribution and migration route.

FIGURE 3.2.2. Sensitivity areas for white whales.
JUNE-SEPT., BATCH SPILL, UNTREATED

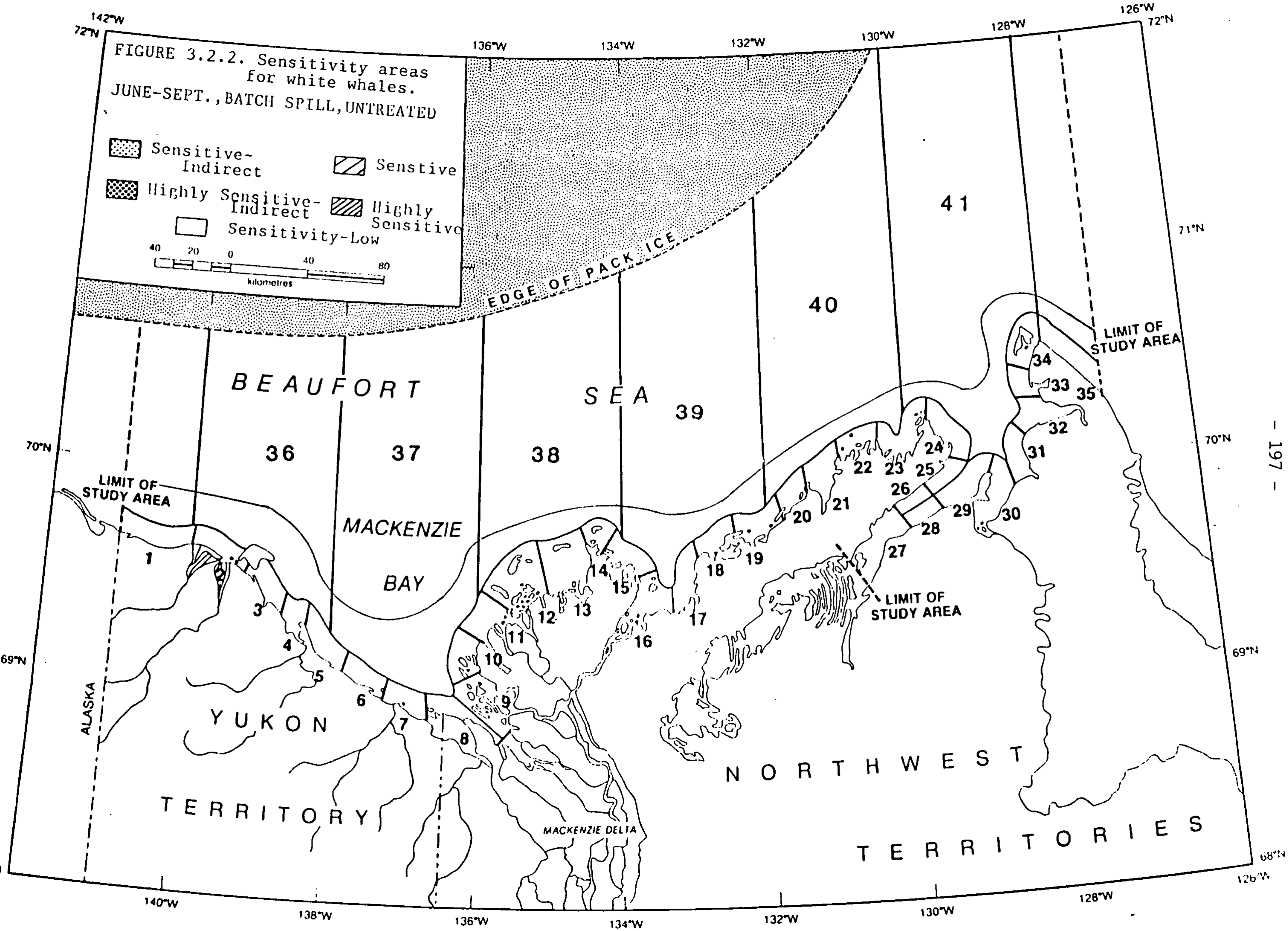
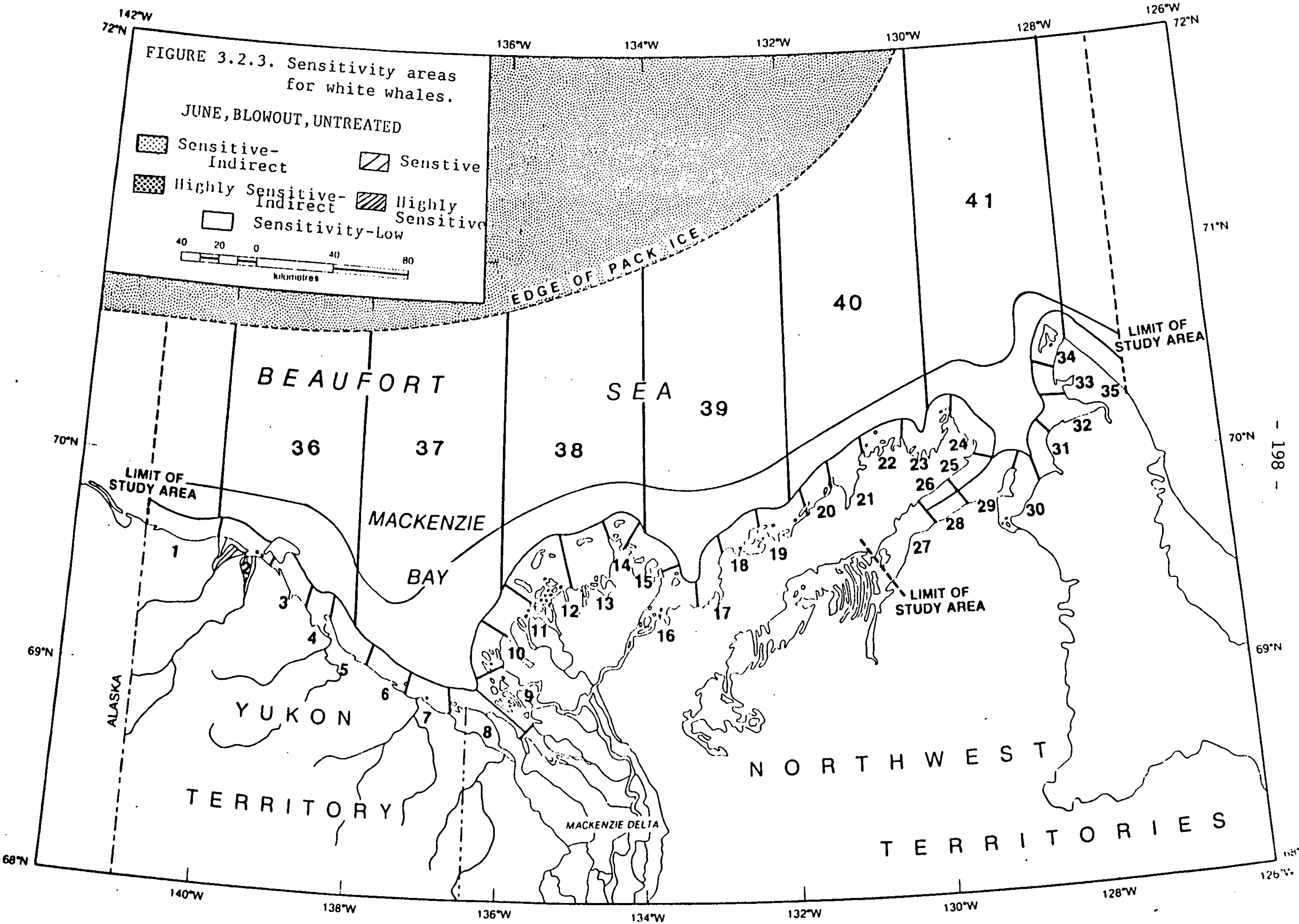


FIGURE 3.2.3. Sensitivity areas for white whales.



