HUMPBACK, FINBACK, MINKE AND PILOT WHALE DISTRIBUTIONS IN NEWFOUNDLAND AND LABRADOR 1976-1983

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Humpback, finback, minke and pilot whale distributions in Newfoundland and Labrador 1976 - 1983

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science

Department of Psychology
Memorial University of Newfoundland
August, 1987
St. John's, Newfoundland

ISBN 0-315-50499-4

ABSTRACT

An increase in the incidence of whale entrapments in fixed fishing gear in the late 1970s in Newfoundland and Labrador led to the establishment of a network of observers in April 1979, to monitor annual changes in inshore whale abundance. This thesis presents humpback, finback, minke and pilot whale sighting records, and evaluates the observer network both as a means of determining the spatial and temporal distribution of whales, and as a means of monitoring annual fluctuations in their relative abundance.

An analysis of the sighting records (from land-based observers: 1979 - 1982 and from shipboard observers: 1976 - 1983) indicated similarities in the summer distributions (June - September) of the three species of baleen whales. Humpback, finback and minke whales shared an affinity for the east coasts of Newfoundland and Labrador. Minkes, however, were rarely seen offshore and appeared to be more dispersed than humpback and finback whales. Pilot whales were found to be distributed further south than the baleen whales. They frequented bays on the east, south and west coasts of Newfoundland.

The temporal distributions resulting from this study indicated that all four species were most abundant during the months of historically high prey availability (capelin and squid). However, the monthly distributions of

humpback, finback and pilot whales suggested that portions of each summer population arrived off the north coast of Newfoundland in May and June, apparently preceding the main inshore migration of capelin and squid to this area.

The observer network appeared to provide an effective means of determining whale distribution. The reliability of whale identifications was checked through tests and field notes. The spatial and temporal distribution of observer effort was not correlated with the spatial and temporal distribution of the whales. Furthermore, the distributions resulting from this study overlapped with historical records of sightings and whaling catches for all four species.

The shipboard observer network appeared to provide a more accurate means of monitoring annual changes in whale abundance than the land-based observer network. The land-based network failed to detect the post-1980 decrease in humpback whales in the inshore waters of east and southeast Newfoundland (as indicated by a decline in entrapment in fixed fishing gear). This was attributed mostly to the land-based network's tendency to under-report observer effort during the periods of infrequent sightings.

ACKNOWLEDGEMENTS

I would like to express my appreciation to Dr. Jon Lien for his contribution to this study: whale sighting records, ideas, equipment, encouragement and financial support. I would like to thank the members of my Thesis Committee, Drs. Gary Stenson (of Fisheries and Oceans Canada, St. John's), Joe Brown (of Memorial University of Newfoundland) and Jon Lien, for reviewing and commenting on the initial draft of this dissertation. I would like to express my gratitude to the Department of Psychology, and especially to Drs. Jack Strawbridge and Graham Skanes for their continued support throughout the research and preparation of this document.

I am indebted to Dr. Hal Whitehead (of Dalhousie University, Nova Scotia) for writing the programs to commputerize and to analyze the whale sighting data, for providing a substantial number of shipboard whale sighting records, for giving me the opportunity to participate in his research on Humpback whales in Newfoundland, and for reviewing the initial draft of this document. Thank you, also, to Greg Bennett and George Reid of Memorial University of Newfoundland Computing Services, for making the necessary changes in Dr. Whitehead's programs to transfer them from a personal computer to the university's mainframe.

I would like to thank Dr. Jake Rice of Fisheries and Oceans, St. John's, for his advice concerning statistical analyses of the data. Thank you to Mr. Bob Hooper of the Department of Biology, Memorial, for the loan of equipment. Thank you to Ms. Kathleen Ingham and Mr. Paul (Tad) Pennoyer for teaching me to sail and for their help in the collection of field data.

A special thanks is extended to the fishermen and lighthouse keepers of Newfoundland and to the students and staff of the university, all of whom contributed whale sightings.

It is difficult to find the appropriate words to thank my husband, Donald Tinker for his invaluable help, understanding and unfailing support, even when I sailed off with our 'home' to collect field data.

Financial support was provided by a scholarship from Natural Sciences and Engineering Research Council of Canada and by a fellowship from Memorial University of Newfoundland.

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1. INTRODUCTION

1.1 Introduction and Objectives:

A dramatic increase in the incidence of whale collisions with fixed fishing gear occurred in the inshore waters of Newfoundland and of Labrador during the late 1970s and early 1980s, respectively (Whitehead and Lien 1982). Humpback whales (Megaptera novaeangliae) were responsible for 70 - 90% of the gear damages (Lien 1980a). Collisions resulted in whale mortality and financial loss to the fishing industry. During the period of highest collision frequency in 1979 and 1980, at least 13 and 17 humpbacks, respectively, died as a result of entrapment, and the costs for gear damage and lost fish were estimated at $3.5 and $1.9 million dollars, respectively (Lien 1980a).

In April 1979 a land-based whale sighting network was initiated in conjunction with the establishment of a structured reporting system that enabled fishermen to report whale collision-related damage to fishing gear (Lien et al. 1980). The sighting network was intended to provide year-round information on the inshore distribution and abundance of all species of whales in Newfoundland and Labrador. The long-term goal of the sighting network was to establish an on-going data base to monitor the annual variability in the distribution and relative abundance of each species. The sighting network was augmented by shipboard sightings collected both before and during the

existence of the land-based network.

The objectives of this thesis are two-fold: First, to determine the summer distributions of four of the most common species of whales in Newfoundland and Labrador (humpback, finback Balaenoptera physalus, minke B. acutorostrata and pilot whales Globicephala malaena), during the period from 1976 - 1983; Second, to evaluate the observer network as a means of: (1) determining spatial and temporal distributions of different whale species and (2) monitoring the annual variability in the relative abundance of whales in the shelf waters of Newfoundland and Labrador.

1.2 Review of Newfoundland and Labrador Cetacean Distribution

1.2.1 Humpback:

In the northwest Atlantic, the majority of humpback whales migrate between winter calving/breeding grounds in the West Indies and summer feeding grounds in the productive Continental Shelf waters off New England, eastern Canada, west Greenland and Iceland (Kellogg 1929). Resightings of humpback whales photographed in the West Indies and in the feeding areas, indicate that humpbacks from all these parts of the North Atlantic intermingle in the West Indies (Katona and Whitehead 1981, Whitehead et al. 1982, Katona et al. 1983, Sears 1983, Mattila et al. 1985). The absence of photographic matches of animals between the summer feeding grounds, suggests the existence of at least four separate feeding sub-populations in the northwest Atlantic: (1) Gulf of Maine

/ southeast Nova Scotia, (2) Gulf of St. Lawrence / Newfoundland / Labrador / Grand Banks, (3) west Greenland and (4) Iceland (Katona et al. 1983).

The wintering grounds for the majority of Newfoundland and Labrador humpbacks range from 10°N to 22°N (Kellogg 1929, Whitehead and Moore 1982, Mitchell and Reeves 1983), but there are occasional winter sightings and ice entrapments off the coast of Newfoundland (Williamson 1961, Sergeant 1966, Perkins and Beamish 1979, Merdsoy et al. 1979, Mitchell and Reeves 1983).

In Newfoundland and Labrador, humpback whales (Figure 1) have been recorded off the north and east coasts of Newfoundland, southeast coast of Labrador (south of Hamilton Inlet), and on the Southeast Shoal of the Grand Banks (Sergeant 1966, Mitchell 1973, Perkins and Whitehead 1977, Balcomb and Nichols 1978, Boles 1980, Parsons 1981, Whitehead 1981, Hay 1982). Whaling catches were taken mostly from southeast Labrador, south and northeast Newfoundland (Sergeant 1966, Mitchell and Reeves 1983).

There were very few sighting records from the west coast of Newfoundland (Perkins and Beamish 1979, Hay 1982), although the observer effort has been minimal. Information from whaling catches from the Gulf of St. Lawrence, taken between 1850 - 1900 (Mitchell and Reeves 1983), and from surveys conducted along the north shore of the Gulf of St. Lawrence (Sears 1983) indicates that the largest concentrations of humpback whales in the Gulf of St Lawrence

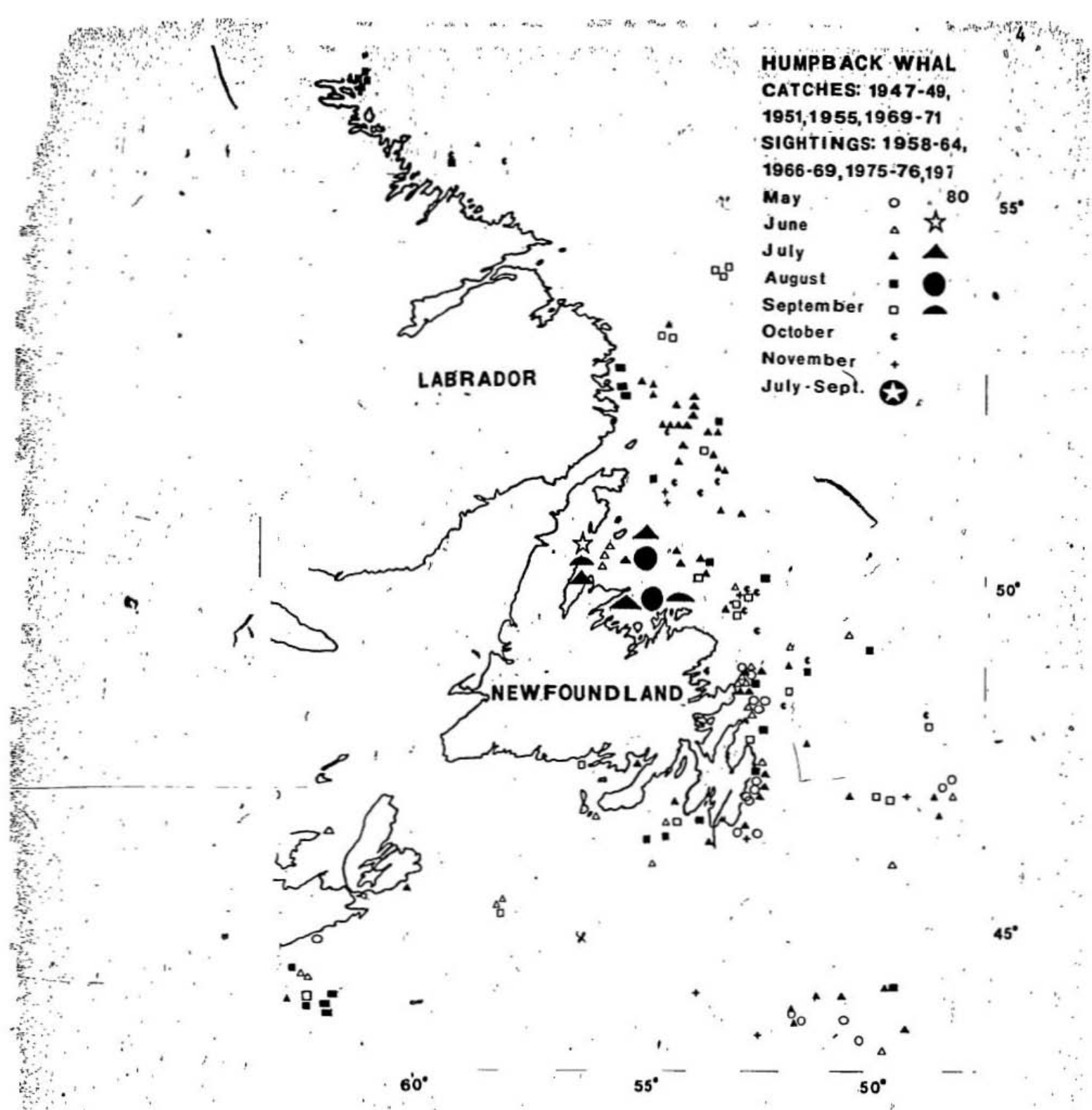

Figure 1. Humpback whale catch and sighting records by month from eastern Canadian waters. The open star (June), solid large triangle (July), solid large circle (August) and the solid half moon (September) indicate approximate positions of sightings (i.e., no exact positions were provided). The star enclosed in the black circle marks the vicinity of over 50 humpback sightings (July-September) recorded during whaling operations. One degree latitude equals 60 nautical miles.

occurred off the northwest tip of Newfoundland, just west of the Strait of Belle Isle.

Reports of humpback whales entrapments in fixed fishing gear have come from all areas of the Newfoundland and Labrador coastline south of Hamilton Inlet Bank (Lien 1979a, 1980a, Lien and Aldridge 1982, Lien et al. 1982, 1983, 1984, 1985). Over 85% of all humpback entrapments recorded from 1979 - 1985, have been from the east and northeast coasts of Newfoundland and from the southeast coast of Labrador. Humpback entrapments in fixed fishing gear were rare on the west and southwest coasts of Newfoundland.

The pronounced increase in the incidence of humpback entrapments in fishing gear in Newfoundland and in Labrador during the late 1970s and early 1980s, respectively (Whitehead and Lien 1982), appeared to be due to a shift in distribution and not to an increase in the population. Whitehead (1982) found no evidence from the population censusing done in the Caribbean and in Newfoundland / Labrador, that the northwest Atlantic population substantially increased or decreased during this period. Recent estimates for humpbacks in the northwest Atlantic approach 6000 (Matilla et al. 1985).

1.2.2 Finback:

Finbacks are found on both sides of the Atlantic from the edge of the ice to the subtropics (Allen 1916, Tomilin 1957, Slijper et al. 1964, Jonsgaard 1966a). The existence of a number of separate stocks of finbacks has been proposed for the northwest Atlantic including: (1) Nova Scotia / New England, (2) Newfoundland / Labrador, (3) Gulf of St. Lawrence and (4) west Greenland (Mitchell 1974a, Brodie 1975). However, Sergeant (1977) and Arnason (1981) have argued that finback whales in the North Atlantic may exist in a patchy continuum rather than distinct stocks.

The range for finback whales in the northwest Atlantic extends northward to 57°N off the northeast coast Labrador (Sergeant 1966), and to 72°N off the west coast of Greenland (Jonsgaard 1966b cited in Sergeant 1977), but no connection has been found for the finback populations between these areas (Mitchell 1974a, Whitehead et al. 1982). Tagging returns in eastern Canada indicated an exchange on the order of 10% between the finbacks of Nova Scotia and Newfoundland (Mitchell 1974a).

Little is known about the wintering grounds of finback whales, but Slijper et al. (1964) suggested that they go southward as far as 10°N during the winter. Finbacks have been sighted year-round in the shelf and slope waters off New England (Powers et al. 1982) and Nova Scotia (Brodie 1975), and in late winter and early spring from the Gulf of

St. Lawrence, along the west coast of Newfoundland (Sergeant and Fisher 1957) and off the Avalon Peninsula (Sergeant 1966). Based upon the frequency of winter sightings, Tomilin (1957) and Sergeant (1977) suggested that many finbacks in the North Atlantic, undergo relatively short migrations for the winter, shifting to slightly warmer waters either seaward or along the coast. Kellogg (1929) proposed that the northwest Atlantic finback population was stratified and shifted north and south, so that the grounds occupied by the southern population in summer are occupied by the northern population in winter.

In Newfoundland and Labrador finback sightings (Figure 2) have been recorded on the south coast, at Burgeo and Miquelon (Sergeant and Fisher 1957), off the Avalon Peninsula (Hay 1982), in Notre Dame and Canada bays on the northeast coast of Newfoundland (Perkins and Whitehead 1977) and along the coast of Labrador (Boles 1980, Brice-Bennett 1980). Although finbacks appear to feed further offshore than humpback and minke whales (Perkins and Whitehead 1977, Whitehead et al. 1982, Piatt et al. 1987), occasionally they have become entrapped in fixed fishing gear inshore. The majority of the finback entrapments have occurred on the northwest coast of Newfoundland (Lien 1979a, 1980a, Lien and Aldridge 1982).

Whale catching records (Figure 2) for eastern Canada indicate that finbacks were usually caught in the shelf waters off Nova Scotia, northern Newfoundland, east of the

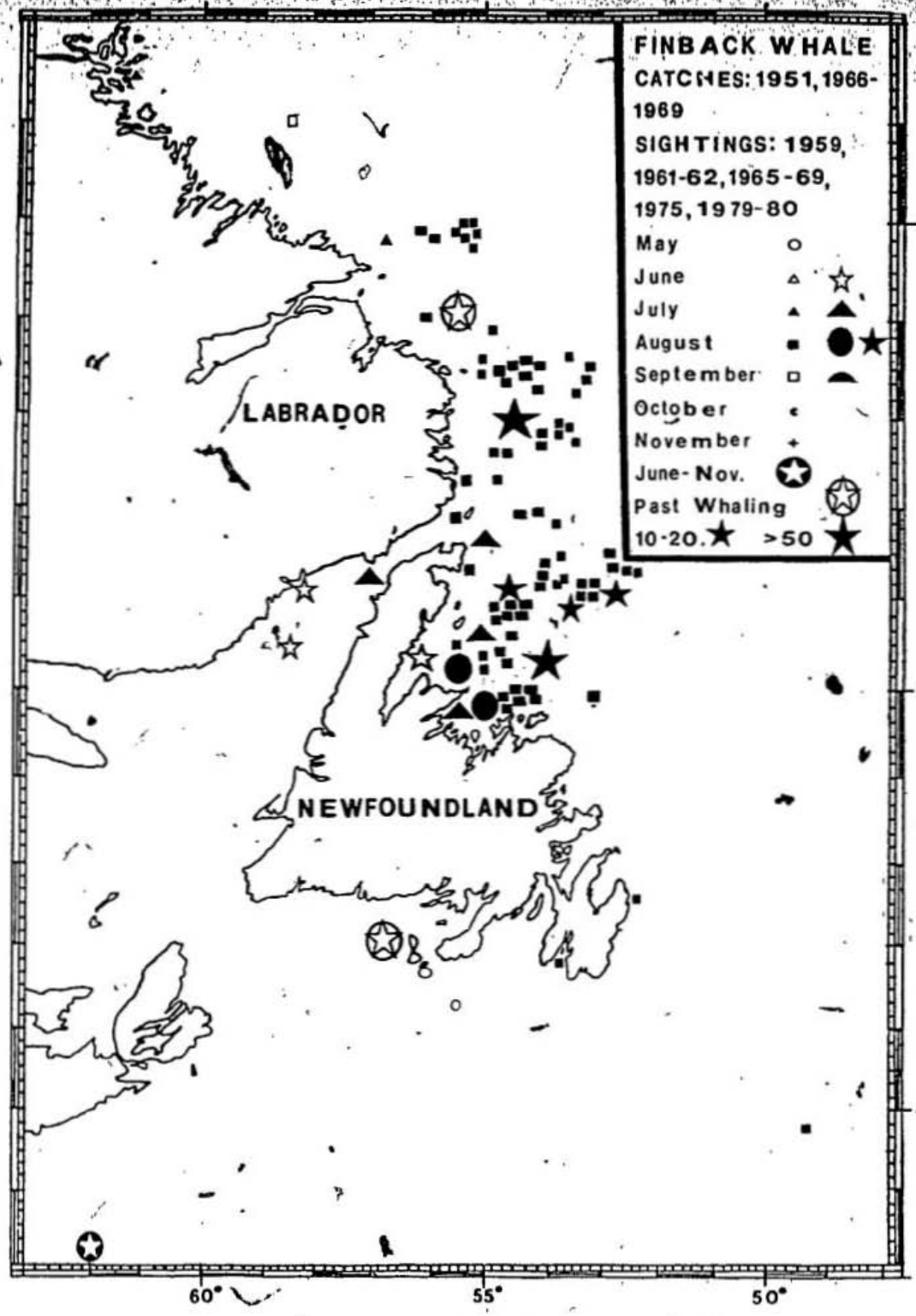

Figure 2. Finback whale catch and sighting records by month from eastern Canadian waters. All of the finback whale catches off Newfoundland and Labrador were taken in August, 1951. The solid black star (August) indicates areas with high numbers of finback catches (the larger the symbol, the higher the numbers of whales taken). The star enclosed within the black circle marks a finback whaling area off Nova Scotia. The remaining symbols are identified in Figure 1.

Strait of Belle Isle and off the coast of Labrador to 57°N (Sergeant 1966, Mitchell 1974a, Sutcliffe and Brodie 1977 and Brice-Bennett 1980).

There are no reliable current population estimates available for the northwest Atlantic finback whales (Mizroch et al. 1984), and it is unknown if the population is stable, recovering or declining. Whaling in eastern Canada ended in 1972. Population estimates for finbacks on the whaling grounds off eastern Canada declined steadily from 4500 in 1966 to 2000 in 1972 (Allen 1973).

1.2.3 Minke:

Minkes are found on both sides of the North Atlantic from the tropics to the high Arctic (Tomilin 1957, Slijper et al. 1964), perhaps in separate stocks in the eastern and western North Atlantic (Christensen 1975).

Little is known about the seasonal movements of minkes. Slijper et al. (1964) proposed that the majority of minkes migrate between feeding grounds in the higher latitudes and overwintering grounds in the latitudes below 30°N.

In Newfoundland and Labrador, most of the minke sighting records and whaling catches (Figure 3) were from the coastal waters off east and north Newfoundland (Sergeant and Fisher 1957, Sergeant 1963, Perkins and Whitehead 1977, Mitchell and Kozicki 1975, Parsons 1981), and from Hamilton Inlet and the Narrows at Rigolet, Labrador (Allen 1916, Boles 1980). Minke whales were also reported from the

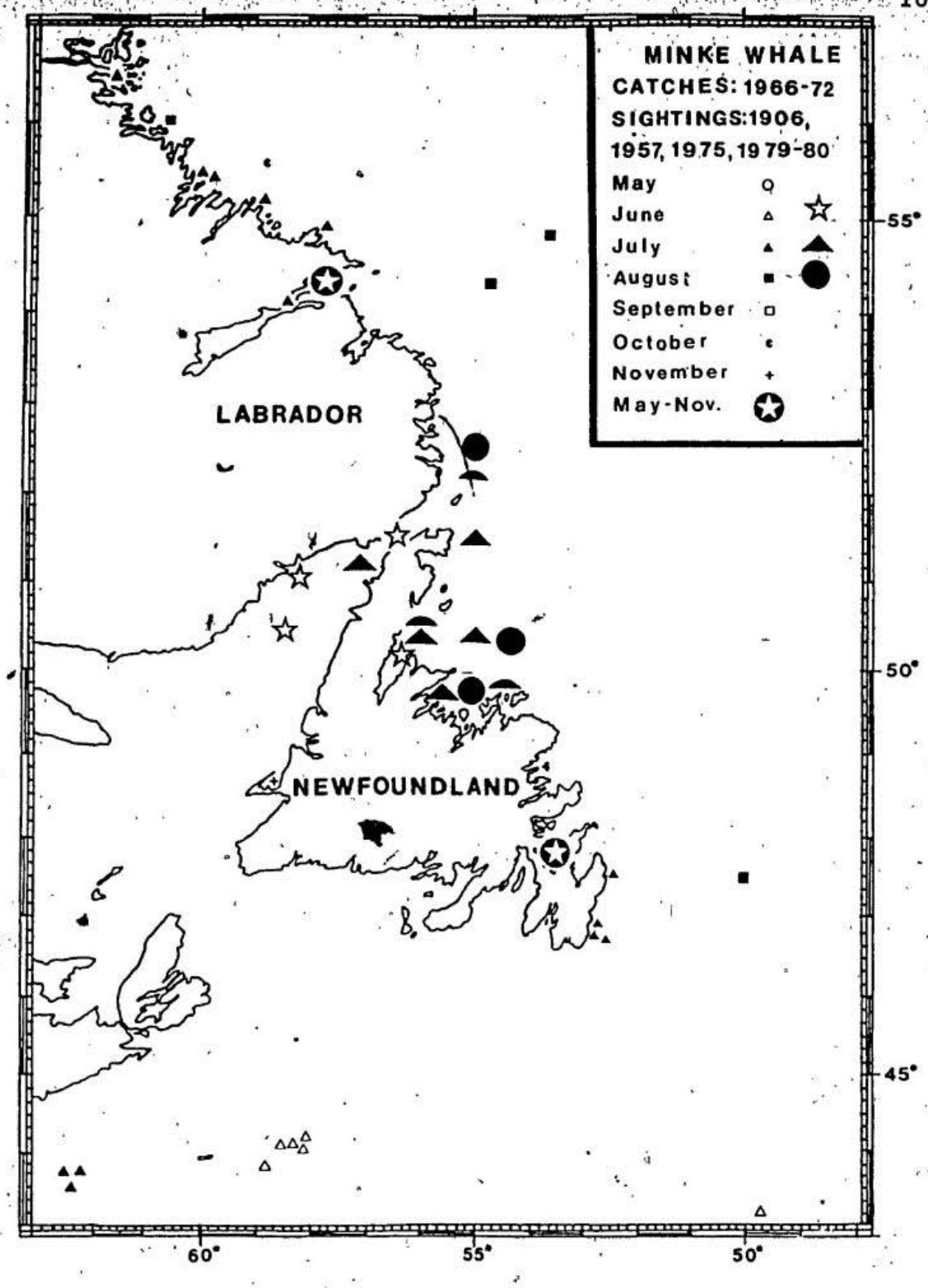

Figure 3. Minke whale sighting and catch records by month from eastern Canadian waters. The star enclosed within the black circle indicates a minke whaling area in Trinity Bay. The remaining symbols are identified in Figure 1.

Quebec and Newfoundland shores bordering the Gulf of St. Lawrence (Sergeant 1963, Sergeant et al. 1970, Perkins and Whitehead 1977, Sears 1979).

Minkes were hunted annually between 1947 - 1972 from a shore-based station in Trinity Bay, Newfoundland. The majority of the catches were made at the head of Trinity Bay and in Conception Bay, with a few in Bonavista Bay (Sergeant 1963, Mitchell and Kozicki 1975). Almost 60% of the minke entrapments, recorded between 1979 - 1985, occurred in the waters around the Avalon Peninsula (Cape Bonavista to Cape St. Mary's). The southeast tip of the Burin Peninsula and the southeast coast of Labrador were also areas of relatively higher numbers of minke entrapments (Lien 1979a, 1980a, Lien and Aldridge 1982, Lien et al. 1982, 1983, 1984, 1985).

No reliable estimates of population size exist for minke whales in the northwest Atlantic (Mitchell 1974b, Hay 1982).

1.2.4 Pilot Whale:

The long-finned pilot whale appears to be distributed continuously across the deep waters of the North Atlantic (Brown 1961). Moore et al. (1979), however, could not conclude whether or not there is a continuity between eastern and western North Atlantic stocks, based upon morphological comparisons of Faeroese and Newfoundland catches.

In the northwest Atlantic, pilot whales range from Cape Hatteras, where they overlap with the short-finned pilot whale (G. macrorhyncha) (Powers et al. 1982), to western Greenland (Sergeant and Fisher 1957, Sergeant 1968). Sergeant and Fisher (1957) reported a number of records of pilot whales from the Gulf of St. Lawrence, mostly from the northern tip of Cape Breton Island and along the edge of the Laurentian Channel. Pilot whales are rarely seen in shelf waters during the winter. They have been sighted on the southern edges of the Grand Banks of Newfoundland (Sergeant 1982). Sergeant (1962) suggested that they winter in the offshore waters influenced by the North Atlantic Drift.

Only in Newfoundland has an inshore migration of pilot whales been recorded as a regular event (Sergeant and Fisher 1957, Sergeant 1962, Mercer 1975). This inshore migration normally begins in July and is associated with the inshore migration of a major prey item, short-finned squid (Illex illecebrosus) (Mercer 1975).

Pilot whales were most frequently sighted in the deeper bays along the south and east coasts of Newfoundland (Figure 4), including: Hermitage, Fortune, Conception, Trinity, Bonavista, Notre Dame and White bays (Sergeant and Fisher 1957, Sergeant 1962, Parsons 1981). Whaling occurred from small boats primarily in Trinity and Bonavista bays, and occasionally in Notre Dame and Conception bays (Sergeant 1962). Over 85% of all pilot whale entrapments in fixed fishing gear occurred in White, Notre Dame, Bonavista,

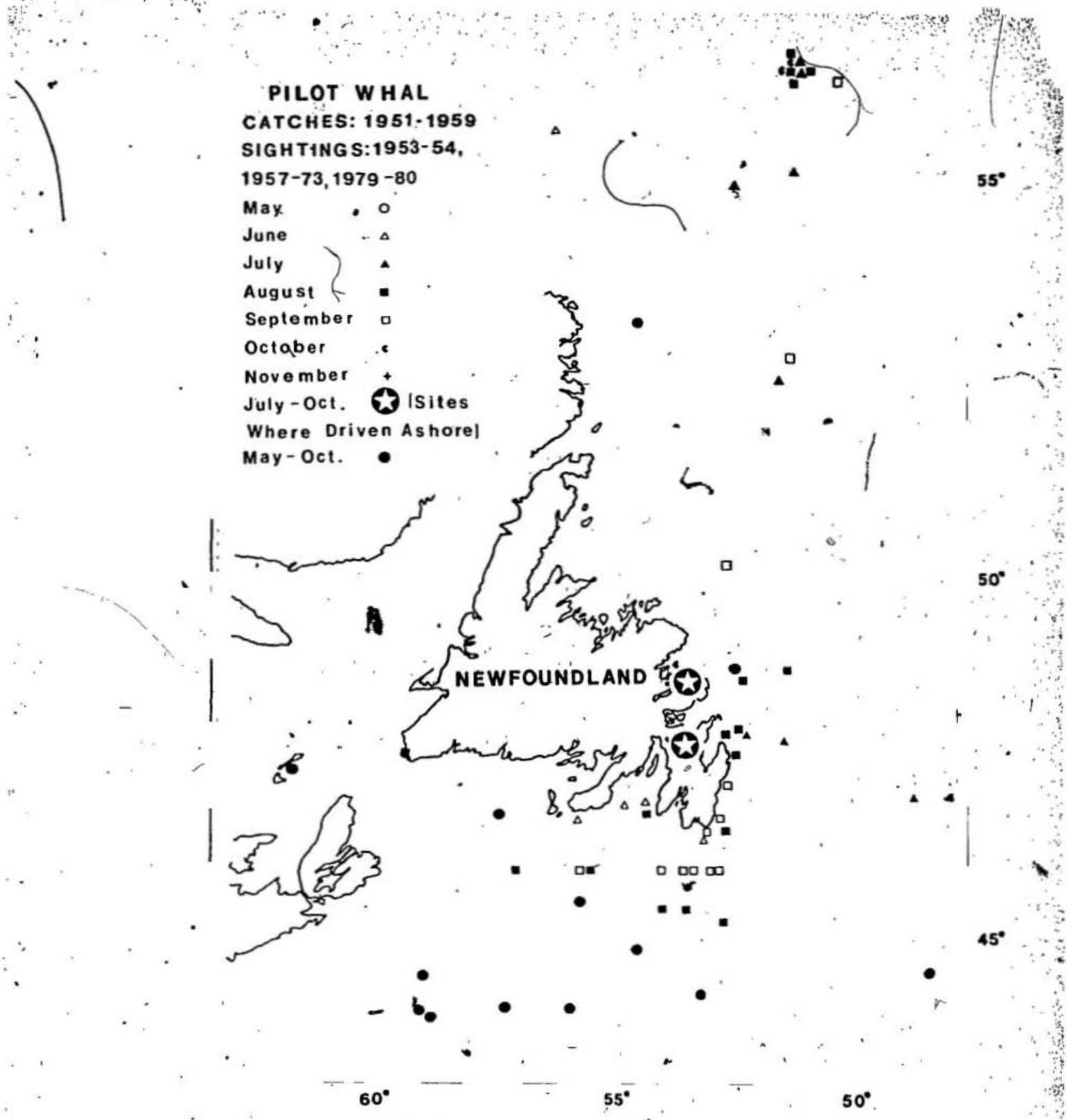

Figure 4. Pilot whale sighting and catch records by month from eastern Canadian waters.

Trinity, Conception and Placentia bays (Lien 1979a, 1980a, Lien and Aldridge 1982, Lien et al. 1982). In contrast, they have been recorded only at irregular intervals on the west coast of Newfoundland (Sergeant and Fisher 1957, Lien 1979a, Lien et al. 1982).

No reliable population estimates are available for pilot whales in the northeast Atlantic (Mitchell 1974a, Mercer 1975). Cumulative catches off eastern Newfoundland between the 1940s and 1972, exceeded 50,000 whales (Mitchell 1974a, Mercer 1975), but the Newfoundland stock collapsed during the late 1950's (Mitchell 1974a). Hay (1982) estimated 13,167 $\pm$ 3155 whales off eastern Newfoundland and Labrador in an August 1980 aerial survey. The current status of this population is unknown.

1.3 Whale Sighting Networks in the North Atlantic:

Most of the information regarding the distribution and migration of whales in the North Atlantic has come from whaling ship logbooks and whaling catch statistics (Allen 1916, Kellogg 1929, Townsend 1935, Jonsgaard 1951, 1966b, Sergeant and Fisher 1957, Tomilin 1957, Sergeant 1962, 1963, 1966, 1977, Mitchell 1974a, 1974b, Mitchell and Kozicki 1975, Sutcliffe and Brodie 1977, Arnason 1981, Martin 1981, Mitchell and Reeves 1983). Networks composed of a variety of observers (many of whom were volunteers), observing from a variety of platforms (e.g., airplanes, fishing boats, private boats, oceanographic research vessels, cliffs, etc.), were used first during the 1950s as a means of recording live cetacean sightings. A summary of observer networks is presented in Appendix I.

Whale sighting networks have shared a common objective to collect information on the distribution of cetaceans (among other marine animals) by establishing central data bases to consolidate and process the sighting records contributed by a large number of observers. Earlier sighting networks recorded only the larger whales including: rorquals (no distinction was made among blue B. musculus, finback, sei B. borealis and Bryde's B. edeni whales), sperm Physeter catodon, humpback, right Eubalaena glacialis and minke whales (Brown 1958, Slijper et al. 1964). Most of the recent sightings networks have kept records on all of the cetaceans sighted in a study area

(Mitchell 1975a, Sears 1979, Evans 1980, Parsons 1981, Mayo 1982, Powers et al. 1982, Stone et al. 1983, Kenney 1983).

Observers have been recruited from the naval, meteorological and merchant services, coast guard personnel, offshore observer programs, universities, private organizations, government fisheries agencies, and from the public (Appendix I). Most of the networks relied on shipboard observers (Brown 1958, Sergeant 1961, Slijper et al. 1964, Parsons 1981, Mayo 1982, Powers et al. 1982, Kenney 1983), augmented by occasional aerial surveys (Sergeant 1961, Sears 1979, Parsons 1981, Kenney 1983). Only a few projects have used land-based observers (Mitchell 1975a, Evans 1980, Mayo 1982). Most network observers aboard ships collected observations without influencing the ship's course.

Observation effort varied with each network and with individual observers. Consequently, whale sighting rates were calculated differently for each network. The shipboard sighting rates were expressed as the number of whales per unit of distance travelled or per unit of observation time (Brown 1958, Slijper et al. 1964, Mayo 1982, Powers et al. 1982). Land-based sighting rates were expressed as daily averages (Mitchell, 1975a) or monthly sighting frequencies (Evans, 1980).

Two shortcomings have been anticipated with the use of observer networks as a means of collecting cetacean sightings: the uncertain reliability of species

identifications and the uneven coverage of observation effort both seasonally and geographically (Evans 1980).

Most network organizers provided participants with standardized reporting sheets and field guides (Mackintosh 1952, Sergeant 1961, Slijper et al. 1964, Leatherwood et al. 1976, Evans 1980, Lien et al. 1980). Evans (1980) noted the relative impact of field aids on the reliability of cetacean identifications. He estimated that only about one-third of the early records, which were collected for the inshore waters of Britain and Ireland, provided enough details for reliable identification of the species reported. This increased to 60 - 70%, following the distribution of field guides and standardized recording forms.

None of the networks mentioned any attempts to evaluate the reliability of their observers (experienced or inexperienced) using standardizing tests. Most programs relied upon the presence of cetologists, trained or experienced observers and/or upon the accompaniment of sufficient details with sighting reports to determine reliable identification.

The uneven geographic and seasonal distribution of observer effort might not be as great a potential bias as originally thought in some studies. Comparisons of maps showing the distribution of observation effort with maps of plotted whale sighting frequencies indicate that the areas/seasons with high whale concentrations did not generally overlap with areas/seasons of high observation

effort (Slijper et al. 1964, Evans 1980 and Powers et al. 1982). Nevertheless, uneven distribution of observer effort remains an important factor to consider in the analysis of whale distribution.

2. MATERIALS AND METHODS

2.1 Study Area:

There were two study areas: the 'land-based study area', which included the inshore waters around Newfoundland and southeast Labrador, 46°N - 52°N and 52°W - 59°W (Figure 5), and the 'shipboard study area', which covered the continental shelf waters around Newfoundland and Labrador and on the Grand Banks of Newfoundland, 43°N - 57°N and 49°W - 61°W (Figure 6). Although the delimitative coordinates of the shipboard study area encompassed those of the land-based area, the areas did not necessarily overlap. With the exception of ports of call (St. John's, Newfoundland 47°34'N, 52°41'W, in particular) shipboard sightings were collected beyond 2 km of the coastline. Land-based observations were generally made within 2 km of shore, usually from headlands or elevated positions (e.g., cliffs).

The land-based study area was divided into 15 units (hereafter referred to as 'sections'), which consisted of one or more subunits corresponding to the Department of Fisheries Newfoundland Region Statistical Sections (hereafter referred to as 'statistical areas'). The shipboard study area was divided into 17 sections, which were composed of one or more rectangular subunits of one degree latitude x one degree longitude (hereafter referred to as 'one degree squares'). The one degree squares were

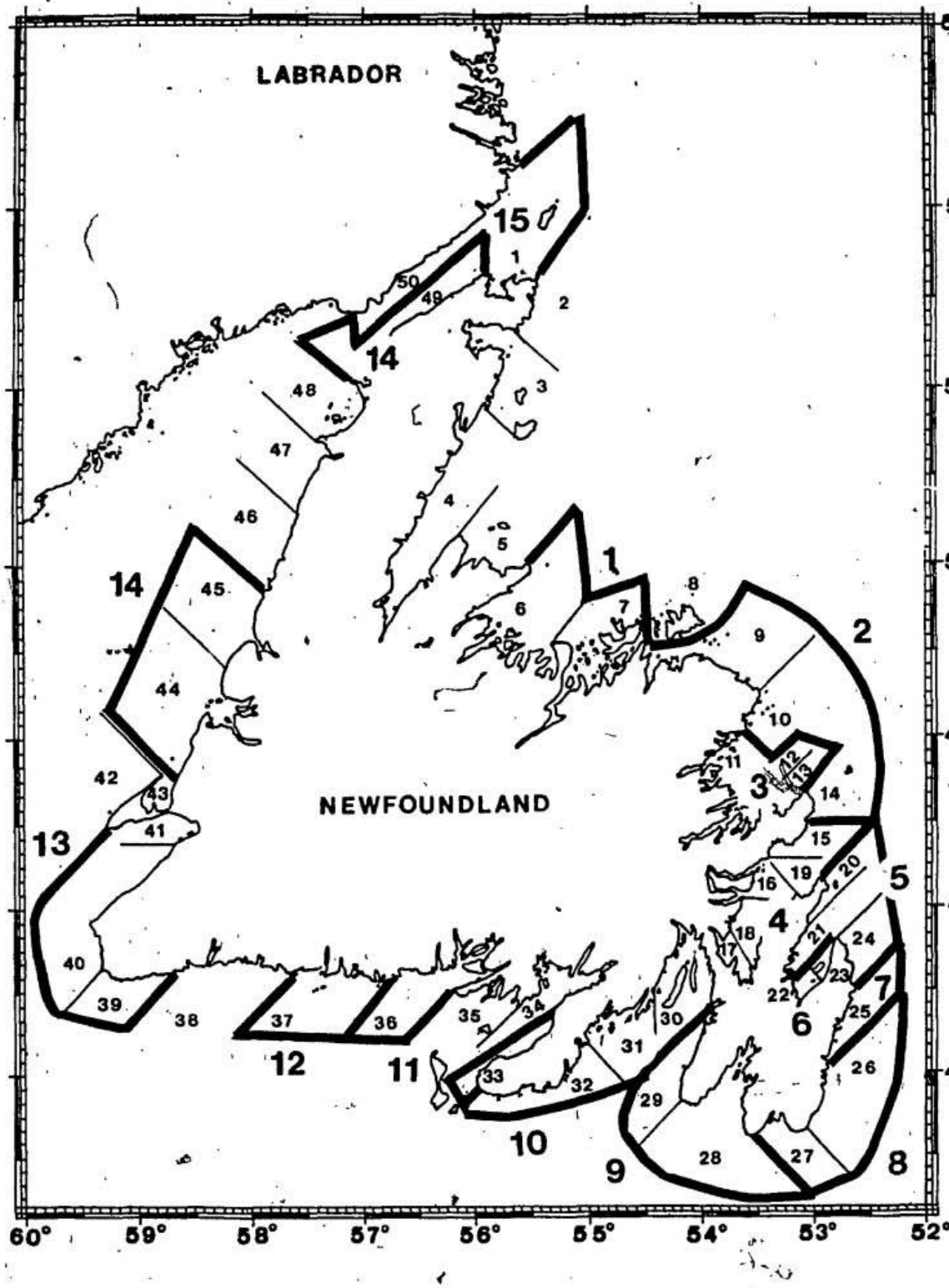

Figure 5. The study area (outlined) surveyed by the land-based observer network. The 15 sections of the land-based study area are composed of Department of Fisheries Newfoundland and Labrador Region Statistical Sections. One degree latitude equals 60 nautical miles.

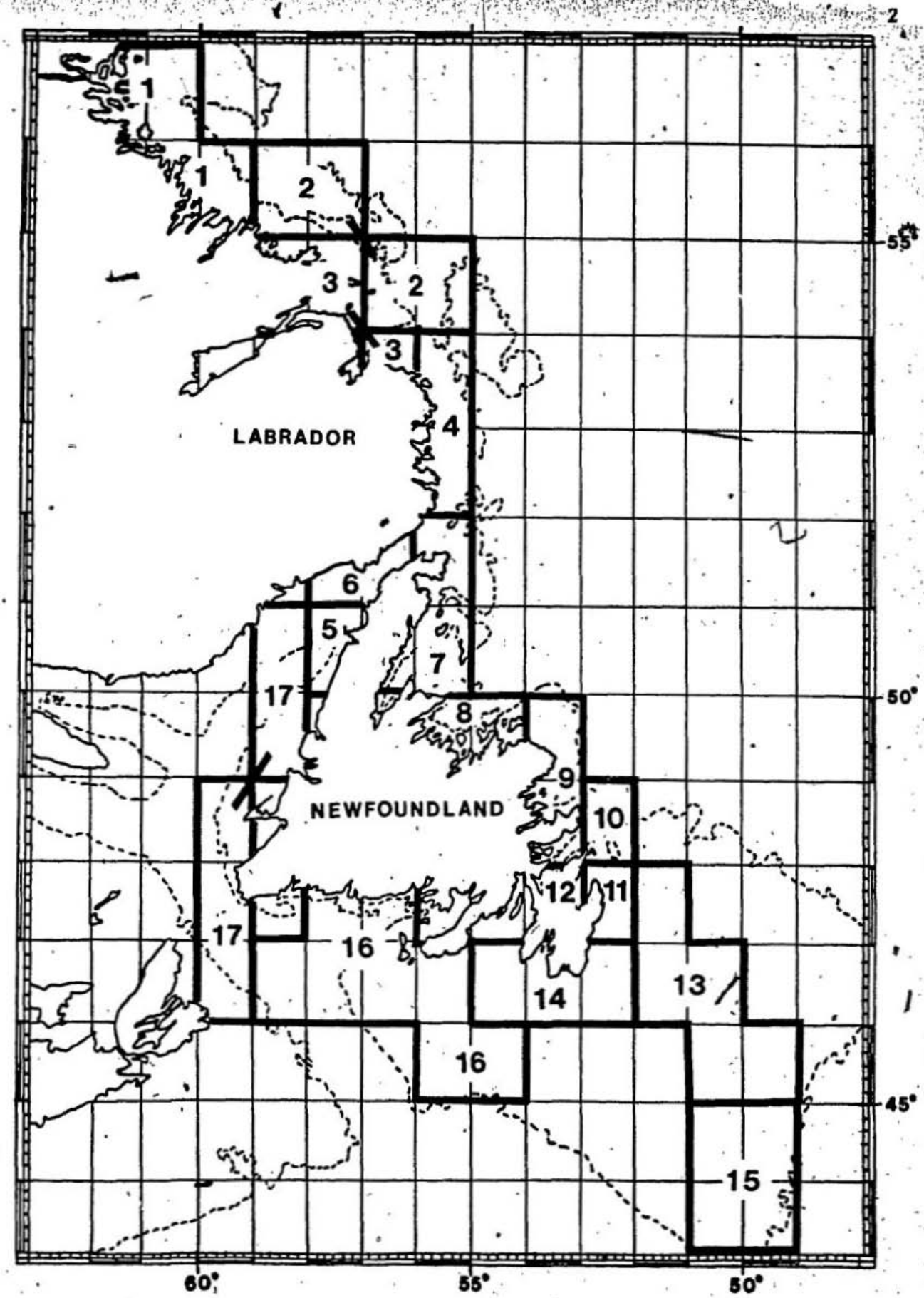

Figure 6. The study area surveyed by the shipboard network observers. The 17 sections of the shipboard study area are composed of one degree squares.

individually identified by referring to the degrees of latitude and longitude in the lower right-hand (SE) corner of the square. An attempt was made to divide both the land-based and the shipboard study areas into sections of relatively equitable observer effort. Statistical areas and one degree squares belonging to one section were either contiguous or in close proximity to each other.

2.2 Sighting Network:

2.2.1 Observers:

The sighting data came from two sources; from cruise reports of marine vessels, which were engaged in whale research within the shipboard study area, and from participants of a whale watching network, which was initiated in April 1979 (Lien 1979b, 1980b, Lien et al. 1980).

The whale watching network contributed both land-based and shipboard data. Network participants were volunteers, who were recruited from among the province's lighthouse keepers, faculty and students in the Departments of Biology and Psychology at Memorial University, members of the Royal Newfoundland Yacht Club, fishermen, and interested individuals residing beside the coast. Data from 1979 and 1980 have been summarized previously (Lien 1979b, 1980b, Lien et al. 1980).

The network observers were divided into two groups: Memorial (University) whale watchers (MWW) and Canadian

Coast Guard lighthouse keepers (LHK). The MWW, initially recruited in 1979, made up a diverse 'catch all' group, ranging from fishermen to experienced whale researchers. The LHK, organized in 1980, made up a relatively uniform network of observers that maintained weekly summaries of whale abundance for the areas viewed from their lighthouse stations. The MWW were recruited annually each spring, while the LHK operated instead on a perennial basis, submitting regular reports throughout the year or the ice-free period. MWW tended to be more mobile than LHK, making observations from several locations throughout the summer or from different locations in different years. There was a high turnover rate of MWW each year, and observations were generally collected May - September. MWW kept their sighting records and field notes in supplied notebooks, which were submitted to the Memorial University Whale Research Group each October.

Most of the fishermen included with the MWW, participated in the alarm experiments that were conducted as part of a study of whale collisions with inshore fishing gear (Lien 1979b, 1980b). The alarm experiments were limited to two fishing seasons, the first of which overlapped with the formation of the MWW network in 1979. These fishermen were asked to record whales they encountered each day as they went to and from their fishing gear, which was located within a 1 - 5 km radius of their home port (Lien 1979b). They were called by phone each week and asked

to give the daily records for the week (Lien 1980b).

A number of MWW collected whale sightings from marine vessels. Observations were recorded from vessels going about their normal business unrelated to whales (e.g., fishing or travelling between hydrographic stations / ports of call), or from whale research vessels performing standard surveys or in transit. Observations were made during daylight hours, while the vessels were under way. Days on which visibility was hampered by fog or rough weather (i.e., reducing the visibility to less than 3500 meters), were excluded from the data. Sighting records from cruise reports, in combination with observations from shipboard MWW, were collectively referred to as the 'shipboard sighting data'.

2.2.2 Observer Experience and Preparation:

Network participants (LHK and MWW) had a broad range of experience at whale identification; from a first-time effort observing/recording whales to active involvement in whale research. Observer reliability at the outset of the sighting network was unknown, although several LHK were ex-whalers (Lien, personal communication) and MWW (excluding fishermen) had been asked to rate their own level of confidence at identifying whales, when they joined the network.

MWW (excluding fishermen) were given an audio/visual training session in whale identification at the beginning of

each field season. They were provided with posters and field guides (including: Katona et al. 1977, Hay 1979, Lien and Johnson 1980). Fishermen were given help in identifying whales at meetings, organized by the Whale Research Group, and provided with posters and the Lien and Johnson (1980) field guide. Contact with LHK was restricted to phone and mail services. They received posters and the same three field guides provided to MWW. In 1982 a new guide (Lien and Hennessey 1982) was substituted for all other field guides and distributed to all LHK and MWW.

Most of the longer cruises (listed in Appendix 2) had a professional cetologist or an experienced observer aboard.

2.2.3 Testing Observer Reliability:

In 1982 MWW were tested for reliability of whale identification, using slides, after each training session. However, this method of evaluating observer reliability could not be practically applied to observers in remote locations. A printed test, composed of 48 black and white photographs of whales (Appendix 3), was developed in 1982, and distrbuted to all LHK and MWW (except fishermen associated in the alarm experiments), who had participated in the whale sighting network from 1979 - 1982. The test was intended to determine the reliability of the observers' identifications, primarily for humpback, finback, minke and pilot whales, although pictures of other species found off the coasts of Newfoundland and Labrador were also included.