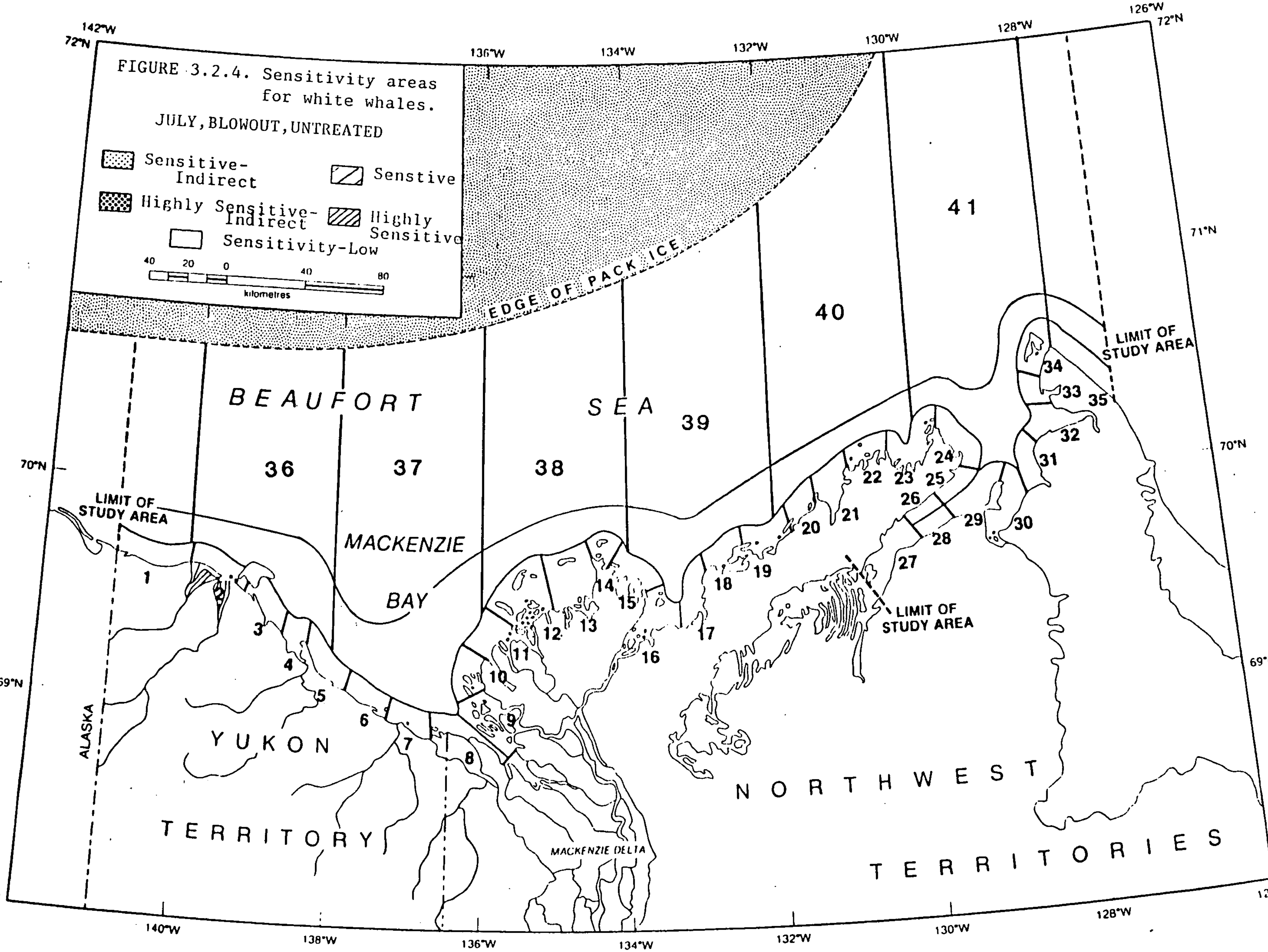


FIGURE 3.2.4. Sensitivity areas for white whales.

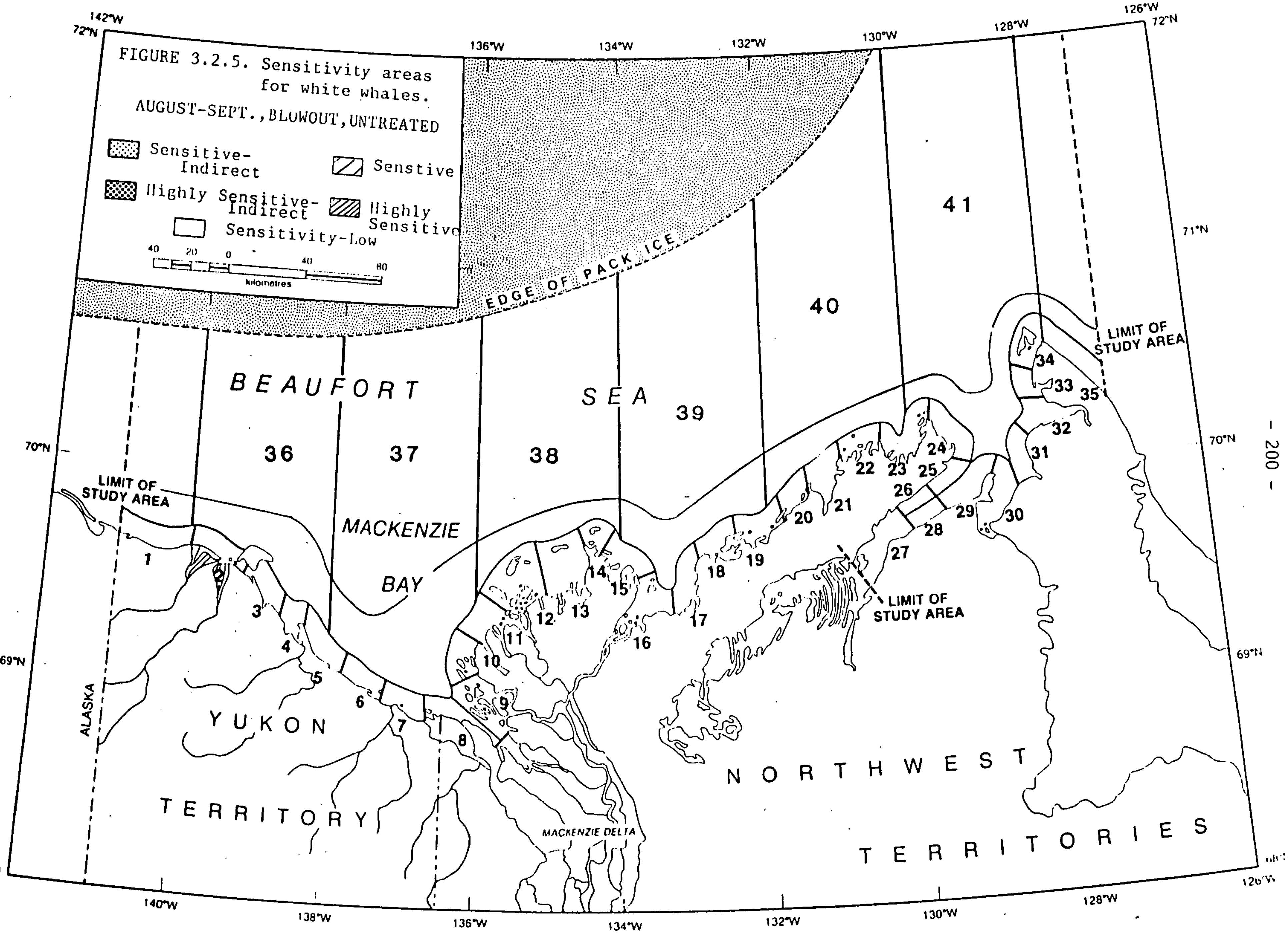


FIGURE 3.2.5. Sensitivity areas for white whales.
AUGUST-SEPT., BLOWOUT, UNTREATED

3.3 RINGED SEAL (*Phoca hispida hispida*)

The ringed seals are the most important and wide spread species of marine mammal in the Canadian Arctic. They form an important trophic link between lower trophic levels and polar bear and arctic fox and are hunted by virtually all coastal arctic communities for both domestic and commercial purposes.

The sub-species *Phoca hispida hispida*, to which the ringed seals in the Eastern Beaufort Sea belong, is circumpolar in distribution occupying the ice and waters of the Arctic basin of Eurasia, Greenland, and North America. The total size of this population appears to be roughly 6 - 7 million individuals (Stirling and Calvert 1979). There is some indication from the work of Fedoseev and Nazarenko (1972) that this population is divided into stocks or "local ecological races" but there is no indication in the literature as to how these stocks might be identified or differentiated. For the purposes of the present work it has been assumed that the ringed seals of the Canadian Beaufort Sea, Amundsen Gulf, the Alaskan Beaufort, northern Bering, and Chuckchi Seas constitute a single stock (Figure 3.3.1). This stock is composed of at least 50,000 to 70,000 individuals but the number appears to fluctuate in certain years. Hence this stock constitutes roughly 10 - 20% of the global population.

3.3.1 Habits, Movements, and Timing Within the Southern Beaufort Sea Area

The annual cycle of ringed seal habits is closely related to the cycle of sea ice conditions and hence their distribution is somewhat related to the availability of certain kinds of ice. Although there is little known of the summer, open-water habits of ringed seal it appears that they are principally pelagic and are widely dispersed throughout the study area. There is some evidence that seals haul out on offshore pack ice in the western part of the study area or on ice-remnants along the coast or on ice-free segments of the coast, but the bulk of the population appears to be pelagic. With the onset of freeze-up, movements of ringed seals become restricted. As the ice forms, breeding adults establish territories and breathing holes in areas of stable landfast ice. Non-breeders and immatures however, make use of open water leads and polynyas and shore leads to breath. Ringed seal pups are born in birth lairs constructed under the snow which covers the breathing holes. Most ringed seal pups are born in late March and early April. Females suckle the young for roughly two months, weaning and abandoning them in June roughly at the time of spring breakup. The moult among ringed seals occurs from late March until July with a peak in June. During the moult, animals haul out for at least a part of the day at the edge of the ice, along cracks or leads, or at their breathing holes. With the disappearance of stable fast ice in July, ringed seals adopt a pelagic habit. Little is known of their habits and movements during the ice-free period, but it appears that they are widely dispersed throughout the offshore waters with some individuals hauling out at the edge of the pack ice. Very few individuals appear to be associated with coastal areas.

There is some suggestions from the work of Frost and Lowry (1984) that there is a concerted northeast movement of ringed seals from the Bering Sea area into the Beaufort Sea during the ice free period, followed by movement in the opposite direction during freeze-up in the fall.

3.3.2 Distribution and Vulnerability

Details of the distribution of ringed seals in the study area are best known for the period of maximum ice cover from late October to June. During this period, breeding adults occupy areas of stable fast ice while non-breeders and immatures are more strongly associated with the open water areas of polynyas. Areas of greatest concentration of breeding adults include the bays and inlets of eastern and southern Amundsen Gulf. Lesser concentrations are associated with the fast ice off the Tuktoyaktuk Peninsula, Yukon, and Alaska. Only low densities of ringed seals are associated with the offshore pack ice. During breakup in June, ringed seals are associated with shore fast ice in Amundsen Gulf and along the coast of the Tuktoyaktuk Peninsula, Yukon and Alaska. During this period seals are widely distributed with no apparent areas of aggregation. Seal densities are seldom greater than 1 seal/km^2 of ice. During the ice-free period from July to September, seals are primarily pelagic in habit. They apparently are widely distributed throughout the Amundsen Gulf, Beaufort and Chukchi Seas during most of this period. Aerial surveys in the southern Canadian Beaufort Sea since 1980 have sometimes recorded relatively large seal densities in the range of 0.08 to 0.4 seals/km^2 in the nearshore and offshore waters of the eastern Tuktoyaktuk Peninsula during late August or early September. In other years, by contrast, few seals have been recorded in this area (Renaud and Davis, 1980; Harwood and Ford 1983; McLaren and Davis 1985; Harwood and Borstd 1985; Duval et al. 1986). There is some evidence of concentrations of seals with the edge of the pack ice north of the Yukon and Alaska coasts but the extent or degree of these aggregations is unknown. Some seals appear to be associated with remnants of ice along shorelines and with ice free shorelines but there is little evidence of large concentrations in any of these areas.

Ringed seals are considered to be invulnerable to significant effects from batch spills during both the June haul-out period and the ice-free periods from July to September. In June ringed seals are widely distributed in ice covered areas. The ice cover would largely limit the spread of oil and prevent it from reaching most seals. In addition the high mobility of seals would allow those exposed to oil to move out of the contaminated area without suffering more than minor reversible effects. In the July to September period, the widely dispersed nature of ringed seals would limit the number of seals exposed to oil. As with the June period, the high mobility of ringed seals would allow exposed seals to move out of the contaminated area without suffering more than minor effects, even if the spill were to occur in the offshore area of the eastern Tuktoyaktuk Peninsula in late August or September when larger densities of seals often occur. Even in the event of a major blowout during these periods, it is highly doubtful that ringed seals would ever suffer mortality at more than the NEGLIGIBLE level.

3.3.3 Resource Use

The ringed seal is an important domestic and commercial hunt objective in the southern Beaufort Sea area. Due to the widely dispersed character of the population however, impact from oil spills on the resource would be NEGLIGIBLE.

References: Burns, 1970; Burns and Harbo 1972; Duval et al. 1986; Frost and Lowry 1981; Harwood and Borstad 1985; Harwood and Ford 1983; Kingsley 1984; Kingsley et al 1985; McLaren and Davis 1985; Renaud and Davis 1980.

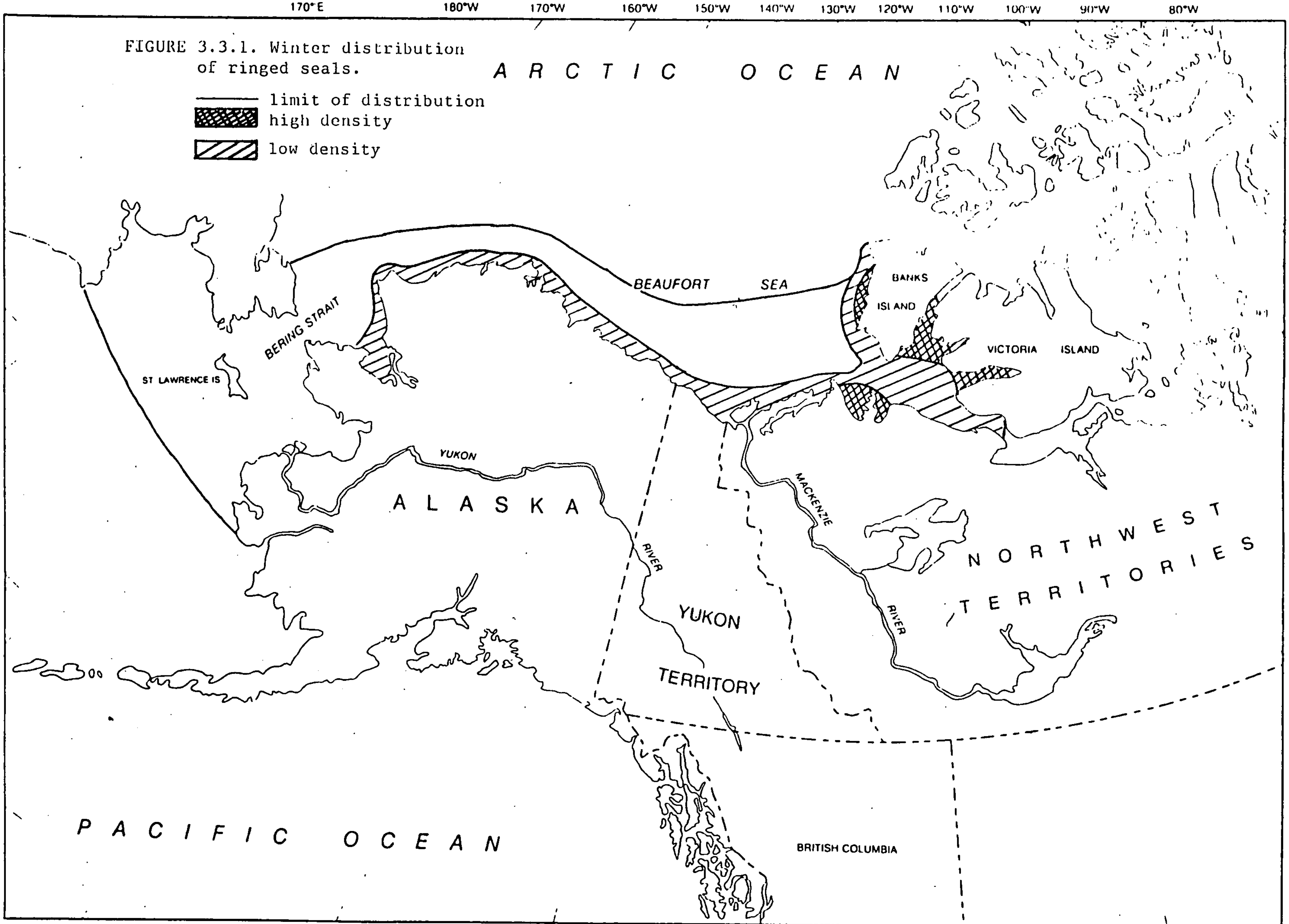


FIGURE 3.3.1. Winter distribution of ringed seals.
limit of distribution
high density
low density
ARCTIC OCEAN
BEAUFORT SEA
BANKS ISLAND
VICTORIA ISLAND
BERING STRAIT
ST LAWRENCE IS
ALASKA
YUKON
RIVER
MACKENZIE
RIVER
YUKON TERRITORY
NORTHWEST TERRITORIES
BRITISH COLUMBIA
PACIFIC OCEAN
170°E
180°W
170°W
160°W
150°W
140°W
130°W
120°W
110°W
100°W
90°W
80°W
75°N
70°N
65°N
60°N
55°N
50°N

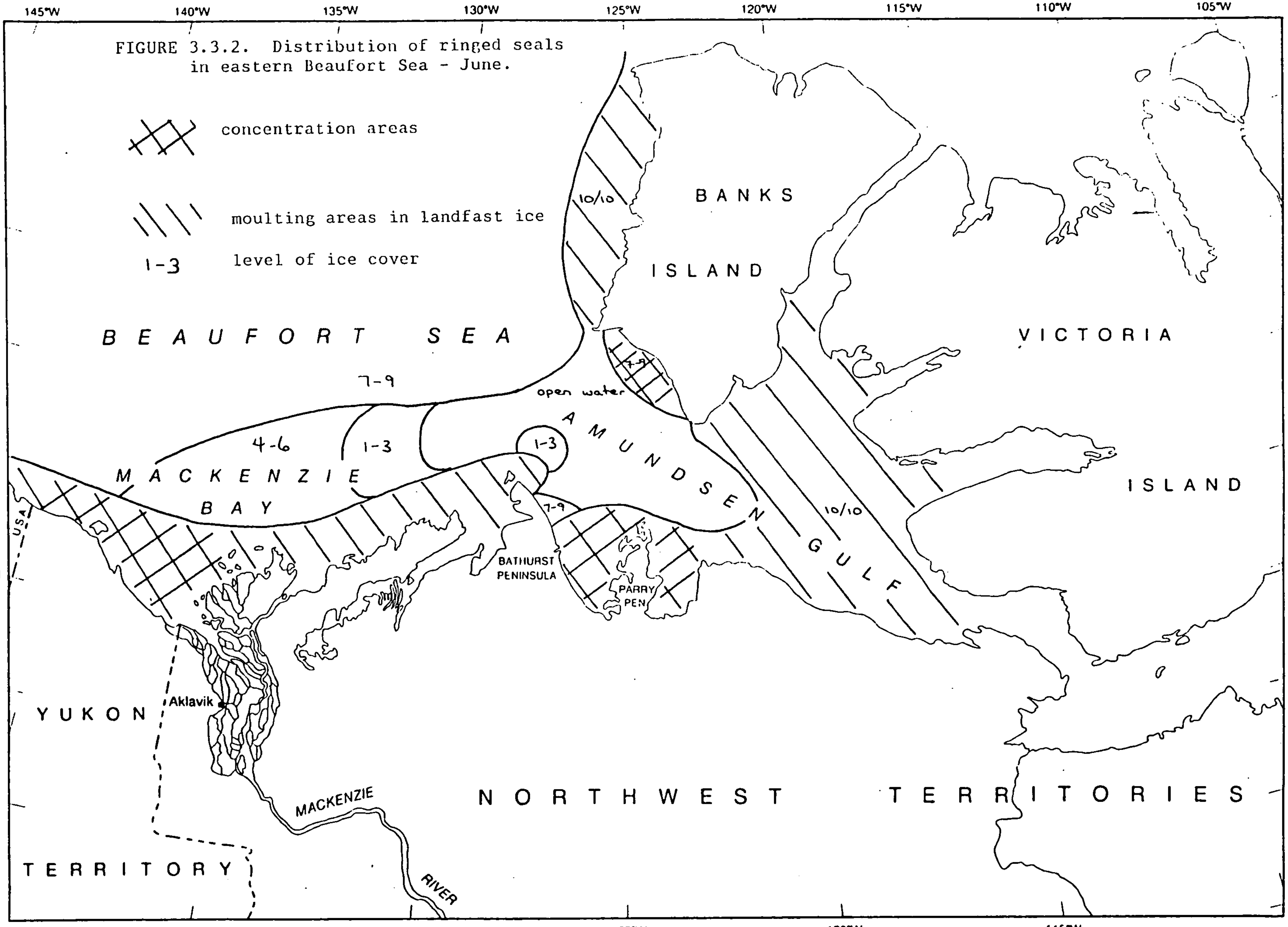


FIGURE 3.3.2. Distribution of ringed seals in eastern Beaufort Sea - June.