The tests were graded according to the responses given by 19 experienced whale researchers (hereafter referred to as 'experts'), who were professionally involved in whale research. The experts included most of the professional cetologists who accompanied the surveys designated with asterisks in Appendix 2. Correct responses in the test were not restricted to a single species if the experts gave a range of answers. The test instructions indicated that responses of 'Don't know', 'Large or small whale' and 'Baleen or toothed whale' were acceptable for some of the answers. The experts' reactions to the poorer quality pictures dictated when these answers were appropriate. The percentage of correct responses for each species was calculated for each observer. Network participants who scored less than 50% of the mean expert score for a given species were removed from the analysis of that species. Incorrect answers were examined for species bias, i.e., responses that indicated that observers repeatedly confused the species being tested with other species. If 50% or more of the incorrect responses for a given species were identified as another species, the data were also removed from the analysis of the other species.

Wherever possible, data from untested observers was cross-checked with the data collected by other observers (tested and untested) in the area, or checked with any available field notes provided by the observer. Cross-checking was used particularly in the case of the

alarm experiment fishermen.

2.3 Observer Network Data:

2.3.1 Sighting Data Storage and Retrieval:

The data from LHKs' weekly reports, MWWs' notebooks and from cruise reports were computerized. Coded information included observer, location, vessel (shipboard observations), year, month, week (land-based observations), distance travelled (shipboard observations), species and estimated number sighted.

The method of reporting numbers of whales sighted differed among observers. LHK and many of the alarm experiment fishermen did not count the whales that they sighted but, instead, estimated the number of whales (per sighting, per day or per week) on a 4-point scale: 0 ('none'), 1 ('few' or 1 - 5 whales), 3 ('common' or 6 - 20 whales) and 4 ('plentiful' or over 20 whales).

Most MWW (both land-based and shipboard) and research cruise reports estimated numbers of whales per sighting or per day. All whale counts from the shipboard data were converted to the 4-point scale of whale abundance (hereafter referred to as 'abundance classes' or 'abundance categories'). This was accomplished by converting the whale count for each ship track to the appropriate abundance class. A ship track was defined as a vessel's daily line of travel in a one degree square.

2.3.2 Analysis of Whale Sighting Data:

2.3.2.1 Units of Observer Effort and Indices of Whale Abundance:

Many land-based MWW made daily entries in their notebooks, while most LHK and the alarm experiment fishermen provided weekly summaries. Because a 'week' represented the smallest unit of effort common all groups of land-based observers, weeks were used as the basic units of land-based observer effort. Thus, the highest daily whale count for a given week was used to provide the abundance class for that week. For example, if an observer sighted a single humpback whale on one or more days of a given week, these observations were combined and the humpback whale count was assigned an abundance class 1 for that week. The assignment of abundance classes was to some extent subjective because multiple sightings of the same whale(s) were difficult to discern from sightings of different whales. For example, a pair of humpback whales sighted on three days of a given week could be recorded as an abundance class 1 (if the same two whales were sighted each day), or as an abundance class 2 (if six different whales were sighted). Fortunately, there were few judgement calls, in part, because observers' field notes or cross-checks with another observer at the same location, guided the selection of appropriate abundance classes.

In addition to estimating weekly whale counts from daily entries of a single observer, occasionally it was

necessary to obtain a single estimate of whale abundance from two or more observers reporting from the same location for a given week. This was true particularly for inshore fishermen, who either fished together or fished in the same vicinity, but submitted separate sighting records. The whale abundance estimates from each report were cross-checked, and the highest estimate of each species for a given week was entered as a single observation (i.e., the group of observers was treated as a single observer).

Shipboard observer effort was expressed in either nautical miles or number of ship tracks (defined in Section 2.3.1).

Two indices of whale abundance were used in the analysis of the sighting data: sighting rate and sighting frequency. Sighting rates provided an overall estimate of numbers of whales, and sighting frequencies indicated numbers of whale sightings. Sighting rates for the land-based network results were expressed as the mean abundance class per week. Sighting rates for the shipboard network results were expressed either as the number of whales per nautical mile or as the mean abundance class per ship track. The latter measure of shipboard observer effort was used for instances when whale counts had been converted into abundance classes. Sighting frequencies were expressed as the number of whale sightings per week for the land-based data, and per ship track for the shipboard data.

2.3.2.2 Whale Distribution:

The overall distributions of each species were identified in the land-based and shipboard study areas using all available data for the summer study period; June - September, 1979 - 1982 (land-based) and 1976 - 1983 (shipboard). The proportion of sightings attributable to each abundance class (observed frequency of each abundance class divided by the total number of sightings for a given area), provided an indication of mean aggregation size. It was assumed that areas marked by the regular presence of smaller aggregations of whales (0 - 5 whales) were no less significant than areas marked by sporadic visits of large aggregations of whales (> 5 whales). Consequently, sighting rates were used in combination with sighting frequencies to identify which sections had a higher affinity for each species, i.e., sections were rank-ordered using the mean of the ranks of both abundance indices. In addition, contingency tables were used to compare sighting frequencies among sections, and to identify sections with the highest sighting frequencies (from the relative contributions of each section to the total X^2, Elliott 1977).

Regression analysis was performed on sighting rates and observer effort to see if the spatial distribution of each species had been affected by observer effort.

Monthly and annual changes in distribution were examined by dividing the land-based and shipboard study areas into north, east and south sections, roughly

counterpart to Labrador/the north coast of Newfoundland, the east coast of Newfoundland and the south coast of Newfoundland. Monthly and annual sighting rates were calculated for each section.

Annual sighting rates and frequencies for each section were correlated with year to check for annual shifts in distribution. Trends in monthly and annual whale abundance were compared between sections by correlation analysis. Correlation analysis was also used to compare trends in monthly/annual whale abundance between species and between land-based and shipboard study areas (using comparable sections).

2.3.2.3 Fluctuations in Whale Abundance:

Fluctuations in monthly and annual whale abundance were examined for each species. The analyses of monthly abundance used data from all available months, including: January - December (land-based data) and May - September (shipboard data). Analyses of annual summer abundance were initially performed on all of the available June - September data for each year, and then on data corrected for annual differences in observer effort (using only the statistical areas, one degree squares and months common to each year).

Mean annual summer abundance was correlated with year to determine any overall trends in whale abundance. The Freidman two-way analysis of variance by ranks (Elliott 1977) was used to test for differences in mean abundance

among months and among years for each species. The variability in abundance among sections was not expected to interfere with reaching conclusions about the differences in the months/years, because the test ranked abundance only within blocks (sections) (Elliott 1977). When significant differences were found in whale abundance among months or years, multiple comparisons using the Freidman test were made among the months/years by comparing the differences between their rank sums, to a critical range (Elliott 1977). Correlation analysis was used to compare trends in monthly/annual whale abundance between species and between land-based and shipboard study areas (using comparable months and years).

Regression analysis was performed on sighting rates and observer effort to see if monthly/annual abundance of each species had been affected by observer effort.

3. RESULTS

3.1 Observer Networks:

3.1.1 Distribution of Observer Effort & Contributions of Each Observer Group:

Land-based observers contributed 1547 weeks of summer observer effort (June - September, 1979 - 1982) from 38 Newfoundland Statistical Regions. The distribution of land-based observer effort is shown in Figure 7.

Seventy-four LHK from 43 locations within the study area participated in the land-based sighting network by submitting a minimum of two weekly reports during the summer months (June - September) from 1980 - 1982 (Appendix 4). They contributed 57% of the total summer land-based observer effort (Table 1), from 1979 - 1982. LHK contributed 90% of the observer effort outside of the summer months, and all of the winter sighting effort (December - February). Lighthouse stations were located on headlands around the coasts of Newfoundland and southeast Labrador (Appendix 4).

Twenty-five MWW (excluding alarm experiment fishermen) submitted at least two weekly reports (totaling 22% of the summer observer effort) to the land-based whale sighting data base, from 1979 - 1982 (Table 1). Thirty-two fishermen in 1979 and 159 fishermen in 1980, from a total of 53 locations, collected whale sightings in conjunction with the alarm experiments which were conducted as part of a study of

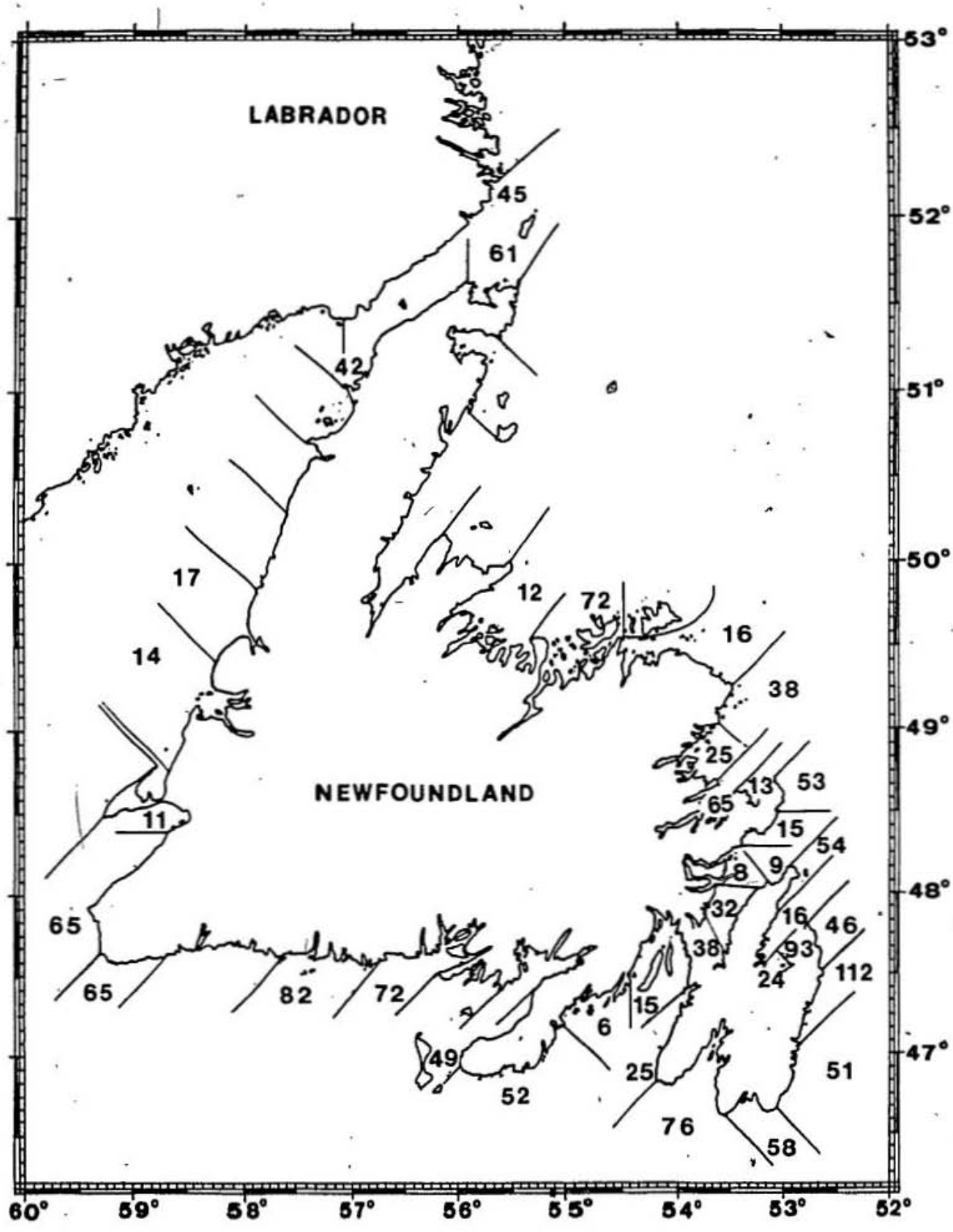

Figure 7. Distribution of summer observer effort (in weeks) for June-September, 1979-1982 in the land-based study area.

TABLE 1

Contributions of each observer group and of tested observers to the whale sighting data base

These tables show the relative contributions of each observer group to the total and to the summer data bases. Some of the land-based locations had both LHK and MWW. Numbers marked with an asterisk indicate the total number of observer locations.

I: Summer Land-Based Data Base (June - September, 1979 - 1982):

Group	No. of Obsvrs	No. of Locatn	Effort (wks)	Contrb to Tot Obsvrs (%)	Contrb to Tot Effort (%)	No. of Tested Obsvrs in Grp	No. of Locatn	Effort (wks)	% Tested Obsvrs in Grp	% Tested Effort of Grp
LHK	74	43	881	48.7	56.9	18	16	254	24.3	28.8
MWW	25	32	341	16.4	22.0	11	20	231	44.0	67.7
AF	53	53	325	34.9	21.0	0	0	0	0	0
TOTAL:	152	116*	1547			29	34*	485	19.1	31.4

II: Total Land-Based Data Base (January - December, 1979 - 1982):

Group	No. of Obsvrs	No. of Locatn	Effort (wks)	Contrb to Tot Obsvrs (%)	Contrb to Tot Effort (%)	No. of Tested Obsvrs in Grp	No. of Locatn	Effort (wks)	% Tested Obsvrs in Grp	% Tested Effort of Grp
LHK	74	43	1512	48.7	66.8	18	16	510	24.3	33.7
MWW	25	32	418	16.4	18.5	11	20	279	44.0	66.7
AF	53	53	334	34.9	14.7	0	0	0	0	0
TOTAL:	152	116*	2264			29	34*	789	19.1	34.8

III: Total Shipboard Data Base (May - September, 1976 - 1983):

Group	No. of Obsvrs	Effort (n mi)	Contrib to Obsr Total (%)	Contrib to Tot Effort (%)	No. of Tested Obsvrs in Grp	Effort (n mi)	% Tested Obsvrs in Grp	% Tested Effort of Grp
Expert	18	32720	41.9	75.0	9	20077	50.0	61.4
MWW	25	10876	58.1	25.0	8	6980	32.0	64.2
TOTAL:	43	43596			17	27057	39.5	62.1

whale collisions in fixed fishing gear (Lien 1979b, 1980b). They contributed one-fifth of the summer land-based observer effort from 1979 - 1982. MWW and the alarm experiment fishermen, who participated in the sighting network, were located mostly around the Avalon Peninsula (Appendix 4).

Land-based locations with a minimum of four weeks of data per summer for two or more years were designated as principal observer locations. There were 39 principal observer locations (in 24 statistical areas) manned by LHK, MWW and alarm experiment fishermen. Appendix 5 provides an account of the annual and monthly distribution of effort in these locations. The principal observer locations and other place names mentioned in the text, are mapped in Appendices 7 and 6, respectively. Forty-seven LHK from 26 locations were counted among the principal observers of the network (many locations had more than one LHK, a principal and two or more assistants). LHK, from 7 of these locations, provided year-round observations. By contrast, there was a high turnover rate of MWW each year. Eighteen MWW and 42 alarm experiment fishermen from a total of 15 locations submitted observations for more than one summer. No MWW made observations throughout an entire year.

Twenty-five MWW participated in the shipboard observer network, although cruise and research reports, submitted by experienced whale researchers made up almost 70% of the shipboard sighting data (Table 1).

Shipboard routes by month and by year are shown in Appendix 8. The east coast of Newfoundland was surveyed

every year (1976 - 1983). Southeast Labrador was surveyed sometime during the July - September period, every year except 1976. Surveys along the west coast of Newfoundland and on the Grand Banks of Newfoundland occurred from 1980 - 1983. Whitehead and others conducted whale research off the Bay de Verde Peninsula, southeast Newfoundland, from 1978 - 1981, and performed annual cetacean surveys along the east coast of Newfoundland to Labrador each year except for 1977 and 1980 (Perkins and Whitehead 1977, Whitehead et al. 1978, 1979, 1980, 1981, Whitehead and Carscadden 1985). On the northeast coast of Newfoundland, one fisherman collected observations from May - October, 1979 - 1982, while fishing the area within a 65 km radius of Point Riche. The distribution of shipboard observer effort for June - September, 1976 - 1983, is presented in Figure 8.

3.1.2 Observer Reliability:

One-third of the land-based observer effort was contributed by observers, who were tested for their reliability in identifying whales (Table 1). The proportion of observer effort contributed by tested shipboard observers was higher, exceeding 62%. Not all observers were given the reliability test. In particular, fishermen who had participated in the alarm experiments two years before the test was developed, were not tested. The process of cross-checking and summarizing the sightings submitted by multiple observers in one area for the same week, probably helped to eliminate much of the questionable data from

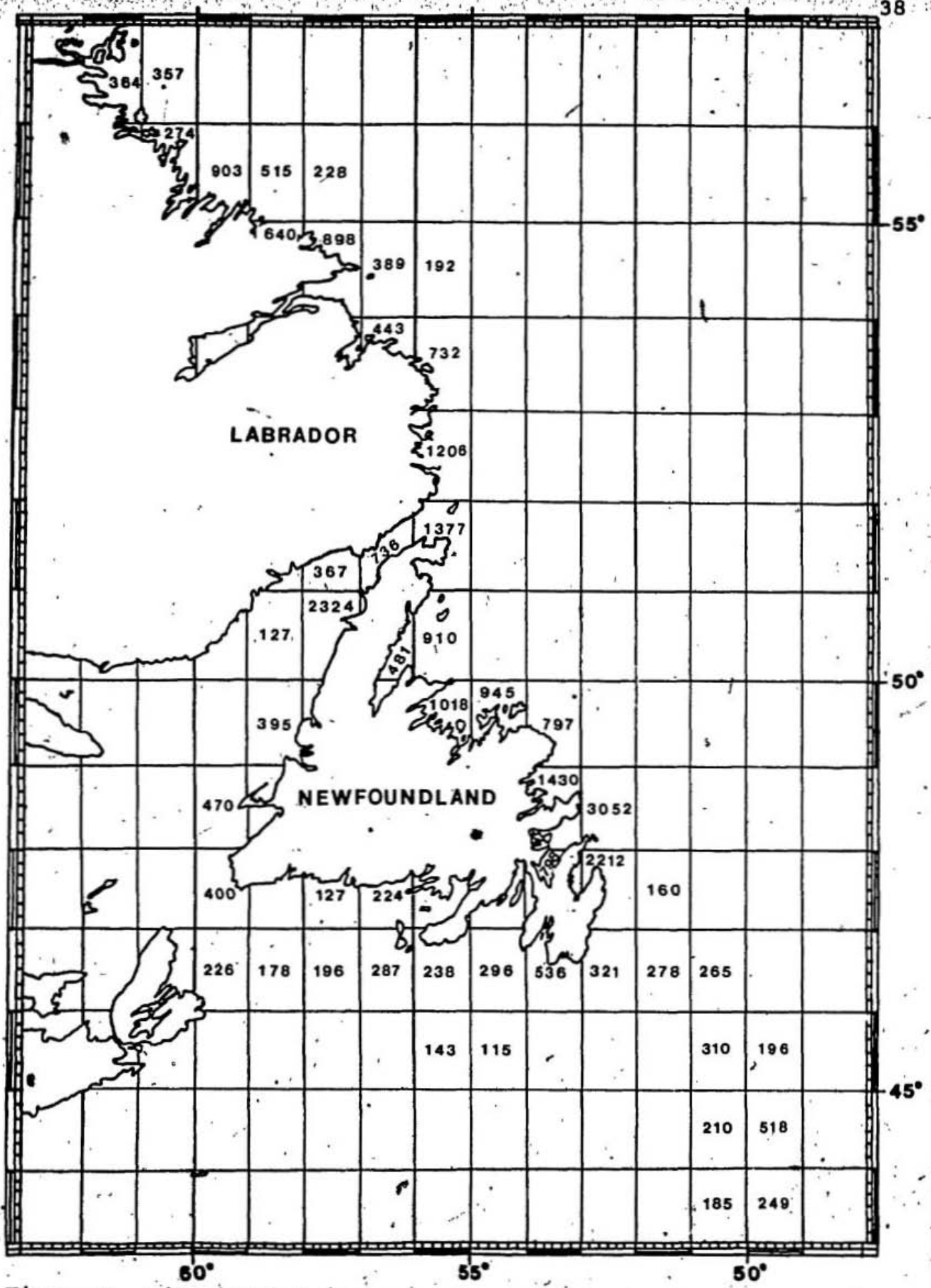

Figure 8. Distribution of summer observer effort (in nautical miles) for June-September, 1976-1983, in the shipboard study area.

untested observers. Nevertheless, data from untested observers who submitted sole source reports were included (Appendix 4). These observers contributed to approximately 37% of the land-based effort and 9% of the shipboard effort.

Reliability test results are presented in Table 2. All of 19 tests distributed to expert whale researchers were completed and returned. This group correctly identified 91% (43.5 $\pm$ 3.3) of the pictures (Table 2). The tests from the network observers (land-based and shipboard), therefore, were graded out of 43.5. The MWW (land-based and shipboard) correctly identified 76% (or 32.9 $\pm$ 4.9) of the 43.5 answers and LHK, 66% (or 28.7 $\pm$ 5.5). Assuming that the untested, sole source observers would have obtained test scores comparable to the tested LHK and MWW, then approximately 11% of the land-based and 3% of the shipboard data were unreliable (the LHK and MWW together, correctly identified an average of 71% of the 43.5 answers).

Many of the test answers were intended to check the reliability of humpback, finback, minke and pilot whale identifications. The resulting responses for each of the four species were graded for the percentage of correct answers and were examined for any bias toward a species (by repeatedly favouring one or more species in incorrect responses). Most of the observers who were excluded from the analyses of a given species made no attempt to identify the pictures of that species; i.e., left the answers blank or admitted to not recognizing the species. Finback and minke whales were the two species most commonly confused

TABLE 2

Reliability test mean scores for each observer group

Summary of the average scores obtained by the observers who were tested for their reliability at whale identification.

Observer Type	No. of Tests Sent	No. of Tests Ret'd	% Ret'd	Mean Total Score (/48) ± s.d.	Mean Hpbk Score (/16) ± s.d.	Mean Fin Score (/7) ± s.d.	Mean Minke Score (/6) ± s.d.	Mean Pilot Score (/7) ± s.d.
Expert Researchers	19	19	100	43.5 ± 3.3	15.2 ± 1.4	6.0 ± 1.3	5.3 ± 0.9	6.6 ± 0.5
Lighthouse Keepers	74	18	24	28.7 ± 5.5	10.4 ± 3.0	3.9 ± 1.6	3.6 ± 1.3	3.6 ± 1.4
Whale Watchers	33	15	45	32.9 ± 4.9	11.4 ± 2.8	3.7 ± 1.4	3.8 ± 1.4	4.3 ± 1.4

with each other in the test, even by the experts. Much of the confusion probably can be attributed to the absence of any scale in the pictures. Only three observers were excluded from the analysis for humpback whales. More observers (8) were excluded from the finback whale analysis than for any of the other species. In total, only 8% of the land-based observer effort was excluded because of poor reliability scores. Only one observer's data were excluded because of species bias. Details of data excluded by poor test scores are presented in Appendix 9.

3.2 Whale Sighting Results

3.2.1 Humpback:

3.2.1.1 Spatial and Temporal Distribution:

Humpback whales were sighted in all sections of each study area (Tables 3 and 4), but were distributed predominately along the south and east coasts of Newfoundland and the southeast coast of Labrador (Figures 9 and 10). The land-based results indicated that humpback whales were present in waters off Newfoundland throughout the year (Table 5), although their abundance was significantly higher from May - August than it was from September - April, $p < 0.05$ (Figure 11). The shipboard results indicated that humpback abundance was significantly lower in September than it was from May - August (Table 6, Figure 11). No significant differences in humpback abundance were found among the months, from May - August (shipboard results). There was no significant correlation

TABLE 3

Distribution of humpback whales from the summer land-based network results (June - September, 1979 - 1982).

'Abun' - the total abundance of whales in each section, (x1 + x2 + x3), where x is the observed frequency of sightings. 'Sight Freq.' - sighting frequency, expressed as the proportion of the total number of weeks with sightings. '$Contrib^{n}$ to X^{2}' - the contribution of each section's observed sighting frequency to the X^{2} statistic. The asterisks in this column designate sections which have higher than the expected frequency of sightings.

Land-Bd Section	Stat Areas	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight -Rate Abun/Tot	Sight Freq	Ranks (/15) Sight Rate	Sight Freq	Mean	$Contrib^{n}$ to Total X^{2}
1	6,7	51	18	10	5	84	53	0.631	0.393	9	9	9	0.35
2	9,10,14	28	17	23	30	98	153	1.560	0.714	1	1.5	1	*17.49
3	11,12,13	64	12	7	5	88	41	0.466	0.273	10	11	10	5.35
4	15 - 19	59	26	15	6	106	74	0.698	0.443	8	7.5	8	0.01
5	20,21,24	45	37	31	7	120	120	1.000	0.625	2.5	3	2	*9.90
6	22,23	84	19	14	0	117	47	0.402	0.282	11	11	11.5	6.32
7	25	46	30	22	14	112	116	1.036	0.589	2.5	4	3.5	*6.08
8	26,27	52	28	24	6	110	94	0.854	0.527	6	5.5	6	*2.13
9	28,29	46	25	22	8	101	93	0.921	0.544	4.5	5.5	5	*2.76
10	30,31,32	60	11	2	0	73	15	0.233	0.178	13	13	13	11.10
11	33,36	35	58	24	4	121	118	0.975	0.711	4.5	1.5	3.5	*21.05
12	37	58	22	2	0	82	26	0.317	0.293	12	11	11.5	3.84
13	39,40,41	87	9	0	0	96	9	0.094	0.094	14.5	14.5	14.5	25.74
14	44,45,49	65	8	0	0	73	8	0.110	0.110	14.5	14.5	14.5	17.80
15	1,50	59	27	7	13	106	80	0.755	0.443	7	7.5	7	0.01
TOTALS		839	347	203	98	1487	1047	0.704	0.436	-	-	-	230.3 ($p < 0.01$)

TABLE 4

Humpback whale distribution from the summer shipboard network results. (June - September, 1976 - 1983).

'Total No. of Whales' - actual number of whales counted. 'Sight Freq' - sighting frequency, expressed as the proportion of the total number of tracks with sightings. 'Cntrib^{n} to Total X^2' - the contribution of each section's observed sighting frequency to the X^2 statistic. The asterisks in this column designate sections which have higher than the expected frequency of sightings.

Ship-Bd Section	Latitude, Longitude	Obsv'd Freq (in tracks) 0	1	2	3	Total No.of Track	Dist (n mi)	Total No. of Whales	Sight Rate (#/n mi)	Sight Freq.	Ranks (/17) Sight Rate	Sight Freq.	Mean	Contrib^{n} to Total X^2
1	55°-57°,60°-62°	48	1	0	0	49	1898	1	0.000	0.020	16	16	16	9.40
2	54°-56°,55°-58°	34	5	0	3	42	1324	128	0.097	0.190	6	8.5	7	0.30
3	53°-55°,56°-59°	63	9	1	0	73	1981	24	0.012	0.137	12	10.5	10	2.79
4	50°-52°,55°-56°	13	11	8	5	37	1938	332	0.171	0.649	3	2	2.5	*27.96
5	50°-51°,57°-58°	88	15	0	0	103	2324	24	0.010	0.146	12	12	12	3.24
6	51°-52°,56°-58°	55	8	0	0	63	1103	18	0.016	0.127	12	12	12	2.95
7	50°-52°,55°-57°	43	12	4	0	59	2768	69	0.025	0.271	9.5	5	7	0.41
8	49°-50°,54°-56°	47	8	2	1	58	1908	82	0.043	0.190	7.5	8.5	9	0.43
9	48°-50°,53°-54°	61	11	6	3	81	2227	245	0.110	0.247	4.5	7	5	0.09
10	48°-49°,52°-53°	48	23	27	12	110	3052	763	0.250	0.564	1	1	1	*52.74
11	47°-48°,52°-53°	97	22	13	2	134	2212	243	0.110	0.276	4.5	4	4	*1.19
12	47°-48°,53°-54°	75	2	1	0	78	798	16	0.020	0.038	9.5	17	14	12.51
13	45°-48°,49°-52°	33	4	0	0	37	1209	6	0.005	0.108	14	10.5	12	2.42
14	46°-47°,52°-55°	29	6	5	0	40	1153	53	0.046	0.275	7.5	6	7	0.34
15	43°-45°,49°-51°	15	8	7	3	33	1162	251	0.216	0.545	2	3	2.5	*14.14
16	45°-48°,54°-59°	43	1	0	0	44	1508	1	0.001	0.023	16	15	16	8.26
17	46°-51°,58°-60°	43	2	0	0	45	1618	2	0.001	0.044	16	14	16	6.78
TOTALS		835	148	74	29	1086	30183	2258	0.075	0.231	-	-	-	189.8 ($p < 0.01$)

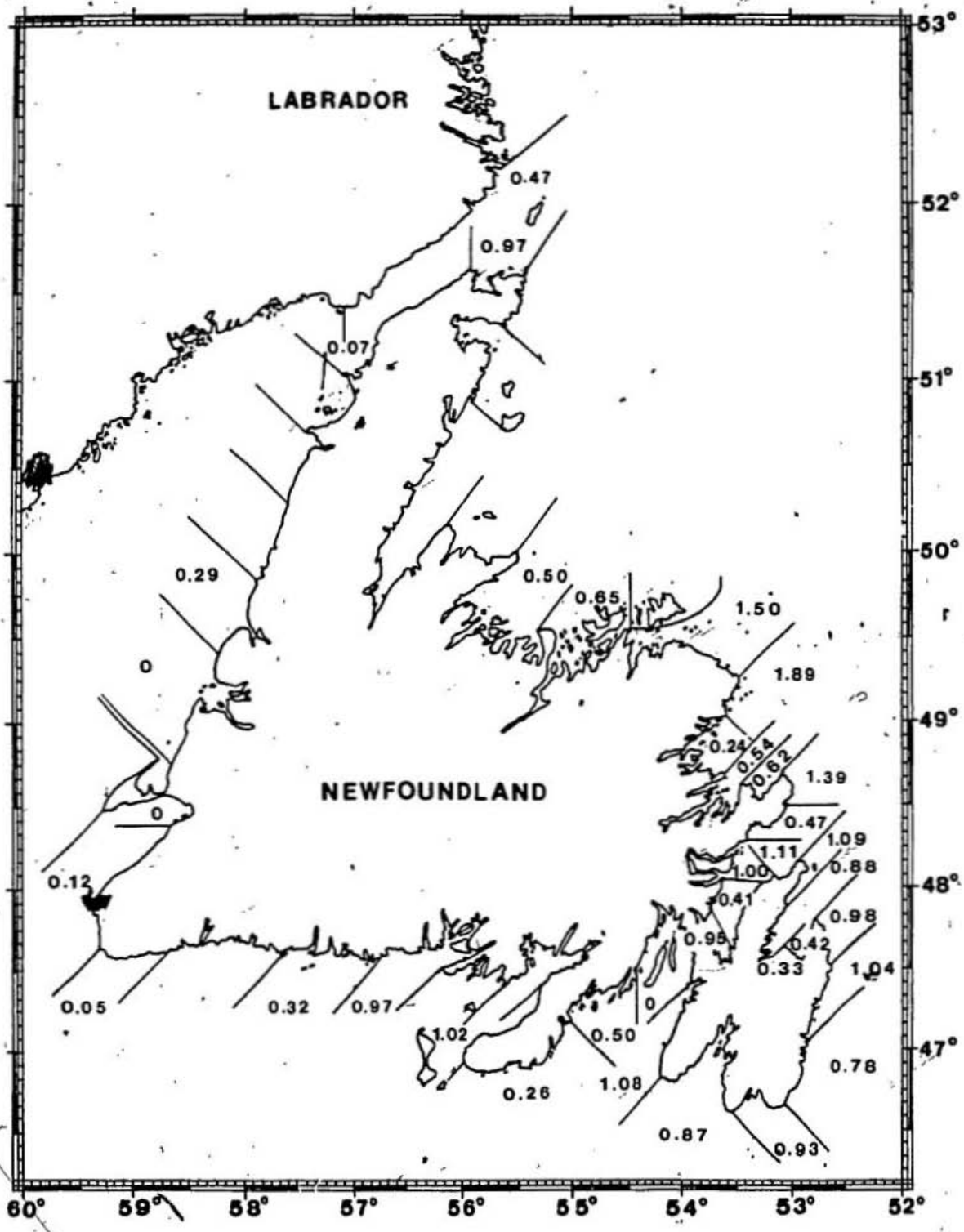

Figure 9. Summer sighting rates of humpback whales for each statistical area within the land-based study area.

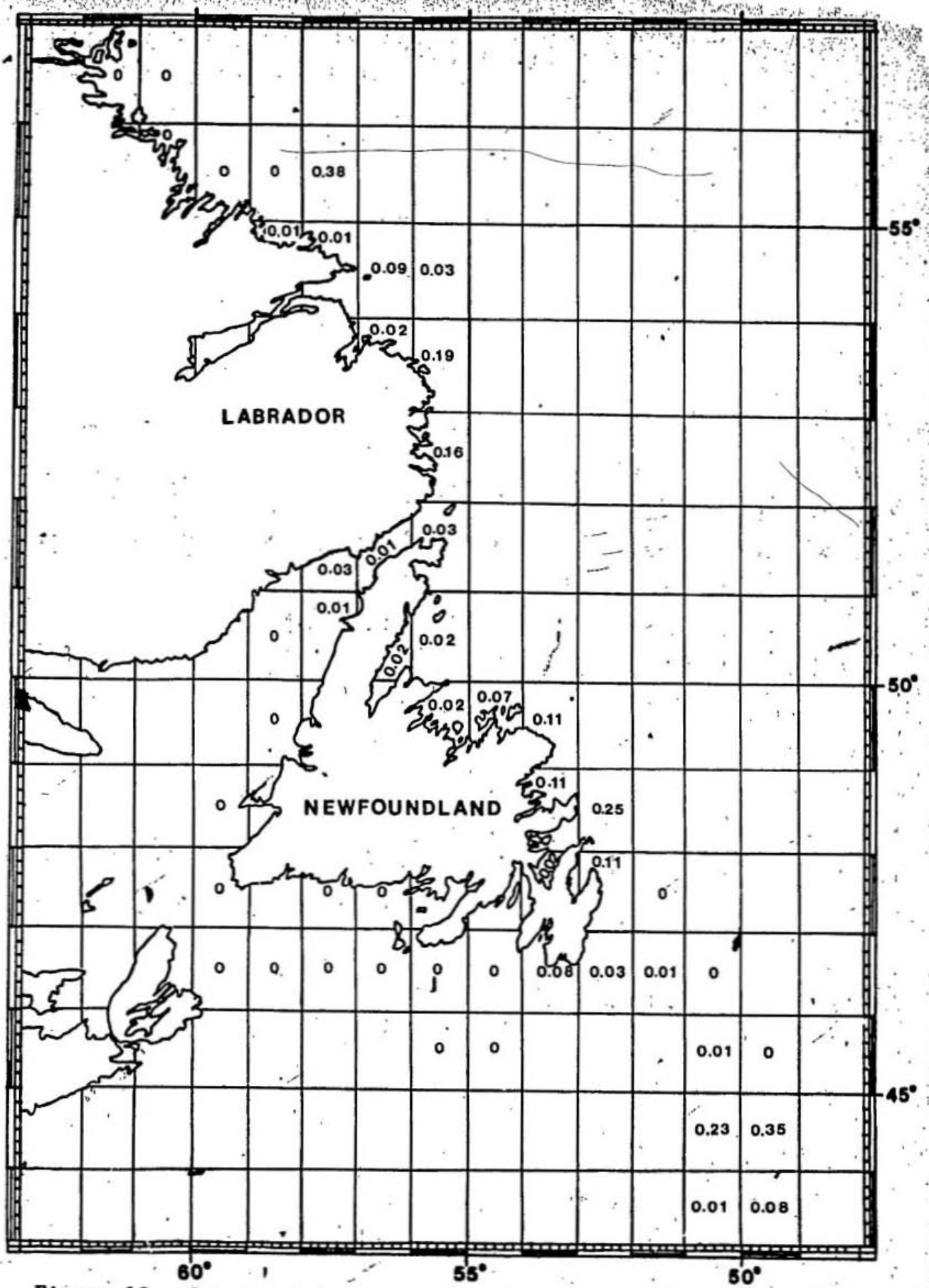

Figure 10. Summer sighting rates of humpback whales for each one degree square within the shipboard study area.

TABLE 5

Monthly abundance of humpback whales from the land-based network results, 1979 - 1982.

Column headings are identified in Table 3.

Month	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
Dec-Feb	114	10	2	0	126	14	0.0952	0.1111
Mar/Apr	111	12	4	2	129	26	0.1395	0.2016
May	168	53	20	9	250	120	0.3280	0.4800
June	232	118	71	39	460	377	0.4956	0.8196
July	306	141	100	38	585	455	0.4769	0.7778
August	181	61	26	18	286	167	0.3671	0.5839
September	120	27	6	3	156	48	0.2308	0.3141
Oct/Nov	124	22	4	0	150	30	0.1733	0.2000

TABLE 6

Monthly abundance of humpback whales from the shipboard network results, 1976 - 1983.

Column headings are identified in Table 4.

Month	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Track	Dist (n mi)	No. of Whales	Sight Freq	Sight Rate
May	97	11	1	0	109	2572	30	0.1101	0.0117
June	233	48	26	4	311	6893	492	0.2508	0.0714
July	262	58	30	12	362	9406	907	0.2762	0.0964
Aug	238	28	16	12	294	10042	785	0.1905	0.0782
Sept	102	14	2	1	119	3842	113	0.1429	0.0294

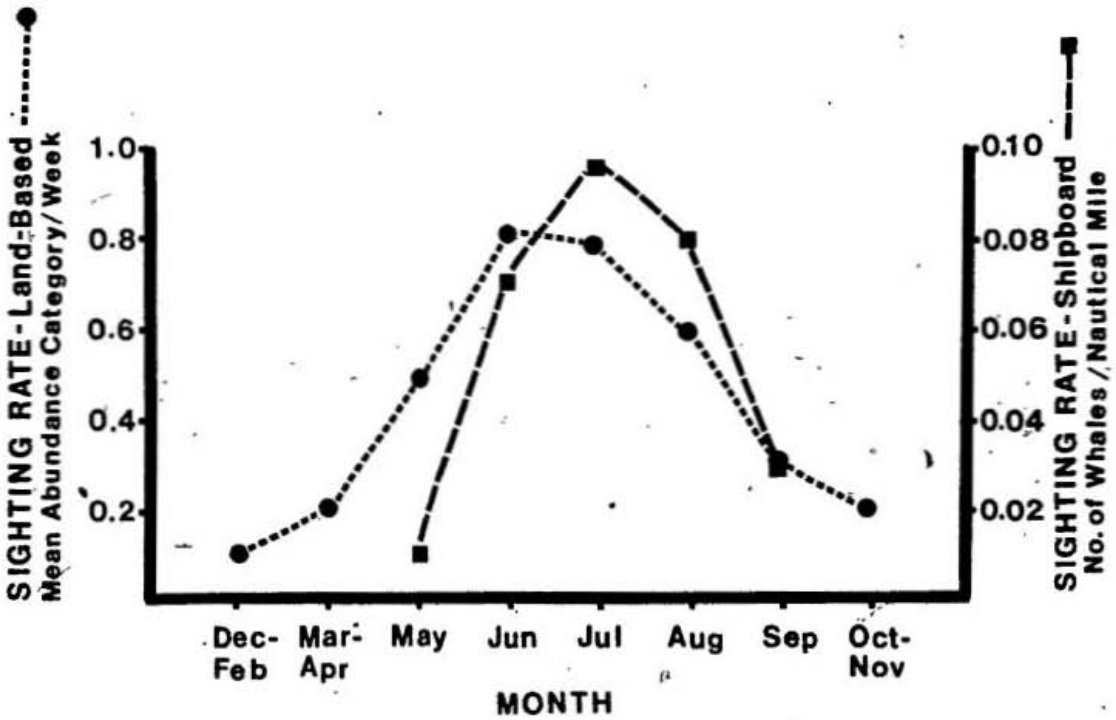

Figure 11. Monthly sighting rates for humpback whales in the land-based and shipboard study areas.

in monthly humpback abundance between the land-based and shipboard results. Monthly humpback abundance was not significantly correlated with effort, from May - September, for the results of either network.

The highest sighting frequencies for humpback whales in the land-based network results, occurred in sections off the northeast coast of Newfoundland (including the headlands from Cape Bonavista to Peckford's Island) and off the south coast of Newfoundland (Hermitage and Fortune bays). Sighting frequencies in these sections (Table 3) exceeded 0.71 throughout the summer (about one humpback sighting every ten days). Despite similar sighting frequencies, the northeast coast of Newfoundland had a higher humpback sighting rate (1.56 or about 6 whales / week) than Hermitage and Fortune bays (0.98 or 1 - 5 whales / week). The difference indicated the higher occurrence of large aggregations (> 5 whales) of whales off the northeast coast of Newfoundland. Seventy-six percent of the humpback sightings off the northeast coast consisted of more than five whales compared to 33% in Hermitage and Fortune bays. The lowest sighting frequencies occurred along the southwest and west coasts with one humpback sighting every 9 - 11 weeks.

There was a significant correlation ($p < 0.05$) between humpback distribution and observer effort in the land-based study area. However, the significance of this correlation depended upon the inclusion of two land-based sections on the south coast of Newfoundland; one with high observer

effort/high sighting rates and the other with low effort/low sighting rates. These two sections were double-checked for possible sampling biases, but none were apparent. There were several observers in both areas data sections and usually more than one per location. Six observers had completed reliability tests and all of them demonstrated ability to identify humpback whales in the test. Although two were excluded from the analysis of minke and pilot whales and one from the analysis of finback whales, none of the remaining tested observers appeared to confuse humpback whales with other species. The reports submitted independently from observers in each area tended to be similar. The observers in the area of Hermitage and Fortune bays reported frequent humpback whale sightings, while the observers on the west side of Placentia Bay reported few. Sightings from Hermitage and Fortune bays were not limited to humpback whales, but included numerous sighings of finback, minke and pilot whales, and occasional sightings of unidentified whales and porpoises.

In the shipboard study area, humpback whales were most abundant off the east coast of Newfoundland (Cape Broyle - Cape Freels), off the southeast coast of Labrador (south of Hamilton Inlet), and on the Southeast Shoal. All of these areas were frequented by large aggregations of humpback whales; i.e., 54 - 63% of the sightings contained more than five whales. No large aggregations of humpback whales were recorded on the southwest or west coasts of Newfoundland or north of 56°N.

3.2.1.2 Changes in Spatial Distribution over Time:

The land-based network results indicated that many humpback whales appeared to bypass the south and east coasts of Newfoundland, arriving in the Strait of Belle Isle and off southeast Labrador in May (Figure 12, Appendix 10). This was not detected in the shipboard results because there were no surveys in north section of the shipboard study area in May and June (Figure 13, Appendix 11).

There was a significant correlation between the monthly humpback sighting rates for the north and south sections of the land-based study area ($p < 0.01$), but not between north and east sections. Humpback sighting rates increased in May and remained high through August for both the north and south sections. Humpback abundance in the east section did not increase until June (Figure 12). There was a significant correlation between the monthly sighting rates for the east sections of the land-based and shipboard study areas May - September ($p < 0.005$).

Land-based observers on the north coast of Newfoundland recorded humpback whale sightings in Notre Dame Bay as late as December (Appendix 12). Records of winter sightings were restricted to the east (Bonavista and Trinity bays) and south (Hermitage and St. Mary's bays) coasts of Newfoundland although much of the north coast and the Labrador coast were reported to be covered by ice from January - March. The earliest spring record in the Strait of Belle Isle occurred in April. Appendix 13 gives details of monthly humpback

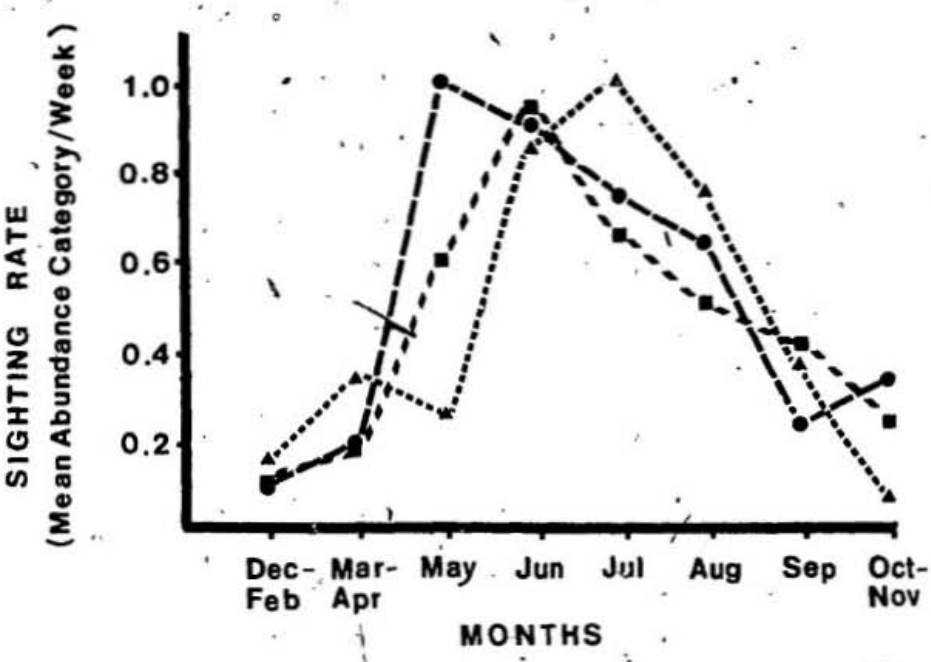

Figure 12. Monthly sighting rates of humpback whales in the north (——), east (·····) and south (– – –) sections of the land-based study area

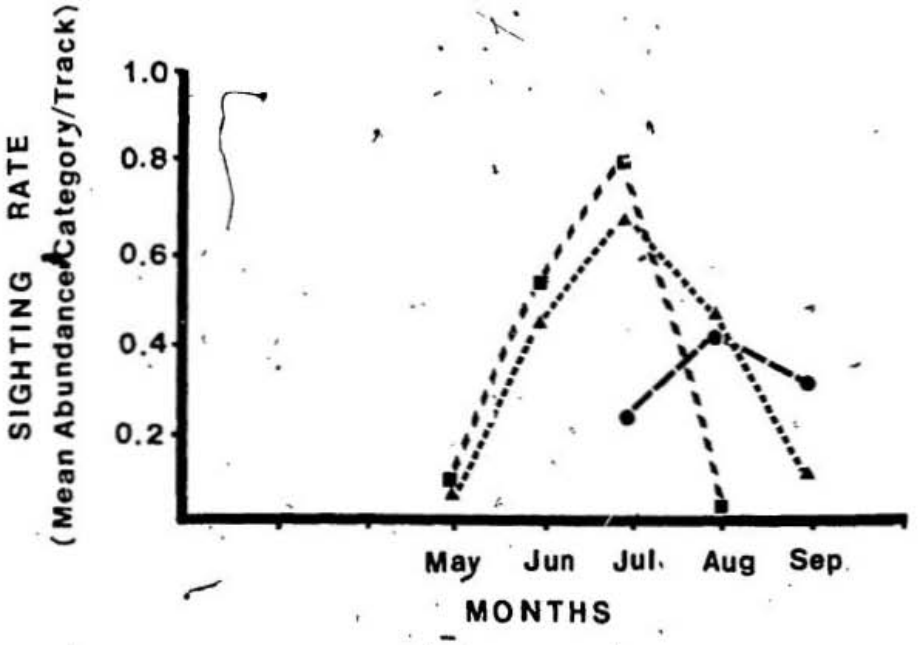

Figure 13. Monthly sighting rates of humpback whales in the north (——), east (·····) and south (– – –) sections of the ship-board study area

distribution in the shipboard study area.

The results indicated annual shifts in humpback whale distribution. Humpback sighting frequencies in the north section of the land-based study area significantly increased ($p < 0.05$) from 1980 - 1982 (Figure 14, Appendix 14). Humpback abundance (rates and frequencies) significantly declined ($p < 0.05$) in the east section of the shipboard study area from 1976 - 1983 (Figure 15, Appendix 15). There were no significant trends in humpback abundance in the east and south sections of the land-based study area or in the north section of the shipboard study area (Figures 14 and 15). There were no significant correlations between the land-based and shipboard results for annual humpback abundance in either north or east sections.

3.2.1.3 Annual Trends in Relative Abundance:

Humpback sighting rates significantly declined from 1976 - 1983 in the shipboard study area ($p < 0.05$), as indicated by a correlation analysis performed on years with a similar distribution of effort; i.e., using only the one degree squares common to each year (Figure 19, Table 10). This subsample reduced the study area primarily to the east section of the shipboard study area, where a decline in humpback abundance was noted in the preceding section. No annual trends in the relative abundance of humpback whales were detected for either study area, when each study area was sampled as a whole (Figures 16 - 18, Table 7 - 9).

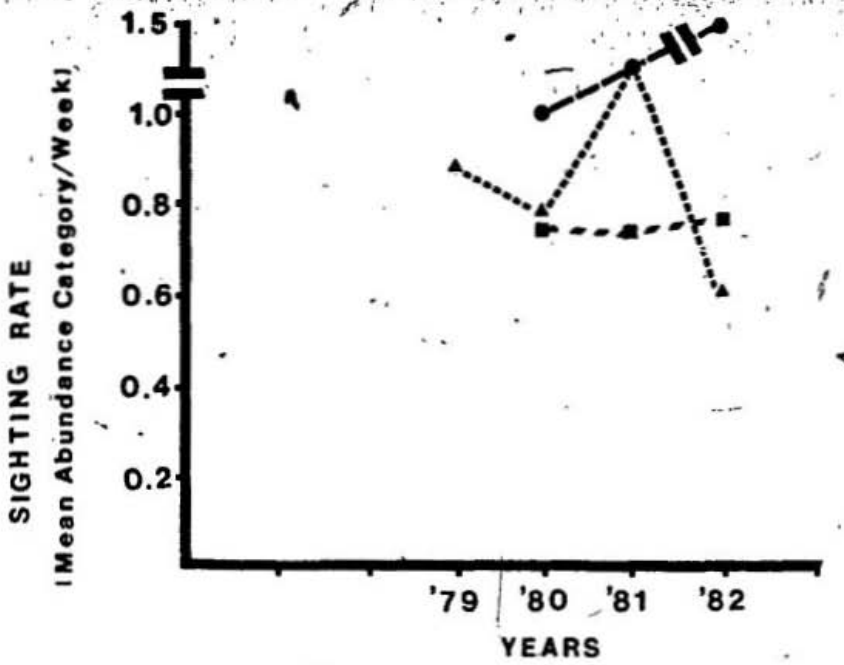

Figure 14 . Annual sighting rates of humpback whales in the north(——), east(·····) and south(– – –) sections of the land-based study area

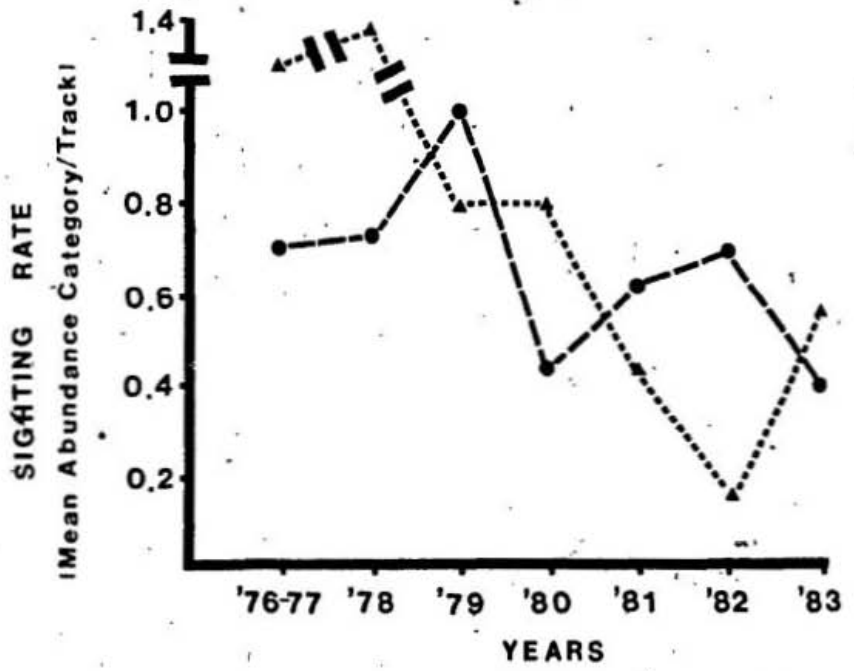

Figure 15 . Annual sighting rates of humpback whales in the north(——) and east(·····) sections of the shipboard study area

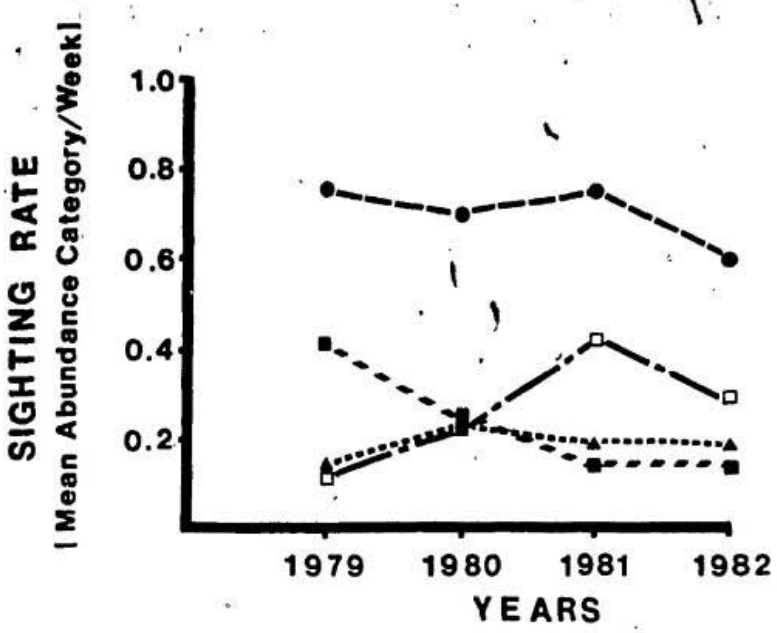

Figure 16. Annual summer sighting rates of humpback (——), finback (·····), minke (– – –) and pilot (·——) whales based on all available data from the land-based study area

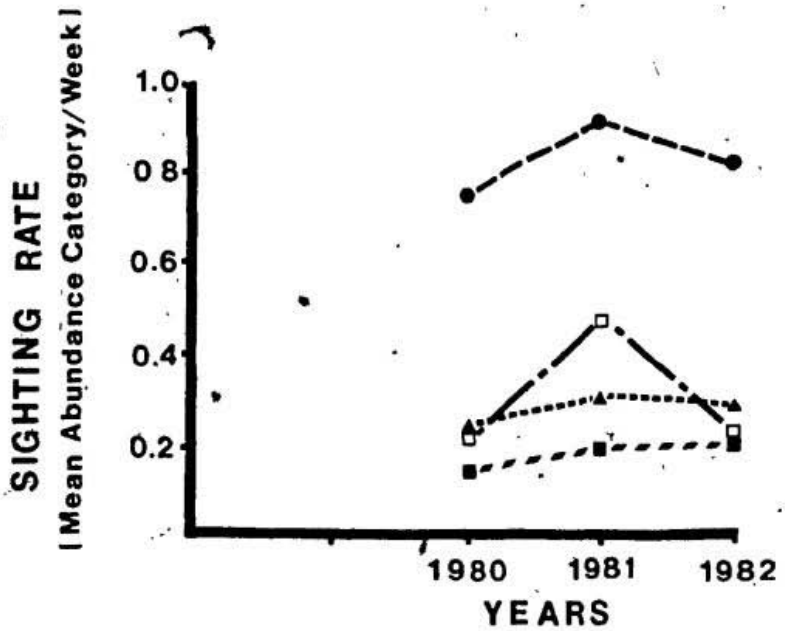

Figure 17. Annual summer sighting rates of humpback (——), finback (·····), minke (– – –) and pilot (·——) whales from land-based data sorted for months and statistical areas common to each year

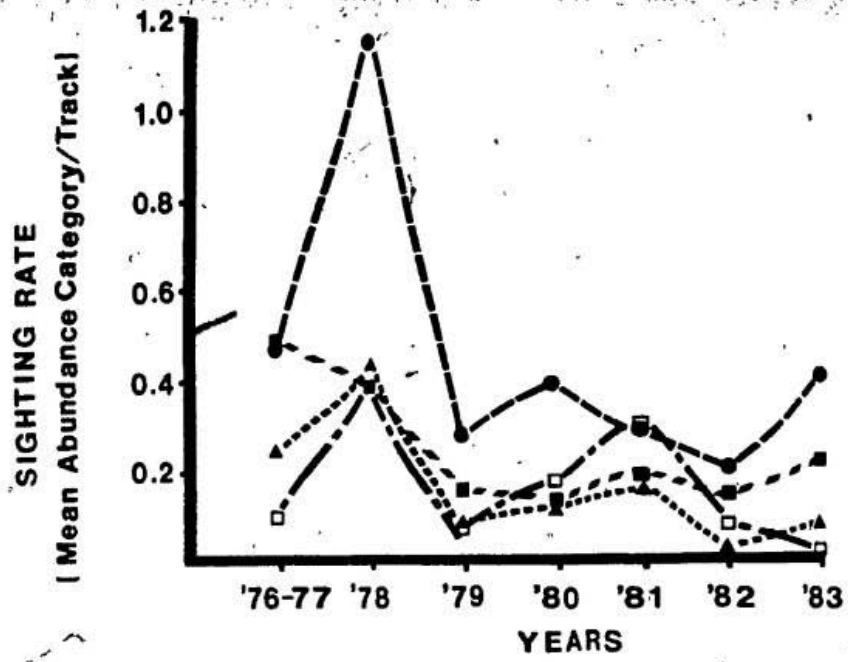

Figure 18. Annual summer sighting rates of humpback (——), finback (------), minke (– – –), and pilot (-—) whales based on all available data from the shipboard study area

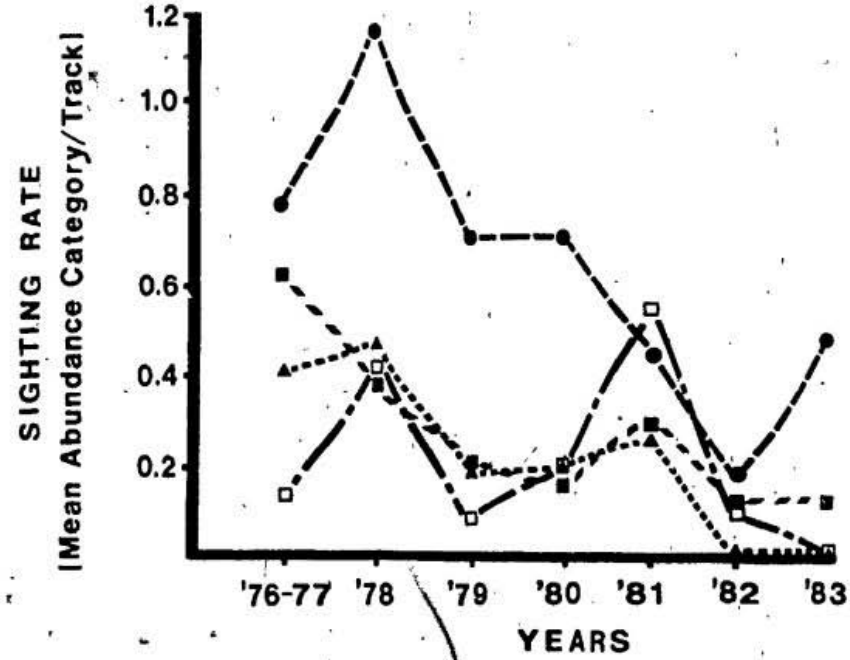

Figure 19. Annual summer sighting rates of humpback (——), finback (------), minke (– – –), and pilot (-—) whales from shipboard data sorted for one degree squares common to each year

TABLE 7

Relative summer abundance of humpback whales from land-based data (June - September).

Column headings are identified in the legend for Table 3.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979	100	47	33	10	190	143	0.4737	0.7530
1980	347	157	84	39	628	442	0.4459	0.7040
1981	222	81	62	31	396	298	0.4394	0.7520
1982	169	62	24	18	273	164	0.3810	0.6007

TABLE 8

Relative summer abundance of humpback whales from land-based data sorted for months and statistical areas common to each year.

1979 was excluded from these results because there was little overlap in the study area between 1979 and the remaining three years. The comparison among 1980, 1981 and 1982 included 11 area sections: 1, 2, 6, 7, 8, 10, 11, 12, 13, 14 and 15. The comparison between 1980 and 1981 excluded only section 3.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1980	120	67	28	17	232	174	0.4828	0.7500
1981	108	46	50	19	225	203	0.5110	0.9022
1982	81	32	23	14	156	126	0.4808	0.8077
1980	209	107	51	26	393	287	0.4682	0.7303
1981	170	59	61	20	310	241	0.4516	0.7774

TABLE 9

Relative summer abundance of humpback whales from the shipboard data (June - September).

Column headings are identified in the legend for Table 4.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	49	17	9	1	76	2961	36	0.3553	0.4737
1978	11	13	11	3	38	1558	44	0.7105	1.1579
1979	211	19	10	11	251	7137	72	0.1594	0.2868
1980	166	28	18	8	220	6136	88	0.2454	0.4000
1981	147	27	10	3	187	5344	56	0.2139	0.2995
1982	201	31	7	3	242	4956	54	0.1694	0.2231
1983	52	13	9	0	74	2091	31	0.2973	0.4189

TABLE 10

Relative summer abundance of humpback whales from the shipboard data sorted for the one degree squares common to each year.

The area sampled included sections 6, 7, 8, 9, 10, and 11.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	18	15	7	1	41	1882	32	0.5610	0.7805
1978	11	11	11	3	36	1467	42	0.6944	1.1670
1979	59	14	10	11	94	2706	67	0.3723	0.7128
1980	53	13	16	6	88	2494	63	0.3977	0.7159
1981	51	12	9	1	73	2141	33	0.3014	0.4520
1982	89	10	3	1	103	1951	19	0.1359	0.1845
1983	20	7	4	0	31	982	15	0.3548	0.4839

3.2.2 Finback:

3.2.2.1 Spatial and Temporal Distribution:

Finback whale distribution was significantly correlated ($p < 0.05$) with humpback whale distribution in the shipboard study area. Shipboard results indicated that finbacks were found primarily off the east coasts of Newfoundland and Labrador (on Hamilton Bank) and on the Southeast Shoal (Figure 20, Table 11). Sightings were rare on the southwest and west coasts of Newfoundland and north of 55°N.

There was no correlation between the distributions of finback and humpback whales in the land-based study area. The highest finback sighting rate for any land-based section (Figure 21) was recorded off Ferolle Point (0.98 or 1 - 5 whales / week), where few humpbacks were sighted. However, finback and humpback whale distribution did overlap in areas, notably Hermitage and Fortune bays. This area had the highest sighting frequencies for both species (Tables 3 and 12).

The finback sightings in Hermitage and Fortune bays tended to be of small aggregations. Large aggregations of finbacks were seen mostly off Ferolle Point, where 60% of the sightings had more than five whales (Table 12). There were few shipboard sightings of large aggregations of finbacks. Less than 25% of the shipboard sightings had six or more whales and groups of 20 or more whales were seen only off Bonavista and Notre Dame bays (Table 11).

The land-based results indicated that finback whale abundance was significantly higher from May - September than

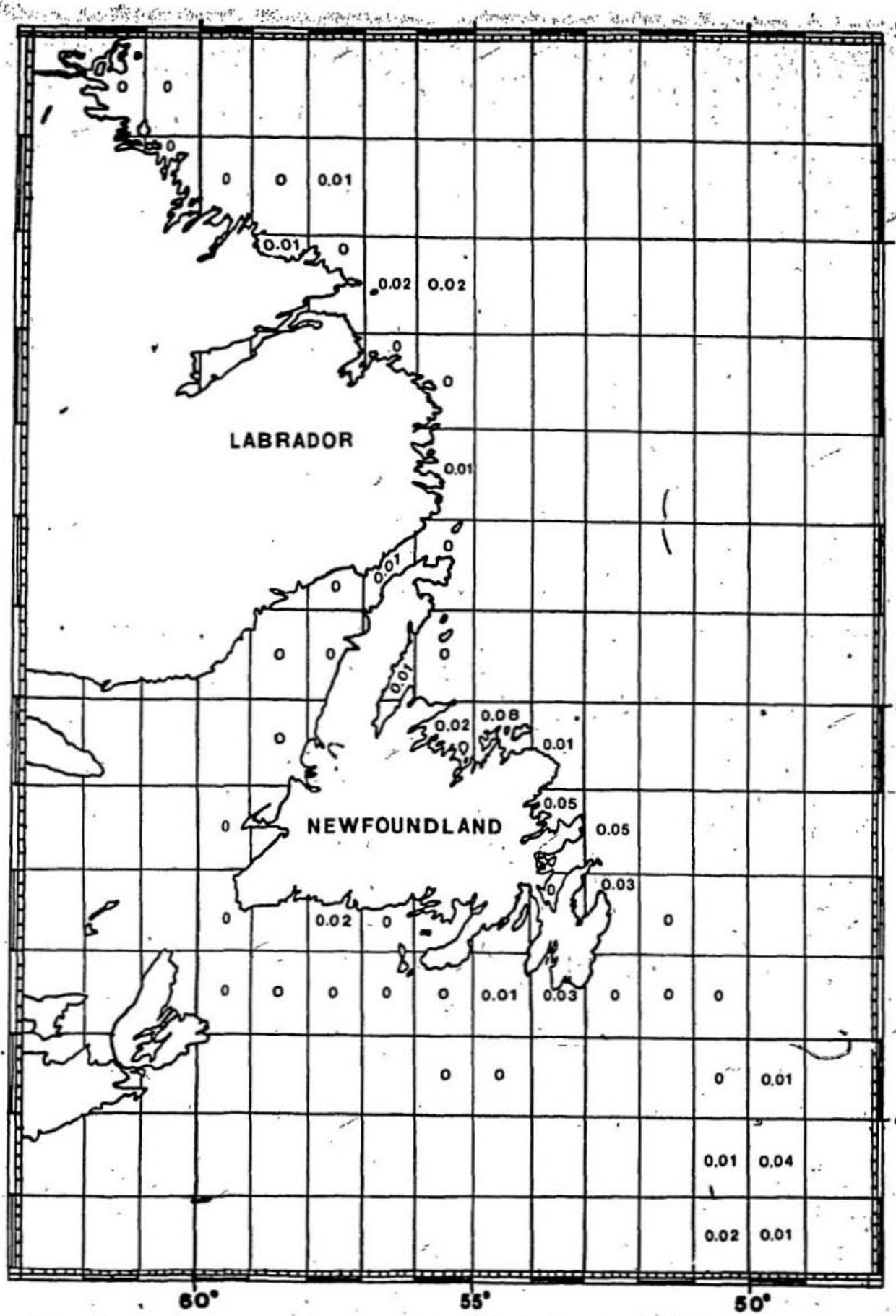

Figure 20. Summer sighting rates of finback whales for each one degree square within the shipboard study area.

TABLE 11

Finback whale distribution from the summer shipboard network results.
(June - September, 1976 - 1983).

Column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Obsv'd Freq (in tracks) 0	1	2	3	Total No.of Track	Dist (n mi)	Total No. of Whales	Sight Rate (#/n mi)	Sight Freq.	Ranks (/17) Sight Rate	Sight Freq.	Mean	Contrib^n to Total X^2
1	55°-57°,60°-62°	47	2	0	0	49	1898	2	0.001	0.041	13	13	13	1.58
2	54°-56°,55°-58°	38	4	0	0	42	1324	14	0.011	0.095	7	7	7	0.00
3	53°-55°,56°-59°	71	2	0	0	73	1981	6	0.003	0.027	13	15.5	15.5	3.62
4	50°-52°,55°-56°	35	1	1	0	37	1938	12	0.006	0.054	8	11	8.5	*0.69
5	50°-51°,57°-58°	99	4	0	0	103	2324	4	0.002	0.039	13	13	13	3.56
6	51°-52°,56°-58°	61	2	0	0	63	1103	4	0.004	0.032	13	15.5	15.5	2.74
7	50°-52°,55°-57°	55	4	0	0	59	2768	5	0.002	0.068	13	9.5	10.5	0.51
8	49°-50°,54°-56°	49	5	2	2	58	1908	91	0.048	0.155	1.5	4	2	*2.06
9	48°-50°,53°-54°	74	3	3	1	81	2227	81	0.036	0.086	3	7	6	0.33
10	48°-49°,52°-53°	80	21	9	0	110	3052	153	0.050	0.273	1.5	1	1	*35.33
11	47°-48°,52°-53°	119	11	4	0	134	2212	66	0.030	0.119	4	5	4.5	0.33
12	47°-48°,53°-54°	78	0	0	0	78	798	0	0.000	0.000	13	17	17	7.53
13	45°-48°,49°-52°	34	3	0	0	37	1209	3	0.002	0.081	13	7	8.5	0.92
14	46°-47°,52°-55°	31	9	0	0	40	1153	19	0.016	0.225	6	2.5	4.5	*6.83
15	43°-45°,49°-51°	26	5	2	0	33	1162	29	0.025	0.212	5	2.5	3	*4.56
16	45°-48°,54°-59°	41	3	0	0	44	1508	3	0.002	0.068	13	9.5	10.5	0.37
17	46°-51°,58°-60°	43	2	0	0	45	1618	2	0.001	0.044	13	13	13	1.27
TOTALS		981	81	21	3	1086	30183	494	0.016	0.097	-	-	-	78.8 ($p < 0.01$)

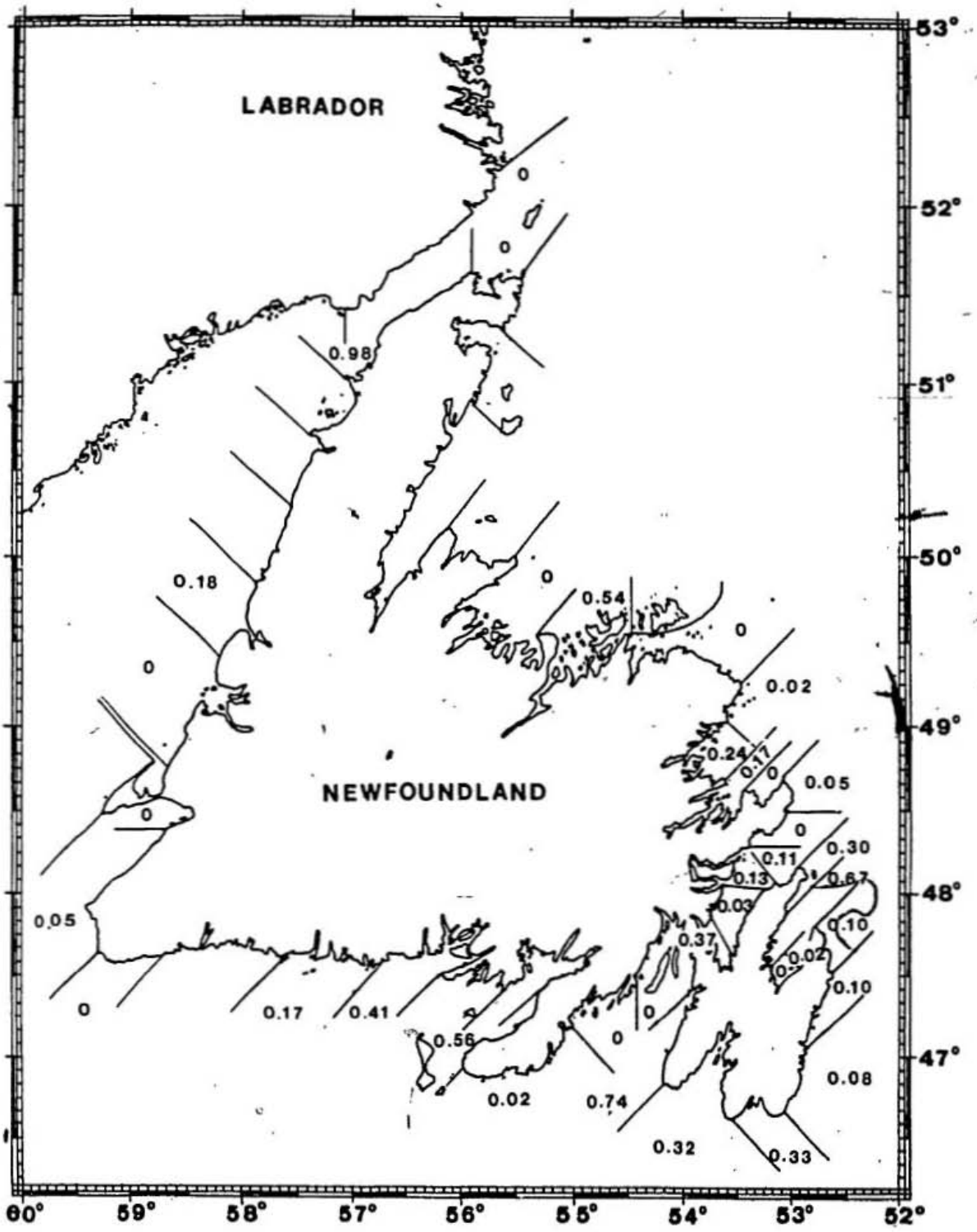

Figure 21. Summer sighting rates of finback whales for each statistical area within the land-based study area

TABLE 12

Distibution of finback whales from the summer land-based network results (June - September, 1979 - 1982).

Column headings are identified in the legend for Table 3.

Land-Bd Section	Stat Areas	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Rate Abun/Tot	Sight Freq	Ranks (/15) Sight Rate	Sight Freq	Mean	Contrib^{n} to Total X^2
1	6,7	56	18	9	1	84	39	0.464	0.333	3	3	3	*19.08
2	9,10,14	77	2	0	0	79	2	0.025	0.025	11.5	11	11	8.13
3	11,12,13	61	12	0	0	73	12	0.164	0.164	8.5	5	7	*0.11
4	15 - 19	95	5	6	0	106	17	0.160	0.104	8.5	9	9	1.47
5	20,21,24	94	7	10	0	111	27	0.243	0.153	5	6	5	0.01
6	22,23	79	1	0	0	80	1	0.012	0.012	13.5	13	13	10.02
7	25	90	6	2	0	98	10	0.102	0.082	10	10	10	3.00
8	26,27	95	7	8	0	110	23	0.209	0.136	6	8	7	0.12
9	28,29	69	15	10	1	95	38	0.400	0.274	4	4	4	*9.86
10	30,31,32	72	1	0	0	73	1	0.014	0.014	13.5	12	13	8.98
11	33,36	70	42	5	1	118	57	0.483	0.407	2	1	1.5	*52.46
12	37	70	10	2	0	82	14	0.171	0.146	7	7	7	0.00
13	39,40,41	138	3	0	0	141	3	0.021	0.021	11.5	14.5	13	15.47
14	44,45,49	46	11	15	1	73	44	0.603	0.370	1	2	1.5	*23.81
15	1,50	90	0	0	0	90	0	0.000	0.000	15	14.5	13	13.43
TOTALS		1218	140	67	4	1429	288	0.202	0.148	-	-	-	195.1 ($p < 0.01$)

it was from October - April, $p < 0.05$ (Figure 22, Table 13). Shipboard network results indicated that finback abundance was significantly lower in May than it was from June - September, $p < 0.05$ (Figure 23, Table 14). No significant differences in abundance were found among the months, May - September (land-based results) or June - September (shipboard results). There was no correlation between the land-based and shipboard monthly finback abundance. However, monthly finback sighting rates were correlated with those of humpback ($p < 0.001$) and minke ($p < 0.01$) in the land-based study area, for the period from January - December. Monthly finback abundance was not correlated with observer effort for the period from May - September for either data base.

3.2.2.2 Changes in Spatial Distribution over Time:

Finback whales were present in the north section of the land-based study area before the influx of seasonal migrants appeared in the south section in May (Figure 23, Appendix 18). Finback abundance increased in the east section of the land-based study area in June, and in the north section it increased in July. There were no correlations in monthly finback abundance among sections of each study area, or between the land-based and shipboard results.

The shipboard network results indicated that finback whale numbers peaked in the south section in June and in the east section in July (Figure 24, Appendix 19). There were no finback whales in the south section of the shipboard

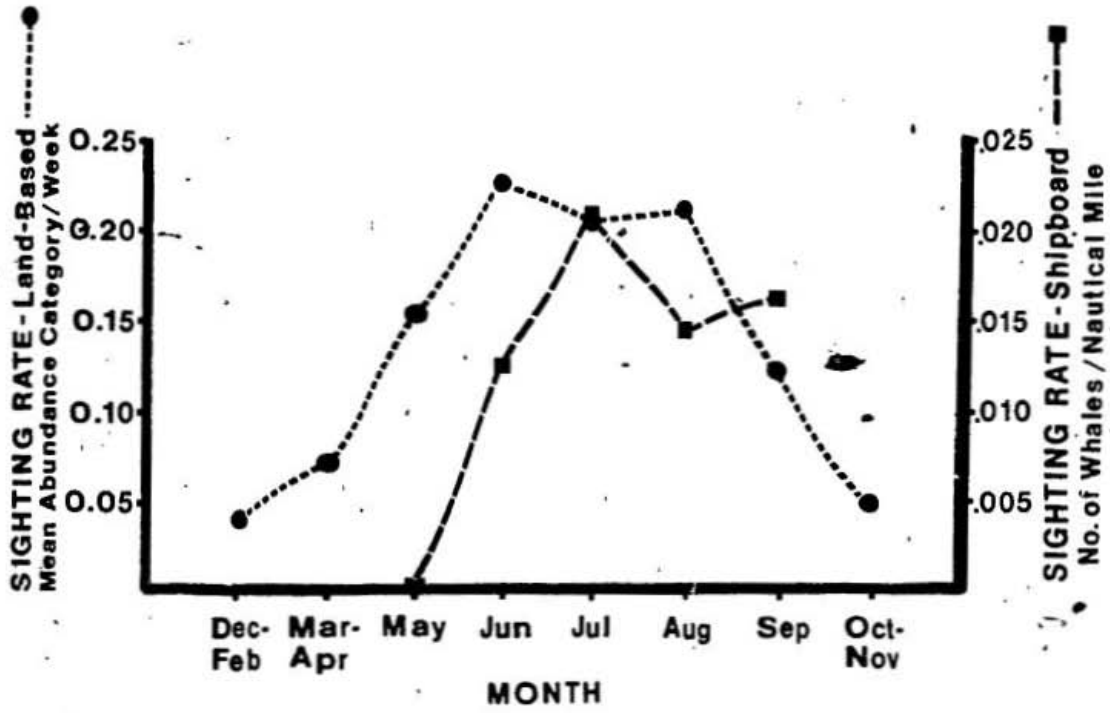

Figure 22. Monthly sighting rates for finback whales in the land-based and shipboard study areas.

TABLE 13

Monthly abundance of finback whales from the land-based network results, 1979 - 1982.

Column headings identified in the legend for Table 3.

Month	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
Dec-Feb	138	4	1	0	143	6	0.0350	0.0420
Mar/Apr	131	8	1	0	140	10	0.0643	0.0714
May	215	21	9	0	245	39	0.1224	0.1592
June	356	43	24	2	425	97	0.1624	0.2282
July	467	56	26	2	551	114	0.1524	0.2069
August	234	31	14	0	279	59	0.1613	0.2115
September	140	13	3	0	156	19	0.1025	0.1218
Oct/Nov	155	8	0	0	163	8	0.0491	0.0491

TABLE 14

Monthly abundance of finback whales from the shipboard network results, 1976 -1983.

Column headings are identified in legend for Table 4.

Month	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Track	Dist (n mi)	No. of Whales	Sight Freq	Sight Rate
May	108	1	0	0	109	2572	1	0.0092	0.0004
June	280	28	3	0	311	6893	86	0.0997	0.0125
July	320	31	11	0	362	9406	200	0.1160	0.0213
Aug	268	18	7	1	294	10042	146	0.0884	0.0145
Sept	112	4	0	2	119	3842	64	0.0504	0.0167

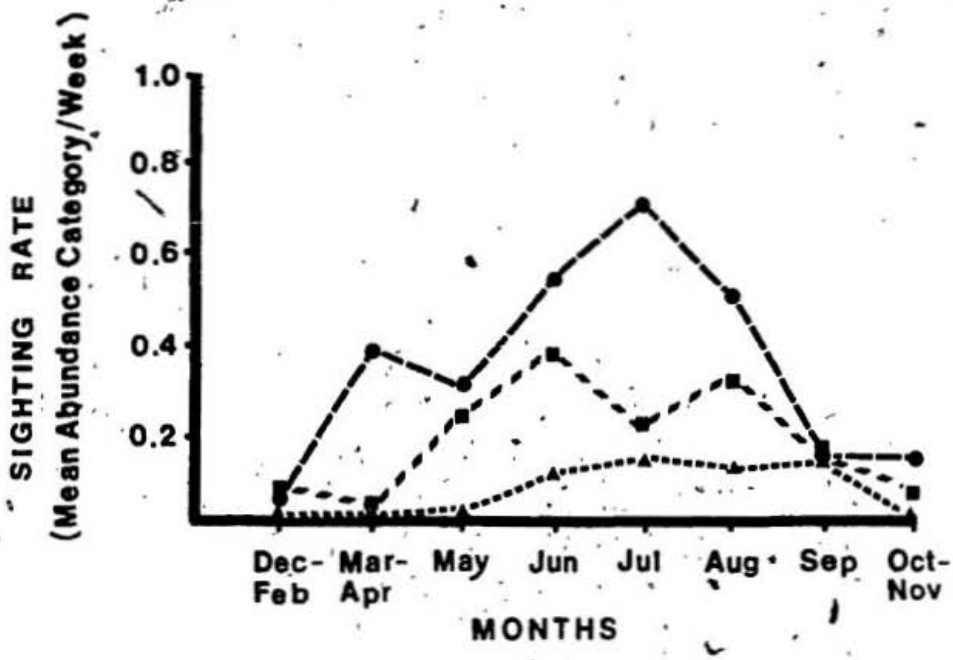

Figure 23. Monthly sighting rates of finback whales in the north (——), east (------) and south (– – –) sections of the land-based study area

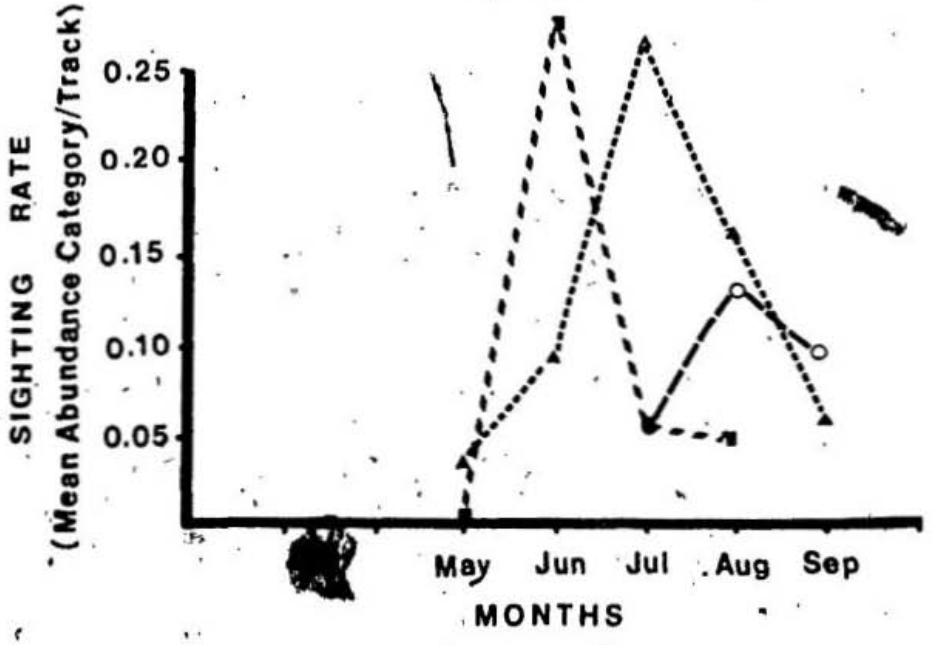

Figure 24. Monthly sighting rates of finback whales in the north (——), east (.....) and south (– – –) sections of the ship-board study area

study area in May. However, there were few shipboard observations in May from the south and east sections, and none in the area west of Cape St. Mary's, where the May sightings in the south section of the land-based network data had been recorded (Appendix 20).

There were correlations in monthly abundance between finback and humpback whales. Monthly finback sighting rates were significantly correlated with those of humpback in the east sections of both land-based ($p < 0.05$) and shipboard ($p < 0.05$) study areas, for the periods from January - December and from May - September, respectively. A significant correlation ($p < 0.005$) also occurred between humpback and finback monthly sighting rates in the south section of the land-based study area, for the period from January - December.

Winter and early spring (from December - April) sightings of finback whales in the land-based study area were confined mostly to the north and south sections (Appendix 20). Ferolle Point (north section) and the south coast of Newfoundland from Burgeo to Fortune Bay were the areas most frequented by finback whales during these months.

Annual finback abundance (rates and frequencies) significantly declined ($p < 0.05$) in the east section of the shipboard study area from 1976/77 - 1983 (Figure 26, Appendix 23). There was a significant correlation ($p < 0.05$) between annual finback and humpback abundance in the east section of the shipboard study area. There was no significant change in annual finback abundance in the east

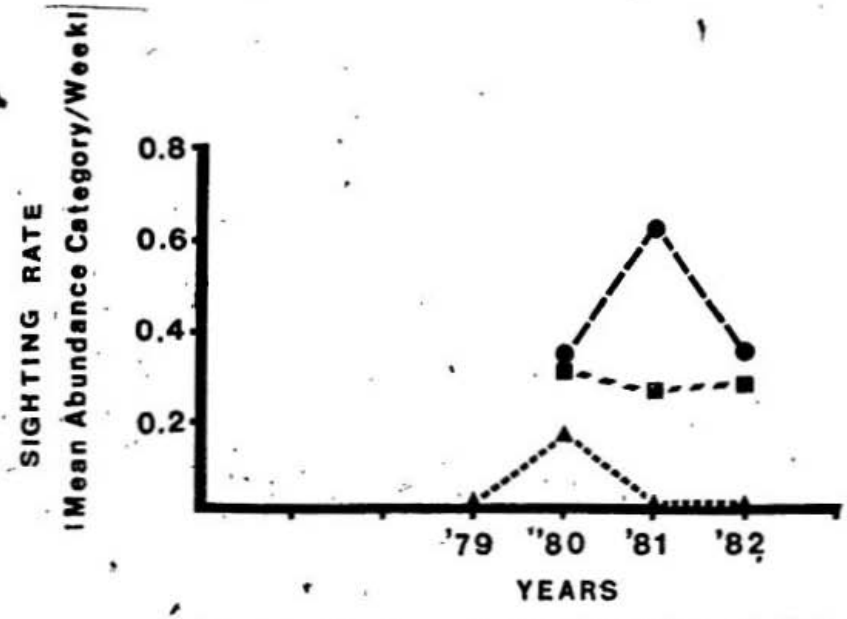

Figure 25. Annual sighting rates of finback whales in the north (——), east (·····) and south (– – –) sections of the land-based study area

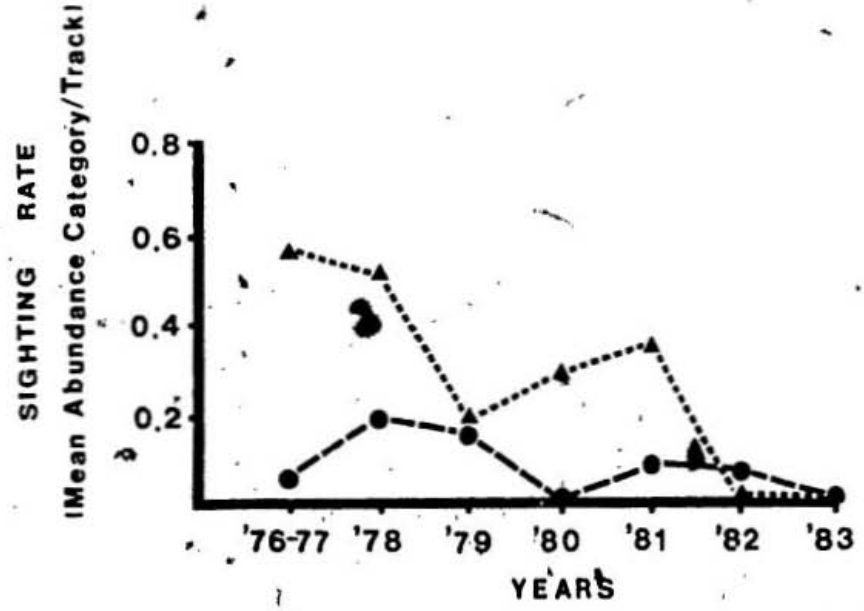

Figure 26. Annual sighting rates of finback whales in the north (——) and east (·····) sections of the shipboard study area

section of the land-based study area, from 1979 - 1982 (Figure 25, Appendix 22). However, a reanalysis of the shipboard data, using only annual sighting rates from 1979 - 1982, also indicated no decline in finback whale abundance in the east section of the shipboard study area.

3.2.2.3 Annual Trends in Relative Abundance:

A decline in overall finback abundance was detected in the shipboard network results for the period from 1976/77 - 1983, particularly when the data analyzed were confined to only the one degree squares surveyed each year, $p < 0.01$ (Figures 18 and 19, Tables 15 and 16). A Freidman test indicated significant differences in annual finback sighting rates among years, for the period from 1976/77 - 1983. Multiple comparisons of the differences between the rank sums for each year indicated no significant differences among the years from 1976/77 - 1981, but the 1982 and 1983 sighting rates were significantly lower ($p < 0.05$) than the 1976/77 and 1978 sighting rates. There was a significant correlation ($p < 0.05$) between finback and humpback annual abundance in the shipboard study area (Figures 18 and 19).

No trends were found in overall finback abundance in the the land-based study area (Figures 16 and 17, Tables 17 and 18). However, the land-based observer network collected data for a shorter period than the shipboard observer network. For the period from 1979 - 1982, there were also no trends found in the overall abundance of finback whales in the shipboard area. A Freidman test performed on the

TABLE 15

Relative summer abundance of finback whales from the shipboard data (June - September).

Column headings are identified in the legend for Table 4.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	6[illegible]10		2	2	76	2961	20	0.1842	0.2632
1978	26	7	5	0	38	1558	17	0.3158	0.4474
1979	234	12	4	1	251	7137	23	0.0677	0.0916
1980	196	20	4	0	220	6136	28	0.1091	0.1273
1981	172	18	6	1	187	5344	33	0.1337	0.1765
1982	235	7	0	0	242	4956	7	0.0289	0.0289
1983	67	7	0	0	74	2091	7	0.0946	0.0946

TABLE 16

Relative summer abundance of finback whales from shipboard data sorted for the one degree squares common to each year.

The area sampled included sections 4, 7, 8, 9, 10 and 11.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	30	7	2	2	41	1882	17	0.2683	0.4146
1978	24	7	5	0	36	1467	17	0.3333	0.4722
1979	82	7	4	1	94	2706	18	0.1276	0.1915
1980	73	12	3	0	88	2494	18	0.1704	0.2045
1981	59	9	5	0	73	2141	19	0.1918	0.2603
1982	102	1	0	0	103	1951	1	0.0097	0.0097
1983	31	0	0	0	31	982	0	0.0000	0.0000

TABLE 17

Relative summer abundance of finback whales from the land-based data (June - September).

Column headings are identified in the legend for Table 3.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979	164	8	8	1	181	27	0.0939	0.1492
1980	498	67	32	1	598	134	0.1672	0.2241
1981	336	36	17	2	391	76	0.1407	0.1944
1982	220	29	10	0	259	49	0.1506	0.1892

TABLE 18

The relative summer abundance of finback whales, from land-based data sorted for months and statistical areas common to each year.

The sections of the study area included in this summary are given in the legend for Table 8.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight. Freq.	Sight. Rate
1980	162	26	8	1	197	45	0.1777	0.2284
1981	154	30	13	1	198	59	0.2222	0.2980
1982	117	19	10	0	146	39	0.1986	0.2671
1980	311	44	26	1	382	86	0.1859	0.2251
1981	239	36	16	2	293	70	0.1843	0.2389

shipboard data from 1979 - 1982, indicated no significant differences in finback abundance among years. There were no correlations between land-based and shipboard annual finback abundance.

3.2.3 Minke:

3.2.3.1 Spatial and Temporal Distribution:

Minke whales had a predominately east coast distribution (Figures 27 and 28, Tables 19 and 20) that extended from Placentia Bay to northeast coast of Labrador (Makkovik Bank and Nain). Minke distribution was not correlated with either humpback or finback distribution in either study area. The highest minke whale sighting frequencies occurred in bays around the Avalon Peninsula (Figures 27 and 28), and in Groswater Bay, Hamilton Inlet (Figure 28). With the exception of St. George's and Bonne bays, minkes were rarely recorded along the southwest and west coasts of Newfoundland (Figures 27 and 28). Minke distribution was not correlated with the distribution of observer effort.

Monthly minke abundance in the land-based study area (Figure 29, Table 21) was significantly higher in June and July than it was in the remaining months of the year ($p < 0.05$). There were significant correlations in monthly abundance between minkes and other species for the land-based results: with humpback ($p < 0.001$) and finback ($p < 0.01$) for the period from January - December, and with humpback ($p < 0.05$) for the period from June - September.

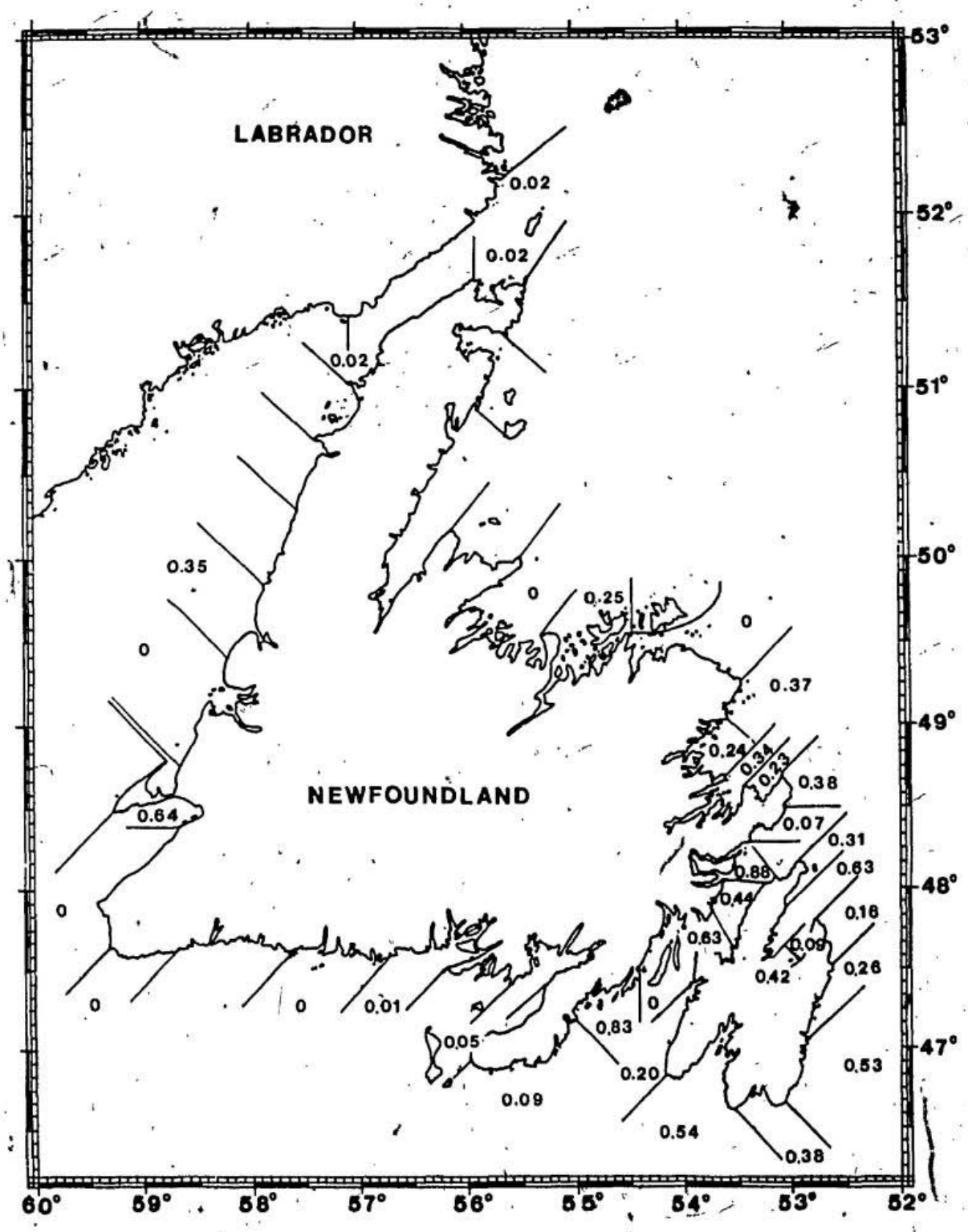

Figure 27. Summer sighting rates of minke whales for each statistical area within the land-based study area.