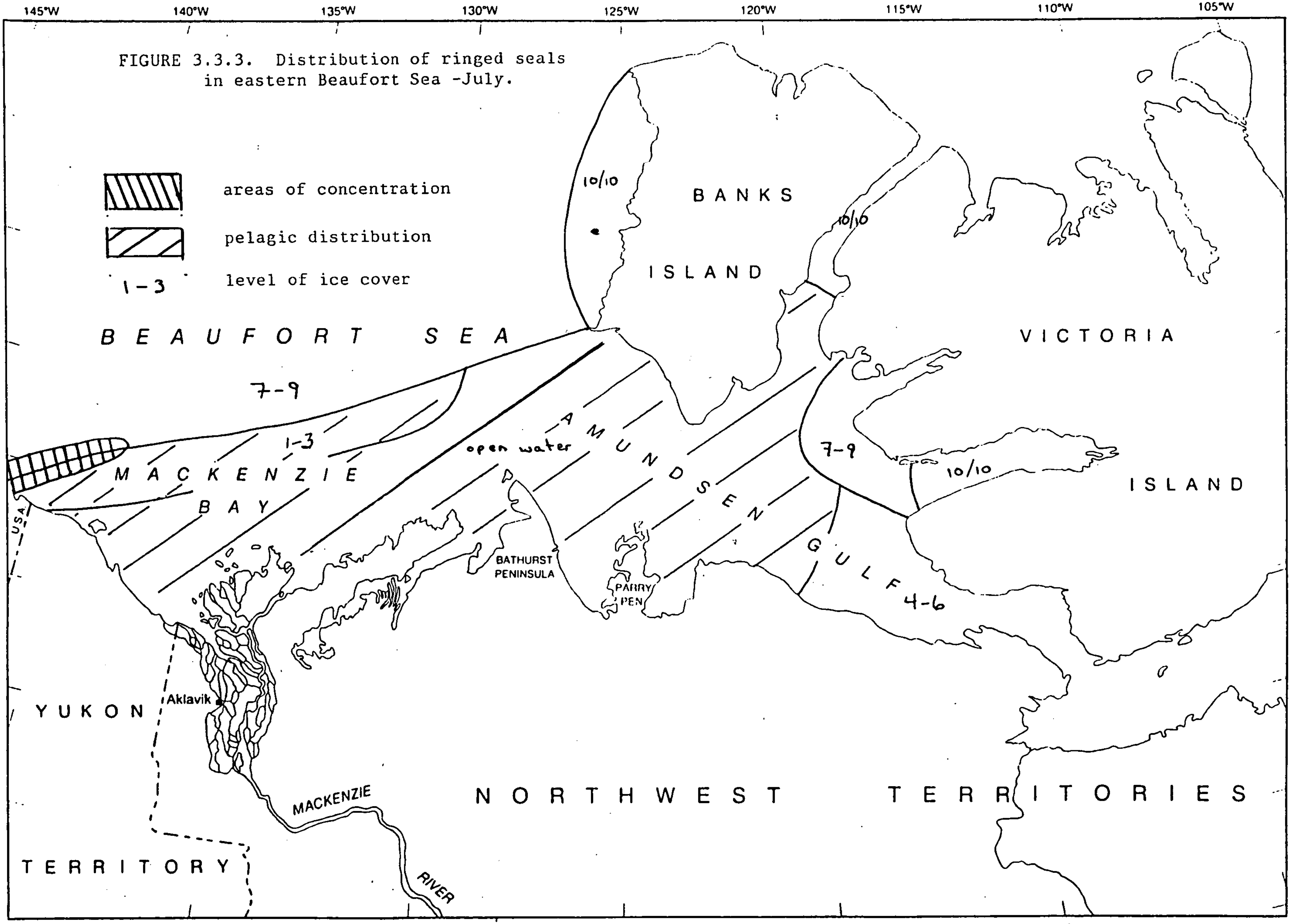


FIGURE 3.3.3. Distribution of ringed seals in eastern Beaufort Sea -July.

FIGURE 3.3.4. Distribution of ringed seals in eastern Beaufort Sea - August.

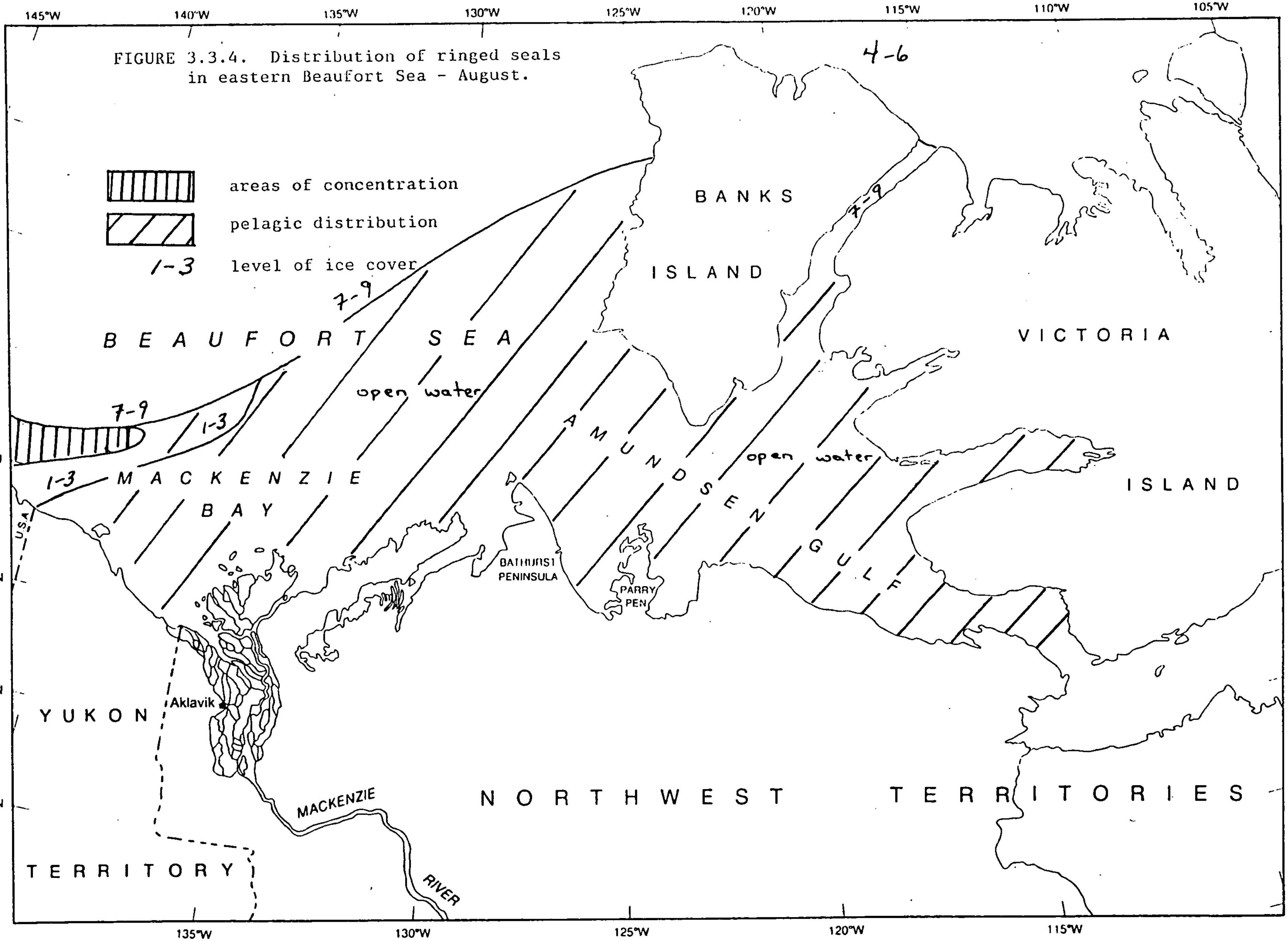
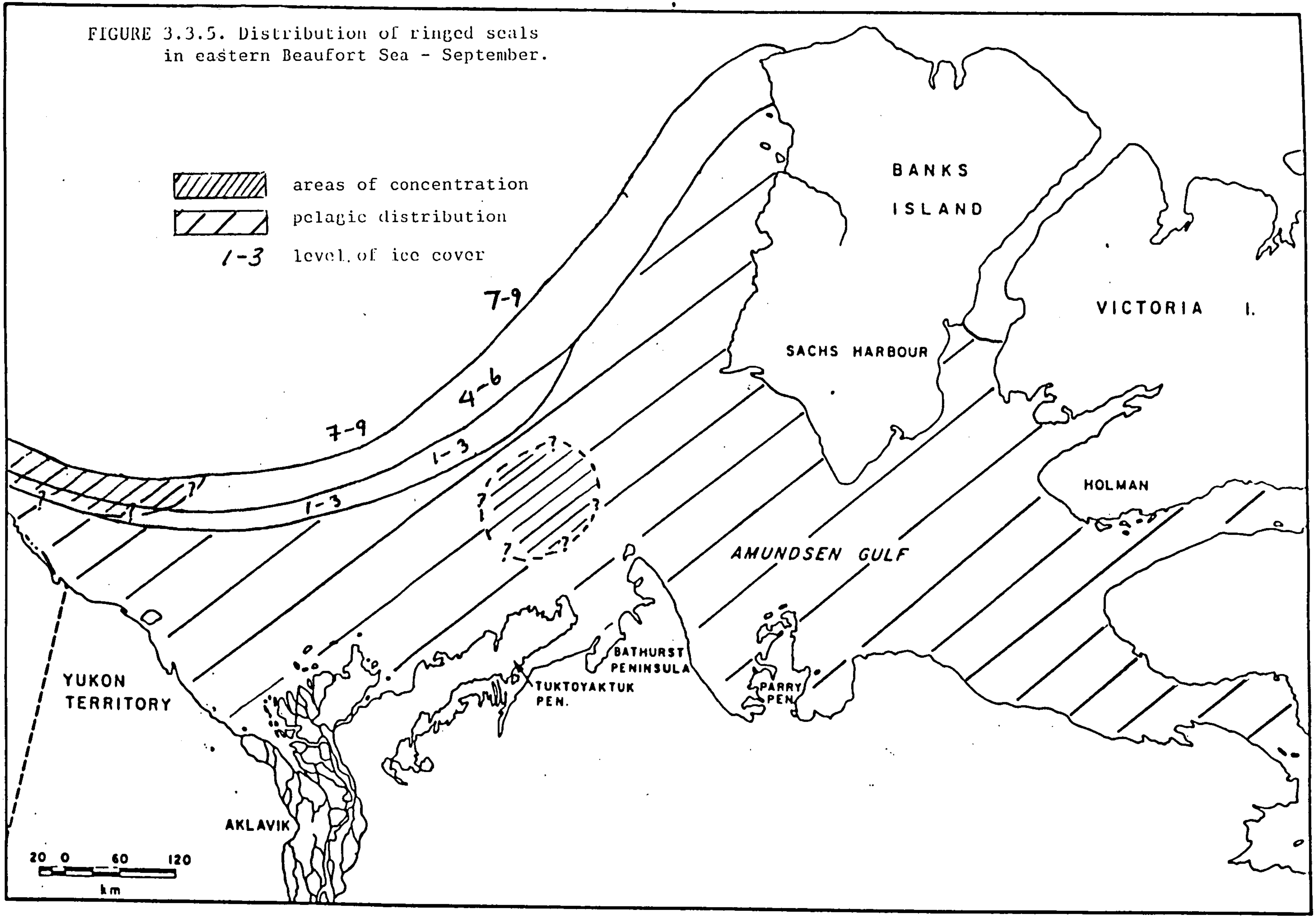


FIGURE 3.3.5. Distribution of ringed seals in eastern Beaufort Sea - September.