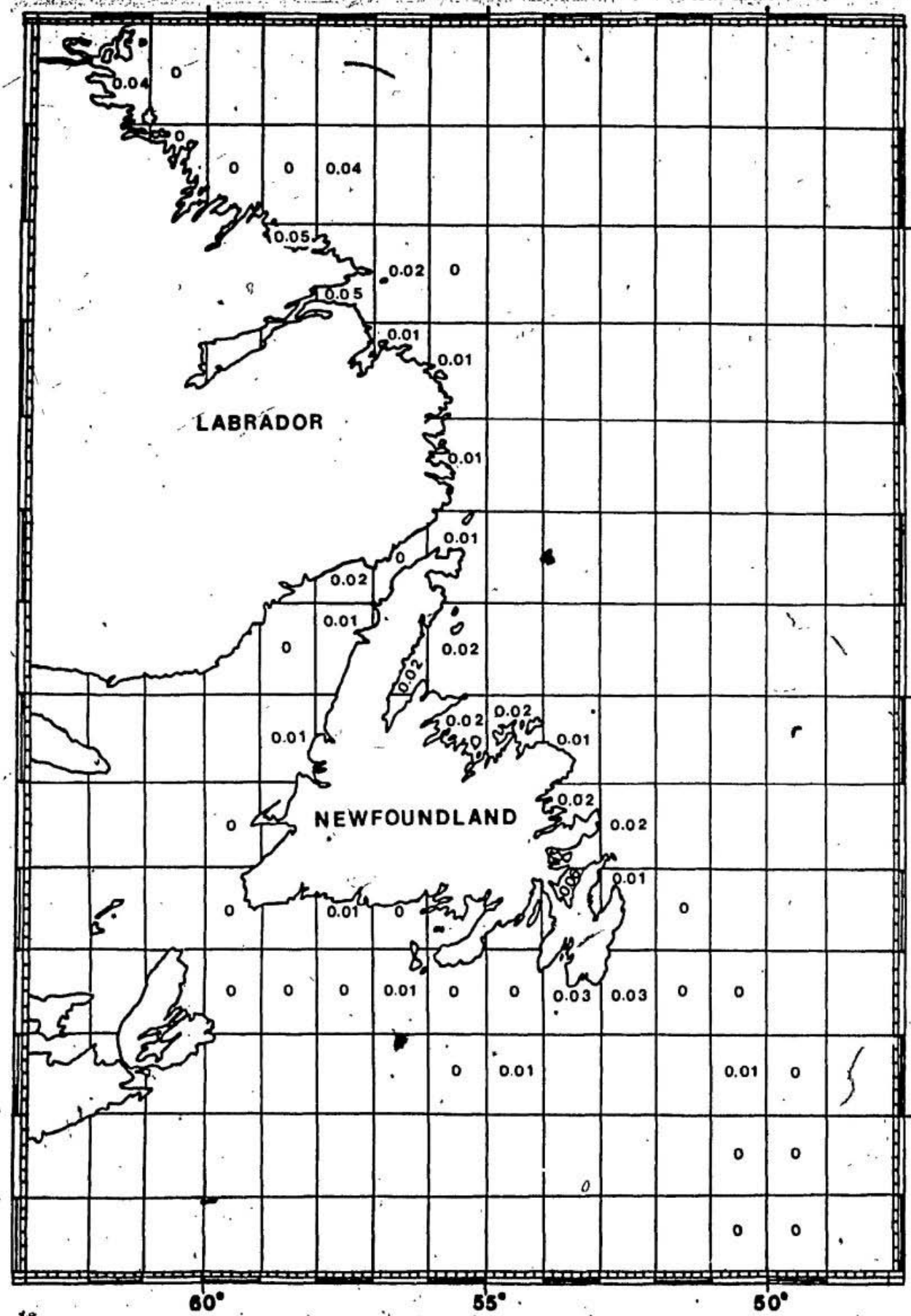

Figure 28. Summer sighting rates of minke whales for each one degree square within the shipboard study area.

TABLE 19

Distibution of minke whales from the summer land-based network results (June - September, 1979 - 1982).

Column headings are identified in the legend for Table 3.

Land-Bd Section	Stat Areas	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Rate Abun/Tot	Sight Freq	Ranks (/15) Sight Rate	Sight Freq	Mean	Contrib^{n} to Total X^2
1	6,7	66	18	0	0	84	18	0.214	0.214	8	8	8	0.01
2	9,10,14	75	31	1	0	107	33	0.308	0.299	4.5	4	4	*4.11
3	11,12,13	74	27	2	0	103	31	0.301	0.282	4.5	5	5	*2.56
4	15 - 19	62	40	4	0	106	48	0.453	0.415	2	2	2	*21.42
5	20,21,24	87	28	3	0	118	34	0.288	0.263	6	6	6	*1.60
6	22,23	99	18	0	0	117	18	0.154	0.154	9	9	9	1.72
7	25	83	27	1	0	111	29	0.261	0.252	7	7	7	*1.97
8	26,27	65	41	4	0	110	49	0.445	0.409	2	2	2	*20.95
9	28,29	59	38	4	0	101	46	0.455	0.416	2	2	2	*20.56
10	30,31,32	65	7	1	0	73	9	0.123	0.110	10	10	10	3.47
11	33,36	115	3	0	0	118	3	0.025	0.025	13	15	14	19.07
12	37	82	0	0	0	82	0	0.000	0.000	15	13.5	14	17.17
13	39,40,41	91	3	2	0	96	7	0.073	0.052	12	12	12	11.34
14	44,45,49	66	7	0	0	73	7	0.096	0.096	11	11	11	4.49
15	1,50	88	2	0	0	90	2	0.022	0.022	14	13.5	14	15.06
TOTALS		119	290	22	0	1505	334	0.222	0.207	-	-	-	182.8 ($p < 0.01$)

TABLE 20

Minke whale distribution from the summer shipboard network results. (June - September, 1976 - 1983).

Column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Obsv'd Freq (in tracks) 0	1	2	3	Total No.of Track	Dist (n mi)	Total No. of Whales	Sight Rate (#/n mi)	Sight Freq.	Ranks (/17) Sight Rate	Sight Freq.	Mean	Contrib^{n} to Total X^2
1	55°-57°,60°-62°	40	8	1	0	49	1898	15	0.008	0.184	12.5	9	10	0.00
2	54°-56°,55°-58°	36	4	2	0	42	1324	17	0.013	0.143	8	10	9	0.39
3	53°-55°,56°-59°	48	23	2	0	73	1981	81	0.041	0.342	2	1	1	*9.96
4	50°-52°,55°-56°	22	15	0	0	37	1938	19	0.010	0.405	10	2	7	*9.86
5	50°-51°,57°-58°	93	10	0	0	103	2324	23	0.010	0.097	10	16.5	12.5	4.23
6	51°-52°,56°-58°	58	4	1	0	63	1103	7	0.006	0.079	12.5	15	15	3.75
7	50°-52°,55°,57°	43	14	2	0	59	2768	42	0.015	0.271	6.5	4	4.5	*2.44
8	49°-50°,54°-56°	46	10	2	0	58	1908	38	0.020	0.207	4	7.5	7	0.16
9	48°-50°,53°-54°	63	15	3	0	81	2227	37	0.017	0.222	6.5	5	7	0.64
10	48°-49°,52°-53°	80	28	2	0	110	3052	61	0.020	0.273	4	3	2	*4.71
11	47°-48°,52°-53°	120	14	0	0	134	2212	22	0.010	0.104	10	16.5	12	4.60
12	47°-48°,53°-54°	62	14	2	0	78	798	48	0.060	0.205	1	7.5	3	0.19
13	45°-48°,49°-52°	33	4	0	0	37	1209	4	0.003	0.108	15.5	11	12	*1.16
14	46°-47°,52°-55°	30	9	1	0	40	1153	26	0.022	0.250	4	6	4.5	*0.95
15	43°-45°,49°-51°	31	2	0	0	33	1162	2	0.002	0.061	15.5	14	17	2.73
16	45°-48°,54°-59°	40	4	0	0	44	1508	5	0.003	0.091	15.5	12.5	15	2.07
17	46°-51°,58°-60°	41	4	0	0	45	1618	4	0.002	0.089	15.5	12.5	15	2.12
TOTALS		886	185	18	0	1086	30183	451	0.015	0.187	-	-	-	61.4 ($p < 0.01$)

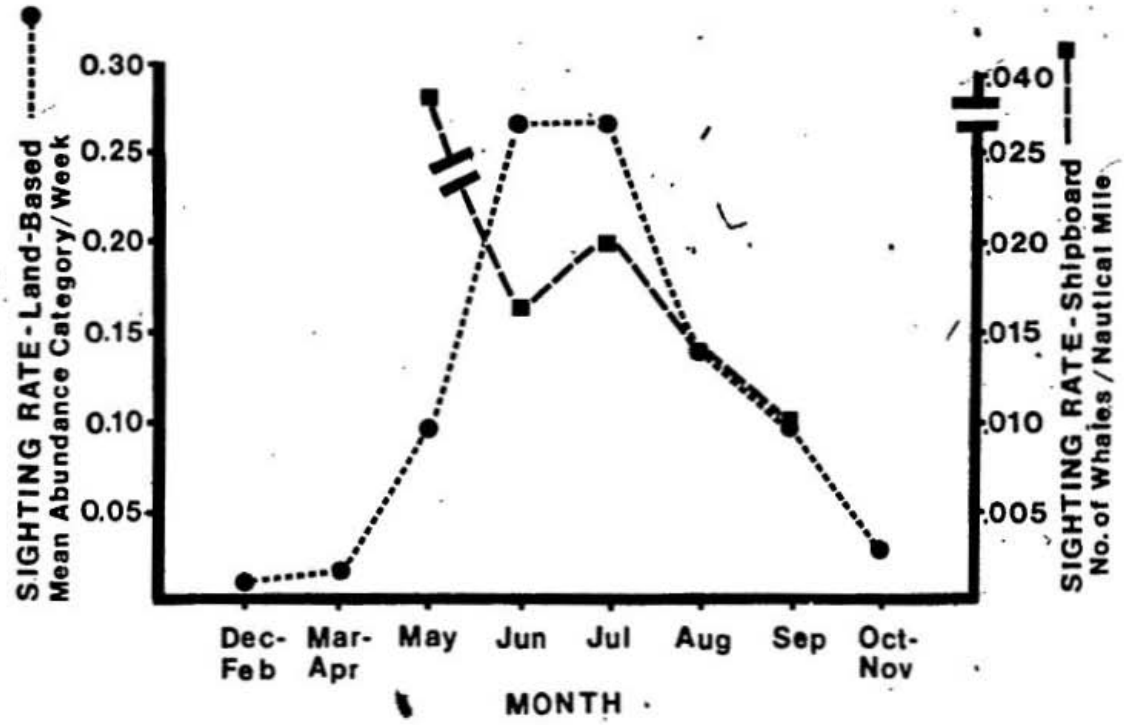

Figure 29. Monthly sighting rates for minke whales in the land-based and shipboard study areas.

TABLE 21

Monthly abundance of minke whales from the land-based network results (1979 - 1982).

Column headings identified in legend of Table 3.

Month	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
Dec-Feb	124	1	0	0	125	1	0.0080	0.0080
Mar/Apr	131	2	0	0	133	2	0.0150	0.0150
May	223	21	1	0	245	23	0.0898	0.0939
June	348	102	10	0	460	122	0.2435	0.2652
July	440	144	7	0	591	158	0.2555	0.2673
August	250	34	3	0	287	40	0.1289	0.1394
September	139	10	2	0	151	14	0.0795	0.0927
Oct/Nov	139	2	1	0	142	4	0.0211	0.0282

TABLE 22

Monthly abundance of minke whales from the shipboard network results (1976 - 1983).

Column headings are identified in legends for Table 4.

Month	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Track	Dist (n mi)	No. of Whales	Sight Freq	Sight Rate
May	87	16	6	0	109	2572	104	0.2018	0.0404
June	257	51	3	0	311	6893	112	0.1736	0.0162
July	290	65	7	0	362	9406	185	0.1989	0.0197
Aug	235	52	7	0	294	10042	139	0.2007	0.0138
Sept	104	14	1	0	119	3842	36	0.1260	0.0094

There were no correlations in monthly abundance between minkes and other species in the shipboard study area.

There was no correlation in monthly minke abundance between the land-based and shipboard study areas. The shipboard network results (Figure 29, Table 22) indicated a longer period of high seasonal abundance for this species (Figure 29). There were no significant differences among the May - August monthly sighting rates in the shipboard study area. Minkes were not sighted December and January.

Monthly minke abundance was correlated with observer effort in the land-based study area, for the period from June - September ($p < 0.05$).

3.2.3.2 Changes in Spatial Distribution over Time:

Minke whales were first sighted later in the north section of the land-based study area than in the south and east sections (Figure 30). The land-based results indicated a northward shift in the peak of minke whale abundance, from the south and east sections during June and July to the north and east sections during August - September (Figure 30, Appendix 26). There was a significant correlation ($p < 0.05$) in monthly minke sighting rates between the east and south sections of the land-based area. Although there were no correlations in monthly abundance between the land-based and shipboard sections, minke abundance in the shipboard study area also appeared to shift slightly northward in late summer. Monthly minke sighting rates increased in the north section and decreased in the east

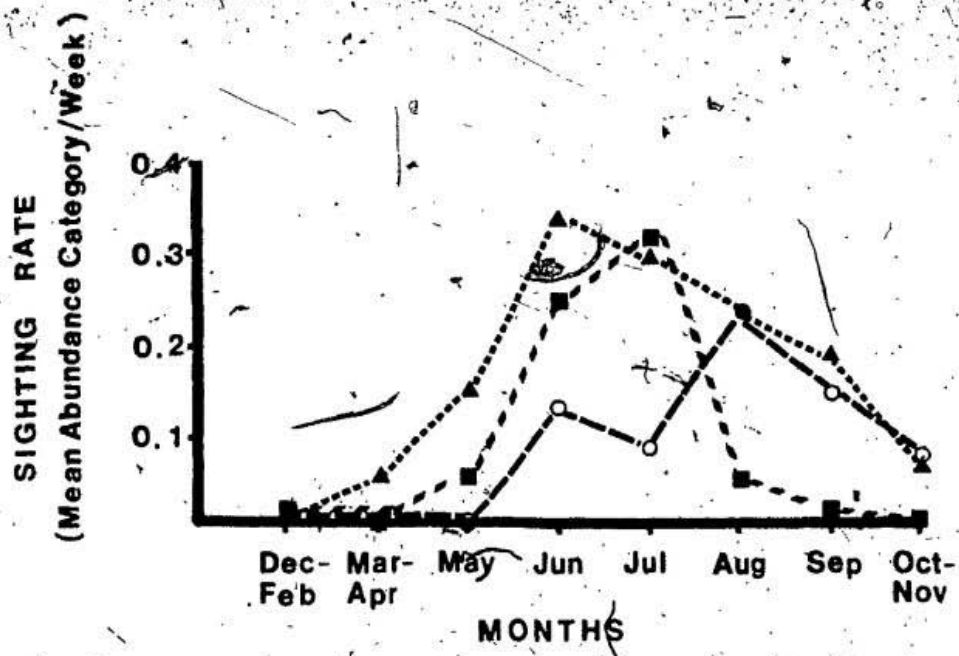

Figure 30. Monthly sighting rates of minke whales in the north (——), east (------), and south (– – –) sections of the land-based study area

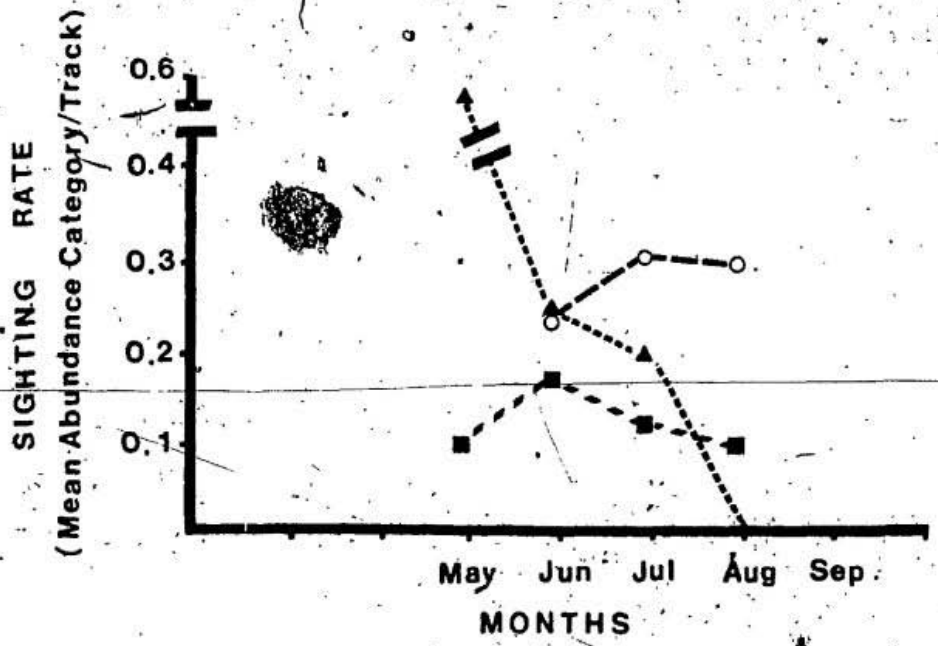

Figure 31. Monthly sighting rates of minke whales in the north (——), east (--------) and south (– – –) sections of the ship-board study area

section of the shipboard study area during August and September (Figure 31, Appendix 27). September (shipboard and land-based) and October/November (land-based) sightings were recorded mostly from the northeast coast of Newfoundland (Bonavista and Notre Dame bays) and from the southeast coast of Labrador (Appendices 28 and 29). Late winter/early spring sightings were recorded only off the south (Burgeo) and southeast coasts (Conception Bay) of Newfoundland (Appendix 28).

There were correlations in monthly abundance between minke and humpback whales ($p < 0.005$) and between minke and finback whales ($p < 0.01$) for the east section of the land-based study area, for the period from January - December. There was also a significant correlation ($p < 0.05$) in monthly abundance between minke and humpback whales in the south section of the land-based study area for the same period. In the shipboard study area, monthly minke abundance was correlated only with that of finback whales for the south section ($p < 0.005$), for the period from June - September.

There was a significant decline ($p < 0.05$) in annual minke abundance (rates and frequencies) in the north section of the shipboard study area from 1976/77 - 1983 (Figure 33, Appendix 31). However, annual minke abundance in the north section of the land-based study area was not correlated with year, for the period from 1980 - 1982 (Figure 32, Appendix 30). A reanalysis of annual minke abundance from the shipboard results, limiting the data to the period from 1980

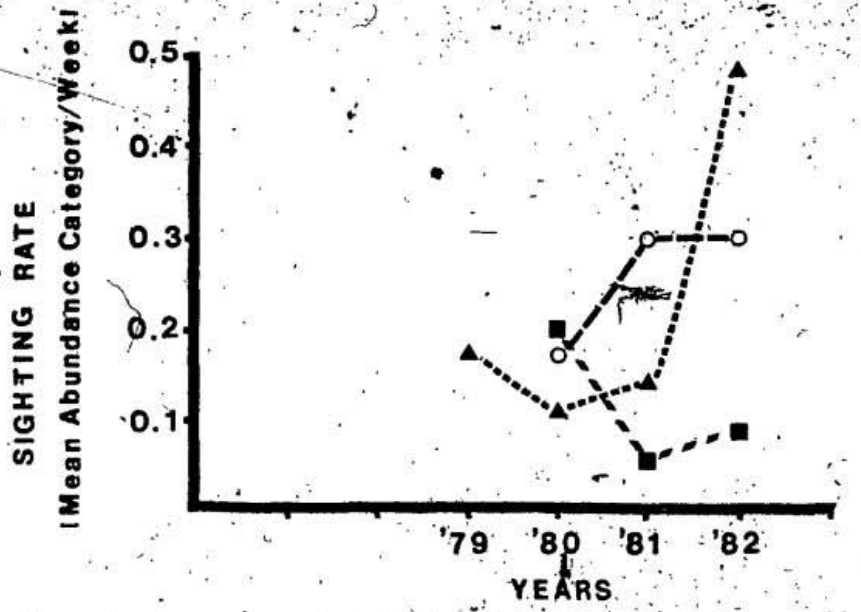

Figure 32. Annual sighting rates of minke whales in the north (——), east (·····) and south (– – –) sections of the land-based study area

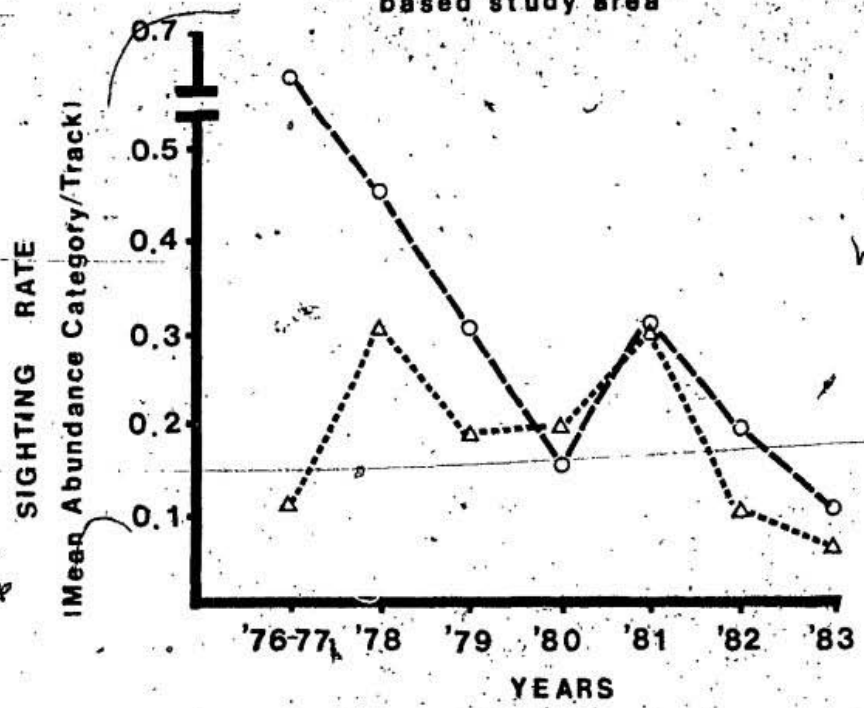

Figure 33. Annual sighting rates of minke whales in the north (——) and east (·····) sections of the shipboard study area

- 1982, also indicated no significant decrease in minke abundance. There was no correlation in annual minke abundance between the land-based and shipboard study areas.

3.2.3.3 Annual Trends in Relative Abundance:

Annual changes in overall minke abundance were correlated with annual changes in humpback ($p < 0.05$) and finback ($p < 0.01$) abundance in the shipboard study area (Figure 18). There was a significant decline found in overall minke abundance in the shipboard study area from 1976/77 - 1983 (Figure 19).

No annual trends were detected in minke abundance for the period from 1979 - 1982 for either the land-based (Figures 16 and 17, Tables 23 and 24) or the shipboard (Figures 18 and 19, Tables 25 and 26) network results.

Annual minke abundance was not correlated with annual effort for either the land-based or shipboard study area.

3.2.4 Pilot Whales:

3.2.4.1 Spatial and Temporal Distribution:

Both observer networks indicated that pilot whales were sighted inshore along all parts of the Newfoundland coastline, south of 52°N, particularly in the Bay of Islands and in Notre Dame, Bonavista, Trinity, Conception, Hermitage and Fortune bays (Figures 34 and 35, Tables 27 and 28). In addition, pilot whale sighting rates were high off Burgeo and off Ferolle Point (land-based network results) and in the Laurentian Channel (shipboard network results). There

TABLE 23

Relative summer abundance of minke whales from land-based data (June – September).

Column headings are identified in the legend for Table 3.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979	116	71	3	0	190	78	0.3895	0.4105
1980	489	128	15	0	632	158	0.2263	0.2500
1981	343	54	2	0	398	58	0.1407	0.1457
1982	246	37	2	0	285	41	0.1368	0.1439

TABLE 24

Relative summer abundance of minke whales from land-based data sorted for months and statistical common to each year.

Sections of the study area included in this summary are given in the legend for Table 8.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1980	200	27	2	0	229	31	0.1266	0.1354
1981	184	39	1	0	224	41	0.1786	0.1830
1982	123	26	2	0	151	30	0.1854	0.1987
1980	317	63	7	0	388	79	0.1856	0.2036
1981	255	44	2	0	301	48	0.1528	0.1595

TABLE 25

Relative summer abundance of minke whales from shipboard data (June - September).

Column headings are identified in the legend for Table 4.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	45	25	6	0	76	2961	43	0.4079	0.4868
1978	23	15	0	0	38	1558	15	0.3947	0.3947
1979	213	34	4	0	251	7137	42	0.1514	0.1673
1980	289	31	0	0	220	6136	31	0.1409	0.1409
1981	152	32	3	0	187	5344	38	0.1872	0.2032
1982	207	32	3	0	242	4956	38	0.1446	0.1570
1983	59	13	2	0	74	2091	[illegible]	0.2027	0.2297

TABLE 26

Relative summer abundance of minke whales from shipboard data sorted for the one degree squares common to each year.

The area sampled included sections 4, 7, 8, 9, 10, and 11.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	21	17	3	0	41	1882	26	0.4878	0.6341
1978	22	14	0	0	36	1467	14	0.3889	0.3889
1979	75	18	1	0	94	2706	20	0.2021	0.2128
1980	73	15	0	0	88	2494	15	0.1704	0.1704
1981	53	18	2	0	73	2141	20	0.2740	0.3014
1982	92	9	2	0	103	1951	13	0.1068	0.1262
1983	27	4	0	0	31	982	4	0.1290	0.1290

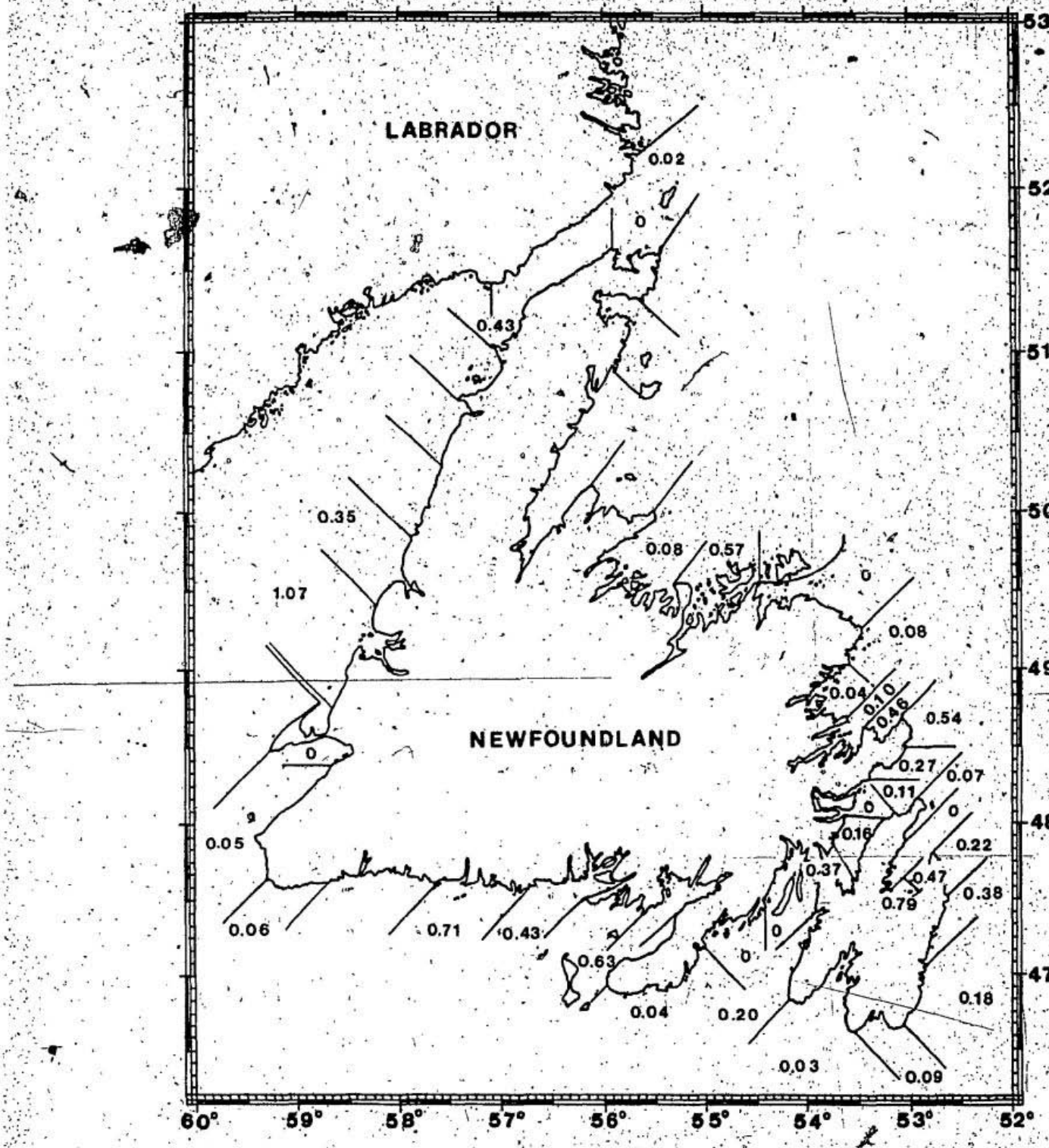

Figure 34. Summer sighting rates of pilot whales for each statistical area within the land-based study area.

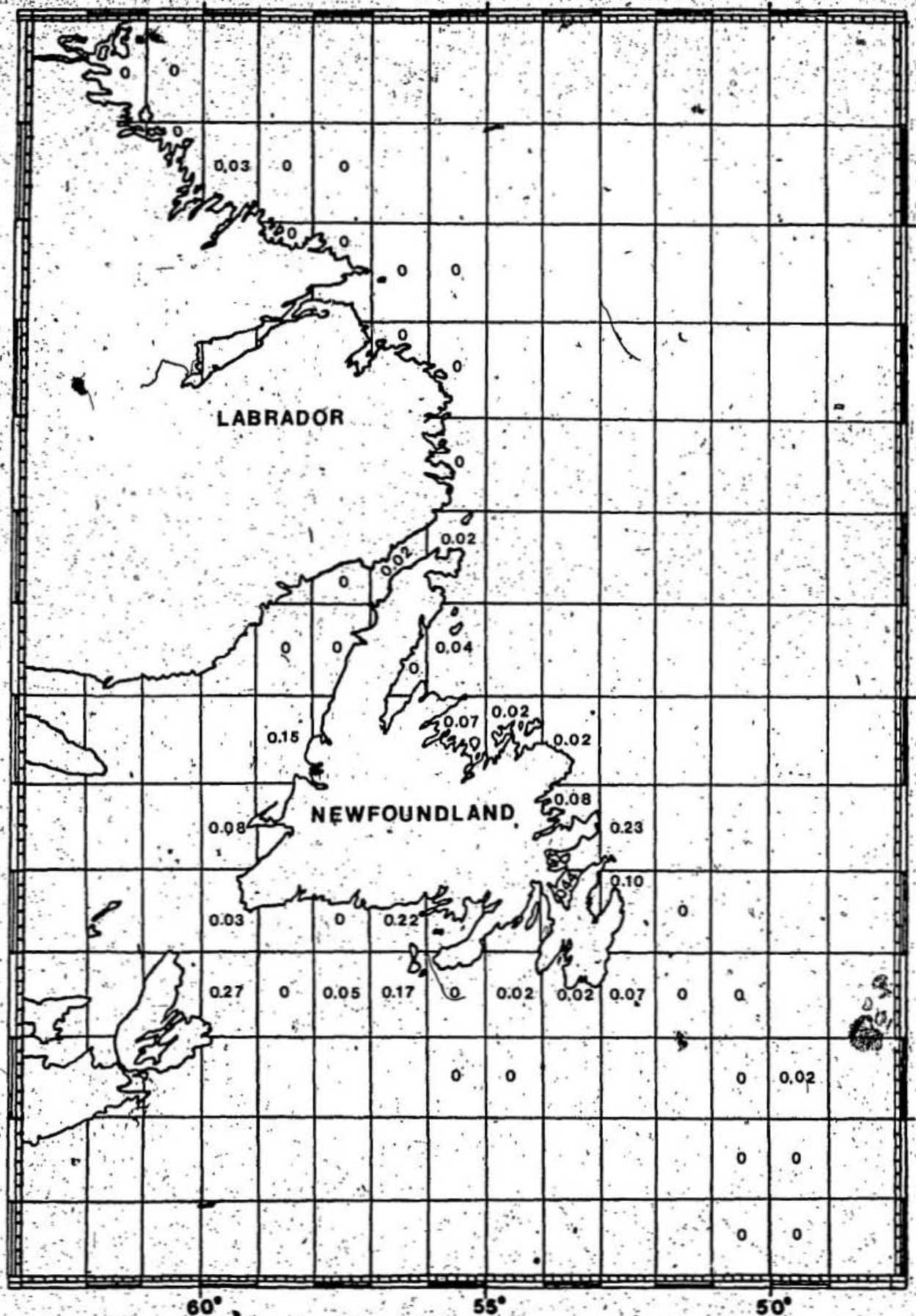

Figure 35. Summer sighting rates of pilot whales for each one degree square within the shipboard study area.

TABLE 27

Distibution of pilot whales from the summer land-based network results (June - September, 1979 - 1982).

Column headings are identified in the legend for Table 3.

Land-Bd Section	Stat Areas	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Rate Abun/Tot	Sight Freq	Ranks (/15) Sight Rate	Sight Freq	Mean	Contrib^{n} to Total X^2
1	6,7	64	7	4	9	84	42	0.500	0.238	5	4	4.5	*9.08
2	9,10,14	80	2	2	6	90	24	0.267	0.111	7	8	7.5	0.10
3	11,12,13	82	3	0	3	88	12	0.136	0.068	9	6	7.5	*2.14
4	15 - 19	96	2	2	6	106	24	0.226	0.094	8	9	9	0.70
5	20,21,24	113	3	1	3	120	14	0.117	0.058	11	11	11	4.06
6	22,23	92	3	6	16	117	63	0.538	0.214	3	5	4.5	*7.86
7	25	96	0	5	11	112	43	0.384	0.143	6	7	6	*0.36
8	26,27	102	5	0	3	110	14	0.127	0.073	10	10	10	2.25
9	28,29	98	0	2	1	101	7	0.069	0.030	12	12.5	12	7.13
10	30,31,32	72	0	1	0	73	2	0.027	0.014	14	12.5	13.5	7.08
11	33,36	90	4	10	14	118	66	0.559	0.237	3	2	2.5	*12.58
12	37	56	5	10	11	82	58	0.707	0.317	1	1	1	*25.18
13	39,40,41	136	3	2	0	141	7	0.050	0.035	13	14	13.5	8.76
14	44,45,49	54	4	10	5	73	39	0.534	0.260	3	3	2.5	*11.22
15	1,50	89	1	0	0	90	1	0.011	0.011	15	15	15	9.15
TOTALS		1336	42	55	88	1521	416	0.274	0.122	-	-	-	122.8 ($p < 0.01$)

TABLE 28

Pilot whale distribution from the summer shipboard network results. (June - September, 1976 - 1983).

Column headings are identified in the legend for Table 4. The chi-square statistic is not given in this table because over 20% of the cell frequencies had less than five sightings.

Ship-Bd Section	Latitude, Longitude	Obsv'd Freq (in tracks) 0	1	2	3	Total No. of Track	Dist (n mi)	Total No. of Whales	Sight Rate (#/n mi)	Sight Freq.	Ranks (/17) Sight Rate	Sight Freq.	Mean
1	55°-57°,60°-62°	46	2	1	0	49	1898	27	0.014	0.061	10	10	10
2	54°-56°,55°-58°	42	0	0	0	42	1324	0	0.000	0.000	14	16.5	16.5
3	53°-55°,56°-59°	70	3	0	0	73	1981	3	0.002	0.041	14	12	12
4	50°-52°,55°-56°	36	1	0	0	37	1938	1	0.000	0.027	14	13.5	13.5
5	50°-51°,57°-58°	103	0	0	0	103	2324	0	0.000	0.000	14	16.5	16.5
6	51°-52°,56°-58°	62	0	1	0	63	1103	15	0.001	0.016	14	15	15
7	50°-52°,55°-57°	55	2	0	2	59	2768	64	0.023	0.068	8.5	9	9
8	49°-50°,54°-56°	52	1	3	2	58	1908	89	0.047	0.103	6.5	5	6.5
9	48°-50°,53°-54°	73	4	1	3	81	2227	130	0.058	0.099	6.5	5	6.5
10	48°-49°,52°-53°	96	0	4	10	110	3052	702	0.230	0.127	2	1	1.5
11	47°-48°,52°-53°	122	3	6	3	134	2212	221	0.100	0.090	3.5	7.5	4.5
12	47°-48°,53°-54°	69	2	3	4	78	798	351	0.440	0.115	1	2.5	1.5
13	45°-48°,49°-52°	35	2	0	0	37	1209	4	0.003	0.054	14	11	11
14	46°-47°,52°-55°	36	1	2	1	40	1153	39	0.034	0.100	8.5	5	8
15	43°-45°,49°-51°	32	1	0	0	33	1162	1	0.001	0.030	14	13.5	13.5
16	45°-48°,54°-59°	39	2	1	2	44	1508	120	0.080	0.114	5	2.5	3
17	46°-51°,58°-60°	41	0	1	3	45	1618	170	0.105	0.089	3.5	7.5	4.5
TOTALS		1009	24	23	30	1086	30183	1797	0.060	0.071	-	-	-

were few sightings of pilot whales reported off Labrador or on the Grand Banks of Newfoundland, including the Southeast Shoal. There was a significant correlation ($p < 0.005$) between minke and pilot whale distributions among the sections of the shipboard study area.

Pilot whale abundance was significantly higher from June - October/November than it was from December - May in the land-based study area (Figure 36, Table 29). The Freidman test indicated no significant differences in pilot whale sighting rates among the months, June - October/November. However, pilot whale abundance in the shipboard study area peaked in August (Figure 36, Table 30); i.e., multiple comparisons with the Freidman test indicated that the August sighting rates were significantly higher than the sighting rates for May, June, July and September ($p < 0.05$). There was no correlation in monthly pilot whale abundance between the shipboard and land-based study areas. The land-based network results suggest that seasonal abundance did not decrease until November. No pilot whales were recorded by land-based observers in December and January. Monthly pilot whale abundance was not significantly correlated with monthly effort January - December (land-based study area) or May - September (either study area).

3.2.4.2 Changes in Spatial Distribution over Time:

The earliest spring pilot whale sightings were recorded in April from Ferolle Point and Conception Bay (Appendix

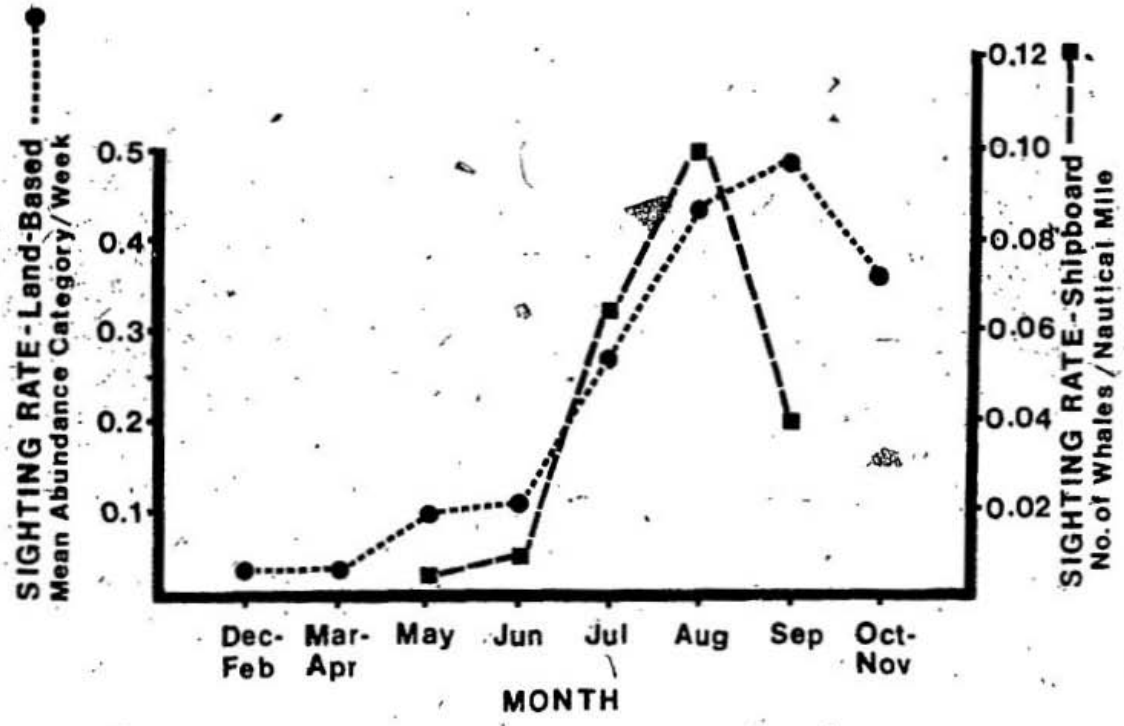

Figure 36. Monthly sighting rates for pilot whales in the land-based and shipboard study areas.

TABLE 29

Monthly abundance of pilot whale from the land-based network results (1979 -1982).

Column headings are identified in the legend for Table 3.

Month	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
Dec-Feb	150	0	2	0	152	4	0.0132	0.0263
Mar/Apr	149	0	2	0	151	4	0.0132	0.0265
May	237	11	7	0	255	25	0.0706	0.0980
June	432	13	10	6	461	51	0.0629	0.1106
July	517	14	19	36	586	160	0.1178	0.2716
August	235	8	20	26	289	126	0.1868	0.4360
September	135	7	6	21	169	82	0.2012	0.4852
Oct-Nov	146	2	11	13	172	63	0.1512	0.3663

TABLE 30

Monthly abundance of pilot whale from the shipboard network results (1976 - 1983).

Column headings are identified in the legend for Table 4.

Month	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Track	Dist (n mi)	No. of Whales	Sight Freq	Sight Rate
May	108	0	1	0	109	2572	15	0.0092	0.0058
June	301	6	4	0	311	6893	71	0.0322	0.0103
July	338	10	6	8	362	9406	610	0.0663	0.0648
Aug	259	5	11	19	294	10042	1016	0.1190	0.1012
Sept	111	3	2	3	119	3842	152	0.0672	0.0396

36). The land-based network results indicated that the seasonal influx of pilot whales started in the north section in May and June before occurring in the south and east sections (Figure 37). Pilot whale abundance in the land-based study area peaked in the north section during July, in the south section during August, and on the east coast during the period from September - October/November (Figures 37). There were no correlations in monthly pilot whale abundance among the sections of the land-based study area. The highest pilot whale sighting frequencies occurred in September and October/November off the east coast, particularly off the Avalon Peninsula (Appendix 36). There were no correlations in monthly pilot whale abundance between the shipboard and land-based data. The decrease in pilot whale sighting rates in the east section of the shipboard study area occurred in September (Figure 38), preceding the decrease in the east section of the land-based study area (Figure 37).

An increase in pilot whale abundance in 1981 occurred in all sections of both study areas, but was most pronounced in the north sections (Figures 39 and 40, Appendices 38 and 39). The land-based and shipboard changes in annual pilot whale abundance were significantly correlated ($p < 0.05$) for the north sections. There was also a significant correlation ($p < 0.05$) in the annual pilot whale sighting rates between the north and east sections of the shipboard study area for the period from 1979 - 1982.

The annual fluctuations in abundance of pilot whales

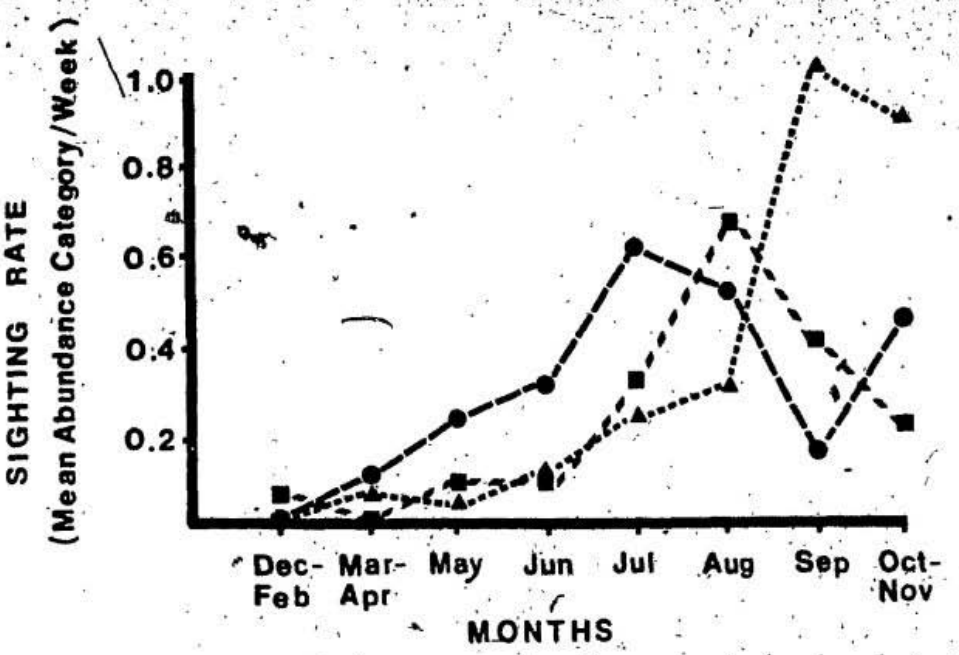

Figure 37. Monthly sighting rates of pilot whales in the north (———), east (·····) and south (– – –) sections of the land-based study area

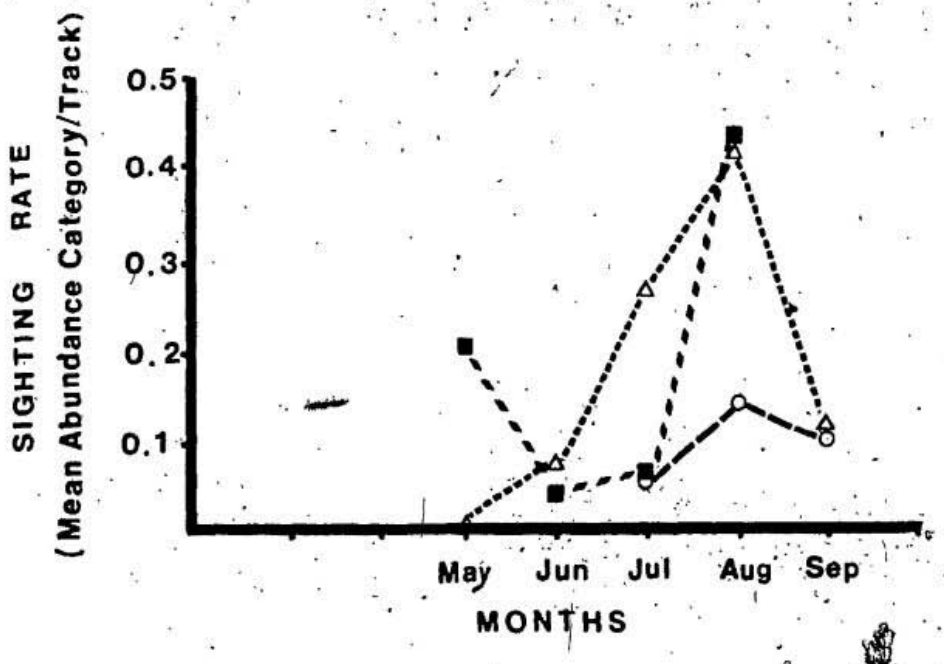

Figure 38. Monthly sighting rates of pilot whales in the north (———), east (·····) and south (– – –) sections of the ship-board study area

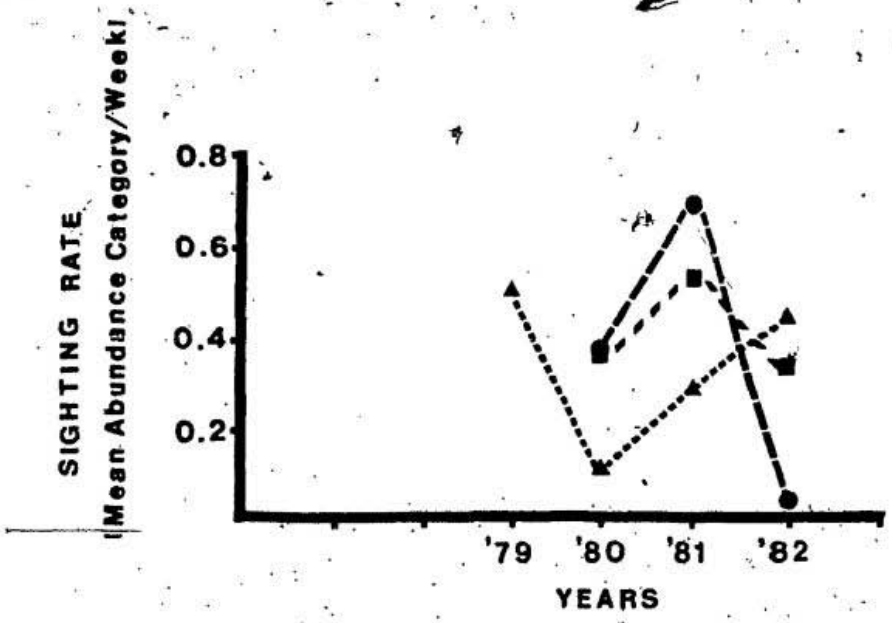

Figure 39. Annual sighting rates of pilot whales in the north (——), east (·····) and south (– – –) sections of the land-based study area

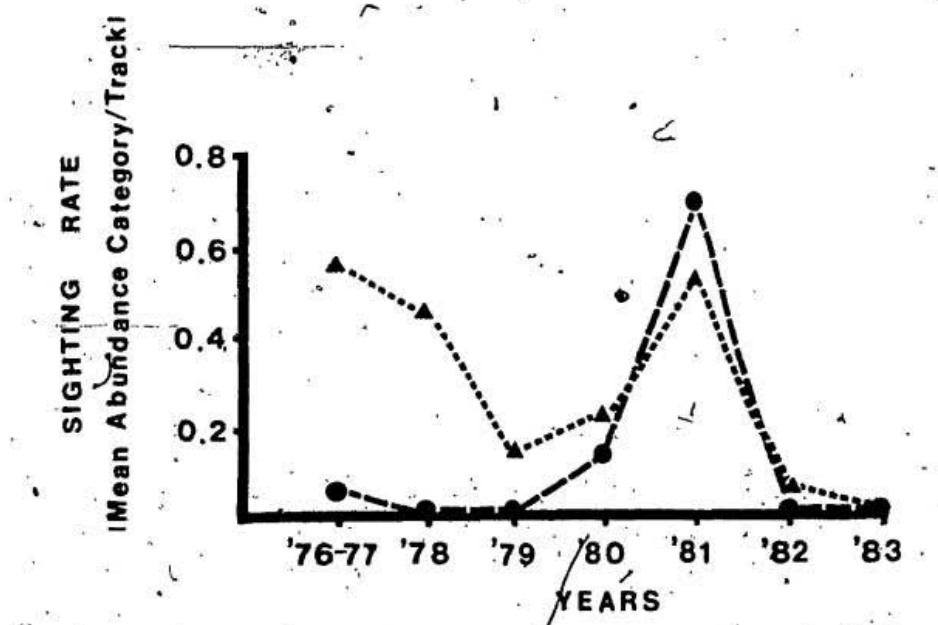

Figure 40. Annual sighting rates of pilot whales in the north (——) and east (·····) sections of the shipboard study area

were significantly correlated ($p < 0.005$) with those of finback whales in north section of the shipboard study area, for the period from 1976 - 1983.