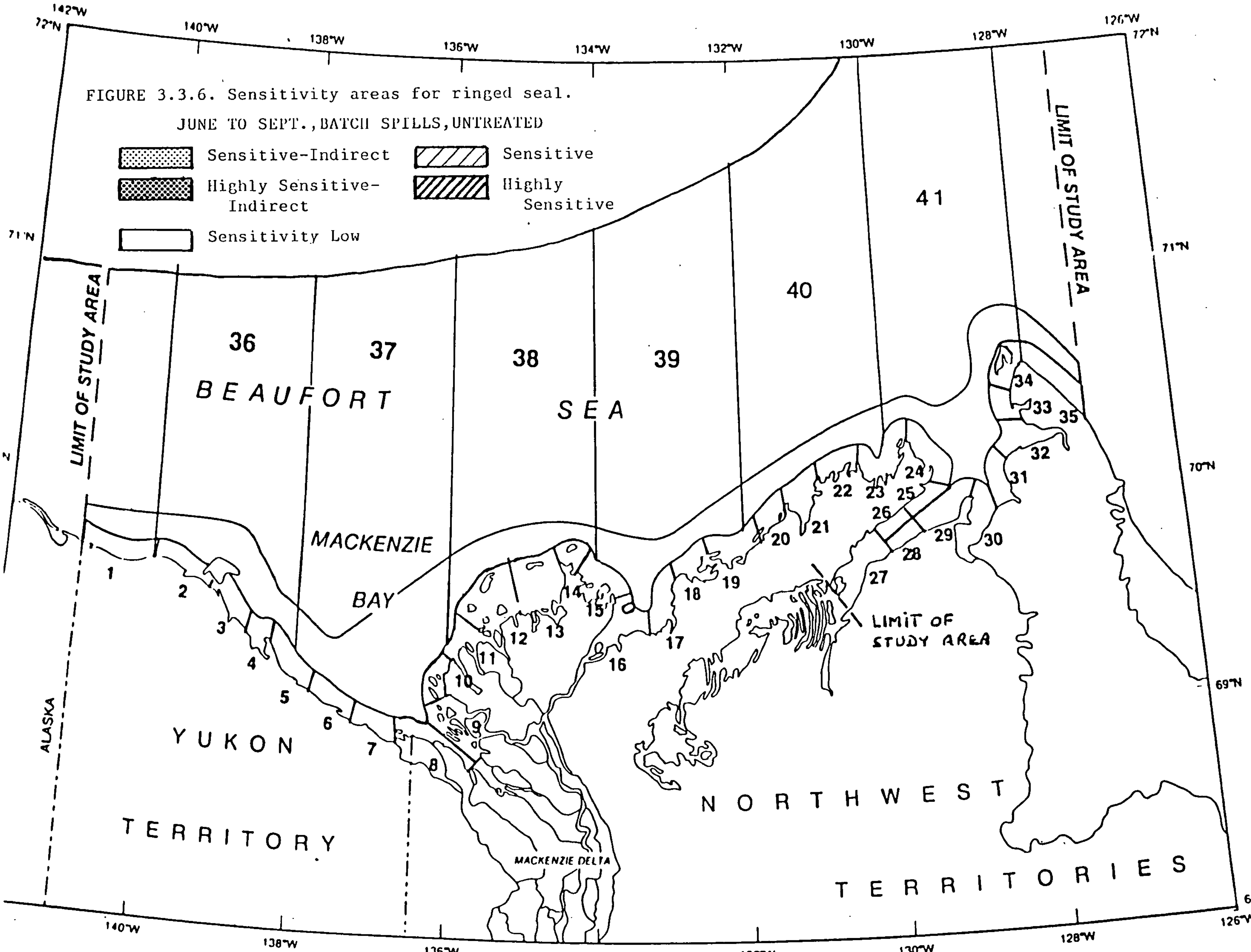


FIGURE 3.3.6. Sensitivity areas for ringed seal.
JUNE TO SEPT., BATCH SPILLS, UNTREATED

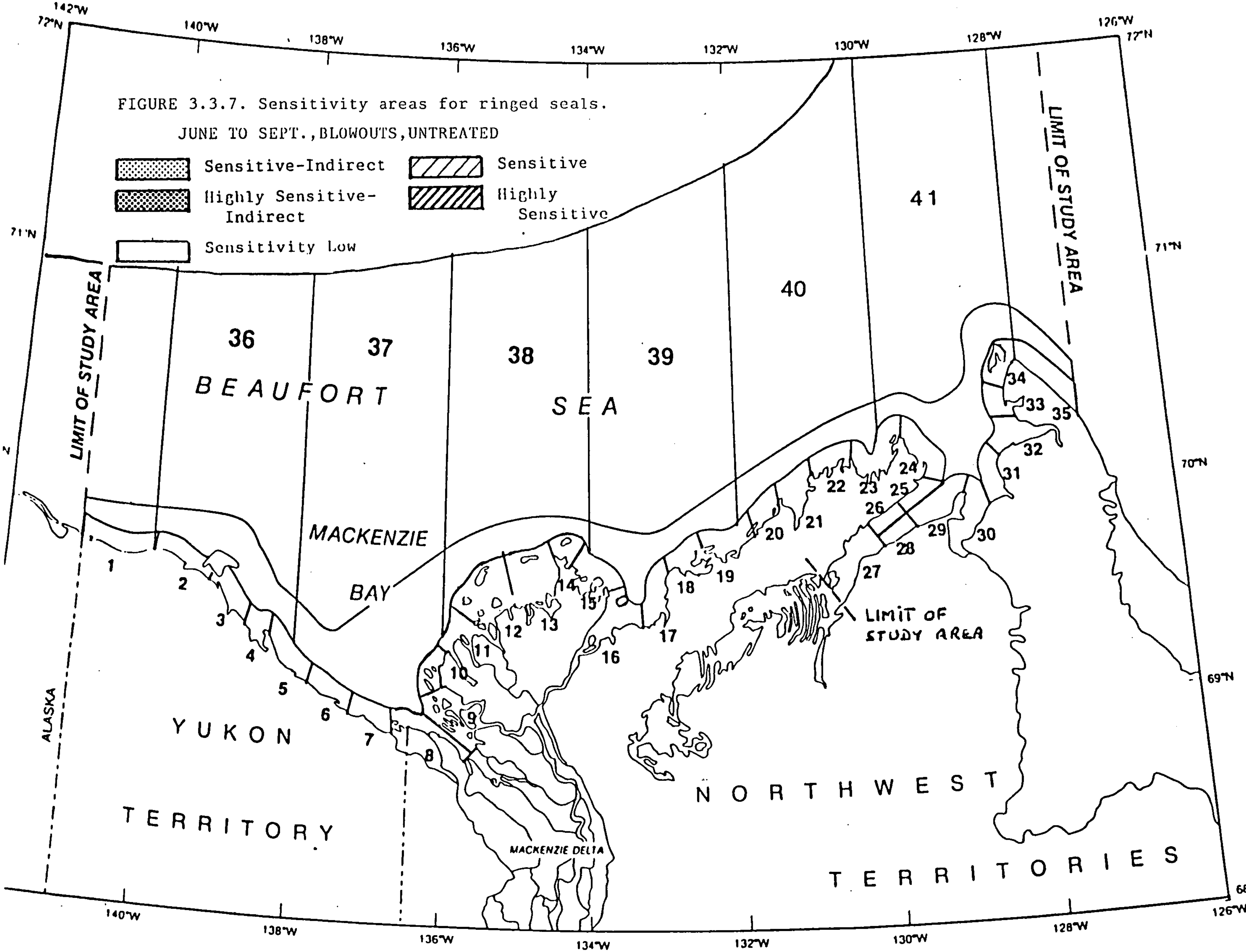


FIGURE 3.3.7. Sensitivity areas for ringed seals.
JUNE TO SEPT., BLOWOUTS, UNTREATED

3.4 POLAR BEAR (*Ursus maritimus*)

Polar bears are abundant in the western Arctic where they constitute a major top carnivore in the marine food chain, and where they are the object of a controlled hunt by the Inuit. Polar bears are managed under an international conservation agreement to which Canada is a party.

Polar bears are circumpolar in distribution and are common across the Canadian Arctic. The global population numbers roughly 15,000 to 20,000 individuals of which roughly half occur in the Canadian Arctic. Although individuals may travel long distances, the bears in the Beaufort Sea area show a high degree of fidelity for specific locations during the spring. In the Beaufort Sea researchers have identified two stocks: one associated with the west coast of Banks Island and Amundsen Gulf, and a second with the mainland coast from Point Barrow to Cape Dalhousie. Together these stocks total roughly 4,000 - 4,500 individuals or 20 to 25% of the global population. For the purposes of this work the combined U.S.-Canadian Beaufort Sea population will be considered the target stock.

In the Canadian Arctic, polar bear are hunted for their hides on the basis of quotas set for each community by government management agencies.

3.4.1 Habits, Movements, and Timing Within the Southern Beaufort Sea Area

The seasonal distribution and movement of the polar bear in the western Arctic is closely related to the availability their principal prey species, the ringed seal, which in turn is determined by seasonally changing sea ice conditions. From freeze-up in the fall to break-up in the spring adult males, non-breeders, immatures, and females with cubs (i.e., all bears with the exception of pregnant females) occupy the southeastern areas of the Beaufort Sea and Amundsen Gulf. Most of these bears occur at the edge of small open leads or in areas of heavy ice cover in active zones with ice movement. These areas are favoured by sub-adult ringed seals and hence this area is critical feeding habitat for polar bear. This habitat forms a narrow band parallel to the mainland coast from the western edge of the study area to Cape Pary and northward off the west coast of Banks Island. Adult female with cubs of the year appear to avoid these locations and use areas of stable land-fast ice.