3.2.4.3 Annual Changes in Relative Abundance:

No annual trends in overall pilot whale abundance were detected for either study area (Figures 16 - 19, Tables 31 - 34). Pilot whale abundance fluctuated from year-to-year in the shipboard study area. Multiple comparisons with the Friedman test indicated no significant differences in pilot whale abundance among the years: 1976/77, 1978, 1980 and 1981. However, pilot whale sighting rates were significantly higher ($p < 0.05$) in 1981 than in 1979, 1982 or 1983 (Tables 33 and 34). There were no significant differences in pilot whale abundance among years in the land-based study area (Tables 31 and 32).

There was no correlation between annual pilot whale abundance and annual observer effort.

TABLE 31

Relative summer abundance of pilot whales from land-based data (June - September).

Column headings are identified in the legend for Table 3.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979	180	1	4	5	190	21	0.0526	0.1105
1980	567	21	23	25	636	142	0.1085	0.2233
1981	338	12	18	41	409	171	0.1736	0.4181
1982	251	7	11	17	286	80	0.1224	0.2797

TABLE 32

Relative summer abundance of pilot whales from land-based data sorted for months and statistical areas common to each year.

Sections for the study area included in this summary are given in the legend for Table 8.

Year	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1980	231	8	13	7	259	55	0.1081	0.2124
1981	197	10	14	26	247	116	0.2024	0.4696
1982	161	4	7	8	180	42	0.1056	0.2333
1980	374	14	17	15	420	93	0.1095	0.2214
1981	247	11	16	33	307	142	0.1954	0.4625

TABLE 33

Relative annual abundance of pilot whales from shipboard data (June - September).

Column headings are identified in the legend for Table 4.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	71	3	1	1	76	2961	8	0.0658	0.1053
1978	32	1	1	4	38	1558	15	0.1579	0.3947
1979	239	6	5	1	251	7137	19	0.0478	0.0757
1980	203	5	5	8	220	6136	39	0.0818	0.1773
1981	161	4	9	12	187	5344	58	0.1337	0.3102
1982	230	6	3	3	242	4956	21	0.0522	0.0913
1983	74	0	0	0	74	2091	0	0.0000	0.0000

TABLE 34

Relative annual abundance of pilot whales from shipboard data sorted for the one degree squares common to each year.

The area sampled included sections 4, 7, 8, 9, 10, and 11.

Year	Obsv'd Freq (in tracks) 0	1	2	3	Total No. Tracks	Total Naut. Miles	Abun	Sight Freq	Sight Rate
1976-77	38	1	1	1	41	1882	6	0.0731	0.1463
1978	30	1	1	4	36	1467	15	0.1667	0.4167
1979	89	2	2	1	89	2706	9	0.0532	0.0957
1980	80	2	2	4	80	2494	18	0.0909	0.2045
1981	57	1	6	9	73	2141	40	0.2192	0.5479
1982	96	4	2	1	103	1951	11	0.0680	0.1068
1983	31	0	0	0	31	982	0	0.0000	0.0000

4. DISCUSSION

4.1 Evaluation of the Observer Network:

4.1.1 As a Means of Determining Whale Distribution:

The observer network functioned as a practical means of collecting whale distribution data, offering a high return for a relatively modest investment. The land-based observer network submitted 1547 weeks of observer effort (from June - September, 1979 - 1982) from 38 statistical areas of Newfoundland and Labrador. Shipboard observers surveyed a total of 30,183 nautical miles (from June - September, 1976 - 1983) along all coasts of Newfoundland and Labrador, and on the Grand Banks of Newfoundland. The shipboard observer effort was subject to more inter-year geographic and seasonal variability than the land-based effort (e.g., larger study area, mobile observers, general movement northward at the beginning of the summer, southward at the end). However, together the observer networks provided: wide geographic coverage of the study area (both inshore and offshore), intensive sampling effort (in total man-hours), synchronous collection of data from several locations (land-based network), year-round effort in some locations (land-based network), potential for a long-term data base, sampling consistency from many observers who incorporated their observation periods into daily routines, and a means by which the reliability of the data could be assessed.

The uncertain relibility of the whale identifications

and the uneven coverage of observer effort are both concerns of volunteer networks (Evans 1980). Reliable whale identification can be difficult even for experienced whale watchers and cetologists. Although this factor could not be entirely eliminated from the results of this study, it was minimized in a number of ways. The primary tool for checking the reliability of whale identifications was a test which requested volunteers to identify a series of black and white photographs of whales. To the best of my knowledge, the Newfoundland and Labrador observer network was the first to have its observers (experienced and inexperienced) tested for their reliability at whale identification.

Although many of the network observers completed tests (Section 3.1.2), 69% of the observer effort from the land-based study area and 38% of the observer effort from the shipboard data were submitted by untested observers. All data, including those which were submitted by untested observers, were checked by means of questionnaires, observers' field notes, reports from other observers in the same area and/or personal contact. Nevertheless, untested observers, who submitted sole source observations, contributed approximately 37% of the land-based effort and 9% of the shipboard effort to this study. Assuming that the untested observers were subject to the same error rate as the tested observers (averaging 30% on the reliability test, for both LHK and MWW), then about 11% of the land-based data and 3% of the shipboard data, that were provided by untested, solitary observers was unreliable.

The mean reliability test score for the group of experts was significantly higher than that of either LHK or MWW (Section 3.1.2). The majority of MWW were students and staff connected with Memorial University, and many had former research experience (although few had had whale watching experience). Thus, it was reasonable that their mean test score fell between those of the experts and the LHK. Some of the LHK were former whalers, but most had little experience at whale identification.

The reliability test permitted the removal of less reliable data from the analyses of each species. The test results indicated that the degree of reliability depended upon the species of whale identified. Humpback whales, for example, were identified with a high degree of confidence in the test, probably due to distinctive physical features, conspicuous surface behaviour, frequent inshore sightings, and media attention (mostly related to entrapment with fixed fishing gear). Only three observers were excluded from the analysis of humpback whale sightings. Finback whales were the least reliably identified of the four species, even by the experts, and therefore, the species with the most observers removed from analysis (8).

Field notes also indicated that observers identified finback whales with the least degree of confidence. Slijper et al. (1964) and Evans (1980) also found that observers had the most difficulty telling rorquals apart, particularly, blue, fin and sei whales. The tendency for observers to include finbacks with 'unidentified whales' was reported for

both observer networks. The extent to which this was reported each year, did not change, and thus was not expected to affect the analysis of annual finback abundance.

The tests were also examined for any species that observers repeatedly confused with the species being tested. The results indicated that most observers relied on responses, such as, 'Don't know', 'Can't tell', 'Baleen whale', in lieu of guessing the species. Only one observer was removed for potentially confusing whale species, and he performed poorly on the entire test.

Few correlations were found between whale spatial/temporal distribution and the distribution of observer effort (geographical, annual or monthly). The results for pilot whales, in particular, appeared to be little influenced by the distribution of observer effort. Pilot whales were sighted most commonly in the late summer and early fall when observer effort had decreased. Furthermore, pilot whales were frequently sighted on the west and southwest coasts of Newfoundland, which had less observer effort than other parts of the Newfoundland coastline.

The correlation found between humpback whale distribution and the geographic distribution of observer effort in the land-based study area (Section 3.2.1.1) was dependent upon the inclusion of the land-based sections along the south coast of Newfoundland. These sections offered extremes of high effort/high sighting rates and low effort/low sighting rates. These two sections were

double-checked for possible sampling biases, but none were apparent. Observers appeared to report reliably despite the correlation between effort and whale abundance.

The results also indicated a significant correlation between monthly minke abundance and monthly effort, June - September (Section 3.2.3.1). Minkes were significantly more abundant in June and July when the observer effort was highest. It is unlikely this correlation with effort necessarily masked the actual seasonal pattern of minke abundance. The seasonal abundance of minke whales off eastern Newfoundland has been correlated with the inshore availability of capelin (Mallotus villosus) in June and July (Piatt et al. 1987). Furthermore, Sergeant (1963) identified a paucity in whaling catches in eastern Newfoundland in August and September, which he felt reflected a real scarcity in minke whales. Given that the highest minke sighting rates/frequencies occurred off the Avalon Peninsula (Section 3.2.3.1) and that there were no other correlations between minke distribution/abundance and observer effort (Sections 3.2.3.2 and 3.2.3.3), it is unlikely that this correlation indicated a sampling bias.

The observer networks appeared to function well as a means of determining whale distribution. Nevertheless, the reliability of whale identifications continues to be a concern. Future studies relying on sighting networks could be improved by using only trained or tested observers, possibly testing them periodically (with revised tests) to monitor improvement with experience.

4.1.2 As a Means of Monitoring Changes in Whale Abundance:

Whale entrapment in fixed fishing gear (Lien 1979a, 1980a, Lien and Aldridge 1982, Lien et al. 1982, 1983) was the best available indicator of inshore whale abundance in Newfoundland and Labrador from 1979 - 1983. Most of the whale surveys that were used previously to indicate changes in inshore abundance (Whitehead and Lien 1982, Whitehead and Carscadden 1985), have been included in the data base for the shipboard observer network. Consequently, annual entrapment rates were used as the basis for evaluating the observer network as a means of monitoring changes in whale abundance.

Both observer networks reported their highest numbers of pilot whale sightings in 1981, a result that overlapped with the pronounced increase in pilot whale entrapment reported by Lien and Aldridge (1982). Furthermore, the sighting networks detected shifts in humpback distribution that had been indicated by asynchronous variation in whale entrapment in different parts of the coastline. The shipboard results indicated a decrease in humpback whale abundance off the east coast of Newfoundland from 1976 - 1983 (Section 3.2.1.2), while the land-based results indicated an increase in humpback whale abundance off the northeast coast of Newfoundland / southeast coast of Labrador from 1980 - 1982 (Section 3.2.1.2). Lien (et al. 1982) reported a decrease in whale entrapment off the east coast of Newfoundland in the early 1980s, which was

accompanied by an increase in whale entrapment off Labrador.

There were no annual trends in overall minke abundance indicated by either sighting records (Sections 3.2.3.2 and 3.2.3.3) or annual entrapment rate (Whitehead and Lien 1982, Lien et al. 1982, 1983), for the period of overlap, from 1979 - 1983. Finback whales were rarely caught in fishing gear (Perkins and Beamish 1979, Lien 1979a, 1980a), and thus whale entrapment was not a good indicator of annual finback abundance.

The land-based network results appeared to be a poor indicator of annual abundance at least for humpback whales on the east coast of Newfoundland in 1981. Humpback abundance in the east section of the land-based study area remained at 1979 - 1980 levels or increased in 1981 (Sections 3.2.1.2 and 3.2.1.3), despite a considerable decrease in humpback entrapment off the east coast of Newfoundland in 1981 (Lien and Aldridge 1982). Comments from observers (obtained with a questionnaire that was distributed to land-based observers in 1982), indicated that land-based observers had noticed a general decrease in the number of whale sightings in 1981 and 1982. However, a number admitted to submitting reports only for weeks when whales had been sighted. This under-reporting of effort would have been likely to have led to over-estimates of humpback whale abundance in the land-based study area in 1981, and possibly 1982.

Future investigations, using an observer network to monitor annual whale abundance, could improve estimates of

abundance by checking with regular contributors during the field season to see if missing reports meant an absence of whales or no observer effort.

The under-reporting of effort did not seem to occur during the collection of data by the shipboard observer network, probably because much of the data came from organized surveys, often conducted by cetologists. Furthermore, it was relatively easy to estimate shipboard effort. Shipboard observers generally travelled the shortest distance between ports, and most observers provided information on ports, time of travel and weather conditions.

4.2 Observer Network Results:

4.2.1 Whale Distribution in Newfoundland and Labrador:

Investigations, which have focussed on describing the physical, chemical and biological features of whaling grounds, have concluded that whale distribution is most influenced by the distibution and abundance of their prey (Nemoto 1957, 1959, Nemoto and Kasuya 1965, Nasu 1966, Best 1967, Evans 1971, Kawamura 1974, Gaskin 1976, Volkov and Moroz 1977). Off the east coasts of Newfoundland and Labrador, capelin makes up the largest portion of the diets of humpback, finback and minke whales between June and September (Sergeant 1963, 1966, 1977, Mitchell 1973, 1974b, 1975a). In Newfoundland and Labrador pilot whales feed almost exclusively on short-finned squid, which supports an inshore fishery off the northeast, east and south coasts of Newfoundland from July - October/November (Squires 1957,

Sergeant 1962).

The temporal distributions resulting from an analysis of land-based data (which provided year-round observations) indicated that all four species of whales were most abundant during the months of historically high prey availability. The three baleen species were most abundant from May - September in the land-based study area, and changes in abundance for these months were significantly correlated between humpback and finback whales, and between humpback and minke whales (Section 3.2.1.1, 3.2.2.1 and 3.2.3.1). Pilot whales were most abundant from June - October/November (Section 3.2.4.1).

Temporal distributions for the three baleen whales in the shipboard data were not correlated with those from the land-based data (for the period from May - September). The shipboard results indicated that baleen whale abundance increased later in the year, which may have been a function of the limited observer effort in May and June. Despite the differences between the two data sets, historical sighting and whaling records for all three baleen whales indicate that the temporal distributions resulting from the land-based data were probably accurate as far as the period of seasonal availability. In the waters off eastern Newfoundland, finback, humpback and minke sightings/catches were recorded from June - October/November, from May - October and from May - August/September, respectively (Sergeant 1963, 1966).

The temporal distribution of pilot whales in the

land-based study area agreed with the historical records (Sergeant and Fisher 1957, Sergeant 1962), but did not reflect observer effort. The shipboard results indicated that pilot whale abundance decreased in September, although they continued to be abundant in the land-based study area until October/November (Section 3.2.4.1). This may reflect the predominately inshore distribution of pilot whales in September and October/November.

Humpback and finback spatial distributions in the shipboard study area were significantly correlated (Section 3.2.2.1). Both species were sighted almost exclusively along the east coasts of Newfoundland and Labrador and on the Southeast Shoal (Sections 3.2.1.1 and 3.2.2.1), areas which encompass four of the five major capelin stocks (Figure 41). Although minkes were rarely sighted on the Southeast Shoal, they shared a predominately east coast distribution with humpback whales in the land-based study area, i.e., minke and humpback whales had the most closely related spatial distributions in the land-based study area ($p < 0.08$).

The results of this study indicated that southeast Labrador and northeast Newfoundland were important areas to humpback and finback whales. The sighting rates in these areas were the highest or among the highest for each species (Figures 10 and 20). Other investigations and whaling records also have indicated a concentration of both species in these areas (Sergeant 1966, Mitchell 1973, Perkins and Whitehead 1977, Balcomb and Nichols 1978). The

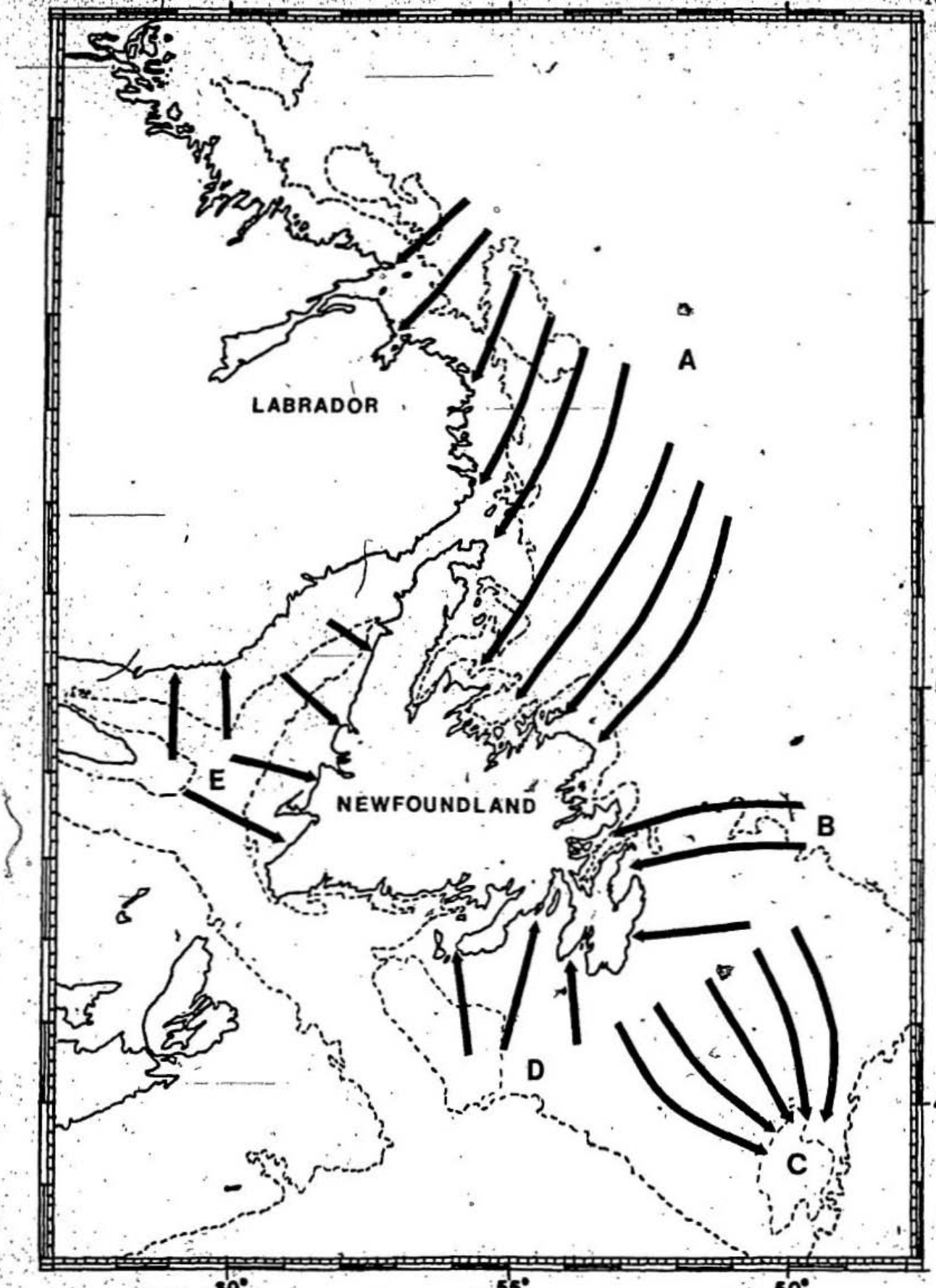

Figure 41. Capelin stocks (A - E) and spawning migrations in Newfoundland and Labrador (after Carscadden 1983, cited in Whitehead and Carscadden 1985).

Labrador-northeast Newfoundland capelin stock (Figure 41, A) is the largest of the five capelin stocks and is probably one of the most important to baleen whales feeding in Newfoundland and Labrador (Whitehead and Carscadden 1985).

Although the distributions of humpback and finback whales in the land-based study area were not correlated, there were similarities. In addition to the overlapping of their distributions on the east coast of Newfoundland, the land-based results indicated that Hermitage and Fortune bays may be an important feeding area to humpback and finback whales in Newfoundland and Labrador (Sections 3.2.1.1 and 3.2.2.1). This area had the highest humpback and finback sighting frequencies in the land-based study area (Tables 3 and 12). This area may fall within the range of the St. Pierre capelin stock's inshore availability (Figure 41, D) although little is known about the size and distribution of this stock (Winters and Carscadden 1978).

The land-based network results also indicated differences between the inshore distributions of finback and humpback whales. In particular, the northwest coast of Newfoundland appeared to be an important area for finback whales, but not for humpback whales. The highest finback sighting rates in the land-based study area occurred off the northwest coast (Figure 20). This area may fall within the spawning area (Figure 41, E) of the small Gulf of St. Lawrence capelin stock (Jangaard 1974).

Pilot whales were distributed in the bays along most parts of the Newfoundland coastline, south of 52°N (both

observer networks, Section 3.2.4.1). Sergeant and Fisher (1957) reported that pilot whales were most frequently sighted in the deeper bays along the south and east coasts of Newfoundland. The land-based and shipboard results indicate that although high pilot whale sighting rates occurred in these areas, pilot whale sighting rates were also high in bays on the west coast of Newfoundland and in the Laurentian Channel. Pilot whale spatial distribution was significantly correlated with minke distibution in the shipboard study area (Section 3.2.3.1), suggesting that minke whales had a distribution that was predominately inshore and more dispersed than that of either humback or finback whales in the shipboard study area.

4.2.2 Seasonal Changes in Whale Distribution:

Land-based results (Sections 3.2.1.2, 3.2.2.2 and 3.2.4.2) indicated that humpback, finback and pilot whales were present off the northeast and/or northwest coasts of Newfoundland during the winter and/or spring, before capelin and squid were expected to be abundant. Increases in the inshore availability of capelin (for spawning) and squid (for feeding) are regulated by water temperatures and thus, generally start on the south coast of Newfoundland and occur progressively later further north (Jangaard 1974, Squires 1957, 1959, Mercer 1975).

The whales probably take a variety of prey before capelin and squid become available. Stomach contents from humpback and finback whales, which were caught off the

coasts of northeast Newfoundland and southeast Labrador, indicated that krill was taken early in the season until it was replaced by capelin in late June (Sergeant 1966). Sergeant (1962) and Mercer (1967 cited in Mercer 1975) have both reported the presence of fish (Atlantic cod Gadus morha and Greenland turbot Reinhardtius hippoglossoides, respectively) in the stomachs of pilot whales taken in Trinity Bay, when squid were scarce inshore.

Herring (Clupea harengus) is another possible prey off the north coast of Newfoundland. Herring has been reported in small quantities in minke stomachs before and after the capelin season on the east coast of Newfoundland (Sergeant 1963, Mitchell 1974b), and finback whales have been reported to follow herring shoals (Sergeant 1966, Brodie 1975). Herring is availiable in Notre Dame and White bays from early May to mid-June when the stock on northeast coast of Newfoundland is spawning (Stobo et al. 1982). The west coast of Newfoundland supports a major herring fishery (Stobo et al. 1982), which may have provided favourable feeding for early winter records of minkes from Port-au-Port Bay (Sergeant 1963) and late winter/early spring sightings of finbacks off the northwest coast (Sergeant 1977).

The results also indicated gradual northward migration of whales through the study area. The sighting rates for all four species increased in the south section of the land-based area before increasing in the east section (Sections 3.2.1.2, 3.2.2.2, 3.2.3.2 and 3.2.4.2). The trend in monthly whale abundance in the east section of the

land-based study area was significantly correlated among the three baleen whales (Section 3.2.3.2). Pilot whale abundance peaked in the south section of the land-based study area in August, before peaking in the east section for the period from September - October/November.

The period of seasonal abundance for minke whales was longer in the shipboard study area (from May - August) than the land-based study area (June and July), suggesting some offshore movement occurs after July, in addition to northward movement. These results agreed with Perkins and Whitehead's (1977) observation that minkes moved progressively offshore during the period from July - September, and with Mitchell and Kozicki's (1975) hypothesis that minke whales either follow the offshore movement of post spawning capelin or move northward to the next spawning group of capelin.

Humpback and finback whales were present on the south coast year-round, particularly in the vicinity of Hermitage and Fortune bays. Herring provides a likely prey for whales during the fall and winter as there has been a substantial winter purse seine fishery in the ice-free bays along the western part of the south coast of Newfoundland since 1965 (Hodder and Winters 1972). Squid is also a possible prey item in this area during August and September. Krill may be a prey item, although little is known about its availability in this area. The south coast of Newfoundland was a noted winter whaling area for both species (Sergeant 1966, 1977).

4.2.3 Annual Fluctuations in Whale Distribution:

Humpback whale abundance significantly decreased in the east section of the shipboard study area from 1976/77 - 1983 (Section 3.2.1.2), while increasing in the north section of the land-based study area from 1980 - 1982 (Section 3.2.1.2). This inter-year shift in humpback whale distribution was identified first by Lien et al. (1982), who reported a general decrease in whale entrapment with fixed fishing gear off the east coast of Newfoundland from 1978 - 1983 (Lien et al. 1983), and an increase in the occurrence of residual whale entrapment off south Labrador during the early 1980s (Lien and Aldridge 1982, Lien et al. 1982). Whitehead and Carscadden (1985) attributed the changes in inshore whale abundance in different parts of the coastline to changes in the relative abundance and age-class composition of offshore capelin schools.

4.2.4 Annual Trends in Relative Abundance:

There was a significant decline in finback abundance throughout the entire shipboard study area during the period from 1976 - 1983 (Section 3.2.2.3). Although humpback and minke abundance also appeared to decline in the shipboard study area for this period (Sections 3.2.1,3 and 3.2.3.3), these decreases occurred primarily off the east coast of Newfoundland, where a decrease in humpback whale entrapment had been reported (Lien et al. 1983).

Reasons for the apparent decline in relative abundance of finback whales are obscure. One contributing factor

might be a slow recovery from whaling activities. In eastern Canada, the most recent finback fishery operated between 1965 - 1972 (Mizroch et al. 1984). Population estimates, based on catch per unit effort data from this fishery, indicated a steady decline from 4500 animals in 1967 to 2000 in 1972 (Allen 1973).

Trophic competition could also be a factor, both among baleen whales (Mitchell 1975b, Whitehead and Carscadden 1985), and among the wide variety of fish species, marine mammals and seabirds that feed on capelin (Winters and Carscadden 1978, Piatt et al. 1987). Baleen whales appear to change their geographic distributions, on a scale of days and weeks, in response to changing capelin abundance (Whitehead et al. 1980b, Piatt et al. 1987). Whitehead (1981) thought that some competition probably does occur between humpback and finback whales. Both humpback and finback whales are distributed in much the same areas (Sections 3.2.1.1 and 3.2.2.1), eat predominately capelin in Newfoundland and Labrador (Sergeant 1966, Mitchell 1973, 1975a, Sergeant 1977), share a preference for 2- to 3-yr old, mainly immature capelin (Whitehead and Carscadden 1985), and feed in much the same manner (Gaskin 1976, Watkins and Schevill 1979, Whitehead 1981). However, Piatt et al. (1987) found evidence from investigations off southeast Newfoundland that capelin predation by seabirds and cod may dwarf consumption by baleen whales and may actually limit the feeding potential of whales. They sighted finbacks in Witless Bay only during days of

extremely high capelin abundance and they suggested that finback whales may require higher prey densities than minke and humpback whales.

In conclusion, the results from this study support earlier investigations which have indicated that the temporal and spatial distributions of humpback, finback, minke and pilot whales in Newfoundland and Labrador are largely dependent upon the availability of capelin and squid (Sergeant and Fisher 1957, Sergeant 1963, 1966, Mitchell and Kozicki 1975, Mercer 1975, Whitehead and Carscadden 1985). Furthermore, the study indicates that the scarcity of historical sightings and whaling catches reported for the three baleen whales, on the west and southwest coasts of Newfoundland, reflects their actual distribution and not just the distribution of observer effort.

The study results also suggest that at least a portion of the humpback, finback and pilot whale populations in Newfoundland and Labrador feed opportunistically, taking a variety of prey, in addition to capelin and squid. Some whales appeared to overwinter (humpback and finback whales in Hermitage and Fortune bays) or arrive off the north coast of Newfoundland (humpback, finback and pilot whales to the vicinities of Ferolle Point and/or Notre Dame Bay) before capelin and squid were expected to be either available or abundant.

The shipboard results indicate a decline in the finback population in Newfoundland and Labrador, which could not be

accounted for by a shift in distribution within the study area, from one year to the next. The reason for this apparent decline is unknown, and additional work is needed.

The sighting network functioned well as a means of determining whale distribution. The results are supported by the distributions resulting from earlier records of sightings and whaling catches. The land-based observer network proved to be promising as a means of determing distribution, particularly because it permitted the synchronous collection of data from a number of locations throughout the year. It is recommended to use only observers tested for reliability at whale identification. Secondly, observers could be tested or checked periodically to monitor changes in their reliability at whale identification.

The shipboard network provided a more accurate means of monitoring fluctuations in whale abundance than the land-based network. Land-based observer effort decreased with decreasing sightings, which resulted in an overestimation of whale abundance. This situation could be corrected or improved by monitoring observer effort more closely.

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APPENDIX 1.

Whale Sighting Networks in the North Atlantic.

This table presents a summary of the observer networks, which have contributed to the records of live cetacean sightings in the North Atlantic. When available, effort and the number of sightings are given for a portion of each network's study period. An asterisk designates the species of primary interest (i.e., target species) for a given sighting network. N/A indicates that the information was not available.

Network Name	Central Base - Director	Study Period & Period of Rept'd Results	Study Area	Observation Platform	Species	Effort in N.Atl.	Number of Cetacean Sightings	Reference
National Inst. of Oceanography	National Inst. of Oceanography England	4/54 to Present(?) 4/54-12/56	world-wide, inc. the Atlantic	shipboard naval & merchant	rorquals sperm humpback	569,800 n.miles	140	Brown, 1958
Netherlands Whale Res. Group	Netherlands Whale Res. Group T.N.O.	1954-1957	Atlantic, Pacific and Indian	shipboard naval & merchant	rorquals sperm,minke humpback	N/A	N/A	Slijper et al., 1964
Cetacean Group	Cetacean Group Mammal Society, England	1958 to Present 1958-78	inshore Britain & Ireland	85% land-based, 15% shipboard	all cetaceans	N/A	2,000	Evans, 1980
Fisheries Res. Board of Canada	Fisheries Res. Board of Canada	1961 to Present(?)	Eastern Canada	shipboard aerial	all cetaceans	N/A	N/A	Sergeant, 1961
NOAA's Platforms of Opportunity (NOAA's POP)	National Marine Fisheries Service - NE Fisheries Centre	1971 to Present	Northeast U.S. shelf waters	shipboard	all cetaceans	N/A	N/A	Natl. Marine Mamm. Lab 1984, Powers et al. 1982
Land-based Gulf of St. Lawrence Whale Observation Program	Fisheries Res. Board of Canada	5/73-11/74	Les Escoumins Quebec East of Saquenay River	land-based	*minke,fin beluga pilot,blue humpback	19 mos daily	N/A	Mitchell, 1975a

(Continued on next page.)

APPENDIX 1. (Continued)

Whale Sighting Networks in the North Atlantic

Network Name	Central Base - Director	Study Period & Period of Rept'd Results	Study Area	Observation Platform	Species	Effort in N.Atl.	Number of Cetacean Sightings	Reference
Cetacean Res. Group	Provincetown Ctr. Coastal Studies, C.A. Mayo	4/75 to Present 4-6/75-78 4-10/79	Cape Cod Bay & Stellwagen Bank	shipboard land-based (added 11/79)	humpback fin,right minke,pilot porpoise	600 cruises	860	Mayo, 1982
Marine Observer Program	Manomet Bird Observatory, Manomet, MA	1977 to Present 6/80-12/81	Cape Sable, NS to Cape Hatteras, NC	shipboard	sea birds, turtles,all cetaceans	30 cruises	475	Powers et al. 1982
Gulf of Maine Whale Sighting Network	College of the Atlantic S.K. Katona	1978 to Present 1978-81	Gulf of Maine	shipboard land-based	all cetaceans	N/A	2,530	Stone et al. 1983
Cetacean and Turtle Assess'mt Program (CETAP)	University of Rhode Island H.E. Winn	10/78-02/83	Cape Sable, NS to Cape Hatteras, NC	shipboard aerial	all cetaceans sea turtles	250,000 n.miles	11,000	Kenney, 1983
Mingan Island Cetacean Study	Richard Sears	8/79 to Present 8/79	North shore Gulf of St. Lawrence	shipboard aerial	*blue, all cetaceans porpoise,	N/A	69	Sears, 1979
Grand Banks Wildlife Studies	MacLaren Plansearch Ltd	3/80-4/81	Grand Bank of Newfoundland	shipboard aerial	all cetaceans	N/A	456	Parsons, 1981
MUN Whale Research Group Sighting Network	Memorial Univ. of Nfld. Whale Research Group O.J. Lien	4/79-Pres land: 6-9/ 1979-82 ship: 6-9/ 1976-83	Newfoundland and Labrador	land-based shipboard	*humpback *finback *minke *pilot, all cetaceans	land: 1,547wk ship: 30,183 n.miles	land: 1,356 ship: 636	This Study

APPENDIX 2

Marine vessels used for the whale surveys reported in cruise reports, and used by the shipboard observer network

Cruise year and May – September effort (nautical miles travelled in good visibility) are provided for each vessel. Vessel names were unavailable for some of the shorter surveys, so the surname of the observer is given in parentheses. Surveys marked with an asterisk (*) were performed by professional cetologists.

Year	Vessel (Observer)	Nautical Miles Travelled	Year	Vessel (Observer)	Nautical Miles Travelled	Year	Vessel (Observer)	Nautical Miles Travelled
1976	Regina Maris	347*	1980	Westward	1,043*	1981	Firenze	726*
1976	Patience	926*	1980	Bonavista	885*	1981	Regina Maris	2,145*
1976	Wm Carson	236*	1980	Firenze	420*	1981	Westward	1,661*
1977	Regina Maris	2,926*	1980	Rich Point	820	1981	Marangai	376*
1978	Firenze	1,558*	1980	Hakada	135	1981	Rich Point	1,244
1979	Firenze	1,544*	1980	Elsie G	992	1981	ONO-1	630
1979	Westward	1,493*	1980	(Davidson)	237	1981	Mer d'Alors	295
1979	Petite Forte	994*	1980	(Baird)	279	1982	Findrinny	3,532*
1979	Bonavista	2,019*	1980	(Fitzgerald)	415*	1982	(Baird)	97
1979	Northn Seal	2,173*	1980	Polynya	114	1982	(Macduff)	377
1979	Rich Point	1,567	1980	(Pauley)	83	1982	(Peters)	465
1979	(Halliday)	239	1980	Kelly B	172	1982	Dawson	421
1979	Strongbow	179	1980	Maid of Mourne	241	1982	(Linegar)	544
1979	(Spracklin)	123	1980	Ambrose Shea	40	1982	Marangai	183*
1979	(Manuels)	110	1980	Aardvark	816	1982	Rich Point	1,011
1979	Whiteway	337*	1980	(Mahle)	65*	1982	(Richards)	10
1980	Hudson	701*	1980	Marinus	107*	1982	(Richards)	58
1980	Gadus	1,012*	1981	Gadus	1,248*	1982	Firenze	120*
1980	(Laurentius)	151				1983	Findrinny	2,954*

Total = 43,596 nautical miles

Sample of the quiz used to test the reliability of network observers' whale identifications in 1982. Tests were graded according to the answers provided by the 19 experts (their answers are provided). Network observers scored a half point for answers in parentheses.

WHALE IDENTIFICATION QUIZ

Please take a few minutes to examine and identify the whales in each of the following photographs. Most of the pictures are of humpback, finback, minke, pothead whales, porpoises or dolphins. These are the most common species in Newfoundland. However, some additional shots of sperm whales, killer whales, sei whales and right whales have been included to challenge those of you who have become quite experienced at identifying whales.

Some of the pictures are unclear and the whale species may be difficult to identify. The correct answer for these situations would be "Difficult to identify because of the picture" or "Can't tell".

If you do not recognize a species, write "I don't know". However, if you can't identify the species but you can tell that it is a whale or a dolphin, write "Large whale", "Small whale" or "Dolphin/porpoise".

For the occasional picture of a sperm, sei, killer, or right whale, write down the answer "Other" to indicate you know that it is not one of the more-common species. If you recognize any of these rarer whales by species or any of the dolphins, please include your identification in the answer.

Sometimes a picture has two species of whales in it. Please give a response for each type of whale.

For each photograph, choose one or two of the following answers and write it on the line below each picture.

Humpback
Finback
Minke
Pothead (Pilot Whale)
Porpoise/Dolphin
Can't tell
I don't know
Small Whale (less than 30 feet)
Large Whale (more than 30 feet)

Other - Sperm Whale
Sei Whale
Killer Whale (Orca)
Right Whale
White Beaked Dolphin
White-Sided Dolphin
Harbour Porpoise

Please send the completed questionaire to:
Whale Research Group
Memorial University of Newfoundland
St. John's, Nfld.
A1B 9Z9

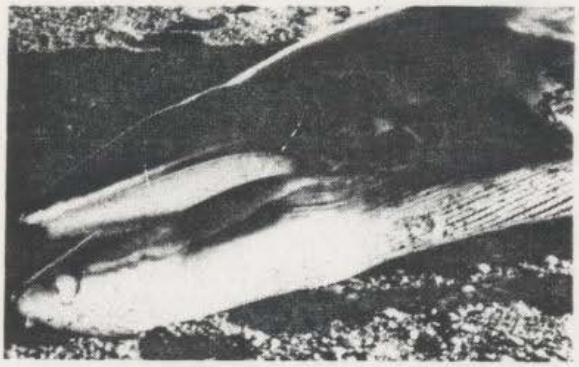
An addressed envelope has been enclosed for this purpose.
Thank you for your cooperation.

1

Can't Tell ± Small Whale (Pilot Whale)

1

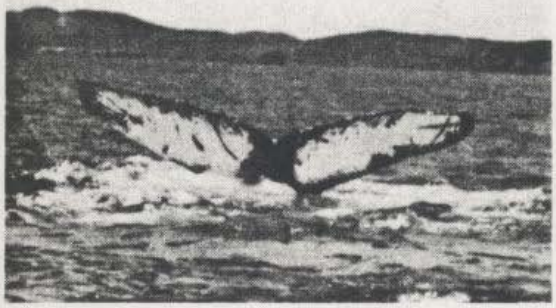
2



Minke

2

3



Humpback

3

4

Orca, Killer Whale

4

5

Humpback

5

6

Humpback

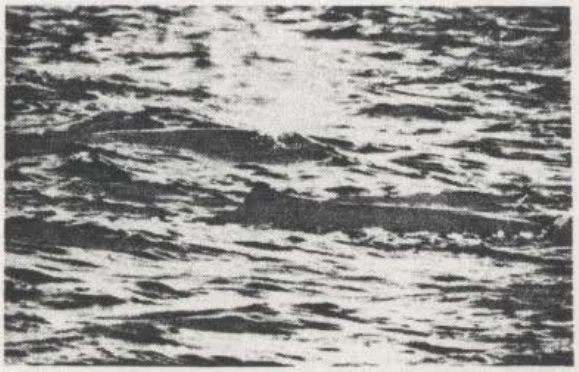
6

7

Minke (Fin)

7

8



Sperm (Humpback, Large Whale, Can't Tell)

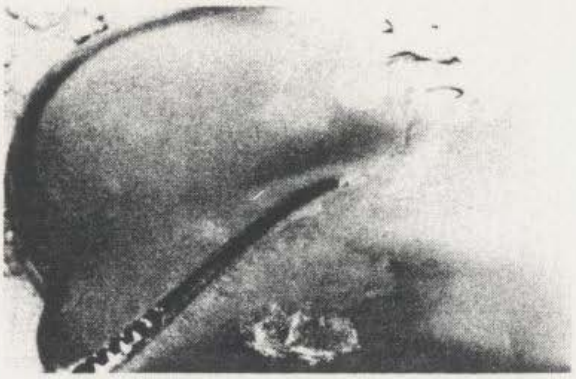
8

9

White-beaked Dolphin, Dolphin,
Lagenorhynchus sp.,(White-sided Dolphin)

9

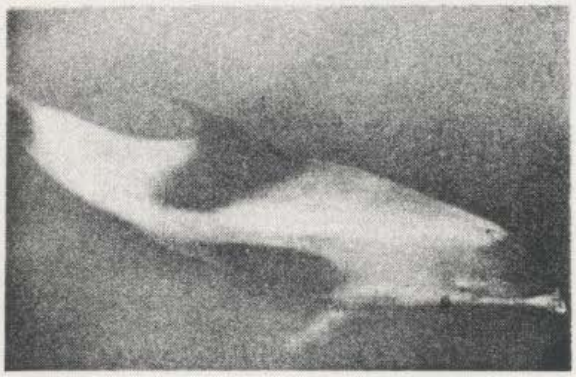
10



Pilot Whale

10

11



11 White-beaked Dolphin (Dolphin)

12

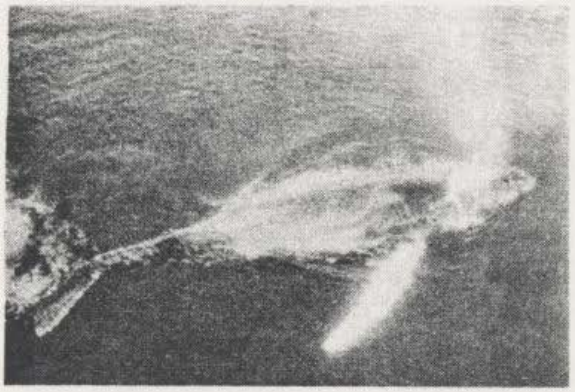
Orca, Killer Whale

12

13

13 Humpback

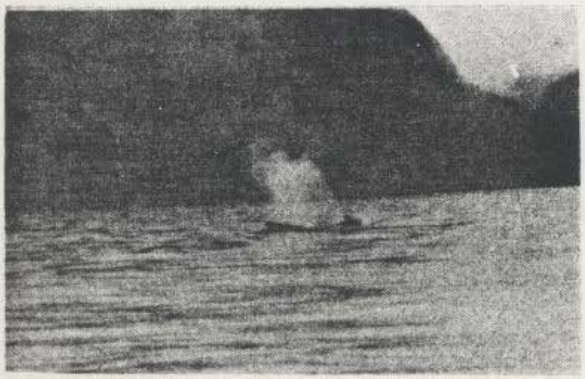
14



Humpback

14

15



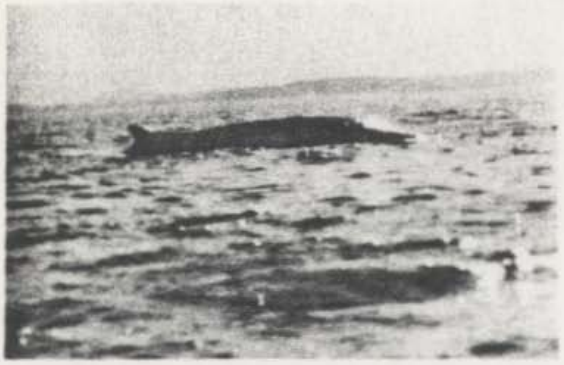
15 Humpback (Large Whale)

16

Humpback (Can't Tell, Large Whale,
Humpback? or Blue?)

16

17

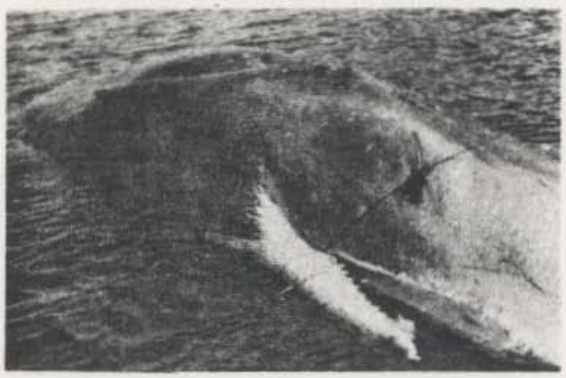


17 Finback (Large Whale, Sei)

18

Sei, Finback (Minke) 18

19



19 Sperm Whale

20

White-beaked Dolphin (Dolphin, Lagenorhynchus sp. White-sided Dolphin) 20

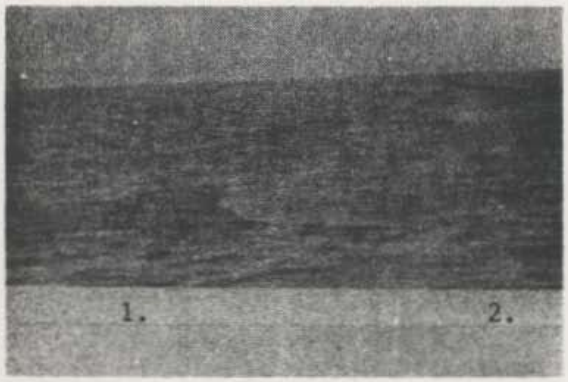
21

21 EXCLUDED FROM TEST

22

Humpback 22

23



23 1. Humpback & 2. Finback (Large Whale, Humpback? Finback?, Sei?)

24

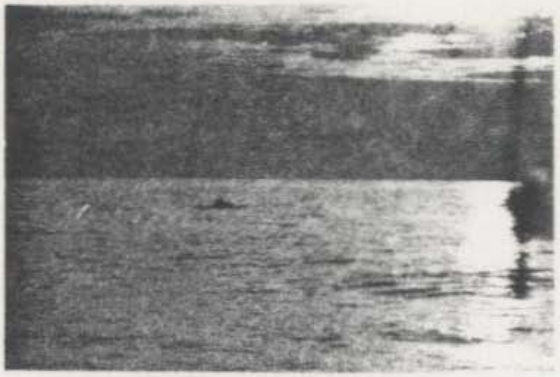
Pilot Whale 24

25

Humpback

25

26



Can't Tell Humpback?

26

27

1. Orca, Killer Whale
& 2. Can't Tell ± Humpback?, Large Whale

27

28

Humpback

28

29

White-beaked Dolphin (Dolphin,
Lagenorhynchus sp. White-sided Dolphin)

29

30

Pilot Whale (Minke, Small Whale)

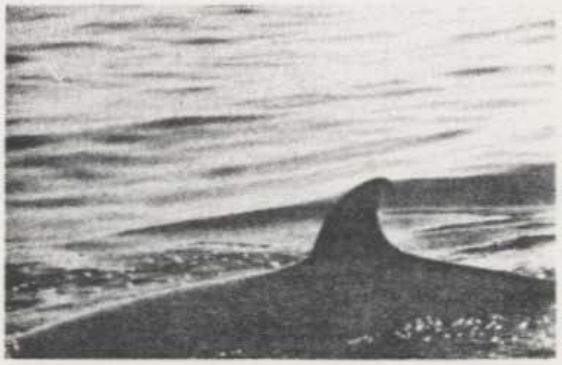
30

31

Humpback

31

32



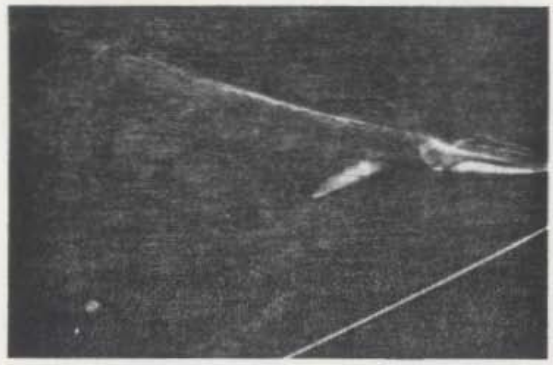
Minke

32

33

33 Humpback

34



34 Finback

35

35 Humpback (Large Whale)

36

36 White-beaked Dolphin, Lagenorhynchus sp., Dolphin, White-sided Dolphin

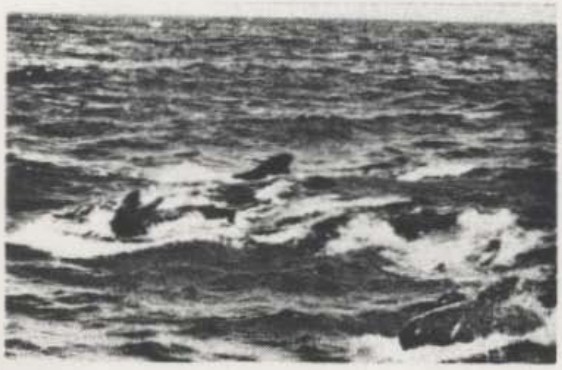
37

37 Humpback (Large Whale)

38

38 Finback

39

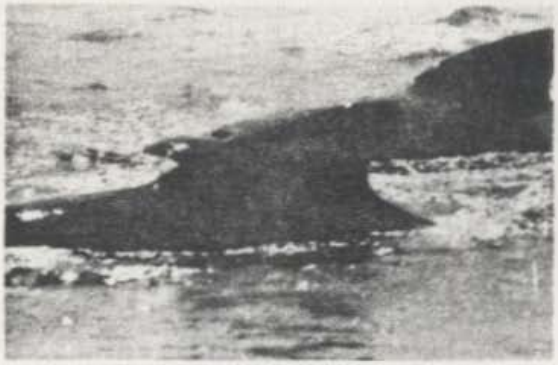


39 Pilot Whale

40

40 Can't Tell ± Large Whale or Humpback?

41



41 Pilot Whale

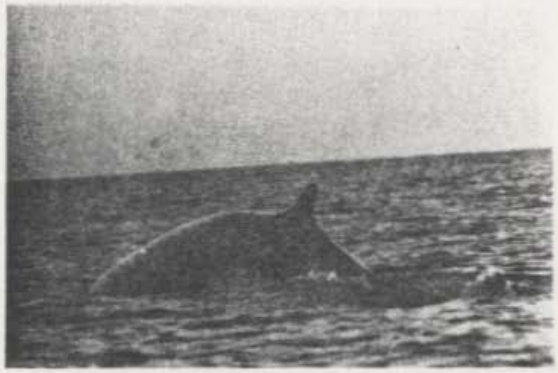
42

Humpback (Large Whale) 42

43

43 Pilot Whale

44



Finback, Minke (Can't Tell, Large Whale, Small Whale) 44

45

45 Right Whale (Large Whale, Other)

46

Finback, Minke (Sei) 46

47

47 Pilot Whale

48

Minke (Can't Tell ± Small Whale) 48

APPENDIX 4

Locations of land-based observers, 1979 - 1982.