Polar bear females mature at roughly 5 to 6 years of age and produce litters of one or two cubs at three year intervals. Pregnant females occupy dens in November. Young are born in December and January. During late March or early April females and young emerge from dens and move to adjacent areas of land-fast ice, presumably to prey on seals. Primary denning habitat for the

U.S.-Canada Beaufort population is on the pack ice. Little denning activity has been recorded on the mainland coast either in Canada or Alaska.

As break-up proceeds in late spring and early summer the ice disappears along the mainland coast and the pack ice retreats northward. At this time seals adopt a pelagic habit, rarely hauling out on the land but being more concentrated at the edge of the pack ice. Most bears appear to migrate north to stay with the pack ice where seals are more abundant and easier to capture.

As freeze-up takes place in October bears move southward presumably to take advantage of the seals which become concentrated in patches of open water as freeze-up proceeds.

Polar bears are vulnerable to the effects of spills during the open water season only when the spilled oil occurs along the edge of the pack ice. Bears appear to be solitary and hence can be expected to be widely distributed along the edge of the pack ice. Hence although some individuals may come into contact with oil when traversing open-water at the edge of the pack ice the number of individuals so affected by batch spills would be small and hence the overall effect on the population would be NEGLIGIBLE. It should be noted, however, that polar bear are mobile and it may be possible for slightly larger numbers to become contaminated as they encounter patches of persistent oil at the edge of the pack ice.

The hazard to polar bears will be greater in the event of a blowout where larger amounts of oil may contaminate a broader area at the edge of the polar ice pack. It would not be unreasonable to expect the level of impact on the polar bear population to reach SLIGHT levels as the contaminated area increases.

3.4.2 Distribution and Vulnerability

During the period of heavy ice cover until break-up occurs in June, polar bear are distributed widely through the southeastern Beaufort Sea and the Amundsen Gulf. This situation persists through June as long as stable ice conditions persist along shorelines and while ringed seals continue to haulout on ice in the south. Because bears appear to be widely dispersed the likely effect of a batch spill at this time can be expected to be NEGLIGIBLE.

As breakup proceeds and ice disappears from the mainland coast and the Amundsen Gulf, polar bears migrate north to remain with the pack ice and few remain in mainland areas. Depending upon ice conditions this condition persists from July until freeze-up begins in October. During this period polar bear are widely distributed in the pack ice and the likelihood of a spill effecting a significant proportion of the population is NEGLIGIBLE.

3.4.3 Resource Use

Polar bears are hunted on the ice during the winter and spring by residents of coastal communities in Canada and Alaska. The sale of polar bear hides is permitted only in Canada and is important to the cash economy of a number of coastal communities in Canada. The effects of most spills on the polar bear population itself would be small. While contamination of the polar bear pelt by oil will render them commercially valueless, the numbers actually affected would be insignificant relative to the total value of the hunt.

References: Frost and Lowry 1984; McLaren and Davis 1985.

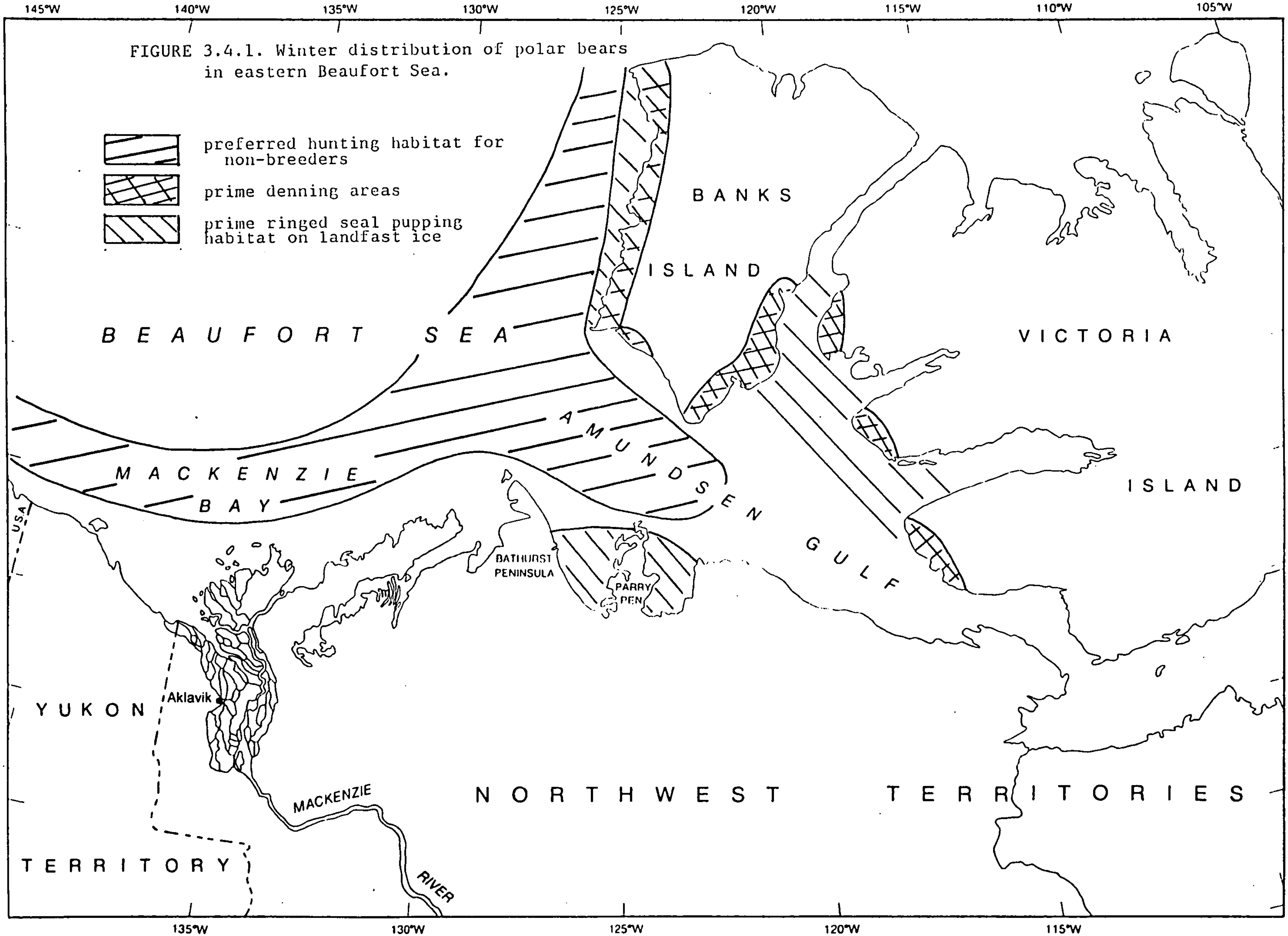


FIGURE 3.4.1. Winter distribution of polar bears in eastern Beaufort Sea.

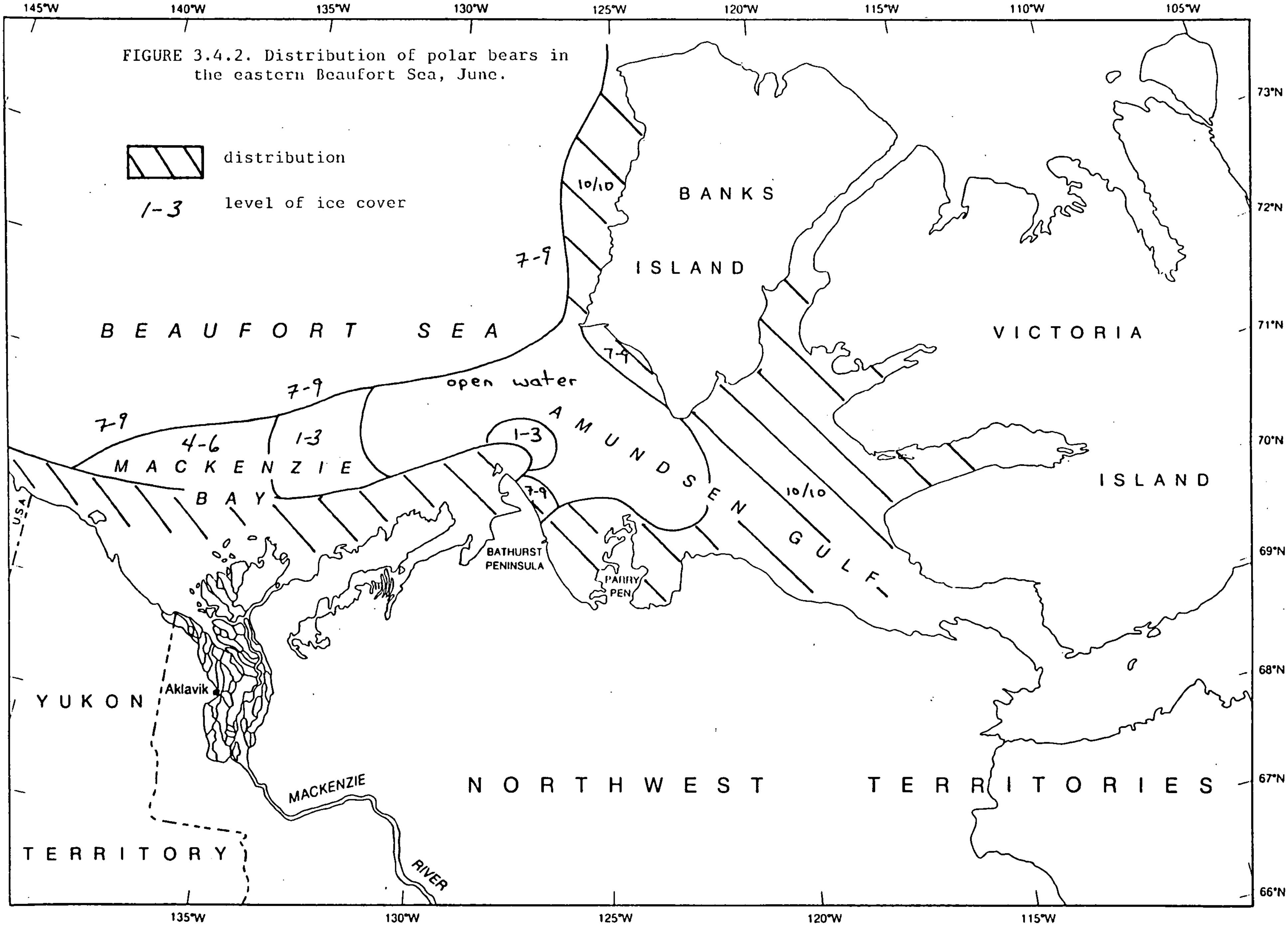


FIGURE 3.4.2. Distribution of polar bears in the eastern Beaufort Sea, June.

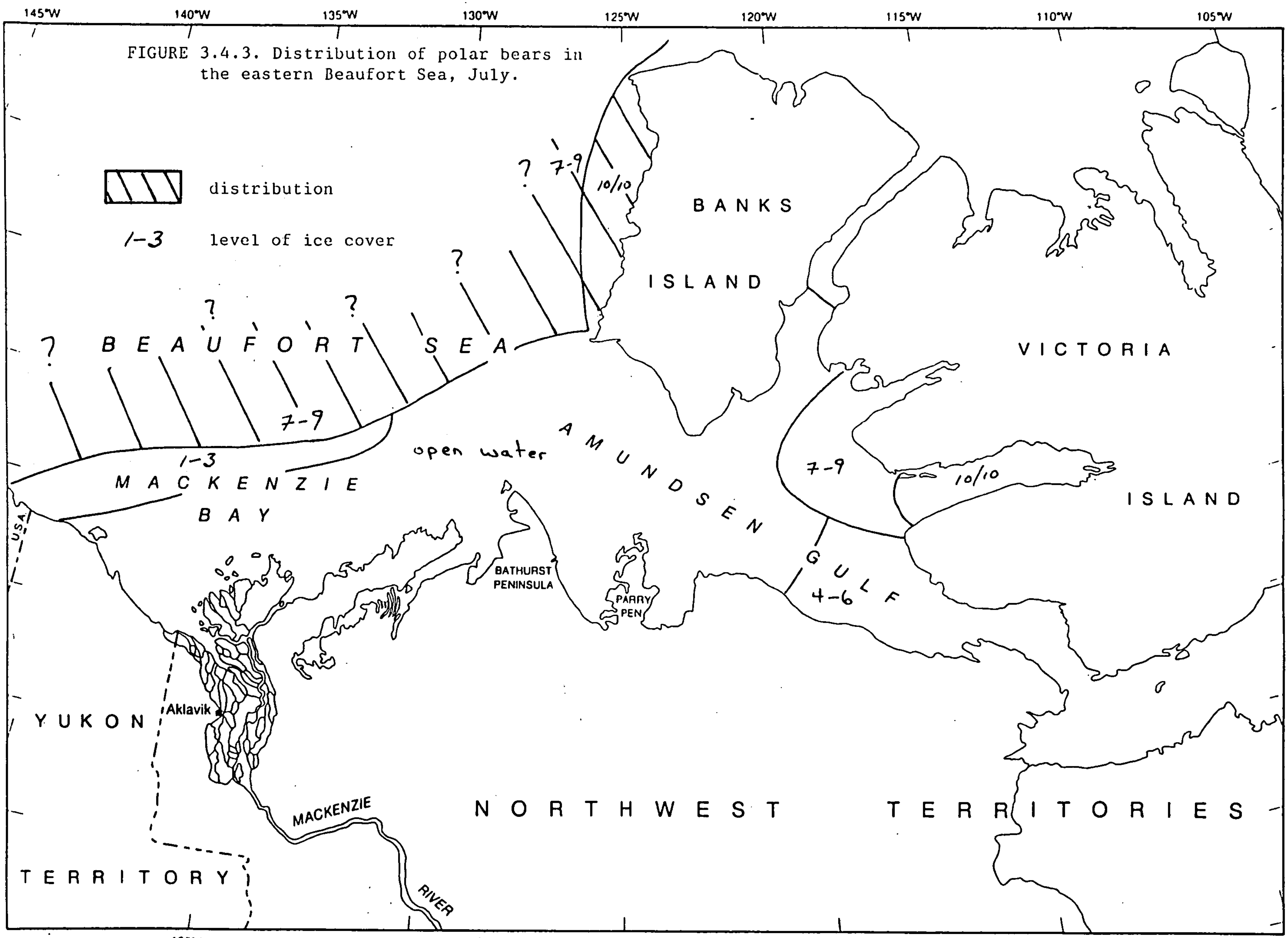


FIGURE 3.4.3. Distribution of polar bears in the eastern Beaufort Sea, July.

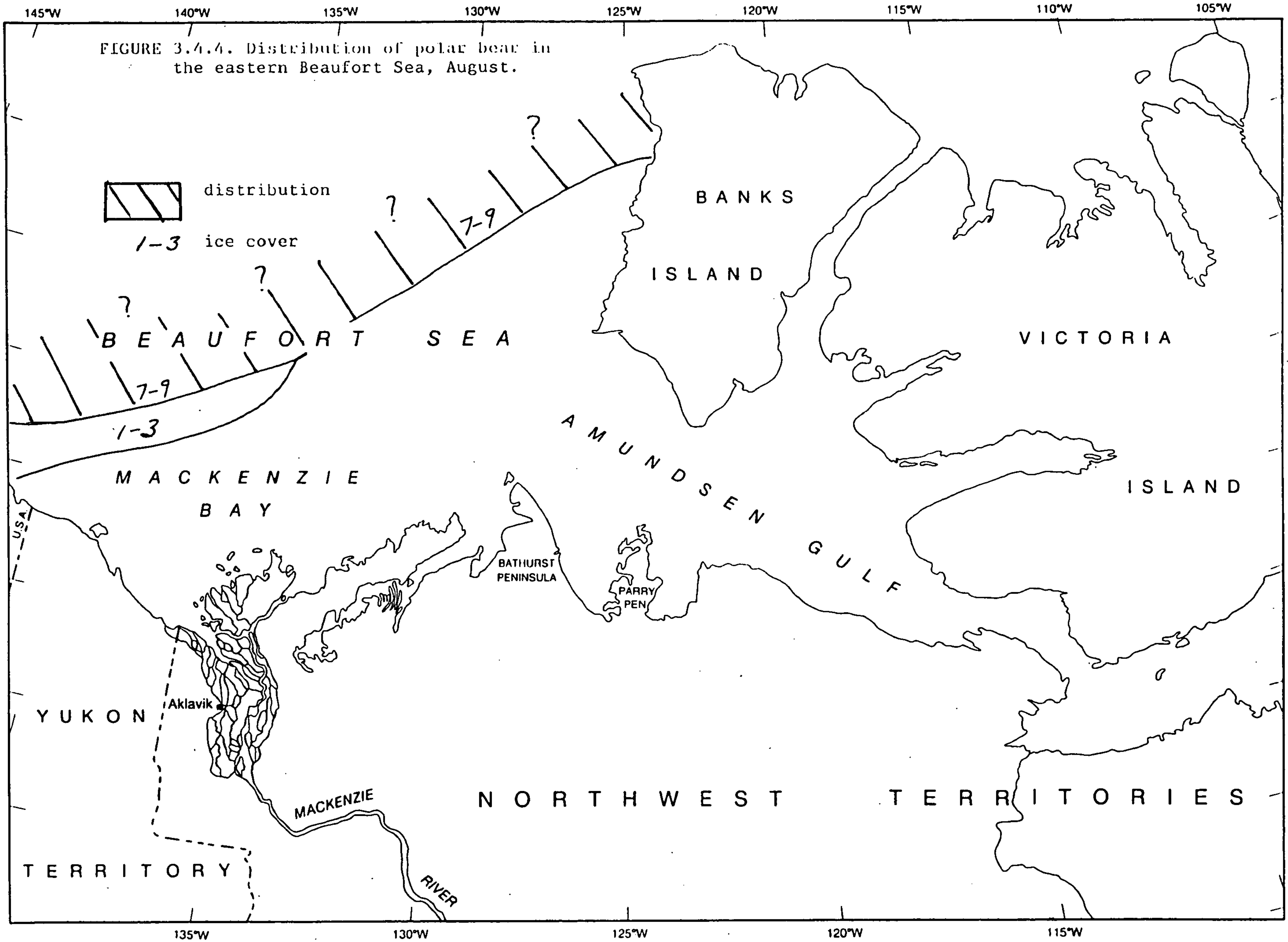


FIGURE 3.4.4. Distribution of polar bear in the eastern Beaufort Sea, August.