Asterisks designate observers who completed the whale identification tests. LHK = lighthouse keeper, NDB = Notre Dame Bay, BB = Bonavista Bay, TB = Trinity Bay, CB = Conception Bay, Trep B = Trepassey Bay, SMB = St. Mary's Bay, FB = Fortune Bay, HB = Hermitage Bay.

Area Section	Location (Lat./Long.)	Stat Area	Observer Type 1979	1980	1981	1982	Number of Tested Observers
1	Gull Is Cape St John, NDB 50°00'N, 55°22'W	6		LHK	LHK		0
1	Surgeon's Cv Hd Exploits Is, NDB 49°31'N, 55°07'W	7		LHK*	LHK*	LHK	1
1	Long Point, Twillingate, NDB 49°41'N, 54°48'W	7		LHK	LHK	LHK	0
1	Baccalao Is, New World Is, NDB 49°41'N, 54°33'W	7		LHK	LHK	LHK	0
2	Peckfords Is, NDB 49°32'N, 53°51'W	9		LHK	LHK*	LHK*	1
2	Cabot Is, BB 49°10'N, 53°22'W	10		LHK	LHK		0
2	Puffin Is, BB 49°04'N, 53°33'W	10		LHK*	LHK*	LHK	1
2	Cape Bonavista 48°42'N, 53°05'W	14		LHK*	LHK*	LHK*	2
2	Spiller's Cove 48°40'N, 53°05'W	14		AF(1)			0
2	Green Is Catalina,TB 48°30'N, 53°03'W	14		LHK*	LHK*		2
2	Melrose, TB 48°29'N, 53°04'W	14		AF(1)			0
3	St. Brendans, BB 48°53'N, 53°39'W	11		MWW AF(7)		MWW	0 0
3	Salvage, BB 48°42'N, 53°39'W	12	MWW* AF(1)	MWW*			1 0
3	Terra Nova National Park, BB 48°30'N, 53°40'W	12		LHK*			1
3	Newman Sd, BB 48°31'N, 53°32'W	12	MWW*	MWW*			1

(continued next page)

APPENDIX 4 (Continued)

Area Section	Location (Lat./Long.)	Stat Area	Observer Type 1979	1980	1981	1982	Number of Tested Observers
3	Clode Sound, BB 48°30'N, 54°00'W	12		MWW			0
3	Plate Cove West 48°31'N, 53°32'W	12		MWW*		MWW*	1
				AF(1)			0
3	Keels, BB 48°40'N, 53°31'W	13		AF(2)			0
3	Bonavista, BB 48°39'N, 53°08'W	13	AF(1)	AF(6)			0
				MWW*			1
4	Horse Chops, TB 48°21'N, 53°13'W	15		LHK*	LHK*		1
					MWW*		1
4	Fort Pt, Trinity TB 48°22'N, 53°21'W	15			LHK		0
4	Old Bonaventure, TB 48°17'N, 53°24'W	16		MWW*			1
4	Bull Arm, TB 47°50'N, 53°50'W	17			MWW*		1
4	Chance Cove, TB 47°45'N, 53°55'W	17	AF(3)				0
4	Tickle Bay, TB 47°43'N, 53°47'W	17	AF(1)				0
4	Collier Bay, TB 47°41'N, 53°41'W	17	AF(1)				0
4	Long Cove, TB 47°40'N, 53°40'W	17	AF(1)				0
4	Norman's Cove, TB 47°31'N, 53°38'W	17	AF(2)				0
4	Chapel Arm, TB 47°30'N, 53°36'W	17	AF(2)				0
4	New Harbour, TB 47°36'N, 53°34'W	17		MWW*			1
4	Hopeall, TB 47°38'N, 53°34'W	18	AF(1)				0
4	Cavendish, TB 47°43'N, 53°26'W	18		AF(2)			0
4	Islington, TB 47°45'N, 53°25'W	18		AF(3)			0
4	Heart's Delight, TB 47°46'N, 53°25'W	18		AF(4)			0
4	Heart's Desire, TB 47°49'N, 53°24'W	18		AF(2)			0
4	Sibley's Cove, TB 48°02'N, 53°08'W	19		AF(8)			0
5	Grates Cove Bay de Verde Pen 48°12'N, 52°57'W	20		AF(11)			0

(continued next page)
APPENDIX 4 (Continued)

Area Section	Location (Lat./Long.)	Stat Area	Observer Type 1979	1980	1981	1982	Number of Tested Observers
5	Baccalieu Is Bay de Verde Pen 48°06'N, 52°49'W	20	MWW	LHK*	LHK*		1
5	Bay de Verde, CB 48°07'N, 52°50"W	20		AF(12)			0
5	Capelin Cove, CB 48°04'N, 52°53'W	20		AF(1)			0
5	Lower Island Cove,CB 48°01'N, 52°56'W	20		AF(5)			0
5	Job's Cove, CB 47°53'N, 53°02'W	20		AF(1)			0
5	Bay Roberts, CB 47°35'N, 53°15'W	21	MWW*				1
5	Port-de-Grave, CB 47°36'N, 53°13'W	21		AF(6)			0
5	Cape St Francis 47°49'N, 52°47'W	24		LHK	LHK		0
5	Pouch Cove 47°46'N, 52°45'W	24	AF(1)	AF(10) MWW			0 0
5	Flatrock 47°42'N, 52°42'W	24		AF(1)			0
5	Torbay 47°39'N, 52°43'W	24		AF(1)			0
5	Logy Bay 47°37'N, 52°41'W	24		MWW			0
6	Harbour Main, CB 47°28'N, 53°09'W	22				MWW	0
6	Foxtrap, CB 47°30'N, 53°00'W	22		AF(11)			0
6	Topsail, CB 47°32'N, 52°54'W	23		AF(1)			0
6	Bell Is, CB 47°39'N, 52°55'W	23		LHK	LHK		
6	St Phillips, CB 47°36'N, 52°53'W	23	MWW	MWW*	MWW*	MWW*	1
7	Cape Spear 47°31'N, 52°37'W	25		LHK MWW			0 0
7	Petty Hr 47°28'N, 52°41'W	25	MWW*	MWW*	MWW*		1
7	Bay Bulls 47°19'N, 52°45'W	25		AF(4)			0
7	Witless Bay 47°17'N, 52°47'W	25		AF(2)	MWW*		1

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APPENDIX 4 (Continued)

Area Section	Location (Lat./Long.)	Stat Area	Observer Type 1979	1980	1981	1982	Number of Tested Observers
7	Gull Is, Witless B 47°15'N, 52°46'W	25	MWW*	MWW*	MWW	MWW*	2
7	Mobile 47°15'N, 52°50'W	25			MWW*		1
7	Tors Cove 47°11'N, 52°49'W	25				MWW*	1
7	Burnt Cove 47°10'N, 52°49'W	25		AF(1)			0
7	Cape Neddick 47°07'N, 52°50'W	25			MWW*		1
8	Cape Broyle 46°39'N, 53°04'W	26			MWW*		1
8	Aquaforte 47°00'N, 52°54'W	26		AF(6)			0
8	Fermeuse 46°56'N, 52°54'W	26	AF(3)	AF(2)			0
8	Bear Cv Pt 46°56'N, 52°54'W	26	AF(2)				0
8	Renews 46°56'N, 52°57'W	26	AF(1)	AF(9)			0
8	Chance Cv, Avalon Pen 46°46'N, 52°59'W	26	AF(1)				0
8	Cape Race 46°39'N, 53°04'W	27		LHK	LHK	LHK	0
8	Powles Hd, Trep B 46°41'N, 53°24'W	27		LHK			0
8	Portugal Cv S, Trep B 46°43'N, 53°14'W	27		AF(5)			0
8	Biscay Bay, Trep B 46°43'N, 53°17'W	27		AF(1)			0
8	Trepassey, Trep B 46°43'N, 53°23'W	27		AF(9)			0
9	Cape Pine 46°37'N, 53°32'W	28			LHK	LHK	0
9	St Shott's 46°38'N, 53°35'W	28	AF(2)	AF(2)			0
9	St Shott's-Gaskiers 46°42'N, 53°38'W	28		AF(7)			0
9	St Stephens, SMB 46°46'N, 53°35'W	28	AF(4)				0
9	St Vincents, SMB 46°47'N, 53°38'W	28	MWW*	MWW* AF(13)	MWW*		1 0
9	Gaskiers, SMB 46°53'N 53°37'W	28	AF(4)	MWW*	MWW*		1

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APPENDIX 4 (Continued)

Area Section	Location (Lat./Long.)	Stat Area	Observer Type 1979	1980	1981	1982	Number of Tested Observers
9	Gaskiers-St Vincent 46°50'N, 53°40'W	28	AF(1)				0
9	Pt La Haye, SMB 46°54'N, 53°37'W	28		LHK	LHK		0
9	Riverhead, SMB 46°59'N, 53°32'W	28	AF(1)				0
9	Peters River, SMB 46°45'N, 53°36'W	28	AF(1)				0
9	Cape St Mary's 46°49'N, 54°12'W	29	MWW	MWW*			1
9	St Bride's, PB 46°55'N, 54°11'W	29		AF(1)			0
10	Colinet Is, SMB 47°01'N, 53°41'W	30		MWW*			1
10	Southern Harbour, PB 47°42'N, 54°00'W	30	AF(1)				0
10	Butler Island, PB 47°36'N, 54°06'W	30	AF(1)				0
10	Marticot Is, PB 47°20'N, 54°35'W	31		LHK	LHK		0
10	Little Burin Is, PB 46°59'N, 55°11'W	32		LHK	LHK*	LHK*	1
10	Allan's Is, Burin Peninsula 46°51'N, 55°48'W	32		LHK*	LHK*	LHK*	1
11	Green Is, FB 46°53'N, 56°06'W	33		LHK	LHK*	LHK*	1
			MWW*	MWW*			1
11	Fortune Hd, FB 47°04'N, 55°52'W	33		LHK			
11	Pass Is, HB 47°29'N, 56°12'W	36		LHK*	LHK*	LHK*	1
11	Dawson's Pt, HB 47°39'N, 56°09'W	36		LHK*	LHK		1
11	Francois, HB 47°33'N, 56°45'W	36		LHK*	LHK*	LHK*	1
12	Penguin Is West 47°23'N, 56°59'W	37		LHK	LHK	LHK	0
12	Ramea 47°31'N, 57°25'W	37		LHK	LHK		0
12	Boar Is 47°36'N, 57°35'W	37		LHK	LHK		0
13	Columbier Is, Burnt Islands 47°35'N, 58°54'W	39		LHK	LHK		0

(continued next page)

APPENDIX 4 (Continued)

Area Section	Location (Lat./Long.)	Stat Area	Observer Type 1979	1980	1981	1982	Number of Tested Observers
13	Channel Head, Port-aux-Basques 47°34'N, 59°07'W	39		LHK*	LHK*	LHK*	1
13	Cape Ray 47°37'N, 59°18'W	40		LHK	LHK	LHK	0
13	Cape Anguille 47°54'N, 59°25'W	40		LHK	LHK	LHK	0
13	Cape St George 48°30'N, 59°15'W	41		MWW			0
14	Bay of Islands 49°10'N, 58°15'W	44				MWW	0
14	Bonne Bay 49°35'N, 57°55'W	45	MWW	MWW	MWW*		1
14	Feroile Pt 51°01'N, 57°06'W	49		LHK	LHK		0
14	Kepple Is, St Barbe 50°38'N, 57°19'W	49				LHK	0
14	Blanc Sablon 51°25'N, 57°09'W	49				MWW	0
15	Pt Amour, Labrador 51°27'N, 56°52'W	50		LHK MWW			0 0
15	Red Bay, Labrador 51°44'N, 56°26'W	50		LHK*		LHK*	1
15	Camp Islands, Labrador 52°10'N, 55°39'W	50		LHK		LHK	0
15	Belle Isle SW 51°53'N, 55°23'W	1		LHK	LHK		0
15	Belle Isle NE 52°01'N, 55°17'W	1		LHK	LHK	LHK	0
15	Cape Norman 51°38'N, 55°55'W	1		LHK	LHK		0
15	Cape Bauld 51°38'N, 55°26'W	1			LHK		0

APPENDIX 5

Description of sampling effort from the principal observer locations

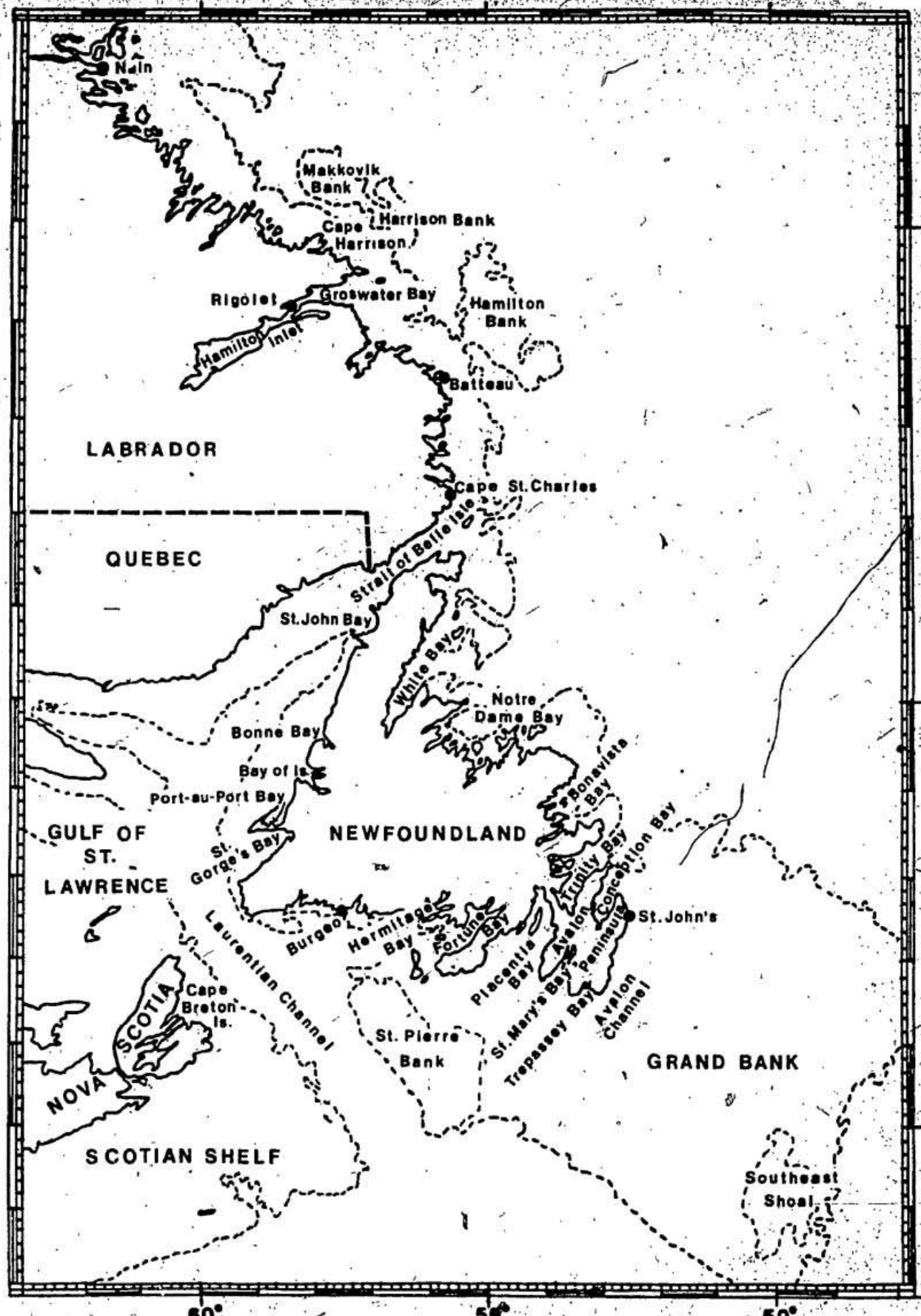
Summary of the months and years sampled from each of the principal observer locations in Newfoundland and Labrador. Asterisks designate years with data submitted by observers tested for reliability at whale identification. LHK = lighthouse keepers, MWW = network whale watchers, AF = alarm experiment fishermen, NDB = Notre Dame Bay, BB = Bonavista Bay, TB = Trinity Bay, CB = Conception Bay, SMB = St. Mary's Bay, FB = Fortune Bay, HB = Hermitage Bay.

Area Section	Location (Lat./Long.)	Observer Type (#Obsrs)	Stat Area	1979	1980	1981	1982	Months Common to ≥ 2 Years
1	Surgeon's Cv Hd NDB 49°31'N, 55°07'W	LHK(3)	1		*5-9	*6-8	9-10	6-9
1	Long Point, NDB 49°41'N, 54°48'W	LHK(1)	7		5-12	1-9+ 11-12	1-10	1-12
1	Baccalao Is, NDB 49°41'N, 54°33'W	LHK(2)	7		6-7	6-8	6-7	6-7
2	Peckfords Is, NDB 49°32'N, 53°51'W	LHK(2)	9		6	*5-7	*6-7	6-7
2	Puffin Is, BB 49°04'N, 53°33'W	LHK(4)	10		*6	*5-9	6-7	6-7
2	Cabot Is, BB 49°10'N, 53°22'W	LHK(2)	10		5+7	4+5+7+8		5+8
3	St Brendan's, BB 48°53'N, 53°39'W	MWW(1) AF(7)	11		6-9		6-8	6-8
3	Salvage, BB 48°42'N, 53°39'W	MWW(1) AF(1)	12	*5+6 +8	*7+8			8
3	Plate Cove West, BB 48°31'N, 53°32'W	MWW(1) AF(1)	12		5-9		*5-8	5-8
3	Cape Bonavista 48°42'N, 53°05'W	LHK(2)	14	*6-7	*6	*1-7	*5-7+10	*5-7
4	Green Is, TB 48°30'N, 53°03'W	LHK(3)	14		*5-8	*5-8+11		*5-8
5	Baccalieu Is 48°06'N, 52°49'W	LHK(3) MWW(1)	20	6-7	*6-8	*5-7		6-7
6	Bell Is, CB 47°39'N, 52°55'W	LHK(1)	23		5-10+12	1-11		5-10
6	St Phillips, CB 47°36'N, 52°53'W	MWW(2)	23	4-8	*5-9	*4-9	*5-7	4-7
7	Petty Harbour 47°28'N, 52°41'W	MWW(1)	25	*6-11	*6-11	*5-10		6-11
7	Gull Is, Witless B 47°15'N, 52°46'W	MWW(2)	25	*4-8	*5-8	*5+7	*6-8	5-8
8	Fermeuse 46°56'N, 52°54'W	AF(5)	26	6-8	6-7			6-7

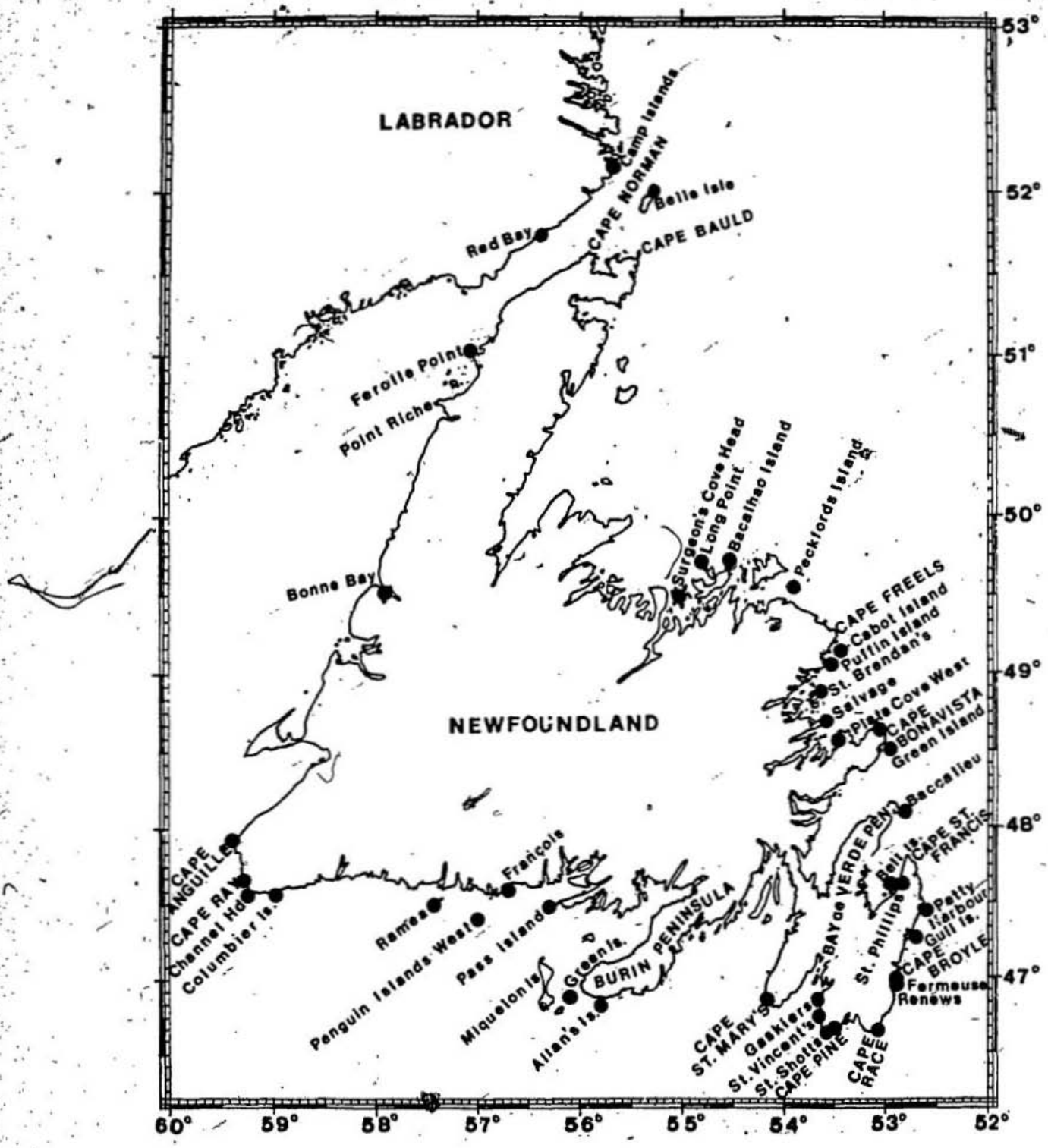
(continued next page)

APPENDIX 5 (Continued)

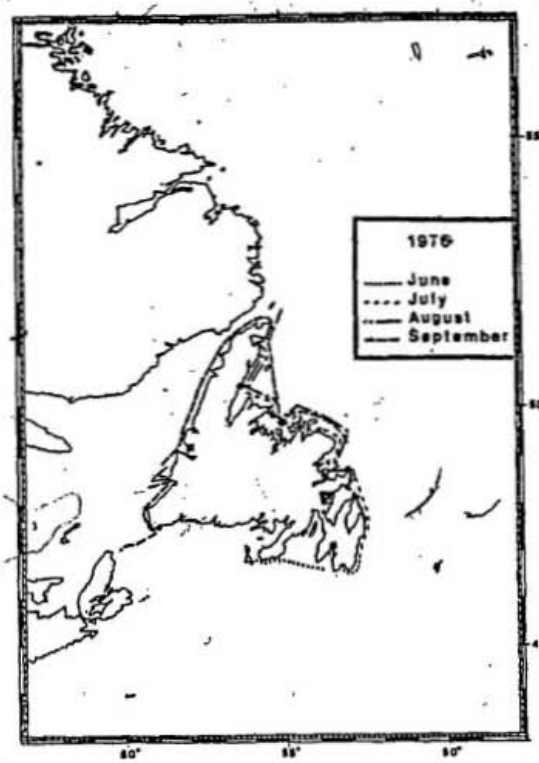
Area Section	Location (Lat./Long.)	Observer Type (#Obsrs)	Stat Area	1979	1980	1981	1982	Months Common to ≥ 2 Years
8	Renews 46°56'N, 52°57'W	AF(2)	26	7	6–8			7
8	Cape Race 46°39'N, 53°04'W	LHK(2)	27		7–8	6+8	6–9	6–8
9	Cape Pine 46°37'N, 53°32'W	LHK(1)	28			6–7	1–7	6–7
9	St Shotts 46°38'N, 53°35'W	AF(2)	28	7	6–8			7
9	St Vincent's, SMB 46°47'N, 53°38'W	MWW(1) AF(13)	28	*6–7	6–7			6–7
9	Gaskiers, SMB 46°53'N, 53°37'W	MWW(1) AF(4)	28	6–7	6–7	*6–7		6–7
9	Cape St Mary's 46°49'N, 54°12'W	MWW(3)	29	6–7	*5+7–8			6–7
10	Allan's Is 46°51'N, 55°48'W	LHK(1)	32		*5–8	*1–12	*1–12	1–12
11	Green Is, FB 46°53'N, 56°06'W	LHK(2) MWW(1)	33	*5–6	*5–7	*3–8 +10–11	*5–11	5–8 +10–11
11	Pass Is, HB 47°29'N, 56°12'W	LHK(1)	36		5–7+12	1–8	4–9	4–8
11	Francois, HB 47°33'N, 56°45'W	LHK(2)	36		*4–10 +12	*1–3 5–8+10	*4–11	4–10
12	Penguin Is West 47°23'N, 56°59'W	LHK(4)	37		5–9+12	1–6	6+10–11	5–6
12	Ramea 47°31'N, 57°25'W	LHK(1)	37		5–10	4–9		5–9
13	Columbier Is, 47°35'N, 58°54'W	LHK(2)	39		5–12	1–6		5–6
13	Channel Head, 47°34'N, 59°07'W	LHK(1)	39		5–12	1–11	1–9	1–11
13	Cape Ray 47°37'N, 59°18'W	LHK(1)	40		5–8	4–7	5+7	5–7
13	Cape Anguille 47°54'N, 59°25'W	LHK(1)	40		5–8	4–10	4–8 +10+12	4–8+10
14	Bonne Bay 49°35'N, 57°55'W	MWW(3)	45	5–7+9	*5–8	5		5–7
14	Feroile Pt 51°01'N, 57°06'W	LHK(1)	49		5–10	4–9		5–9
15	Red Bay, Labrador 51°27'N, 56°52'W	LHK(1)	50		5–6		5–12	5–6
15	Camp Is, Labrador 52°10'N, 55°39'W	LHK(1)	50		7–8		6–7	7
15	Belle Isle NE 52°01'N, 55°17'W	LHK(2)	1		5–6	5–12	5–7	5–7



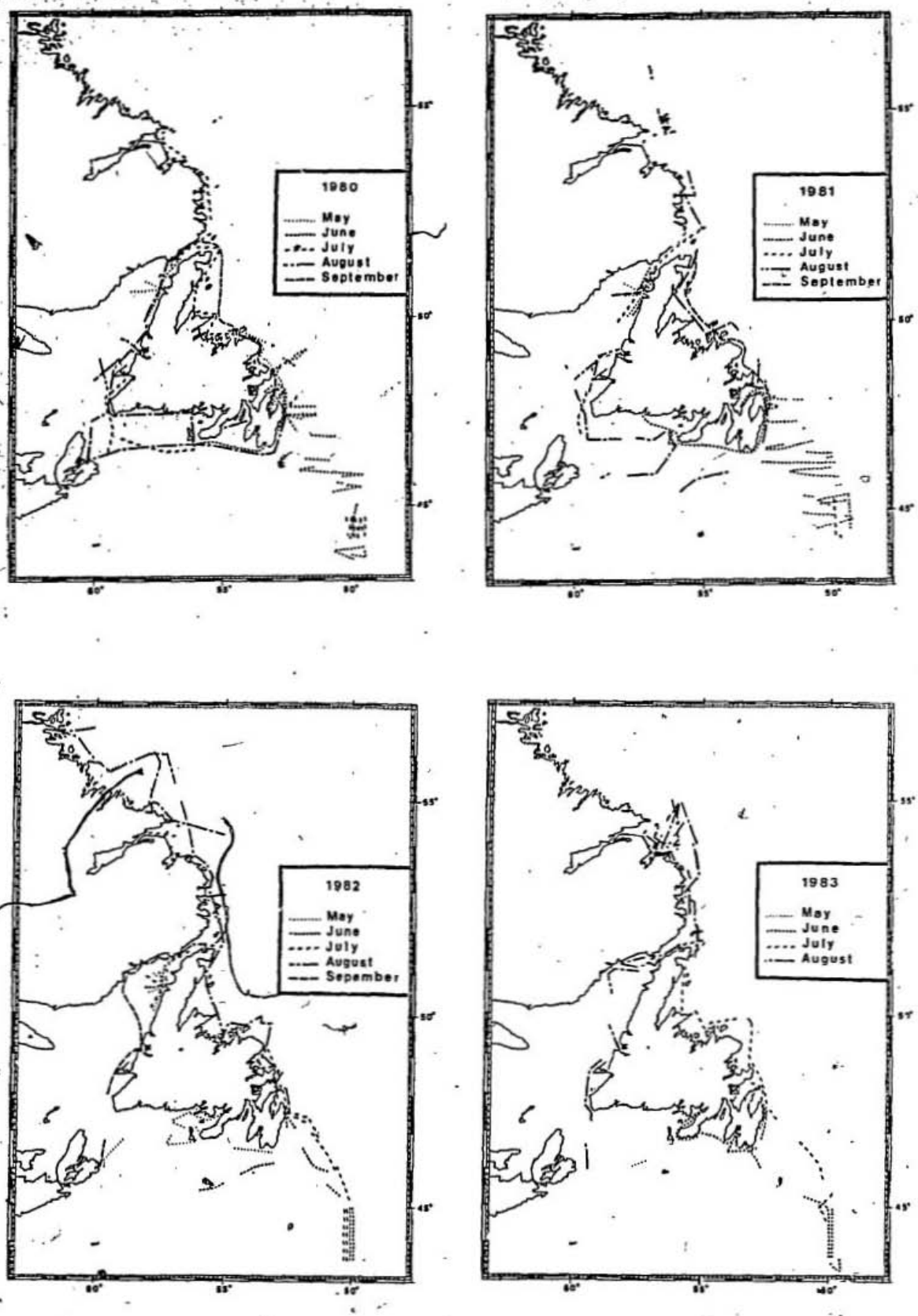
Appendix 6. Place names mentioned in the text.



Appendix 7. Principal observer locations.



Appendix 8. The 1976-1979 vessel routes in the shipboard study area.



Appendix 8. The 1980–1983 vessel routes in the shipboard study area.

APPENDIX 9

Description of the locations of LHK and MWW excluded from the results. Information is provided on their location, observation period, species reported (with the months of the sightings), and the species for which they were indicated to be unreliable at identifying. Observer numbers, unique to each land-based participant, are listed underneath the statistical areas.

Location (Lat./Long.)	Area Sect	Stat Area (Obsr)	Observation Period	Species Reported	Months of Sightings	Unreliably Identified Species
Terra Nova Park Bonavista Bay 48°30'N, 53°40'W	1	12 (134)	5-9/80	H,M,P	H:8/80 M:6-8/80 P:5-7/80	F
Cape Bonavista 48°42'N, 53°05'W	2	14 (32)	6/80,1-7/81 5-6/82	H,F,M,P	H:6/80,82 4-7/81,5-6/82 F:6/81 M,P:6-7/81,6/82	F
Cape Bonavista 48°42'N, 53°05'W	2	14 (33)	7/82	H,M	H,M:7/82	F
Green Is, Catalina Trinity Bay 48°30'N, 53°03'W	2	14 (71)	7/80,6/81	H,M	H:7/80,6/81 M:6/81	H,F,P
Plate Cove West Bonavista Bay 48°31'N, 53°32'W	3	12 (147)	5-8/82	H	H:5-7/82	H,P
Bay Roberts Conception Bay 47°36'N, 53°16'W	5	21 (172)	4-7/79	H,M	H:6-7/79 M:4-8/79	F
Logy Bay 47°37'N, 52°41'W	5	24 (183)	6/82	M	M:6/82	F,M
Signal Hill 47°34'N, 52°41'W	5	24 (183)	7/81	H	H:7/81	F,M
St Phillips Conception Bay 47°36'N, 52°53'W	6	23 (182)	5-9/80 4-9/81 5-7/82	H,M,P	H:7/80 M:7/80,5-7/82 P:6+9/80,4-9/81 7/82	F
Cape Spear 47°31'N, 52°37'W	7	25 (183)	7/81	P	P:7/81	F,M

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APPENDIX 9 (continued).

Location (Lat./Long.)	Area Sect	Stat Area (Obsr)	Observation Period	Species Reported	Months of Sightings	Unreliably Identified Species
Gull Is, Witless Bay 47°15'N, 52°46'W	7	25 (195)	5+7-8/79 5/80,6-8/82	H,M	H:6-8/79,5/80 6-8/82 M:6+8/79,6-8/82	F
Little Burin Is. Placentia Bay 46°59'N, 55°11'W	10	32 (86)	6-7/81	H,F,M,P	H:6/81 F:7/81 M:7/81 P:8/82	M,P
Dawson's Pt., Hermitage Bay 47°39'N, 56°09'W	11	36 (57)	5-6/80	H	H:5-6/80	F,M,P
Channel Head, Port-aux-Basques 47°34'N, 59°07'W	13	39 (18)	5-12/80 1-11/81 1-6+8-12/82	F,M,P	F:5/80 M:6/80 P:5-6/80	H,M
Red Bay, Labrador 51°44'N, 56°26'W	15	50 (116)	5-6/80	H,M	H:6/80 M:6/80	M

APPENDIX 10.

Monthly distibution of humpback whales from land-based data.

Columns headings are identified in the legend for Table 11. 'North' - Notre Dame Bay on the north coast of Newfoundland and the Labrador coast of the Strait of Belle Isle (including Belle Isle). 'East' - east coast of Newfoundland from Cape Broyle to Peckford's Island. 'South' - south coast of Newfoundland from Cape Race to Burgeo.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
December-February:									
North	1+15	18	2	0	0	20	2	0.100	0.100
East	2- 7	26	3	1	0	30	5	0.133	0.167
South	8-12	53	4	1	0	58	6	0.086	0.103
March-April:									
North	1+15	9	0	1	0	10	2	0.100	0.200
East	2- 7	25	5	0	2	32	11	0.219	0.344
South	8-12	56	7	3	0	66	13	0.152	0.197
May:									
North	1+15	22	3	3	9	36	36	0.417	1.000
East	2- 7	62	15	3	0	80	21	0.225	0.262
South	8-12	50	26	14	0	54	54	0.444	0.600
June:									
North	1+15	32	16	7	9	64	57	0.500	0.891
East	2- 7	92	48	29	18	187	160	0.508	0.856
South	8-12	67	45	35	12	159	151	0.579	0.950
July:									
North	1+15	35	11	6	7	59	44	0.407	0.746
East	2- 7	117	68	63	28	276	278	0.576	1.007
South	8-12	103	57	31	3	194	128	0.469	0.660
August:									
North	1+15	23	12	4	2	41	26	0.439	0.634
East	2- 7	76	20	17	13	126	93	0.397	0.738
South	8-12	48	26	5	3	82	42	0.415	0.512
September:									
North	1+15	20	6	0	0	26	6	0.231	0.231
East	2- 7	41	5	3	3	52	20	0.212	0.385
South	8-12	33	16	3	0	52	22	0.365	0.423
October-November:									
North	1+15	24	7	2	0	33	11	0.273	0.333
East	2- 7	26	2	0	0	28	2	0.071	0.071
South	8-12	54	13	2	0	69	17	0.217	0.246

APPENDIX 11

Monthly distibution of humpback whales from shipboard data.

Column headings are identified in the legend for Table 12. 'North' - east coasts of Labrador and Newfoundland, from Notre Dame Bay to Nain. 'East' - east coast of Newfoundland from Cape Broyle to Peckford's Island. 'South' - the Southeast Shoal and south coast of Newfoundland from Cape Race to the Laurentian Channel.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
May:									
North	1- 8					0			
East	9-12	31	2	0	0	33	2	0.061	0.061
South	14-16	9	1	0	0	10	1	0.100	0.100
June:									
North	1- 8					0			
East	9-12	94	21	15	3	133	60	0.293	0.451
South	14-16	42	9	11	1	63	21	0.333	0.540
July:									
North	1- 8	106	19	6	0	131	31	0.191	0.237
East	9-12	92	25	23	10	150	101	0.387	0.673
South	14-16	8	5	1	2	16	13	0.500	0.812
August:									
North	1- 8	103	15	7	9	134	56	0.231	0.418
East	9-12	56	10	9	3	78	37	0.282	0.474
South	14-16	36	1	0	0	37	1	0.027	0.027
September:									
North	1- 8	36	12	2	0	50	16	0.280	0.320
East	9-12	39	2	0	1	42	5	0.071	0.119
South	14-16					0			

APPENDIX 12

Observer network results x month x land-based section for humpback whales

Column headings are identified in the legend to Table 3, Section 3.2.1

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
December to February:										
1	6,7	13	2	0	0	15	2	0.1333	0.1333	4
2	9,10,14	9	0	0	0	9	0	0.0000	0.0000	8
3	11,12,13					0				
4	15 - 19	4	3	1	0	8	5	0.5000	0.6250	1
5	20,21,24					0				
6	22,23	13	0	0	0	13	0	0.0000	0.0000	8
7	25					0				
8	26,27	8	0	0	0	8	0	0.0000	0.0000	8
9	28,29					0				
10	30,31,32	18	0	0	0	18	0	0.0000	0.0000	8
11	33,36	19	4	1	0	24	6	0.2083	0.2500	2.5
12	37	8	0	0	0	8	0	0.0000	0.0000	8
13	39,40,41	14	0	0	0	14	0	0.0000	0.0000	8
14	44,45,49	3	1	0	0	4	1	0.2500	0.2500	2.5
15	1,50	5	0	0	0	5	0	0.0000	0.0000	8
March and April:										
1	6,7	9	0	0	0	9	0	0.0000	0.0000	9.5
2	9,10,14	6	3	0	2	11	9	0.4545	0.8182	2
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24	5	2	0	0	7	2	0.2857	0.2857	4
6	22,23	11	0	0	0	11	0	0.0000	0.0000	9.5
7	25	3	0	0	0	3	0	0.0000	0.0000	9.5
8	26,27	9	0	0	0	9	0	0.0000	0.0000	9.5
9	28,29	9	0	1	0	10	2	0.1000	0.2000	5
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	9.5
11	33,36	20	7	2	0	29	11	0.3103	0.3793	3
12	37	3	0	0	0	3	0	0.0000	0.0000	9.5
13	39,40,41	12	0	0	0	12	0	0.0000	0.0000	9.5
14	44,45,49	9	0	0	0	9	0	0.0000	0.0000	9.5
15	1,50	0	0	1	0	1	2	1.0000	2.0000	1

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APPENDIX 12 (continued)

Observer network results x month x land-based section for humpback whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
May:										
1	6,7	11	1	0	0	12	1	0.0833	0.0833	11.5
2	9,10,14	18	8	2	0	28	12	0.3571	0.4286	3.5
3	11,12,13	4	0	0	0	4	0	0.0000	0.0000	14.5
4	15 - 19	6	2	0	0	8	2	0.2500	0.2500	6.5
5	20,21,24	7	0	1	0	8	2	0.1250	0.2500	9
6	22,23	18	2	0	0	20	2	0.1000	0.1000	11.5
7	25	9	3	0	0	12	3	0.2500	0.2500	6.5
8	26,27	4	0	0	0	4	0	0.0000	0.0000	14.5
9	28,29	1	7	0	0	8	7	0.8750	0.8750	1.5
10	30,31,32	23	2	1	0	26	4	0.1154	0.1538	11.5
11	33,36	14	14	13	0	41	40	0.6585	0.9756	1.5
12	37	8	3	0	0	11	3	0.2727	0.2727	6.5
13	39,40,41	23	7	0	0	30	7	0.2333	0.2333	6.5
14	44,45,49	12	2	0	0	14	2	0.1429	0.1429	11.5
15	1,50	10	2	3	9	24	35	0.5833	1.4583	3.5
June:										
1	6,7	20	3	2	0	25	7	0.2000	0.3600	10
2	9,10,14	9	11	7	9	36	52	0.7500	1.4444	1
3	11,12,13	11	4	1	0	16	6	0.3125	0.3750	10
4	15 - 19	26	6	2	1	35	15	0.2571	0.4286	13
5	20,21,24	15	10	8	4	37	38	0.5946	1.0270	6.5
6	22,23	22	6	4	0	32	14	0.3125	0.4375	10
7	25	9	11	7	4	31	37	0.7097	1.1935	3.5
8	26,27	12	5	9	5	31	38	0.6129	1.2258	5
9	28,29	15	9	11	4	39	43	0.6154	1.1026	6.5
10	30,31,32	17	6	0	0	23	6	0.2609	0.2609	14
11	33,36	9	17	15	3	44	56	0.7954	1.2727	2
12	37	14	8	0	0	22	8	0.3636	0.3636	10
13	39,40,41	29	4	0	0	33	4	0.1212	0.1212	15
14	44,45,49	12	5	0	0	17	5	0.2941	0.2941	10
15	1,50	12	13	5	9	39	50	0.6923	1.2820	3.5
July:										
1	6,7	13	5	6	5	29	32	0.5517	1.1034	4
2	9,10,14	6	4	16	15	41	81	0.8537	1.9756	1
3	11,12,13	28	3	1	2	34	11	0.1765	0.3235	13
4	15 - 19	26	18	8	0	52	34	0.5000	0.6538	8
5	20,21,24	18	21	16	3	58	62	0.6897	1.0690	3
6	22,23	26	9	9	0	44	27	0.4091	0.6136	9
7	25	13	13	13	8	47	63	0.7234	1.3404	2
8	26,27	28	19	14	1	62	50	0.5484	0.8064	5.5
9	28,29	28	14	10	1	53	37	0.4747	0.6981	7
10	30,31,32	18	5	2	0	25	9	0.2800	0.3333	11.5
11	33,36	15	13	5	1	34	26	0.5588	0.7647	5.5
12	37	14	6	0	0	20	6	0.3000	0.3000	11.5
13	39,40,41	31	2	0	0	33	2	0.0606	0.0606	15
14	44,45,49	20	3	0	0	23	3	0.1304	0.1304	14
15	1,50	22	6	0	2	30	12	0.2667	0.4000	10

(continued next page)

APPENDIX 12 (continued)

Observer network results x month x land-based section for humpback whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Overall Rank
August:										
1	6,7	11	8	2	0	21	12	0.4762	0.5714	8
2	9,10,14	9	1	0	6	16	19	0.4375	1.1875	4
3	11,12,13	18	5	4	3	30	22	0.4000	0.7333	8
4	15 - 19	7	2	5	2	16	18	0.5625	1.1250	2.5
5	20,21,24	12	4	6	0	22	16	0.4545	0.7273	5.5
6	22,23	19	3	0	0	22	3	0.1364	0.1364	13.5
7	25	11	5	2	2	20	15	0.4500	0.7500	5.5
8	26,27	11	4	0	0	15	4	0.2667	0.2667	10.5
9	28,29	3	2	1	3	9	13	0.6667	1.4444	1
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	14.5
11	33,36	7	16	3	0	26	22	0.7308	0.8462	2.5
12	37	12	4	1	0	17	6	0.2941	0.3529	10.5
13	39,40,41	17	3	0	0	20	3	0.1500	0.1500	13.5
14	44,45,49	17	0	0	0	17	0	0.0000	0.0000	14.5
15	1,50	12	4	2	2	20	14	0.4000	0.7000	8
September:										
1	6,7	7	2	0	0	9	2	0.2222	0.2222	7
2	9,10,14	4	1	0	0	5	1	0.2000	0.2000	7
3	11,12,13	7	0	1	0	8	2	0.1250	0.2500	7
4	15 - 19	0	0	0	3	3	9	1.0000	3.0000	1.5
5	20,21,24	0	2	1	0	3	4	1.0000	1.3333	1.5
6	22,23	17	1	1	0	19	3	0.1053	0.1579	10
7	25	13	1	0	0	14	1	0.0714	0.0714	11
8	26,27	1	0	1	0	2	2	0.5000	1.0000	3.5
9	28,29					0				
10	30,31,32	10	0	0	0	10	0	0.0000	0.0000	13
11	33,36	4	12	1	0	17	14	0.7647	0.8235	3.5
12	37	18	4	1	0	23	6	0.2174	0.2609	7
13	39,40,41	10	0	0	0	10	0	0.0000	0.0000	13
14	44,45,49	16	0	0	0	16	0	0.0000	0.0000	13
15	1,50	13	4	0	0	17	4	0.2353	0.2353	7
October and November:										
1	6,7	13	1	2	0	16	5	0.1875	0.3125	4
2	9,10,14	2	0	0	0	2	0	0.0000	0.0000	8
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24					0				
6	22,23	9	0	0	0	9	0	0.0000	0.0000	8
7	25	15	2	0	0	17	2	0.1176	0.1176	5
8	26,27					0				
9	28,29					0				
10	30,31,32	19	0	0	0	19	0	0.0000	0.0000	8
11	33,36	27	13	0	0	40	13	0.3250	0.3250	3
12	37	8	0	2	0	10	4	0.2000	0.4000	2
13	39,40,41	16	0	0	0	16	0	0.0000	0.0000	8
14	44,45,49	4	0	0	0	4	0	0.0000	0.0000	8
15	1,50	11	6	0	0	17	6	0.3529	0.3529	1

APPENDIX 13

Observer network results x month x shipboard section for humpback whales
Column headings are identified in the legend for Table 4

Ship-Bd Section	Latitude, Longitude	Obsr'd Freq (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n. mi)	No. of Whales	Sight. Freq.	Sight. Rate	Over -all Rank
May:											
5	50°-51°,57°-58°	50	8	1	0	59	1541	24	0.1525	0.0156	1
9	48°-50°,53°-54°	8	1	0	0	9	224	2	0.1111	0.0089	3
10	48°-49°,52°-53°	4	0	0	0	4	71	0	0.0000	0.0000	6.5
11	47°-48°,52°-53°	7	0	0	0	7	20	0	0.0000	0.0000	6.5
12	47°-48°,53°-54°	12	1	0	0	13	178	2	0.0769	0.0112	3
14	46°-47°,52°-55°	2	0	0	0	2	51	0	0.0000	0.0000	6.5
16	45°-48°,54°-59°	7	1	0	0	8	210	2	0.1250	0.0095	3
17	46°-51°,58°-60°	7	0	0	0	7	277	0	0.0000	0.0000	6.5
June:											
3	53°-55°,56°-59°	2	0	0	0	2	47	0	0.0000	0.0000	11.5
5	50°-51°,57°-58°	46	12	0	0	58	974	20	0.2069	0.0205	5
6	51°-52°,56°-58°	20	2	0	0	22	257	4	0.0909	0.0156	6
8	49°-50°,54°-56°	1	0	0	0	1	12	0	0.0000	0.0000	11.5
9	48°-50°,53°-54°	9	0	0	0	9	210	0	0.0000	0.0000	11.5
10	48°-49°,52°-53°	17	11	7	2	37	998	150	0.5405	0.1503	1
11	47°-48°,52°-53°	36	9	8	1	54	944	142	0.3333	0.1504	2.5
12	47°-48°,53°-54°	32	1	0	0	33	397	1	0.0303	0.0025	8.5
13	45°-48°,49°-52°	26	4	0	0	30	1022	6	0.1333	0.0059	7
14	46°-47°,52°-55°	16	5	5	0	26	804	48	0.3846	0.0597	4
15	43°-45°,49°-51°	11	3	6	1	21	715	119	0.4762	0.1164	2.5
16	45°-48°,54°-59°	15	1	0	0	16	489	2	0.0625	0.0004	8.5
17	46°-51°,58°-60°	2	0	0	0	2	24	0	0.0000	0.0000	11.5
July:											
1	55°-57°,60°-62°	21	0	0	0	21	785	0	0.0000	0.0000	15
2	54°-56°,55°-58°	19	1	0	0	20	708	3	0.0500	0.0042	12
3	53°-55°,56°-59°	35	7	1	0	43	958	19	0.1860	0.0198	7.5
4	50°-52°,55°-56°	5	5	3	0	13	632	49	0.6154	0.0775	3.5
5	50°-51°,57°-58°	21	3	0	0	24	622	6	0.1250	0.0096	10
6	51°-52°,56°-58°	23	4	0	0	27	494	8	0.1481	0.0162	10
7	50°-52°,55°,57	8	3	2	0	13	552	24	0.3846	0.0435	5.5
8	49°-50°,54°-56°	18	3	0	0	21	525	7	0.1429	0.0133	10
9	48°-50°,53°-54°	35	8	4	0	47	856	48	0.2553	0.0561	5.5
10	48°-49°,52°-53°	19	10	15	9	53	1407	520	0.6415	0.3696	1.5
11	47°-48°,52°-53°	20	7	4	1	32	601	90	0.3750	0.1500	3.5
12	47°-48°,53°-54°	18	0	0	0	18	213	0	0.0000	0.0000	15
13	45°-48°,49°-52°	7	0	0	0	7	187	0	0.0000	0.0000	15
14	46°-47°,52°-55°	1	0	0	0	1	10	0	0.0000	0.0000	15
15	43°-45°,49°-51°	4	5	1	2	12	446	130	0.6667	0.2915	1.5
16	45°-48°,54°-59°	3	0	0	0	3	120	0	0.0000	0.0000	15
17	46°-51°,58°-60°	5	2	0	0	7	288	3	0.2857	0.0104	7.5
August:											
1	55°-57°,60°-62°	23	1	0	0	24	978	1	0.0417	0.0010	12
2	54°-56°,55°-58°	15	4	0	3	22	616	125	0.3182	0.2029	4
3	53°-55°,56°-59°	20	2	0	0	22	754	4	0.0909	0.0053	11
4	50°-52°,55°-56°	6	3	3	5	17	907	240	0.6470	0.2646	1
5	50°-51°,57°-58°	11	0	0	0	11	388	0	0.0000	0.0000	14
6	51°-52°,56°-58°	7	2	0	0	9	252	6	0.2222	0.0238	6.5
7	50°-52°,55°,57	23	3	2	0	28	1306	31	0.1786	0.0237	8.5
8	49°-50°,54°-56°	16	2	2	1	21	736	68	0.2381	0.0924	5
9	48°-50°,53°-54°	9	2	2	2	15	671	151	0.4000	0.2250	2.5
10	48°-49°,52°-53°	8	2	5	1	16	538	113	0.5000	0.2100	2.5
11	47°-48°,52°-53°	26	5	1	0	32	515	16	0.1875	0.0311	8.5
12	47°-48°,53°-54°	13	1	1	0	15	98	11	0.1333	0.1122	6.5
14	46°-47°,52°-55°	12	1	0	0	13	339	4	0.0769	0.0118	10
16	45°-48°,54°-59°	24	0	0	0	24	863	0	0.0000	0.0000	14
17	46°-51°,58°-60°	25	0	0	0	25	1080	0	0.0000	0.0000	14
September:											
1	55°-57°,60°-62°	4	0	0	0	4	135	0	0.0000	0.0000	9.5
3	53°-55°,56°-59°	6	0	0	0	6	222	0	0.0000	0.0000	9.5
4	50°-52°,55°-56°	2	3	2	0	7	399	44	0.7143	0.1103	1
5	50°-51°,57°-58°	10	0	0	0	10	340	0	0.0000	0.0000	9.5
6	51°-52°,56°-58°	5	0	0	0	5	100	0	0.0000	0.0000	9.5
7	50°-52°,55°,57	12	6	0	0	18	910	13	0.3333	0.0143	2.5
8	49°-50°,54°-56°	12	3	0	0	15	634	7	0.2000	0.0110	4
9	48°-50°,53°-54°	8	1	0	1	10	489	42	0.2000	0.0859	2.5
10	48°-49°,52°-53°	4	0	0	0	4	109	0	0.0000	0.0000	9.5
11	47°-48°,52°-53°	15	1	0	0	16	152	2	0.0625	0.0132	5
12	47°-48°,53°-54°	12	0	0	0	12	90	0	0.0000	0.0000	9.5
16	45°-48°,54°-59°	1	0	0	0	1	36	0	0.0000	0.0000	9.5
17	46°-51°,58°-60°	11	0	0	0	11	226	0	0.0000	0.0000	9.5

APPENDIX 14

Annual distibution of humpback whales from land-based data.

'North' – Notre Dame Bay on the north coast of Newfoundland and the Labrador coast of the Strait of Belle Isle (including Belle Isle). 'East' – east coast of Newfoundland from Cape Broyle to Peckford's Island. 'South' – south coast of Newfoundland from Cape Race to Burgeo.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979:									
North	1+ 2+15					0			
East	6+ 7	13	15	5	2	35	31	0.629	0.886
South	8+10-12					0			
1980:									
North	1+ 2+15	16	6	5	6	33	34	0.515	1.030
East	6+ 7	36	20	11	5	72	36	0.500	0.792
South	8+10-12	41	32	11	4	88	66	0.534	0.750
1981:									
North	1+ 2+15	24	15	15	8	62	69	0.613	1.113
East	6+ 7	17	9	12	5	43	48	0.605	1.116
South	8+10-12	40	18	18	1	77	57	0.480	0.740
1982:									
North	1+ 2+15	8	5	9	7	29	44	0.724	1.520
East	6+ 7	17	3	3	2	25	15	0.320	0.600
South	8+10-12	29	27	10	2	68	53	0.574	0.779

APPENDIX 15

Annual distibution of humpback whales from shipboard data.

Column headings are identified in the legend for Table 6. 'North' - east coasts of Labrador and Newfoundland, from Notre Dame Bay to Nain. 'East' - east coast of Newfoundland from Cape Broyle to Peckford's Island. 'South' - the Southeast Shoal and south coast of Newfoundland from Cape Race to the Laurentian Channel.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
1976-77:									
North	4+7+9	10	6	4	0	20	14	0.500	0.700
East	10+11	2	5	1	1	9	10	0.778	1.111
1978:									
North	4+7+9	6	2	3	0	11	8	0.454	0.727
East	10+11	4	6	8	2	20	28	0.800	1.400
1979:									
North	4+7+9	9	6	1	4	20	20	0.600	1.000
East	10+11	29	6	9	5	49	39	0.408	0.796
1980:									
North	4+7+9	10	2	2	0	14	6	0.286	0.429
East	10+11	65	17	23	10	115	93	0.435	0.809
1981:									
North	4+7+9	9	1	2	1	13	8	0.308	0.615
East	10+11	33	9	6	0	48	21	0.312	0.438
1982:									
North	4+7+9	10	2	3	1	16	11	0.375	0.688
East	10+11	37	7	0	0	44	7	0.159	0.159
1983:									
North	4+7+9	7	2	1	0	10	4	0.300	0.400
East	10+11	10	3	3	0	16	9	0.375	0.562

APPENDIX 16

Observer network results x year x land-based section for humpback whale
Column headings are identified in the legend for Table 3

Land Based Section	Statistical Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over -all Rank
1979:										
1	6,7					0				
2	9,10,14					0				
3	11,12,13	0	3	2	3	8	16	1.000	2.000	1
4	15 - 19	19	10	7	0	36	24	0.472	0.670	5
5	20,21,24	9	3	1	1	14	8	0.357	0.570	6
6	22,23	8	3	1	0	12	5	0.333	0.420	7
7	25	11	12	4	2	29	26	0.621	0.897	2.5
8	26,27	13	5	6	2	26	23	0.500	0.885	4
9	28,29	19	9	12	2	42	39	0.548	0.929	2.5
10	30,31,32	14	0	0	0	14	0	0.000	0.000	10
11	33,36	3	1	0	0	4	1	0.250	0.250	8
12	37					0				
13	39,40,41					0				
14	44,45,49	4	1	0	0	5	1	0.200	0.200	9
15	1,50					0				
Total or Mean		100	47	33	10	190	143	0.428	0.682	
Std.Dev.								±0.272	±0.563	
1980:										
1	6,7	12	4	2	1	19	11	0.368	0.579	9.5
2	9,10,14	12	6	4	4	26	26	0.538	1.000	4
3	11,12,13	53	9	5	2	69	25	0.232	0.362	12
4	15 - 19	26	13	8	6	53	47	0.509	0.887	7
5	20,21,24	32	27	26	5	90	94	0.644	1.044	2
6	22,23	29	11	8	0	48	27	0.396	0.562	11
7	25	22	11	8	5	46	42	0.522	0.913	5.5
8	26,27	25	15	7	1	48	32	0.479	0.667	8
9	28,29	24	11	8	6	49	45	0.510	0.918	5.5
10	30,31,32	10	0	0	0	10	0	0.000	0.000	15
11	33,36	10	16	5	4	35	38	0.714	1.086	1
12	37	22	16	2	0	40	20	0.450	0.500	9.5
13	39,40,41	37	5	0	0	42	5	0.119	0.119	14
14	44,45,49	24	5	0	0	29	5	0.172	0.172	13
15	1,50	10	8	1	5	24	25	0.583	1.042	3
Total or Mean		348	157	84	39	628	442	0.415	0.591	
Std.Dev.								±0.202	±0.371	
1981:										
1	6,7	24	10	5	3	42	29	0.429	0.690	7.5
2	9,10,14	13	9	13	16	51	83	0.745	1.627	2
3	11,12,13					0				
4	15 - 19	14	3	0	0	17	3	0.176	0.176	11.5
5	20,21,24	3	7	4	1	15	18	0.800	1.200	3
6	22,23	20	5	5	0	30	15	0.333	0.500	9
7	25	8	4	7	5	24	33	0.667	1.375	4
8	26,27	2	4	6	1	13	19	0.846	1.462	1
9	28,29	3	5	2	0	10	9	0.700	0.900	6
10	30,31,32	27	6	2	0	35	10	0.229	0.286	10
11	33,36	10	10	13	0	33	36	0.697	1.091	5
12	37	25	5	0	0	30	5	0.167	0.167	11.5
13	39,40,41	27	2	0	0	29	2	0.069	0.069	13
14	44,45,49	18	0	0	0	18	0	0.000	0.000	14
15	1,50	28	11	5	5	49	36	0.429	0.735	7.5
Total or Mean		222	81	62	31	396	298	0.450	0.736	
Std.Dev.								±0.291	±0.552	
1982:										
1	6,7	15	4	3	1	23	13	0.348	0.565	5.5
2	9,10,14	3	2	6	10	21	44	0.857	2.100	1
3	11,12,13	11	0	0	0	11	0	0.000	0.000	12
4	15-19					0				
5	20,21,24	1	0	0	0	1	0	0.000	0.000	12
6	22,23	27	0	0	0	27	0	0.000	0.000	12
7	25	5	3	3	2	13	15	0.615	1.150	2
8	26,27	12	4	5	2	23	20	0.478	0.870	4
9	28,29					0				
10	30,31,32	9	5	0	0	14	5	0.357	0.357	7
11	33,36	12	31	6	0	49	43	0.755	0.878	3
12	37	11	1	0	0	12	1	0.083	0.083	9
13	39,40,41	23	2	0	0	25	2	0.080	0.080	9
14	44,45,49	19	2	0	0	21	2	0.095	0.095	9
15	1,50	21	8	1	3	33	19	0.364	0.576	5.5
Total or Mean		169	62	24	18	273	164	0.312	0.520	
Std.Dev.								±0.299	±0.616	

APPENDIX 17

Observer network results x year x shipboard study area x humpback whale
The column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over-all Rank
1976-77:											
1	55°-57°,60°-62°	6	0	0	0	6	193	0	0.000	0.000	10.5
2	54°-56°,55°-58°	6	0	0	0	6	185	0	0.000	0.000	10.5
3	53°-55°,56°-59°	2	1	0	0	3	133	1	0.333	0.333	7.5
4	50°-52°,55°-56°	2	2	0	0	4	250	2	0.500	0.500	4.5
7	50°-52°,55°,57°	11	2	2	0	15	564	6	0.267	0.400	7.5
8	49°-50°,54°-56°	5	3	1	0	9	437	5	0.444	0.556	4.5
9	48°-50°,53°-54°	2	3	3	0	8	429	9	0.750	1.125	2
10	48°-49°,52°-53°	1	1	1	1	4	144	6	0.750	1.500	2
11	47°-48°,52°-53°	1	4	0	0	5	192	4	0.800	0.800	2
14	46°-47°,52°-55°	7	1	2	0	10	259	5	0.300	0.500	6
16	45°-48°,54°-59°	5	0	0	0	5	169	0	0.000	0.000	10.5
17	46°-51°,58°-60°	1	0	0	0	1	6	0	0.000	0.000	10.5
Totalor Mean		49	17	9	1	76	2961	36	0.362	0.476	
Std.Dev.									±0.312	±0.478	
1978:											
4	50°-52°,55°-56°	0	2	3	0	5	217	8	1.000	1.600	2
7	50°-52°,55°,57°	4	2	0	0	6	359	2	0.333	0.333	5.5
8	49°-50°,54°-56°	1	2	0	1	4	208	5	0.750	1.250	4
9	48°-50°,53°-54°	2	1	0	0	3	193	1	0.333	0.333	5.5
10	48°-49°,52°-53°	4	6	7	2	19	551	26	0.789	1.368	3
11	47°-48°,52°-53°	0	0	1	0	1	30	2	1.000	2.000	1
Totalor Mean		11	13	11	3	38	1558	44	0.652	1.007	
Std.Dev.									±0.269	±0.545	
1979:											
1	55°-57°,60°-62°	33	0	0	0	33	1329	0	0.000	0.000	11.5
2	54°-56°,55°-58°	15	0	0	0	15	519	0	0.000	0.000	11.5
3	53°-55°,56°-59°	24	1	0	0	25	945	1	0.040	0.040	7
4	50°-52°,55°-56°	3	2	1	0	9	580	13	0.667	1.444	2
5	50°-51°,57°-58°	28	0	0	0	28	624	0	0.000	0.000	11.5
6	51°-52°,56°-58°	8	2	0	0	10	110	2	0.200	0.200	5.5
7	50°-52°,55°,57°	7	6	0	0	13	673	6	0.462	0.462	3.5
8	49°-50°,54°-56°	9	0	0	0	9	322	0	0.000	0.000	11.5
9	48°-50°,53°-54°	13	2	0	3	18	421	11	0.278	0.611	3.5
10	48°-49°,52°-53°	5	4	7	5	21	593	34	0.762	1.619	1
11	47°-48°,52°-53°	24	2	2	0	28	297	6	0.143	0.214	5.5
12	47°-48°,53°-54°	25	0	0	0	25	234	0	0.000	0.000	11.5
14	46°-47°,52°-55°	5	0	0	0	5	117	0	0.000	0.000	11.5
16	45°-48°,54°-59°	10	0	0	0	10	345	0	0.000	0.000	11.5
17	46°-51°,58°-60°	2	0	0	0	2	28	0	0.000	0.000	11.5
Totalor Mean		211	19	10	11	251	7137	72	0.170	0.305	
Std.Dev.									±0.260	±0.532	
1980:											
1	55°-57°,60°-62°	4	0	0	0	4	178	0	0.000	0.000	15.5
2	54°-56°,55°-58°	3	1	0	0	4	126	1	0.250	0.250	7.5
3	53°-55°,56°-59°	7	2	0	0	9	251	2	0.222	0.222	7.5
4	50°-52°,55°-56°	3	1	2	0	6	234	5	0.500	0.830	3
5	50°-51°,57°-58°	13	5	0	0	18	405	5	0.278	0.278	7.5
6	51°-52°,56°-58°	27	0	0	0	27	505	0	0.000	0.000	15.5
7	50°-52°,55°,57°	6	2	0	0	8	363	2	0.250	0.250	7.5
8	49°-50°,54°-56°	2	1	0	0	3	149	1	0.333	0.333	5
9	48°-50°,53°-54°	12	1	1	0	14	309	3	0.143	0.214	10
10	48°-49°,52°-53°	12	4	7	4	27	718	30	0.556	1.111	2
11	47°-48°,52°-53°	18	5	6	2	31	740	23	0.419	0.742	4
12	47°-48°,53°-54°	14	1	1	0	16	161	3	0.125	0.188	12
13	45°-48°,49°-52°	9	1	0	0	10	332	1	0.100	0.100	12
14	46°-47°,52°-55°	6	0	0	0	6	181	0	0.000	0.000	15.5
15	43°-45°,49°-51°	3	2	1	2	8	373	10	0.625	1.250	1
16	45°-48°,54°-59°	12	0	0	0	12	432	0	0.000	0.000	15.5
17	46°-51°,58°-60°	15	2	0	0	17	679	2	0.118	0.118	12
Totalor Mean		166	28	18	8	220	6136	88	0.230	0.346	
Std.Dev.									±0.201	±0.392	

(continued next page)

APPENDIX 17 (continued)

Observer network results x year x shipboard study area x humpback whale

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over -all- Rank
1981:											
2	54°-56°,55°-58°	1	0	0	0	2	95	3	0.500	1.500	2
4	50°-52°,55°-56°	0	1	1	1	3	145	6	1.000	2.000	1
5	50°-51°,57°-58°	26	7	0	0	33	823	7	0.212	0.212	8
6	51°-52°,56°-58°	7	2	0	0	9	138	2	0.222	0.222	8
7	50°-52°,55°,57°	8	0	1	0	9	391	2	0.125	0.250	10
8	49°-50°,54°-56°	3	2	1	0	6	232	4	0.500	0.667	3
9	48°-50°,53°-54°	9	0	0	0	9	284	0	0.000	0.000	14.5
10	48°-49°,52°-53°	18	1	3	0	22	595	7	0.182	0.318	6
11	47°-48°,52°-53°	15	8	3	0	26	551	14	0.423	0.538	4.5
12	47°-48°,53°-54°	7	1	0	0	8	103	1	0.125	0.125	11.5
13	45°-48°,49°-52°	12	3	0	0	15	505	3	0.200	0.200	8
14	46°-47°,52°-55°	8	1	0	0	9	337	1	0.111	0.111	11.5
15	43°-45°,49°-51°	3	0	1	1	5	159	5	0.400	1.000	4.5
16	45°-48°,54°-59°	13	1	0	0	14	454	1	0.071	0.071	13
17	46°-51°,58°-60°	16	0	0	0	16	532	0	0.000	0.000	14.5
Total or Std.Dev.	Mean	147	27	10	3	187	5344	56	0.270 ±0.261	0.481 ±0.589	
1982:											
1	55°-57°,60°-62°	5	1	0	0	6	198	1	0.167	0.167	9
2	54°-56°,55°-58°	1	2	0	2	5	222	8	0.800	1.600	1
3	53°-55°,56°-59°	23	4	1	0	28	432	6	0.179	0.214	8
4	50°-52°,55°-56°	4	3	0	1	8	375	6	0.500	0.750	2.5
5	50°-51°,57°-58°	21	3	0	0	24	472	3	0.125	0.125	11.5
6	51°-52°,56°-58°	10	3	0	0	13	252	3	0.231	0.231	7
7	50°-52°,55°,57°	2	0	1	0	3	173	2	0.333	0.666	5
8	49°-50°,54°-56°	25	0	0	0	25	436	0	0.000	0.000	15
9	48°-50°,53°-54°	22	1	2	0	25	464	5	0.120	0.200	10
10	48°-49°,52°-53°	7	4	0	0	11	338	4	0.364	0.364	6
11	47°-48°,52°-53°	3	0	0	0	33	240	3	0.091	0.091	11.5
12	47°-48°,53°-54°	26	0	0	0	26	237	0	0.000	0.000	15
13	45°-48°,49°-52°	9	0	0	0	9	300	0	0.000	0.000	15
14	46°-47°,52°-55°	1	2	0	0	3	48	2	0.666	0.666	2.5
15	43°-45°,49°-51°	8	5	3	0	16	480	11	0.500	0.688	4
16	45°-48°,54°-59°	3	0	0	0	3	108	0	0.000	0.000	15
17	46°-51°,58°-60°	4	0	0	0	4	180	0	0.000	0.000	15
Total or Std.Dev.	Mean	201	31	7	3	242	4956	54	0.239 ±0.251	0.339 ±0.423	
1983:											
2	54°-56°,55°-58°	8	2	0	0	10	178	2	0.200	0.200	6.5
3	53°-55°,56°-59°	6	0	0	0	6	145	0	0.000	0.000	11
4	50°-52°,55°-56°	2	1	1	0	4	210	3	0.500	0.750	5
6	51°-52°,56°-58°	3	1	0	0	4	98	1	0.250	0.250	6.5
7	50°-52°,55°,57°	5	0	0	0	5	245	0	0.000	0.000	11
8	49°-50°,54°-56°	2	0	0	0	2	124	0	0.000	0.000	11
9	48°-50°,53°-54°	1	3	0	0	4	126	3	0.750	0.750	4
10	48°-49°,52°-53°	1	3	2	0	6	113	7	0.833	1.167	1.5
11	47°-48°,52°-53°	9	0	1	0	10	162	2	0.100	0.200	8
12	47°-48°,53°-54°	3	0	0	0	3	63	0	0.000	0.000	11
13	45°-48°,49°-52°	3	0	0	0	3	72	0	0.000	0.000	11
14	46°-47°,52°-55°	2	2	3	0	7	210	8	0.714	1.143	3
15	43°-45°,49°-51°	1	1	2	0	4	150	5	0.750	1.250	1.5
17	46°-51°,58°-60°	5	0	0	0	5	193	0	0.000	0.000	11
Total or Std.Dev.	Mean	52	13	9	0	74	2091	31	0.292 ±0.338	0.408 ±0.494	

APPENDIX 18

Monthly distibution of finback whales from land-based data.

Sections of the study area are identified in the legend for Appendix 10.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
December-February:									
North	1+14	18	1	0	0	19	1	0.053	0.053
East	2- 7	22	0	0	0	22	0	0.000	0.000
South	8-12	54	3	1	0	58	5	0.069	0.086
March-April:									
North	1+14	12	5	1	0	18	7	0.333	0.389
East	2- 7	21	0	0	0	21	0	0.000	0.000
South	8-12	63	3	0	0	66	3	0.045	0.045
May:									
North	1+14	21	2	3	0	26	8	0.192	0.308
East	2- 7	56	1	0	0	57	1	0.018	0.018
South	8-12	82	13	5	0	100	23	0.180	0.230
June:									
North	1+14	29	4	8	1	42	23	0.310	0.548
East	2- 7	140	6	5	0	151	16	0.073	0.106
South	8-12	109	32	11	1	153	57	0.288	0.373
July:									
North	1+14	27	14	10	1	52	37	0.481	0.712
East	2- 7	214	17	8	0	239	33	0.105	0.138
South	8-12	159	23	8	1	191	42	0.168	0.220
August:									
North	1+14	24	9	5	0	38	19	0.368	0.500
East	2- 7	101	8	3	0	112	14	0.098	0.125
South	8-12	62	14	6	0	82	26	0.244	0.317
September:									
North	1+14	22	2	1	0	25	4	0.120	0.160
East	2- 7	39	2	2	0	43	6	0.085	0.140
South	8-12	43	9	0	0	52	9	0.173	0.173
October-November:									
North	1+14	17	3	0	0	20	3	0.150	0.150
East	2- 7	31	0	0	0	31	31	0.000	0.000
South	8-12	64	5	0	0	69	5	0.078	0.078

APPENDIX 19

Monthly distibution of finback whales from shipboard data.

Sections of the study area are identified in the legend for Appendix 11.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
May:									
North	1- 8					0			
East	9-12	32	1	0	0	33	1	0.030	0.030
South	14-16	10	0	0	0	10	0	0.000	0.000
June:									
North	1- 8					0			
East	9-12	121	11	1	0	133	13	0.090	0.098
South	14-16	47	14	2	0	63	18	0.254	0.286
July:									
North	1- 8	123	8	0	0	131	8	0.061	0.061
East	9-12	120	19	11	0	150	41	0.200	0.273
South	14-16	15	1	0	0	16	1	0.062	0.062
August:									
North	1- 8	122	8	3	1	134	17	0.090	0.127
East	9-12	69	5	4	0	78	13	0.115	0.167
South	14-16	35	2	0	0	37	2	0.054	0.054
September:									
North	1- 8	47	2	0	1	50	5	0.060	0.100
East	9-12	41	0	0	1	42	3	0.024	0.071
South	14-16					0			

APPENDIX 20

Observer network results x month x land-based section for finback whales

Column headings are identified in the legend for Table 3, Section 3.2.1

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
December to February:										
1	6,7	15	0	0	0	15	0	0.0000	0.0000	7.5
2	9,10,14	1	0	0	0	1	0	0.0000	0.0000	7.5
3	11,12,13					0				
4	15 - 19	8	0	0	0	8	0	0.0000	0.0000	7.5
5	20,21,24					0				
6	22,23	13	0	0	0	13	0	0.0000	0.0000	7.5
7	25					0				
8	26,27	8	0	0	0	8	0	0.0000	0.0000	7.5
9	28,29					0				
10	30,31,32	18	0	0	0	18	0	0.0000	0.0000	7.5
11	33,36	21	2	1	0	24	4	0.1250	0.1667	2
12	37	7	1	0	0	8	1	0.1250	0.1250	3
13	39,40,41	40	0	0	0	40	0	0.0000	0.0000	7.5
14	44,45,49	3	1	0	0	4	1	0.2500	0.2500	1
15	1,50	4	0	0	0	4	0	0.0000	0.0000	7.5
March and April:										
1	6,7	8	1	0	0	9	1	0.1111	0.1111	3
2	9,10,14	2	0	0	0	2	0	0.0000	0.0000	9
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24	6	0	0	0	6	0	0.0000	0.0000	9
6	22,23	10	0	0	0	10	0	0.0000	0.0000	9
7	25	3	0	0	0	3	0	0.0000	0.0000	9
8	26,27	9	0	0	0	9	0	0.0000	0.0000	9
9	28,29	10	0	0	0	10	0	0.0000	0.0000	9
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	9
11	33,36	28	1	0	0	29	1	0.0345	0.0345	4
12	37	1	2	0	0	3	2	0.6667	0.6667	1.5
13	39,40,41	34	0	0	0	34	0	0.0000	0.0000	9
14	44,45,49	4	4	1	0	9	6	0.5556	0.6667	1.5
15	1,50	1	0	0	0	1	0	0.0000	0.0000	9

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APPENDIX 20 (continued)

Observer network results x month x land-based section for finback whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
May:										
1	6,7	11	1	0	0	12	1	0.0833	0.0833	4.5
2	9,10,14	19	1	0	0	20	1	0.0500	0.0500	6
3	11,12,13	3	0	0	0	3	0	0.0000	0.0000	11
4	15 - 19	8	0	0	0	8	0	0.0000	0.0000	11
5	20,21,24	6	0	0	0	6	0	0.0000	0.0000	11
6	22,23	12	0	0	0	12	0	0.0000	0.0000	11
7	25	8	0	0	0	8	0	0.0000	0.0000	11
8	26,27	4	0	0	0	4	0	0.0000	0.0000	11
9	28,29	8	0	0	0	8	0	0.0000	0.0000	11
10	30,31,32	26	0	0	0	26	0	0.0000	0.0000	11
11	33,36	23	11	5	0	39	21	0.4103	0.5385	2
12	37	21	2	0	0	23	2	0.0870	0.0870	4.5
13	39,40,41	36	5	1	0	42	2	0.1429	0.1667	3
14	44,45,49	10	1	3	0	14	9	0.3571	0.6429	1
15	1,50	20	0	0	0	20	0	0.0000	0.0000	11
June:										
1	6,7	20	3	2	0	25	7	0.2000	0.2800	4.5
2	9,10,14	23	1	0	0	24	1	0.0417	0.0417	10.5
3	11,12,13	11	2	0	0	13	2	0.1538	0.1538	7.5
4	15 - 19	35	0	0	0	35	0	0.0000	0.0000	13.5
5	20,21,24	28	1	4	0	33	9	0.1515	0.2727	6
6	22,23	21	0	0	0	21	0	0.0000	0.0000	13.5
7	25	22	2	1	0	25	4	0.1200	0.1600	9
8	26,27	27	2	2	0	31	6	0.1290	0.1935	7.5
9	28,29	21	8	6	1	36	23	0.4167	0.6389	2.5
10	30,31,32	23	0	0	0	23	0	0.0000	0.0000	13.5
11	33,36	21	18	2	0	41	22	0.4878	0.5366	2.5
12	37	17	4	1	0	22	6	0.2273	0.2727	4.5
13	39,40,41	43	1	0	0	44	1	0.0227	0.0227	10.5
14	44,45,49	9	1	6	1	17	16	0.4706	0.9412	1
15	1,50	35	0	0	0	35	0	0.0000	0.0000	13.5
July:										
1	6,7	16	8	4	1	29	19	0.4483	0.6552	2
2	9,10,14	34	0	0	0	34	0	0.0000	0.0000	14
3	11,12,13	24	6	0	0	30	6	0.2000	0.2000	5
4	15 - 19	46	2	2	0	50	6	0.0769	0.1154	9
5	20,21,24	45	4	5	0	54	14	0.1667	0.2593	5
6	22,23	29	1	0	0	30	1	0.0333	0.0333	11
7	25	36	4	1	0	41	6	0.1220	0.1463	7.5
8	26,27	51	5	6	0	62	17	0.1774	0.2742	5
9	28,29	43	6	1	0	50	8	0.1400	0.1600	7.5
10	30,31,32	24	1	0	0	25	1	0.0400	0.0400	11
11	33,36	21	11	1	1	34	16	0.3824	0.4706	3
12	37	20	0	0	0	20	0	0.0000	0.0000	14
13	39,40,41	40	2	0	0	42	2	0.0476	0.0476	11
14	44,45,49	11	6	6	0	23	18	0.5217	0.7826	1
15	1,50	27	0	0	0	27	0	0.0000	0.0000	14

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APPENDIX 20 (continued)

Observer network results x month x land-based section for finback whales

Land-Bd Section	Stat Areas	Obs'd Ffeq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Overall Rank
August:										
1	6,7	11	7	3	0	21	13	0.4762	0.6190	1.5
2	9,10,14	15	1	0	0	16	1	0.0625	0.0625	9
3	11,12,13	22	4	0	0	26	4	0.1538	0.1538	7.5
4	15 - 19	12	2	2	0	16	6	0.2500	0.3750	5
5	20,21,24	19	1	1	0	21	3	0.0952	0.1429	7.5
6	22,23	15	0	0	0	15	0	0.0000	0.0000	12.5
7	25	18	0	0	0	18	0	0.0000	0.0000	12.5
8	26,27	15	0	0	0	15	0	0.0000	0.0000	12.5
9	28,29	5	1	3	0	9	7	0.4444	0.7778	1.5
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	12.5
11	33,36	15	9	2	0	26	13	0.4231	0.5000	3
12	37	12	4	1	0	17	6	0.2941	0.3529	5
13	39,40,41	31	0	0	0	31	0	0.0000	0.0000	12.5
14	44,45,49	13	2	2	0	17	6	0.2353	0.3529	5
15	1,50	16	0	0	0	16	0	0.0000	0.0000	12.5
September:										
1	6,7	9	0	0	0	9	0	0.0000	0.0000	10
2	9,10,14	5	0	0	0	5	0	0.0000	0.0000	10
3	11,12,13	4	0	0	0	4	0	0.0000	0.0000	10
4	15 - 19	0	1	2	0	3	5	1.0000	1.6667	1
5	20,21,24	2	1	0	0	3	1	0.3333	0.3333	3
6	22,23	14	0	0	0	14	0	0.0000	0.0000	10
7	25	14	0	0	0	14	0	0.0000	0.0000	10
8	26,27	2	0	0	0	2	0	0.0000	0.0000	10
9	28,29					0				
10	30,31,32	10	0	0	0	10	0	0.0000	0.0000	10
11	33,36	10	7	0	0	17	7	0.4118	0.4118	2
12	37	21	2	0	0	23	2	0.0870	0.0870	5
13	39,40,41	24	0	0	0	24	0	0.0000	0.0000	10
14	44,45,49	13	2	1	0	16	4	0.1875	0.2500	4
15	1,50	12	0	0	0	12	0	0.0000	0.0000	10
October and November:										
1	6,7	13	3	0	0	16	3	0.1875	0.1875	1
2	9,10,14	1	0	0	0	1	0	0.0000	0.0000	7
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24	4	0	0	0	4	0	0.0000	0.0000	7
6	22,23	9	0	0	0	9	0	0.0000	0.0000	7
7	25	17	0	0	0	17	0	0.0000	0.0000	7
8	26,27					0				
9	28,29					0				
10	30,31,32	19	0	0	0	19	0	0.0000	0.0000	7
11	33,36	35	5	0	0	40	5	0.1250	0.1250	2
12	37	10	0	0	0	10	0	0.0000	0.0000	7
13	39,40,41	34	0	0	0	34	0	0.0000	0.0000	7
14	44,45,49	4	0	0	0	4	0	0.0000	0.0000	7
15	1,50	9	0	0	0	9	0	0.0000	0.0000	7

APPENDIX 21

Observer network results x month x shipboard section for finback whales
Column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Obsr'd Freq (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n. mi)	No. of Whales	Sight. Freq.	Sight. Rate	Over -all Rank
May:											
5	50°-51°,57°-58°	59	0	0	0	59	1541	0	0.0000	0.0000	5
9	48°-50°,53°-54°	9	0	0	0	9	224	0	0.0000	0.0000	5
10	48°-49°,52°-53°	3	0	1	0	4	71	7	0.2500	0.0986	1
11	47°-48°,52°-53°	7	0	0	0	7	20	0	0.0000	0.0000	5
12	47°-48°,53°-54°	13	0	0	0	13	178	0	0.0000	0.0000	5
14	46°-47°,52°-55°	2	0	0	0	2	51	0	0.0000	0.0000	5
16	45°-48°,54°-59°	8	0	0	0	8	210	0	0.0000	0.0000	5
17	46°-51°,58°-60°	7	0	0	0	7	277	0	0.0000	0.0000	5
June:											
3	53°-55°,56°-59°	2	0	0	0	2	47	0	0.0000	0.0000	10
5	50°-51°,57°-58°	58	0	0	0	58	974	0	0.0000	0.0000	10
6	51°-52°,56°-58°	22	0	0	0	22	257	0	0.0000	0.0000	10
8	49°-50°,54°-56°	1	0	0	0	1	12	0	0.0000	0.0000	10
9	48°-50°,53°-54°	9	0	0	0	9	210	0	0.0000	0.0000	10
10	48°-49°,52°-53°	31	5	1	0	37	998	20	0.1622	0.0200	3
11	47°-48°,52°-53°	48	6	0	0	54	944	9	0.1111	0.0095	4
12	47°-48°,53°-54°	33	0	0	0	33	397	0	0.0000	0.0000	10
13	45°-48°,49°-52°	27	3	0	0	30	1022	4	0.1000	0.0039	5.5
14	46°-47°,52°-55°	18	8	0	0	26	803	21	0.3077	0.0261	1.5
15	43°-45°,49°-51°	15	4	2	0	21	715	30	0.2857	0.0420	1.5
16	45°-48°,54°-59°	14	2	0	0	16	489	2	0.1250	0.0041	5.5
17	46°-51°,58°-60°	2	0	0	0	2	24	0	0.0000	0.0000	10
July:											
1	55°-57°,60°-62°	19	2	0	0	21	785	2	0.0952	0.0025	6
2	54°-56°,55°-58°	20	0	0	0	20	708	0	0.0000	0.0000	14.5
3	53°-55°,56°-59°	41	2	0	0	43	958	2	0.0465	0.0021	11
4	50°-52°,55°-56°	12	1	0	0	13	632	3	0.0769	0.0047	8.5
5	50°-51°,57°-58°	22	2	0	0	24	622	6	0.0833	0.0096	4
6	51°-52°,56°-58°	26	1	0	0	27	494	4	0.0385	0.0081	10
7	50°-52°,55°-57°	12	1	0	0	13	552	4	0.0769	0.0072	7
8	49°-50°,54°-56°	19	2	0	0	19	525	7	0.0957	0.0133	3
9	48°-50°,53°-54°	44	2	1	0	47	856	14	0.0638	0.0164	5
10	48°-49°,52°-53°	33	13	7	0	53	1407	113	0.3774	0.0803	1
11	47°-48°,52°-53°	25	4	3	0	32	601	42	0.2188	0.0699	2
12	47°-48°,53°-54°	18	0	0	0	18	213	0	0.0000	0.0000	14.5
13	45°-48°,49°-52°	7	0	0	0	7	187	0	0.0000	0.0000	14.5
14	46°-47°,52°-55°	1	0	0	0	1	10	0	0.0000	0.0000	14.5
15	43°-45°,49°-51°	11	1	0	0	12	446	1	0.0833	0.0022	8.5
16	45°-48°,54°-59°	3	0	0	0	3	120	0	0.0000	0.0000	14.5
17	46°-51°,58°-60°	7	0	0	0	7	288	0	0.0000	0.0000	14.5
August:											
1	55°-57°,60°-62°	24	0	0	0	24	978	0	0.0000	0.0000	14
2	54°-56°,55°-58°	18	4	0	0	22	616	6	0.1818	0.0097	5
3	53°-55°,56°-59°	22	0	0	0	22	754	0	0.0000	0.0000	14
4	50°-52°,55°-56°	16	0	1	0	17	907	6	0.0588	0.0066	9.5
5	50°-51°,57°-58°	10	1	0	0	11	388	4	0.0909	0.0103	5
6	51°-52°,56°-58°	8	1	0	0	9	252	3	0.1111	0.0119	5
7	50°-52°,55°-57°	26	2	0	0	28	1306	9	0.0714	0.0070	8
8	49°-50°,54°-56°	16	2	2	1	21	736	61	0.2381	0.0829	1.5
9	48°-50°,53°-54°	12	1	2	0	15	671	22	0.2000	0.0328	3
10	48°-49°,52°-53°	12	3	1	0	16	538	22	0.2500	0.0409	1.5
11	47°-48°,52°-53°	30	1	1	0	32	515	10	0.0625	0.0194	7
12	47°-48°,53°-54°	15	0	0	0	15	98	0	0.0000	0.0000	14
14	46°-47°,52°-55°	12	1	0	0	13	339	1	0.0769	0.0029	9.5
16	45°-48°,54°-59°	23	1	0	0	24	863	1	0.0417	0.0012	11.5
17	46°-51°,58°-60°	24	1	0	0	25	1080	1	0.0400	0.0009	11.5
September:											
1	55°-57°,60°-62°	4	0	0	0	4	135	0	0.0000	0.0000	9
3	53°-55°,56°-59°	6	0	0	0	6	222	0	0.0000	0.0000	9
4	50°-52°,55°-56°	7	0	0	0	7	399	0	0.0000	0.0000	9
5	50°-51°,57°-58°	9	1	0	0	10	340	0	0.0000	0.0000	9
6	51°-52°,56°-58°	5	0	0	0	5	100	0	0.0000	0.0000	9
7	50°-52°,55°-57°	17	1	0	0	18	910	1	0.0556	0.0011	4
8	49°-50°,54°-56°	13	1	0	1	15	634	24	0.1333	0.0379	1.5
9	48°-50°,53°-54°	9	0	0	1	10	489	35	0.1000	0.0716	1.5
10	48°-49°,52°-53°	4	0	0	0	4	109	0	0.0000	0.0000	9
11	47°-48°,52°-53°	16	0	0	0	16	152	0	0.0000	0.0000	9
12	47°-48°,53°-54°	12	0	0	0	12	90	0	0.0000	0.0000	9
16	45°-48°,54°-59°	1	0	0	0	1	36	0	0.0000	0.0000	9
17	46°-51°,58°-60°	10	1	0	0	11	226	1	0.1000	0.0044	3

APPENDIX 22

Annual distibution of finback whales from land-based data.

Sections of the study area are identified in the legend for Appendix 14.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979:									
North	1+ 2+14					0			
East	6+ 7	33	0	0	0	33	0	0.000	0.000
South	8+10-12					0			
1980:									
North	1+ 2+14	26	6	3	0	35	12	0.257	0.343
East	6+ 7	22	2	1	0	25	4	0.120	0.160
South	8+10-12	64	16	4	1	85	27	0.247	0.318
1981:									
North	1+ 2+14	34	13	11	1	59	38	0.424	0.622
East	6+ 7	8	0	0	0	8	0	0.000	0.000
South	8+10-12	59	16	2	0	77	20	0.234	0.260
1982:									
North	1+ 2+14	23	5	3	0	31	11	0.258	0.355
East	6+ 7	5	0	0	0	5	0	0.000	0.000
South	8+10-12	47	14	7	0	98	28	0.214	0.286

APPENDIX 23

Annual distibution of finback whales from shipboard data.

Sections of the study area are identified in the legend for Appendix 15.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
1976-77:									
North	4+7+9	19	1	0	0	20	1	0.050	0.050
East	10+11	5	3	1	0	9	5	0.444	0.555
1978:									
North	4+7+9	10	0	1	0	11	2	0.091	0.182
East	10+11	12	6	2	0	20	10	0.400	0.500
1979:									
North	4+7+9	18	1	1	0	20	3	0.100	0.150
East	10+11	42	5	2	0	49	9	0.143	0.184
1980:									
North	4+7+9	14	0	0	0	14	0	0.000	0.000
East	10+11	44	11	3	0	58	17	0.241	0.293
1981:									
North	4+7+9	12	1	0	0	13	1	0.077	0.077
East	10+11	36	7	5	0	48	17	0.250	0.354
1982:									
North	4+7+9	15	1	0	0	16	1	0.062	0.062
East	10+11	44	0	0	0	44	0	0.000	0.000
1983:									
North	4+7+9	10	0	0	0	10	0	0.000	0.000
East	10+11	16	0	0	0	16	0	0.000	0.000

APPENDIX 24

Observer network results x year x land-based section x finback whale

Column headings are identified in the legend for Table 3, Section 3.2.1

Land-Bd Section	Stat. Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
1979:										
1	6,7					0				
2	9,10,14					0				
3	11,12,13	8	4	0	0	8	4	0.500	0.500	1
4	15 - 19	33	0	3	0	36	6	0.083	0.167	5
5	20,21,24	6	0	1	0	7	2	0.143	0.286	4
6	22,23	12	0	0	0	12	0	0.000	0.000	8
7	25	27	0	0	0	27	0	0.000	0.000	8
8	26,27	26	0	0	0	26	0	0.000	0.000	8
9	28,29	34	3	4	1	42	14	0.190	0.333	2
10	30,31,32	14	0	0	0	14	0	0.000	0.000	8
11	33,36	3	1	0	0	4	1	0.250	0.250	3
12	37					0				
13	39,40,41					0				
14	44,45,49	5	0	0	0	5	0	0.000	0.000	8
15	1,50					0				
Total or Mean		164	8	8	1	181	27	0.116	0.154	
Std. Dev.								± 0.163	0.182	
1980:										
1	6,7	15	4	0	0	19	4	0.211	0.211	5
2	9,10,14	20	2	0	0	22	2	0.091	0.091	11
3	11,12,13	46	8	0	0	54	8	0.148	0.148	8
4	15 - 19	45	5	3	0	53	11	0.151	0.208	7
5	20,21,24	74	7	9	0	90	25	0.178	0.278	5
6	22,23	31	1	0	0	32	1	0.031	0.031	12.5
7	25	41	4	1	0	46	6	0.109	0.130	9.5
8	26,27	39	5	4	0	48	13	0.188	0.271	5
9	28,29	26	11	6	0	43	23	0.395	0.535	2
10	30,31,32	10	0	0	0	10	0	0.000	0.000	14.5
11	33,36	20	11	0	1	32	14	0.375	0.438	3
12	37	36	3	1	0	40	5	0.100	0.125	9.5
13	39,40,41	54	2	0	0	56	2	0.036	0.036	12.5
14	44,45,49	17	4	8	0	29	20	0.414	0.690	1
15	1,50	24	0	0	0	24	0	0.000	0.000	14.5
Total or Mean		498	67	32	1	598	134	0.163	0.213	
Std. Dev.								± 0.138	0.204	

(continued next page)

APPENDIX 24 (continued)

Observer network results x year x land-based section x finback whale

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
1981:										
1	6,7	26	9	6	1	42	24	0.381	0.571	2
2	9,10,14	42	0	0	0	42	0	0.000	0.000	12
3	11,12,13					0				
4	15 - 19	17	0	0	0	17	0	0.000	0.000	12
5	20,21,24	14	0	0	0	14	0	0.000	0.000	12
6	22,23	18	0	0	0	18	0	0.000	0.000	12
7	25	20	2	1	0	23	4	0.130	0.174	5
8	26,27	12	1	0	0	13	1	0.077	0.077	6.5
9	28,29	9	1	0	0	10	1	0.100	0.100	6.5
10	30,31,32	34	1	0	0	35	1	0.029	0.029	8.5
11	33,36	21	10	2	0	33	14	0.364	0.424	3
12	37	25	4	1	0	30	6	0.167	0.167	4
13	39,40,41	46	1	0	0	47	1	0.021	0.021	8.5
14	44,45,49	3	7	7	1	18	24	0.833	1.333	1
15	1,50	33	0	0	0	33	0	0.000	0.000	12
Total or Mean		320	36	17	2	375	76	0.150	0.209	
Std. Dev.								± 0.234	0.367	
1982:										
1	6,7	15	5	3	0	23	11	0.348	0.478	2
2	9,10,14	15	0	0	0	15	0	0.000	0.000	9
3	11,12,13	11	0	0	0	11	0	0.000	0.000	9
4	15-19					0				
5	20,21,24	1	0	0	0	1	0	0.000	0.000	9
6	22,23	18	0	0	0	18	0	0.000	0.000	9
7	25	2	0	0	0	2	0	0.000	0.000	9
8	26,27	18	1	4	0	23	9	0.217	0.391	3
9	28,29					0				
10	30,31,32	14	0	0	0	14	0	0.000	0.000	9
11	33,36	26	20	3	0	49	26	0.469	0.531	1
12	37	9	3	0	0	12	3	0.250	0.250	4
13	39,40,41	38	0	0	0	38	0	0.000	0.000	9
14	44,45,49	21	0	0	0	21	0	0.000	0.000	9
15	1,50	33	0	0	0	33	0	0.000	0.000	9
Total or Mean		220	29	10	0	259	49	0.100	0.127	
Std. Dev.								± 0.166	0.207	

APPENDIX 25

Observer network results x year x shipboard study area x finback whale
The column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over -all Rank
1976-77:											
1	55°-57°,60°-62°	5	1	0	0	6	193	1	0.167	0.167	6
2	54°-56°,55°-58°	6	0	0	0	6	185	0	0.000	0.000	10.5
3	53°-55°,56°-59°	3	0	0	0	3	133	0	0.000	0.000	10.5
4	50°-52°,55°-56°	3	1	0	0	4	250	1	0.250	0.250	4
7	50°-52°,55°-57°	14	1	0	0	15	564	1	0.067	0.067	8
8	49°-50°,54°-56°	4	3	0	2	9	437	9	0.556	1.000	1
9	48°-50°,53°-54°	7	0	1	0	8	429	2	0.125	0.250	5
10	48°-49°,52°-53°	3	1	1	0	4	144	3	0.500	0.500	2
11	47°-48°,52°-53°	3	2	0	0	5	192	2	0.400	0.400	3
14	46°-47°,52°-55°	9	1	0	0	10	259	1	0.100	0.100	7
16	45°-48°,54°-59°	5	0	0	0	5	169	0	0.000	0.000	10.5
17	46°-51°,58°-60°	1	0	0	0	1	6	0	0.000	0.000	10.5
Total or Std.Dev.	Mean	62	10	2	2	76	2961	20	0.181 ±0.203	0.249 ±0.323	
1978:											
4	50°-52°,55°-56°	4	0	1	0	5	217	2	0.200	0.400	3.5
7	50°-52°,55°-57°	6	0	0	0	6	359	0	0.000	0.000	5.5
8	49°-50°,54°-56°	2	0	2	0	4	208	4	0.500	1.000	1
9	48°-50°,53°-54°	2	1	0	0	3	193	1	0.333	0.333	3.5
10	48°-49°,52°-53°	11	6	2	0	19	551	10	0.421	0.526	2
11	47°-48°,52°-53°	1	0	0	0	1	30	0	0.000	0.000	5.5
Total or Std.Dev.	Mean	26	7	5	0	38	1558	17	0.295 ±0.176	0.452 ±0.325	
1979:											
1	55°-57°,60°-62°	32	1	0	0	33	1329	1	0.030	0.030	5
2	54°-56°,55°-58°	15	0	0	0	15	519	0	0.000	0.000	11
3	53°-55°,56°-59°	23	2	0	0	25	945	0	0.000	0.000	11
4	50°-52°,55°-56°	9	0	0	0	9	580	0	0.000	0.000	11
5	50°-51°,57°-58°	27	1	0	0	28	624	1	0.036	0.036	5
6	51°-52°,56°-58°	10	0	0	0	10	110	0	0.000	0.000	11
7	50°-52°,55°-57°	11	2	0	0	13	673	2	0.154	0.154	3
8	49°-50°,54°-56°	9	0	0	0	9	322	0	0.000	0.000	11
9	48°-50°,53°-54°	14	1	2	1	18	421	8	0.222	0.444	1.5
10	48°-49°,52°-53°	15	4	2	0	21	593	8	0.286	0.381	1.5
11	47°-48°,52°-53°	27	1	0	0	28	297	1	0.036	0.036	5
12	47°-48°,53°-54°	25	0	0	0	25	234	0	0.000	0.000	11
14	46°-47°,52°-55°	5	0	0	0	5	117	0	0.000	0.000	11
16	45°-48°,54°-59°	10	0	0	0	10	345	0	0.000	0.000	11
17	46°-51°,58°-60°	2	0	0	0	2	28	0	0.000	0.000	11
Total or Std. Dev.	Mean	234	12	4	1	251	7137	23	0.051 ±0.092	0.072 ±0.143	
1980:											
1	55°-57°,60°-62°	4	0	0	0	4	178	0	0.000	0.000	13.5
2	54°-56°,55°-58°	4	0	0	0	4	126	0	0.000	0.000	13.5
3	53°-55°,56°-59°	9	0	0	0	9	251	0	0.000	0.000	13.5
4	50°-52°,55°-56°	6	0	0	0	6	234	0	0.000	0.000	13.5
5	50°-51°,57°-58°	17	1	0	0	18	405	1	0.056	0.056	7
6	51°-52°,56°-58°	26	1	0	0	27	505	1	0.037	0.037	9
7	50°-52°,55°-57°	8	0	0	0	8	363	0	0.000	0.000	13.5
8	49°-50°,54°-56°	2	1	0	0	3	149	1	0.333	0.333	3
9	48°-50°,53°-54°	14	0	0	0	14	309	12	0.370	0.444	2
10	48°-49°,52°-53°	17	8	2	0	27	718	5	0.129	0.161	4.5
11	47°-48°,52°-53°	27	3	1	0	31	740	1	0.167	0.167	4.5
12	47°-48°,53°-54°	16	0	0	0	16	161	0	0.000	0.000	13.5
13	45°-48°,49°-52°	10	0	0	0	10	332	0	0.000	0.000	13.5
14	46°-47°,52°-55°	5	1	0	0	6	181	1	0.167	0.167	4.5
15	43°-45°,49°-51°	4	3	1	0	8	373	5	0.500	0.625	1
16	45°-48°,54°-59°	11	1	0	0	12	432	1	0.083	0.083	7
17	46°-51°,58°-60°	16	1	0	0	17	679	1	0.059	0.059	7
Total or Std. Dev.	Mean	196	20	4	0	220	6136	29	0.102 ±0.154	0.115 ±0.182	

(continued next page)

APPENDIX 25 (continued)

Observer network results x year x shipboard study area x finback whale

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over-all Rank
1981:											
2	54°-56',55°-58'	2	0	0	0	2	95	0	0.000	0.000	12.5
4	50°-52',55°-56'	3	0	0	0	3	145	0	0.000	0.000	12.5
5	50°-51',57°-58'	32	1	0	0	33	823	1	0.030	0.030	9
6	51°-52',56°-58'	9	0	0	0	9	138	0	0.000	0.000	12.5
7	50°-52',55°-57'	8	1	0	0	9	391	1	0.111	0.111	7.5
8	49°-50',54°-56'	5	1	0	0	6	232	1	0.167	0.167	5.5
9	48°-50',53°-54'	9	0	0	0	9	284	0	0.000	0.000	12.5
10	48°-49',52°-53'	18	2	2	0	22	595	6	0.182	0.273	4
11	47°-48',52°-53'	18	5	3	0	26	551	11	0.308	0.423	1
12	47°-48',53°-54'	8	0	0	0	8	103	0	0.000	0.000	12.5
13	45°-48',49°-52'	12	3	0	0	15	505	3	0.200	0.200	5.5
14	46°-47',52°-55'	6	3	0	0	9	337	3	0.333	0.333	2
15	43°-45',49°-51'	4	0	1	0	5	159	2	0.200	0.400	3
16	45°-48',54°-59'	12	2	0	0	14	454	2	0.143	0.143	7.5
17	46°-51',58°-60'	16	0	0	0	16	532	0	0.000	0.000	12.5
Total or Std.Dev.	Mean	172	18	6	1	187	5344	33	0.111 ±0.117	0.138 ±0.154	
1982:											
1	55°-57',60°-62'	6	0	0	0	6	198	0	0.000	0.000	12
2	54°-56',55°-58'	4	1	0	0	5	222	1	0.200	0.200	2
3	53°-55',56°-59'	28	0	0	0	28	432	0	0.000	0.000	12
4	50°-52',55°-56'	8	0	0	0	8	375	0	0.000	0.000	12
5	50°-51',57°-58'	23	1	0	0	24	472	1	0.042	0.042	5
6	51°-52',56°-58'	12	1	0	0	13	252	1	0.077	0.077	5
7	50°-52',55°-57'	3	0	0	0	3	173	0	0.000	0.000	12
8	49°-50',54°-56'	25	0	0	0	25	436	0	0.000	0.000	12
9	48°-50',53°-54'	24	1	0	0	25	464	1	0.040	0.040	5
10	48°-49',52°-53'	11	0	0	0	11	338	0	0.000	0.000	12
11	47°-48',52°-53'	33	0	0	0	33	240	0	0.000	0.000	12
12	47°-48',53°-54'	26	0	0	0	26	237	0	0.000	0.000	12
13	45°-48',49°-52'	9	0	0	0	9	300	0	0.000	0.000	12
14	46°-47',52°-55'	3	0	0	0	3	48	0	0.000	0.000	12
15	43°-45',49°-51'	14	2	0	0	16	480	2	0.125	0.125	3
16	45°-48',54°-59'	3	0	0	0	3	108	0	0.000	0.000	12
17	46°-51',58°-60'	3	1	0	0	4	180	1	0.250	0.250	1
Total or Std.Dev.	Mean	235	7	0	0	242	4956	7	0.043 ±0.077	0.043 ±0.077	
1983:											
2	54°-56',55°-58'	7	3	0	0	10	178	3	0.300	0.300	2
3	53°-55',56°-59'	6	0	0	0	6	145	0	0.000	0.000	8.5
4	50°-52',55°-56'	4	0	0	0	4	210	0	0.000	0.000	8.5
6	51°-52',56°-58'	4	0	0	0	4	98	0	0.000	0.000	8.5
7	50°-52',55°-57'	5	0	0	0	5	245	0	0.000	0.000	8.5
8	49°-50',54°-56'	2	0	0	0	2	124	0	0.000	0.000	8.5
9	48°-50',53°-54'	4	0	0	0	4	126	0	0.000	0.000	8.5
10	48°-49',52°-53'	6	0	0	0	6	113	0	0.000	0.000	8.5
11	47°-48',52°-53'	10	0	0	0	10	162	0	0.000	0.000	8.5
12	47°-48',53°-54'	3	0	0	0	3	63	0	0.000	0.000	8.5
13	45°-48',49°-52'	3	0	0	0	3	72	0	0.000	0.000	8.5
14	46°-47',52°-55'	3	4	0	0	7	210	4	0.571	0.571	1
15	43°-45',49°-51'	4	0	0	0	4	150	0	0.000	0.000	8.5
17	46°-51',58°-60'	5	0	0	0	5	193	0	0.000	0.000	8.5
Total or Std.Dev.	Mean	67	7	0	0	74	2091	7	0.062 ±0.167	0.062 ±0.167	

APPENDIX 26

Monthly distibution of minke whales from land-based data.