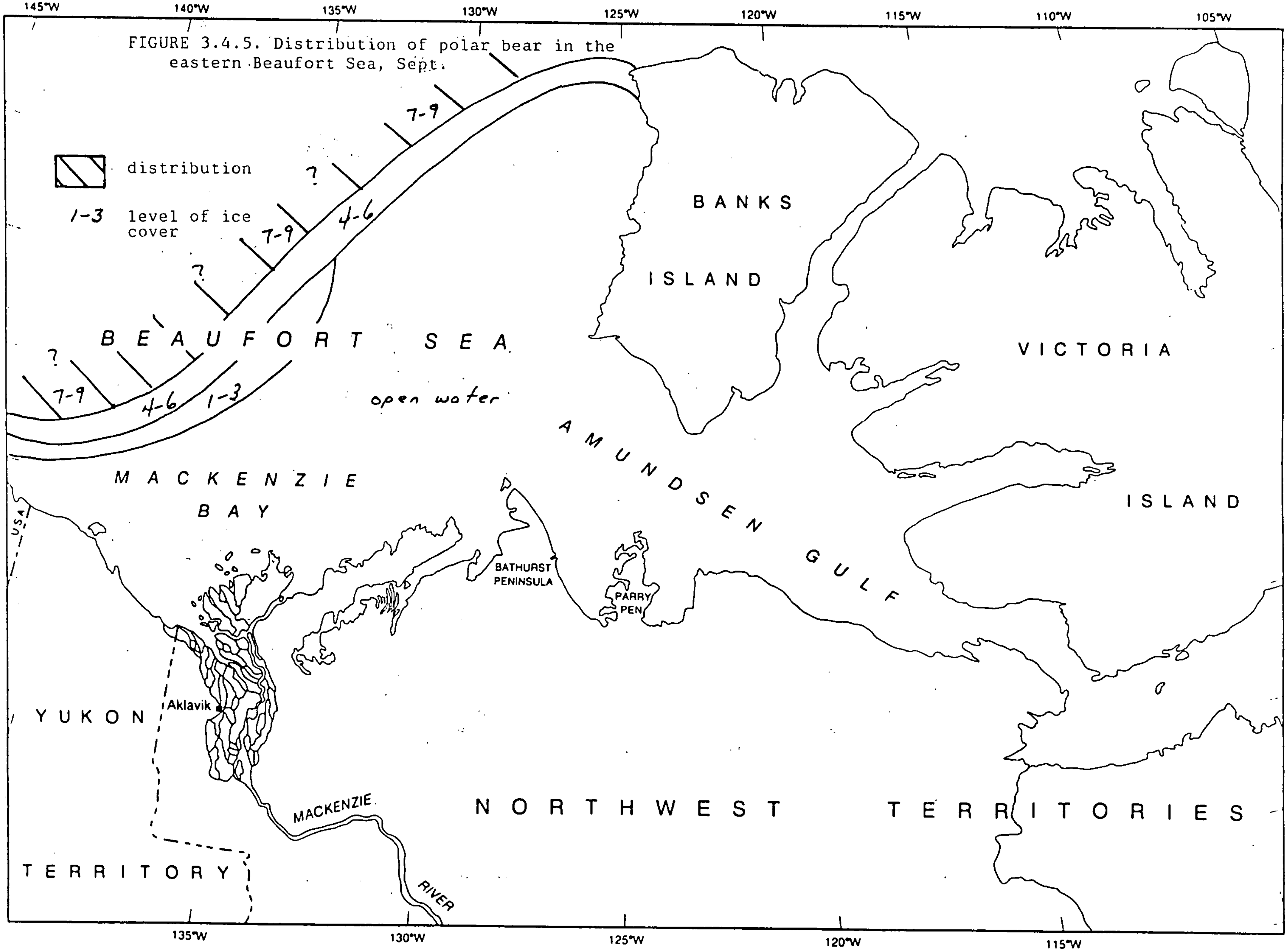


FIGURE 3.4.5. Distribution of polar bear in the eastern Beaufort Sea, Sept.

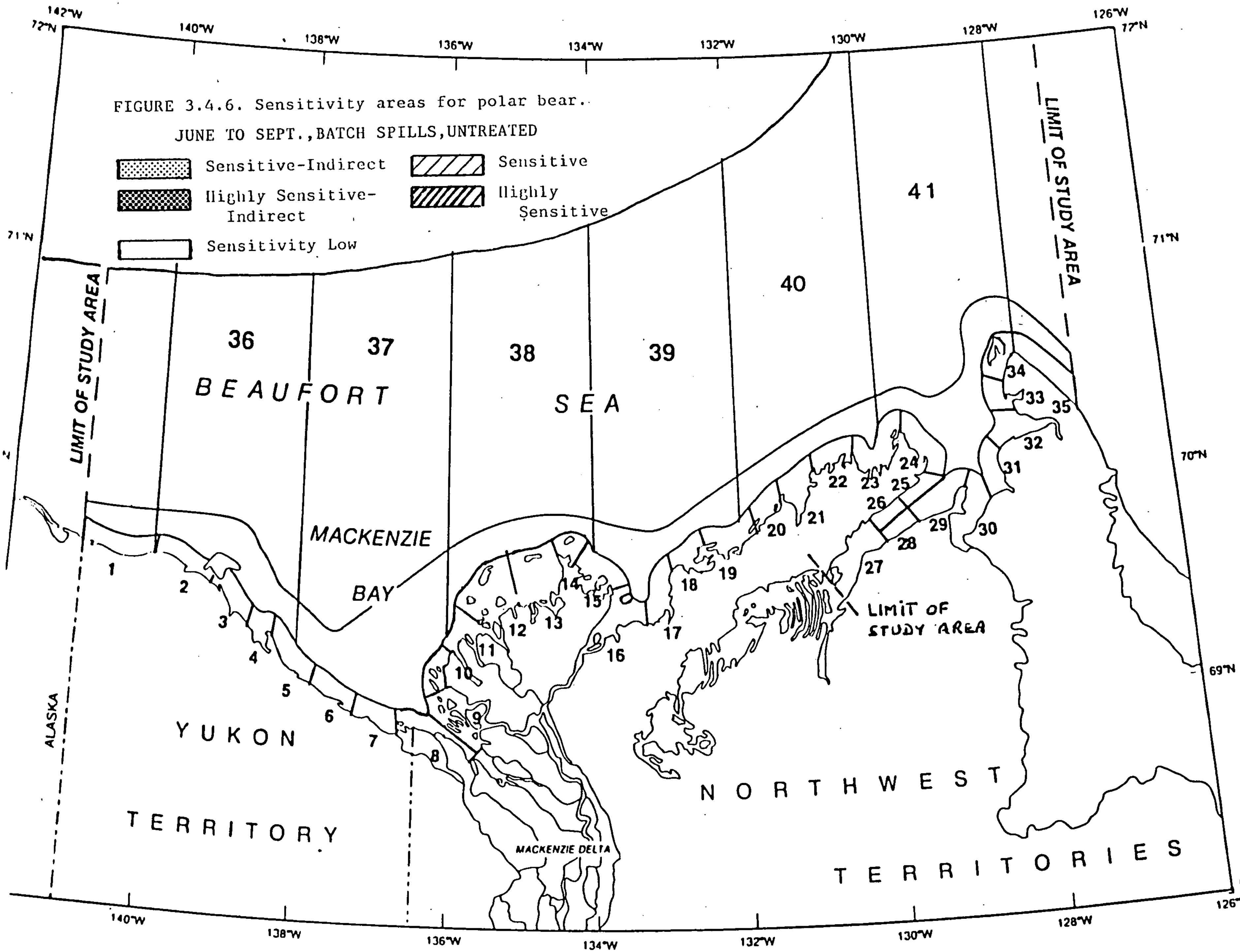


FIGURE 3.4.6. Sensitivity areas for polar bear.
JUNE TO SEPT., BATCH SPILLS, UNTREATED

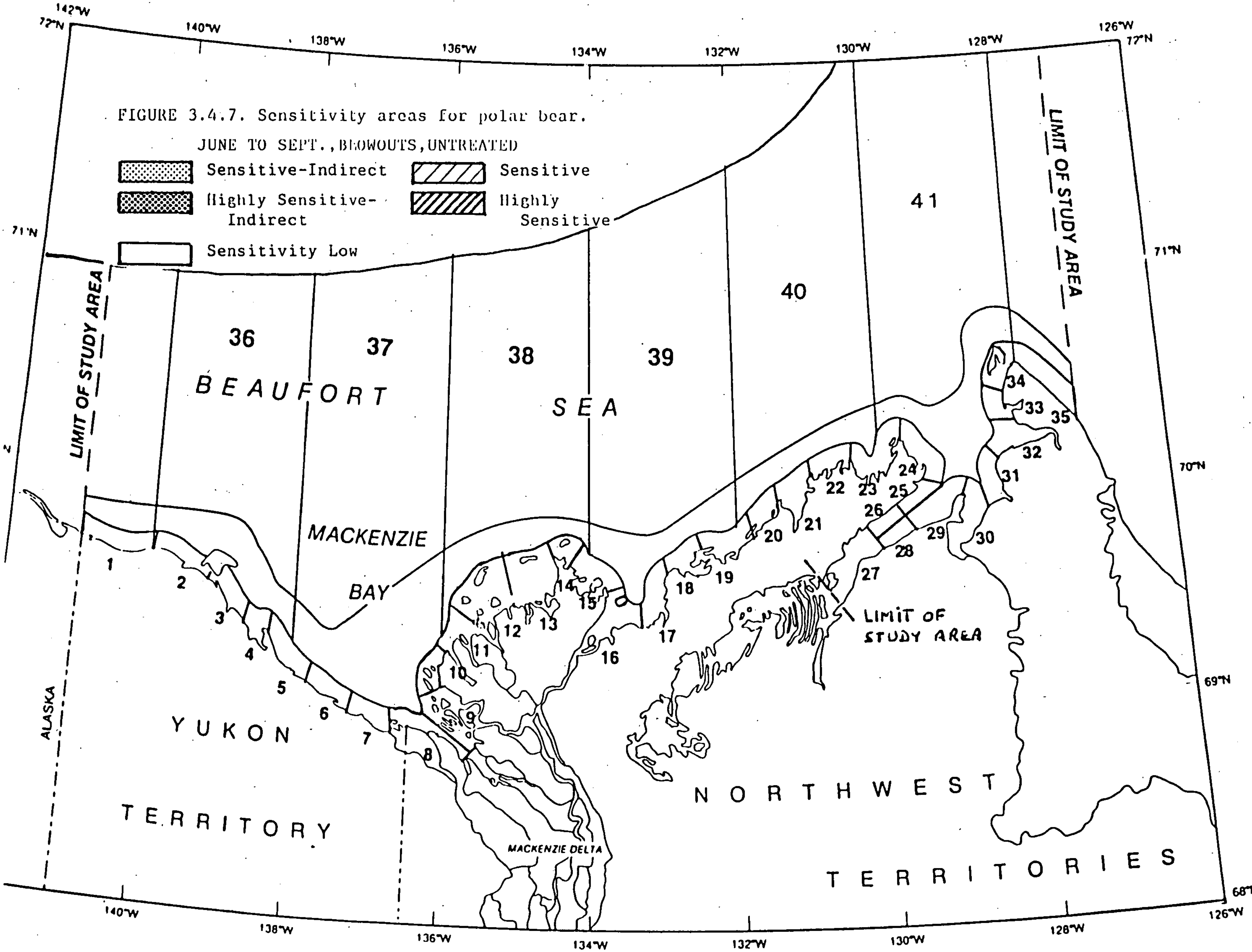


FIGURE 3.4.7. Sensitivity areas for polar bear.

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