Sections of the study area are identified in the legend for Appendix 10.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
December-February:									
North	1+15	19	0	0	0	19	0	0.000	0.000
East	2- 7	30	0	0	0	30	0	0.000	0.000
South	8-12	57	1	0	0	58	1	0.017	0.017
March-April:									
North	1+15	10	0	0	0	10	0	0.000	0.000
East	2- 7	30	2	0	0	32	2	0.062	0.062
South	8-12	66	0	0	0	66	0	0.000	0.000
May:									
North	1+15	32	0	0	0	32	0	0.000	0.000
East	2- 7	69	12	0	0	81	12	0.148	0.148
South	8-12	83	5	0	0	88	5	0.057	0.057
June:									
North	1+15	52	8	0	0	60	8	0.133	0.133
East	2- 7	130	62	2	0	194	66	0.330	0.340
South	8-12	123	27	6	0	156	39	0.212	0.250
July:									
North	1+15	51	5	0	0	56	5	0.089	0.089
East	2- 7	203	78	4	0	285	86	0.288	0.302
South	8-12	135	56	3	0	194	62	0.304	0.320
August:									
North	1+15	33	4	0	0	37	4	0.108	0.237
East	2- 7	103	25	3	0	131	31	0.214	0.237
South	8-12	77	5	0	0	82	5	0.061	0.061
September:									
North	1+15	18	3	0	0	21	3	0.143	0.143
East	2- 7	44	6	2	0	52	10	0.154	0.192
South	8-12	51	1	0	0	52	1	0.019	0.019
October-November:									
North	1+15	23	2	0	0	25	2	0.080	0.080
East	2- 7	27	0	1	0	28	2	0.036	0.071
South	8-12	69	0	0	0	69	0	0.000	0.000

APPENDIX 27

Monthly distibution of minke whales from shipboard data.

Sections of the study area are identified in the legend for Appendix 11.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
May:									
North	1- 8					0			
East	9-12	20	7	6	0	33	19	0.394	0.576
South	14-16	9	1	0	0	10	1	0.100	0.100
June:									
North	1- 8					0			
East	9-12	103	27	3	0	133	33	0.226	0.248
South	14-16	52	11	0	0	63	11	0.175	0.175
July:									
North	1- 8	99	30	2	0	131	34	0.244	0.230
East	9-12	116	31	3	0	150	37	0.227	0.247
South	14-16	15	0	1	0	16	2	0.062	0.125
August:									
North	1- 8	98	30	6	0	134	42	0.269	0.313
East	9-12	64	13	1	0	78	15	0.179	0.192
South	14-16	33	4	0	0	37	4	0.108	0.108
September:									
North	1- 8	36	13	1	0	50	15	0.280	0.300
East	9-12	42	0	0	0	42	0	0.000	0.000
South	14-16						0		

APPENDIX 28

Observer network results x month x land-based section for minke whales

Column headings are identified in the legend to Table 3, Section 3.2.1

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over -all Rank
December to February:										
1	6,7	15	0	0	0	15	0	0.0000	0.0000	6.5
2	9,10,14	9	0	0	0	9	0	0.0000	0.0000	6.5
3	11,12,13					0				
4	15 - 19	8	0	0	0	8	0	0.0000	0.0000	6.5
5	20,21,24					0				
6	22,23	13	0	0	0	13	0	0.0000	0.0000	6.5
7	25					0				
8	26,27	8	0	0	0	8	0	0.0000	0.0000	6.5
9	28,29					0				
10	30,31,32	18	0	0	0	18	0	0.0000	0.0000	6.5
11	33,36	24	0	0	0	24	0	0.0000	0.0000	6.5
12	37	7	1	0	0	8	1	0.1250	0.1250	1
13	39,40,41	14	0	0	0	14	0	0.0000	0.0000	6.5
14	44,45,49	4	0	0	0	4	0	0.0000	0.0000	6.5
15	1,50	4	0	0	0	4	0	0.0000	0.0000	6.5
March and April:										
1	6,7	9	0	0	0	9	0	0.0000	0.0000	8
2	9,10,14	11	0	0	0	11	0	0.0000	0.0000	8
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24	6	1	0	0	7	1	0.1429	0.1429	1
6	22,23	10	1	0	0	11	1	0.0909	0.0909	2
7	25	3	0	0	0	3	0	0.0000	0.0000	8
8	26,27	9	0	0	0	9	0	0.0000	0.0000	8
9	28,29	10	0	0	0	10	0	0.0000	0.0000	8
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	8
11	33,36	29	0	0	0	29	0	0.0000	0.0000	8
12	37	3	0	0	0	3	0	0.0000	0.0000	8
13	30,31,32	16	0	0	0	16	0	0.0000	0.0000	8
14	44,45,49	9	0	0	0	9	0	0.0000	0.0000	8
15	1,50	1	0	0	0	1	0	0.0000	0.0000	8

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APPENDIX 28 (continued)

Observer network results x month x land-based section for minke whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
May:										
1	6,7	12	0	0	0	12	0	0.0000	0.0000	13
2	9,10,14	28	0	0	0	28	0	0.0000	0.0000	13
3	11,12,13	4	1	0	0	5	1	0.2000	0.2000	3.5
4	15 - 19	4	4	0	0	8	4	0.5000	0.5000	1
5	20,21,24	6	2	0	0	8	2	0.2500	0.2500	2
6	22,23	16	4	0	0	20	4	0.2000	0.2000	3.5
7	25	11	1	0	0	12	1	0.0833	0.0833	8.5
8	26,27	4	0	0	0	4	0	0.0000	0.0000	13
9	28,29	7	1	0	0	8	1	0.1250	0.1250	6
10	30,31,32	25	1	0	0	26	1	0.0385	0.0385	10
11	33,36	36	3	0	0	39	3	0.0769	0.0769	8.5
12	37	11	0	0	0	11	0	0.0000	0.0000	13
13	39,40,41	27	2	1	0	30	4	0.1000	0.1333	6
14	44,45,49	12	2	0	0	14	2	0.1429	0.1429	6
15	1,50	20	0	0	0	20	0	0.0000	0.0000	13
June:										
1	6,7	19	6	0	0	25	5	0.2400	0.2400	8.5
2	9,10,14	25	14	1	0	40	16	0.3750	0.4000	3.5
3	11,12,13	12	8	0	0	20	8	0.4000	0.4000	3.5
4	15 - 19	19	16	0	0	35	16	0.4571	0.4571	2
5	20,21,24	26	9	1	0	36	11	0.2778	0.3056	5.5
6	22,23	23	9	0	0	32	9	0.2812	0.2812	7
7	25	25	6	0	0	31	6	0.1935	0.1935	10.5
8	26,27	22	8	1	0	31	10	0.2903	0.3226	5.5
9	28,29	18	17	4	0	39	25	0.5385	0.6410	1
10	30,31,32	20	2	1	0	23	4	0.1304	0.1739	10.5
11	33,36	41	0	0	0	41	0	0.0000	0.0000	14.5
12	37	22	0	0	0	22	0	0.0000	0.0000	14.5
13	39,40,41	30	1	2	0	33	5	0.0909	0.1515	12.5
14	44,45,49	13	4	0	0	17	4	0.2353	0.2353	8.5
15	1,50	33	2	0	0	35	2	0.0571	0.0571	12.5
July:										
1	6,7	24	5	0	0	29	5	0.1724	0.1724	9.5
2	9,10,14	31	14	0	0	45	14	0.3111	0.3111	5
3	11,12,13	32	9	0	0	41	9	0.2195	0.2195	7.5
4	15 - 19	32	18	2	0	52	22	0.3846	0.4231	2
5	20,21,24	40	16	1	0	57	18	0.2982	0.3158	5
6	22,23	36	8	0	0	44	8	0.1818	0.1818	9.5
7	25	32	13	1	0	46	15	0.3043	0.3261	5
8	26,27	29	30	3	0	62	36	0.5323	0.5806	1
9	28,29	34	19	0	0	53	19	0.3585	0.3585	3
10	30,31,32	20	5	0	0	25	5	0.2000	0.2000	7.5
11	33,36	32	2	0	0	34	2	0.0588	0.0588	12
12	37	20	0	0	0	20	0	0.0000	0.0000	14
13	39,40,41	31	2	0	0	33	2	0.0000	0.0000	14
14	44,45,49	20	3	0	0	23	3	0.1304	0.1304	11
15	1,50	27	0	0	0	27	0	0.0000	0.0000	14

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APPENDIX 28 (continued)

Observer network results x month x land-based section for minke whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
August:										
1	6,7	17	4	0	0	21	4	0.1905	0.1905	6.5
2	9,10,14	15	2	0	0	17	2	0.1176	0.1176	8
3	11,12,13	23	10	1	0	34	12	0.3235	0.3529	1.5
4	15 - 19	11	4	1	0	16	6	0.3125	0.3750	1.5
5	20,21,24	18	3	1	0	22	5	0.1818	0.2273	5
6	22,23	21	1	0	0	22	1	0.0454	0.0454	9
7	25	15	5	0	0	20	5	0.2500	0.2500	3
8	26,27	12	3	0	0	15	3	0.2000	0.2000	6.5
9	28,29	7	2	0	0	9	2	0.2222	0.2222	4
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	12.5
11	33,36	26	0	0	0	26	0	0.0000	0.0000	12.5
12	37	17	0	0	0	17	0	0.0000	0.0000	12.5
13	39,40,41	20	0	0	0	20	0	0.0000	0.0000	12.5
14	44,45,49	17	0	0	0	17	0	0.0000	0.0000	12.5
15	1,50	16	0	0	0	16	0	0.0000	0.0000	12.5
September:										
1	6,7	6	3	0	0	9	3	0.3333	0.3333	2
2	9,10,14	4	1	0	0	5	1	0.2000	0.2000	4
3	11,12,13	7	0	1	0	8	2	0.1250	0.2500	4
4	15 - 19	0	2	1	0	3	4	1.0000	1.3333	1
5	20,21,24	3	0	0	0	3	0	0.0000	0.0000	10.5
6	22,23	19	0	0	0	19	0	0.0000	0.0000	10.5
7	25	11	3	0	0	14	3	0.2143	0.2143	4
8	26,27	2	0	0	0	2	0	0.0000	0.0000	10.5
10	30,31,32	10	0	0	0	10	0	0.0000	0.0000	10.5
11	33,36	16	1	0	0	17	1	0.0588	0.0588	6
12	37	23	0	0	0	23	0	0.0000	0.0000	10.5
13	39,40,41	10	0	0	0	10	0	0.0000	0.0000	10.5
14	44,45,49	16	0	0	0	16	0	0.0000	0.0000	10.5
15	1,50	12	0	0	0	12	0	0.0000	0.0000	10.5
October and November:										
1	6,7	14	2	0	0	16	2	0.1250	0.1250	2
2	9,10,14	1	0	1	0	2	2	0.5000	1.0000	1
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24					0				
6	22,23	9	0	0	0	9	0	0.0000	0.0000	6.5
7	25	17	0	0	0	17	0	0.0000	0.0000	6.5
10	30,31,32	19	0	0	0	19	0	0.0000	0.0000	6.5
11	33,36	40	0	0	0	40	0	0.0000	0.0000	6.5
12	37	10	0	0	0	10	0	0.0000	0.0000	6.5
13	39,40,41	16	0	0	0	16	0	0.0000	0.0000	6.5
14	44,45,49	4	0	0	0	4	0	0.0000	0.0000	6.5
15	1,50	9	0	0	0	9	0	0.0000	0.0000	6.5

APPENDIX 29

Observer network results x month x shipboard section for minke whales
Column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Obsr'd Freq (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n. mi)	No. of Whales	Sight. Freq.	Sight. Rate	Over -all Rank
May:											
5	50°-51°,57°-58°	51	8	0	0	59	1541	15	0.1356	0.0097	4.5
9	48°-50°,53°-54°	2	3	4	0	9	224	56	0.7778	0.2500	1
10	48°-49°,52°-53°	2	2	0	0	4	71	4	0.5000	0.0563	2.5
11	47°-48°,52°-53°	7	0	0	0	7	20	0	0.0000	0.0000	7
12	47°-48°,53°-54°	9	2	2	0	11	178	28	0.3077	0.1573	2.5
14	46°-47°,52°-55°	2	0	0	0	2	51	0	0.0000	0.0000	7
16	45°-48°,54°-59°	7	1	0	0	8	210	1	0.1250	0.0048	4.5
17	46°-51°,58°-60°	7	0	0	0	7	277	0	0.0000	0.0000	7
June:											
3	53°-55°,56°-59°	1	1	0	0	1	47	1	0.5000	0.0213	2.5
5	50°-51°,57°-58°	51	7	0	0	58	974	10	0.1207	0.0103	7.5
6	51°-52°,56°-58°	21	1	0	0	22	257	2	0.0454	0.0078	9.5
8	49°-50°,54°-56°	1	0	0	0	1	12	0	0.0000	0.0000	12.5
9	48°-50°,53°-54°	6	3	0	0	9	210	4	0.3333	0.0190	2.5
10	48°-49°,52°-53°	26	9	2	0	37	998	30	0.2973	0.0301	2.5
11	47°-48°,52°-53°	44	10	0	0	54	944	19	0.1852	0.0201	5.5
12	47°-48°,53°-54°	27	5	1	0	33	397	24	0.1818	0.0604	2.5
13	45°-48°,49°-52°	26	4	0	0	30	1022	4	0.1333	0.0039	7.5
14	46°-47°,52°-55°	18	8	0	0	26	804	14	0.3077	0.0174	5.5
15	43°-45°,49°-51°	19	2	0	0	21	715	3	0.0952	0.0042	9.5
16	45°-48°,54°-59°	15	1	0	0	16	489	1	0.0625	0.0020	11
17	46°-51°,58°-60°	2	0	0	0	2	24	0	0.0000	0.0000	12.5
July:											
1	55°-57°,60°-62°	18	3	0	0	21	785	3	0.1429	0.0038	11
2	54°-56°,55°-58°	19	1	0	0	20	708	1	0.0500	0.0014	14
3	53°-55°,56°-59°	27	15	1	0	43	958	56	0.3721	0.0585	3
4	50°-52°,55°-56°	10	3	0	0	13	632	6	0.2308	0.0095	8
5	50°-51°,57°-58°	22	2	0	0	24	622	2	0.0833	0.0032	13
6	51°-52°,56°-58°	25	1	1	0	26	494	8	0.0741	0.0162	9
7	50°-52°,55°,57	8	5	0	0	13	552	12	0.3846	0.0217	4
8	49°-50°,54°-56°	17	3	1	0	21	525	16	0.1905	0.0305	5.5
9	48°-50°,53°-54°	39	6	2	0	47	856	19	0.1702	0.0222	7
10	48°-49°,52°-53°	38	15	0	0	53	1407	28	0.2830	0.0199	5.5
11	47°-48°,52°-53°	30	2	0	0	32	601	6	0.0625	0.0100	11
12	47°-48°,53°-54°	9	8	1	0	18	213	21	0.5000	0.0986	2
13	45°-48°,49°-52°	7	0	0	0	7	187	0	0.0000	0.0000	16
14	46°-47°,52°-55°	0	0	1	0	1	10	6	1.0000	0.6000	1
15	43°-45°,49°-51°	12	0	0	0	12	446	0	0.0000	0.0000	16
16	45°-48°,54°-59°	3	0	0	0	3	120	0	0.0000	0.0000	16
17	46°-51°,58°-60°	6	1	0	0	7	288	1	0.1429	0.0035	11
August:											
1	55°-57°,60°-62°	18	5	1	0	24	978	15	0.2500	0.0153	5.5
2	54°-56°,55°-58°	17	3	2	0	22	616	18	0.2273	0.0292	4
3	53°-55°,56°-59°	16	5	1	0	22	754	18	0.2727	0.0239	2.5
4	50°-52°,55°-56°	10	7	0	0	17	907	7	0.4118	0.0077	5.5
5	50°-51°,57°-58°	10	1	0	0	11	388	4	0.0909	0.0103	9
6	51°-52°,56°-58°	8	1	0	0	9	252	1	0.1111	0.0040	13
7	50°-52°,55°,57	22	4	2	0	28	1306	22	0.2143	0.0168	7
8	49°-50°,54°-56°	15	6	0	0	21	736	15	0.2857	0.0204	2.5
9	48°-50°,53°-54°	8	6	1	0	15	671	21	0.4667	0.0313	1
10	48°-49°,52°-53°	12	4	0	0	16	538	4	0.2500	0.0093	8
11	47°-48°,52°-53°	30	2	0	0	32	515	2	0.0625	0.0039	15
12	47°-48°,53°-54°	14	1	0	0	15	98	1	0.0667	0.0102	10.5
14	46°-47°,52°-55°	12	1	0	0	13	339	2	0.0769	0.0059	13
16	45°-48°,54°-59°	21	3	0	0	24	863	5	0.1250	0.0058	10.5
17	46°-51°,58°-60°	24	1	0	0	25	1080	3	0.1200	0.0028	13
September:											
1	55°-57°,60°-62°	4	0	0	0	4	135	0	0.0000	0.0000	9.5
3	53°-55°,56°-59°	4	2	0	0	6	222	3	0.3333	0.0135	2
4	50°-52°,55°-56°	2	5	0	0	7	399	12	0.7143	0.0301	1
5	50°-51°,57°-58°	10	0	0	0	10	340	0	0.0000	0.0000	9.5
6	51°-52°,56°-58°	4	1	0	0	5	100	1	0.2000	0.0100	5
7	50°-52°,55°,57	13	5	0	0	18	910	10	0.2778	0.0110	3.5
8	49°-50°,54°-56°	13	1	1	0	15	634	10	0.1333	0.0158	3.5
9	48°-50°,53°-54°	10	0	0	0	10	489	0	0.0000	0.0000	9.5
10	48°-49°,52°-53°	4	0	0	0	4	109	0	0.0000	0.0000	9.5
11	47°-48°,52°-53°	16	0	0	0	16	152	0	0.0000	0.0000	9.5
12	47°-48°,53°-54°	12	0	0	0	12	90	0	0.0000	0.0000	9.5
16	45°-48°,54°-59°	1	0	0	0	1	36	0	0.0000	0.0000	9.5
17	46°-51°,58°-60°	11	0	0	0	11	226	0	0.0000	0.0000	9.5

APPENDIX 30

Annual distibution of minke whales from land-based data.

Sections of the study area are identified in the legend for Appendix 14.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979:									
North	1+ 2+15					0			
East	6+ 7	29	6	0	0	35	6	0.171	0.171
South	8+10-12					0			
1980:									
North	1+ 2+15	23	6	0	0	29	5	0.172	0.172
East	6+ 7	64	8	0	0	72	8	0.111	0.111
South	8+10-12	70	13	2	0	85	17	0.176	0.200
1981:									
North	1+ 2+15	38	16	0	0	54	16	0.296	0.296
East	6+ 7	34	8	0	0	42	8	0.190	0.190
South	8+10-12	74	2	1	0	77	4	0.039	0.052
1982:									
North	1+ 2+15	17	7	0	0	24	7	0.292	0.292
East	6+ 7	14	10	1	0	25	12	0.440	0.480
South	8+10-12	62	6	0	0	68	6	0.088	0.088

APPENDIX 31

Annual distibution of minke whales from shipboard data.

Sections of the study area are identified in the legend in Appendix 15.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
1976-77:									
North	4+7+9	8	11	1	0	20	13	0.600	0.650
East	10+11	8	1	0	0	9	1	0.111	0.111
1978:									
North	4+7+9	6	5	0	0	11	5	0.454	0.454
East	10+11	14	6	0	0	20	6	0.300	0.300
1979:									
North	4+7+9	14	6	0	0	20	6	0.300	0.300
East	10+11	41	7	1	0	49	9	0.163	0.184
1980:									
North	4+7+9	12	2	0	0	14	2	0.143	0.143
East	10+11	47	11	0	0	58	11	0.190	0.190
1981:									
North	4+7+9	9	4	0	0	13	4	0.308	0.308
East	10+11	35	12	1	0	48	14	0.271	0.292
1982:									
North	4+7+9	13	3	0	0	16	3	0.188	0.188
East	10+11	40	4	0	0	44	4	0.091	0.091
1983:									
North	4+7+9	9	1	0	0	10	1	0.100	0.100
East	10+11	15	1	0	0	16	1	0.062	0.062

APPENDIX 32

Observer network results x year x land-based section x minke whale
Column headings are identified in the legend to Table 3, Section 3.2.4

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Rank -all Over
1979:										
1	6,7					0				
2	9,10,14					0				
3	11,12,13	2	6	0	0	8	6	0.750	0.750	1
4	15 - 19	15	20	1	0	36	22	0.583	0.611	3
5	20,21,24	6	8	0	0	14	8	0.571	0.571	3
6	22,23	11	1	0	0	12	1	0.083	0.083	8
7	25	23	6	0	0	29	6	0.207	0.207	7
8	26,27	19	7	0	0	26	7	0.269	0.269	6
9	28,29	20	20	2	0	42	24	0.524	0.571	5
10	30,31,32	14	0	0	0	14	0	0.000	0.000	9.5
11	33,36	4	0	0	0	4	0	0.000	0.000	9.5
12	37					0				
13	39,40,41					0				
14	44,45,49	2	3	0	0	5	3	0.600	0.600	3
15	1,50					0				
Total or Mean		[illegible]	71	3	0	190	78	0.358	0.379	
Std. Dev.								± 0.278	[illegible]	
1980:										
1	6,7	15	4	0	0	19	4	0.210	0.210	6
2	9,10,14	30	1	0	0	31	1	0.032	0.032	12.5
3	11,12,13	49	20	2	0	71	24	0.310	0.338	4
4	15 - 19	32	18	3	0	53	24	0.396	0.453	2.5
5	20,21,24	67	20	3	0	90	26	0.256	0.289	5
6	22,23	40	8	0	0	48	8	0.167	0.167	7
7	25	42	4	0	0	46	4	0.087	0.087	10.5
8	26,27	17	28	3	0	48	34	0.646	0.708	1
9	28,29	31	16	2	0	49	20	0.367	0.408	2.5
10	30,31,32	10	0	0	0	10	0	0.000	0.000	14.5
11	33,36	31	1	0	0	32	1	0.031	0.031	12.5
12	37	40	0	0	0	40	0	0.000	0.000	14.5
13	39,40,41	37	3	2	0	42	7	0.119	0.167	8
14	44,45,49	26	3	0	0	29	3	0.103	0.103	9
15	1,50	22	2	0	0	24	2	0.083	0.083	10.5
Total or Mean		489	128	15	0	632	158	0.188	0.205	
Std. Dev.								± 0.183	0.202	

(continued next page)

APPENDIX 32 (continued)

Observer network results x year x land-based section x minke whale

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Rank -all Over
1981:										
1	6,7	34	8	0	0	42	8	0.190	0.190	5
2	9,10,14	32	23	0	0	55	23	0.418	0.418	1.5
3	11,12,13					0				
4	15 - 19	15	2	0	0	17	2	0.118	0.118	7
5	20,21,24	14	0	0	0	14	0	0.000	0.000	12
6	22,23	29	1	0	0	30	1	0.033	0.033	8.5
7	25	14	9	0	0	23	9	0.391	0.391	1.5
8	26,27	11	1	1	0	13	3	0.154	0.231	5
9	28,29	8	2	0	0	10	2	0.200	0.200	5
10	30,31,32	27	7	1	0	35	9	0.229	0.257	3
11	33,36	33	0	0	0	33	0	0.000	0.000	12
12	37	30	0	0	0	30	0	0.000	0.000	12
13	39,40,41	29	0	0	0	29	0	0.000	0.000	12
14	44,45,49	17	1	0	0	18	1	0.056	0.056	8.5
15	1,50	33	0	0	0	33	0	0.000	0.000	12
Total or Mean		326	54	2	0	382	58	0.129	0.136	
Std. Dev.								± 0.146	0.148	
1982:										
1	6,7	17	6	0	0	23	6	0.261	0.261	3.5
2	9,10,14	13	7	1	0	21	9	0.381	0.429	2
3	11,12,13	23	1	0	0	24	1	0.042	0.042	6.5
4	15-19					0				
5	20,21,24	1	0	0	0	1	0	0.000	0.000	10.5
6	22,23	19	8	0	0	27	8	0.296	0.296	3.5
7	25	4	8	1	0	13	10	0.692	0.769	1
8	26,27	18	5	0	0	23	5	0.217	0.217	5
9	28,29					0				
10	30,31,32	14	0	0	0	14	0	0.000	0.000	10.5
11	33,36	47	2	0	0	49	2	0.041	0.041	6.5
12	37	12	0	0	0	12	0	0.000	0.000	10.5
13	39,40,41	25	0	0	0	25	0	0.000	0.000	10.5
14	44,45,49	21	0	0	0	21	0	0.000	0.000	10.5
15	1,50	33	0	0	0	33	0	0.000	0.000	10.5
Total or Mean		246	37	2	0	285	41	0.148	0.158	
Std. Dev.								± 0.213	0.235	

APPENDIX 33

Observer network results x year x shipboard study area x minke whale
The column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over -all Rank
1976-77:											
1	55°-57°,60°-62°	3	3	0	0	6	193	3	0.500	0.500	4.5
2	54°-56°,55°-58°	5	1	0	0	6	185	1	0.167	0.167	8.5
3	53°-55°,56°-59°	1	1	1	0	3	133	3	0.667	1.000	2
4	50°-52°,55°-56°	2	2	0	0	4	250	2	0.500	0.500	4.5
7	50°-52°,55°-57°	6	7	2	0	15	564	11	0.600	0.733	3
8	49°-50°,54°-56°	2	5	2	0	9	437	9	0.778	1.000	1
9	48°-50°,53°-54°	6	2	0	0	8	429	2	0.250	0.250	7
10	48°-49°,52°-53°	4	0	0	0	4	144	0	0.000	0.000	11
11	47°-48°,52°-53°	4	1	0	0	5	192	1	0.200	0.200	8.5
14	46°-47°,52°-55°	6	3	1	0	10	259	5	0.400	0.500	6
16	45°-48°,54°-59°	5	0	0	0	5	169	0	0.000	0.000	11
17	46°-51°,58°-60°	1	0	0	0	1	6	0	0.000	0.000	11
Total or Mean		45	25	6	0	76	2961	43	0.339	0.404	
Std.Dev.									±0.274	±0.364	
1978:											
4	50°-52°,55°-56°	1	4	0	0	5	217	4	0.800	0.800	1
7	50°-52°,55°-57°	4	2	0	0	6	359	2	0.333	0.333	4
8	49°-50°,54°-56°	2	2	0	0	4	208	2	0.500	0.500	2
9	48°-50°,53°-54°	2	1	0	0	3	193	1	0.333	0.333	4
10	48°-49°,52°-53°	13	6	0	0	19	551	6	0.316	0.316	4
11	47°-48°,52°-53°	1	0	0	0	1	30	0	0.000	0.000	6
Total or Mean		23	15	0	0	38	1558	15	0.447	0.447	
Std.Dev.									±0.186	±0.186	
1979:											
1	55°-57°,60°-62°	29	3	1	0	33	1329	5	0.121	0.152	7
2	54°-56°,55°-58°	15	0	0	0	15	519	0	0.000	0.000	13.5
3	53°-55°,56°-59°	19	5	1	0	25	945	7	0.240	0.280	3.5
4	50°-52°,55°-56°	5	4	0	0	9	580	4	0.444	0.444	1
5	50°-51°,57°-58°	26	2	0	0	28	624	2	0.071	0.071	9.5
6	51°-52°,56°-58°	10	0	0	0	10	110	0	0.000	0.000	13.5
7	50°-52°,55°-57°	11	2	0	0	13	673	2	0.154	0.154	6
8	49°-50°,54°-56°	8	1	0	0	9	322	1	0.111	0.111	9.5
9	48°-50°,53°-54°	14	4	0	0	18	421	4	0.222	0.222	5
10	48°-49°,52°-53°	15	5	1	0	21	593	7	0.286	0.333	2
11	47°-48°,52°-53°	26	2	0	0	28	297	2	0.071	0.071	9
12	47°-48°,53°-54°	19	5	1	0	25	234	7	0.240	0.280	3.5
14	46°-47°,52°-55°	5	0	0	0	5	117	0	0.000	0.000	13.5
16	45°-48°,54°-59°	9	1	0	0	10	345	1	0.100	0.100	9.5
17	46°-51°,58°-60°	2	0	0	0	2	28	0	0.000	0.000	13.5
Total or Mean		213	34	4	0	251	7137	42	0.137	0.147	
Std.Dev.									±0.128	±0.137	
1980:											
1	55°-57°,60°-62°	4	0	0	0	4	178	0	0.000	0.000	15
2	54°-56°,55°-58°	4	0	0	0	4	126	0	0.000	0.000	15
3	53°-55°,56°-59°	6	3	0	0	9	251	3	0.333	0.333	2
4	50°-52°,55°-56°	5	1	0	0	6	234	1	0.167	0.167	5
5	50°-51°,57°-58°	16	2	0	0	18	405	2	0.111	0.111	9.5
6	51°-52°,56°-58°	24	3	0	0	27	505	3	0.111	0.111	9.5
7	50°-52°,55°-57°	7	1	0	0	8	363	1	0.125	0.125	9.5
8	49°-50°,54°-56°	3	0	0	0	3	149	0	0.000	0.000	15
9	48°-50°,53°-54°	12	2	0	0	14	309	2	0.143	0.143	5
10	48°-49°,52°-53°	19	8	0	0	27	718	8	0.296	0.296	2
11	47°-48°,52°-53°	28	3	0	0	31	740	3	0.097	0.097	9.5
12	47°-48°,53°-54°	15	1	0	0	16	161	1	0.062	0.062	9.5
13	45°-48°,49°-52°	7	3	0	0	10	332	3	0.300	0.300	2
14	46°-47°,52°-55°	6	0	0	0	6	181	0	0.000	0.000	15
15	43°-45°,49°-51°	8	0	0	0	8	373	0	0.000	0.000	15
16	45°-48°,54°-59°	11	1	0	0	12	432	1	0.083	0.083	9.5
17	46°-51°,58°-60°	14	3	0	0	17	679	3	0.176	0.176	5
Total or Mean		189	31	0	0	220	6136	31	0.118	0.118	
Std.Dev.									±0.110	±0.110	

(continued next page)

APPENDIX 33 (continued)

Observer network results x year x shipboard study area x minke whale

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over -all Rank
1981:											
2	54°-56°,55°-58°	2	0	0	0	2	95	0	0.000	0.000	14.5
4	50°-52°,55°-56°	2	1	0	0	3	145	1	0.333	0.333	2.5
5	50°-51°,57°-58°	30	3	0	0	33	823	3	0.091	0.091	12
6	51°-52°,56°-58°	7	1	1	0	9	138	3	0.222	0.333	6
7	50°-52°,55°-57°	7	2	0	0	9	391	2	0.222	0.222	8.5
8	49°-50°,54°-56°	6	0	0	0	6	232	0	0.000	0.000	14.5
9	48°-50°,53°-54°	5	3	1	0	9	284	5	0.444	0.556	1
10	48°-49°,52°-53°	16	5	1	0	22	595	7	0.273	0.318	4
11	47°-48°,52°-53°	19	7	0	0	26	551	7	0.269	0.269	6
12	47°-48°,53°-54°	6	2	0	0	8	103	2	0.250	0.250	6
13	45°-48°,49°-52°	14	1	0	0	15	505	1	0.067	0.067	12
14	46°-47°,52°-55°	6	3	0	0	9	337	3	0.333	0.333	2.5
15	43°-45°,49°-51°	4	1	0	0	5	159	1	0.200	0.200	8.5
16	45°-48°,54°-59°	12	2	0	0	14	454	2	0.143	0.143	10
17	46°-51°,58°-60°	15	1	0	0	16	532	1	0.062	0.062	12
Total or Std.Dev.	Mean	152	32	3	0	187	5344	38	0.193 ±0.130	0.211 ±0.154	
1982:											
1	55°-57°,60°-62°	4	2	0	0	6	198	2	0.333	0.333	2.5
2	54°-56°,55°-58°	3	1	1	0	5	222	3	0.200	0.600	2.5
3	53°-55°,56°-59°	15	13	0	0	28	432	13	0.464	06464	1
4	50°-52°,55°-56°	6	2	0	0	8	375	2	0.250	0.250	4.5
5	50°-51°,57°-58°	21	3	0	0	24	472	3	0.125	0.125	8
6	51°-52°,56°-58°	13	0	0	0	13	252	0	0.000	0.000	14
7	50°-52°,55°-57°	3	0	0	0	3	173	0	0.000	0.000	14
8	49°-50°,54°-56°	24	1	0	0	25	436	1	0.040	0.040	9.5
9	48°-50°,53°-54°	21	2	2	0	25	464	6	0.160	0.240	6
10	48°-49°,52°-53°	8	3	0	0	11	338	3	0.273	0.273	4.5
11	47°-48°,52°-53°	32	1	0	0	33	240	1	0.030	0.030	9.5
12	47°-48°,53°-54°	22	4	0	0	26	237	4	0.154	0.154	7
13	45°-48°,49°-52°	9	0	0	0	9	300	0	0.000	0.000	14
14	46°-47°,52°-55°	3	0	0	0	3	48	0	0.000	0.000	14
15	43°-45°,49°-51°	16	0	0	0	16	480	0	0.000	0.000	14
16	45°-48°,54°-59°	3	0	0	0	3	108	0	0.000	0.000	14
17	46°-51°,58°-60°	4	0	0	0	4	180	0	0.000	0.000	14
Total or Std.Dev.	Mean	207	32	3	0	242	4956	38	0.118 ±0.142	0.146 ±0.185	
1983:											
2	54°-56°,55°-58°	7	2	1	0	10	178	4	0.300	0.400	4
3	53°-55°,56°-59°	5	1	0	0	6	145	1	0.167	0.167	8.5
4	50°-52°,55°-56°	3	1	0	0	4	210	1	0.250	0.250	6
6	51°-52°,56°-58°	4	0	0	0	4	98	0	0.000	0.000	12
7	50°-52°,55°-57°	5	0	0	0	5	245	0	0.000	0.000	12
8	49°-50°,54°-56°	1	1	0	0	2	124	1	0.500	0.500	2
9	48°-50°,53°-54°	3	1	0	0	4	126	1	0.250	0.250	6
10	48°-49°,52°-53°	5	1	0	0	6	113	1	0.167	0.167	8.5
11	47°-48°,52°-53°	10	0	0	0	10	162	0	0.000	0.000	12
12	47°-48°,53°-54°	0	2	1	0	3	63	4	1.000	1.333	1
13	45°-48°,49°-52°	3	0	0	0	3	72	0	0.000	0.000	12
14	46°-47°,52°-55°	4	3	0	0	7	210	3	0.429	0.429	3
15	43°-45°,49°-51°	3	1	0	0	4	150	1	0.250	0.250	6
17	46°-51°,58°-60°	5	0	0	0	5	193	0	0.000	0.000	12
Total or Std.Dev.	Mean	59	13	2	0	74	2091	17	0.237 ±0.275	0.268 ±0.351	

APPENDIX 34

Monthly distibution of pilot whales from land-based data.

Sections of the study area are identified in the legend for Appendix 10.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
December-February:									
North	1+14	19	0	0	0	19	0	0.000	0.000
East	2- 7	30	0	0	0	30	0	0.000	0.000
South	8-12	56	0	2	0	50	4	0.034	0.069
March-April:									
North	1+14	17	0	1	0	18	2	0.056	0.111
East	2- 7	31	0	1	0	32	2	0.031	0.062
South	8-12	66	0	0	0	66	0	0.000	0.000
May:									
North	1+14	22	2	2	0	26	6	0.154	0.231
East	2- 7	76	3	0	0	79	3	0.038	0.038
South	8-12	83	2	3	0	88	5	0.057	0.091
June:									
North	1+14	34	4	3	1	42	13	0.190	0.310
East	2- 7	173	4	3	4	184	22	0.060	0.120
South	8-12	148	3	4	1	156	14	0.051	0.090
July:									
North	1+14	37	4	5	6	52	32	0.288	0.615
East	2- 7	244	6	6	15	217	63	0.100	0.232
South	8-12	169	3	7	15	194	62	0.129	0.320
August:									
North	1+14	29	1	3	4	37	19	0.216	0.514
East	2- 7	107	2	4	9	122	37	0.123	0.303
South	8-12	58	4	10	10	82	54	0.293	0.658
September:									
North	1+14	22	2	1	0	25	4	0.120	0.160
East	2- 7	35	1	3	17	56	58	0.375	1.036
South	8-12	40	4	2	4	50	20	0.200	0.400
October-November:									
North	1+14	17	0	0	3	20	9	0.150	0.450
East	2- 7	17	1	4	10	32	29	0.469	0.906
South	8-12	61	1	7	0	69	15	0.116	0.217

APPENDIX 35

Monthly distibution of pilot whales from shipboard data.

Sections of the study area are identified in the legend for Appendix 11.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
May:									
North	1- 8					0			
East	9-12	33	0	0	0	33	0	0.000	0.000
South	14-16	9	0	1	0	10	2	0.100	0.200
June:									
North	1- 8					0			
East	9-12	127	2	4	0	133	10	0.045	0.075
South	14-16	61	2	0	0	63	2	0.032	0.032
July:									
North	1- 8	126	4	1	0	131	6	0.038	0.046
East	9-12	132	5	5	8	150	39	0.120	0.260
South	14-16	15	1	0	0	16	1	0.062	0.062
August:									
North	1- 8	126	2	3	3	134	17	0.060	0.127
East	9-12	61	2	4	11	78	32	0.218	0.410
South	14-16	30	1	3	3	37	16	0.189	0.432
September:									
North	1- 8	46	3	0	1	50	5	0.080	0.100
East	9-12	40	0	1	1	42	5	0.048	0.119
South	14-16					0			

APPENDIX 36

Observer network results x month x land-based section for pilot whales

Column headings are identified in the legend to Table 3, Section 3.2.1

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over -all Rank
December to February:										
1	6,7	15	0	0	0	15	0	0.0000	0.0000	6.5
2	9,10,14	9	0	0	0	9	0	0.0000	0.0000	6.5
3	11,12,13					0				
4	15 - 19	8	0	0	0	8	0	0.0000	0.0000	6.5
5	20,21,24					0				
6	22,23	13	0	0	0	13	0	0.0000	0.0000	6.5
7	25					0				
8	26,27	8	0	0	0	8	0	0.0000	0.0000	6.5
9	28,29					0				
10	30,31,32	18	0	0	0	18	0	0.0000	0.0000	6.5
11	33,36	24	0	0	0	24	0	0.0000	0.0000	6.5
12	37	6	0	2	0	8	4	0.2500	0.5000	1
13	39,40,41	40	0	0	0	40	0	0.0000	0.0000	6.5
14	44,45,49	4	0	0	0	4	0	0.0000	0.0000	6.5
15	1,50	4	0	0	0	4	0	0.0000	0.0000	6.5
March and April:										
1	6,7	9	0	0	0	9	0	0.0000	0.0000	8
2	9,10,14	11	0	0	0	11	0	0.0000	0.0000	8
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24	7	0	0	0	7	0	0.0000	0.0000	8
6	22,23	10	0	1	0	11	2	0.0909	0.1818	1.5
7	25	3	0	0	0	3	0	0.0000	0.0000	8
8	26,27	9	0	0	0	9	0	0.0000	0.0000	8
9	28,29	10	0	0	0	10	0	0.0000	0.0000	8
10	30,31,32	15	0	0	0	15	0	0.0000	0.0000	8
11	33,36	29	0	0	0	29	0	0.0000	0.0000	8
12	37	3	0	0	0	3	0	0.0000	0.0000	8
13	39,40,41	34	0	0	0	34	0	0.0000	0.0000	8
14	44,45,49	8	0	1	0	9	2	0.1111	0.2222	1.5
15	1,50	1	0	0	0	1	0	0.0000	0.0000	8

(continued next page)

APPENDIX 36 (continued)

Observer network results x month x land-based section for pilot whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
May:										
1	6,7	11	1	0	0	12	1	0.0833	0.0833	6
2	9,10,14	26	1	0	0	27	1	0.0370	0.0370	8
3	11,12,13	3	1	0	0	4	1	0.2500	0.2500	1.5
4	15 - 19	8	0	0	0	8	0	0.0000	0.0000	12
5	20,21,24	8	0	0	0	8	0	0.0000	0.0000	12
6	22,23	19	1	0	0	20	1	0.0500	0.0500	7
7	25	12	0	0	0	12	0	0.0000	0.0000	12
8	26,27	4	0	0	0	4	0	0.0000	0.0000	12
9	28,29	7	1	0	0	8	1	0.1250	0.1250	4.5
10	30,31,32	26	0	0	0	26	0	0.0000	0.0000	12
11	33,36	35	1	3	0	39	7	0.1026	0.1795	14.5
12	37	11	0	0	0	11	0	0.0000	0.0000	12
13	39,40,41	36	4	2	0	42	8	0.1429	0.1905	3
14	44,45,49	11	1	2	0	14	5	0.2143	0.3333	1.5
15	1,50	20	0	0	0	20	0	0.0000	0.0000	12
June:										
1	6,7	23	2	0	0	25	2	0.0800	0.0800	6
2	9,10,14	29	1	1	2	33	9	0.1212	0.2727	2.5
3	11,12,13	15	1	0	0	16	1	0.0625	0.0625	7.5
4	15 - 19	35	0	0	0	35	0	0.0000	0.0000	13.5
5	20,21,24	34	1	0	2	37	7	0.0811	0.1892	4.5
6	22,23	29	1	2	0	32	5	0.0938	0.1562	4.5
7	25	31	0	0	0	31	0	0.0000	0.0000	13.5
8	26,27	30	1	0	0	31	1	0.0323	0.0323	10
9	28,29	39	0	0	0	39	0	0.0000	0.0000	13.5
10	30,31,32	23	0	0	0	23	0	0.0000	0.0000	13.5
11	33,36	35	2	3	1	41	11	0.1463	0.2683	2.5
12	37	21	0	1	0	22	2	0.0454	0.0909	7.5
13	39,40,41	43	1	0	0	44	1	0.0227	0.0227	10
14	44,45,49	11	2	3	1	17	11	0.3529	0.6471	1
15	1,50	34	1	0	0	35	1	0.0286	0.0286	10
July:										
1	6,7	20	3	1	5	29	20	0.3103	0.6897	2.5
2	9,10,14	32	1	1	2	36	9	0.1111	0.2250	6
3	11,12,13	31	1	0	2	34	7	0.0882	0.2059	8
4	15 - 19	47	2	1	2	52	10	0.0962	0.1923	8
5	20,21,24	57	1	0	0	58	1	0.0172	0.0172	13
6	22,23	34	1	1	8	44	27	0.2273	0.6136	4.5
7	25	43	0	3	1	47	9	0.0851	0.1915	8
8	26,27	57	3	0	2	62	9	0.0806	0.1452	10
9	28,29	51	0	1	1	53	5	0.0377	0.0943	11.5
10	30,31,32	25	0	0	0	25	0	0.0000	0.0000	14.5
11	33,36	24	0	3	7	34	27	0.2941	0.7941	2.5
12	37	12	0	3	5	20	21	0.4000	1.0500	1
13	39,40,41	40	1	1	0	42	3	0.0476	0.0714	11.5
14	44,45,49	17	1	4	1	23	12	0.2609	0.5217	4.5
15	1,50	27	0	0	0	27	0	0.0000	0.0000	14.5

APPENDIX 36 (continued)

Observer network results x month x land-based section for pilot whales

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Over-all Rank
August:										
1	6,7	13	1	3	4	21	19	0.3810	0.9048	3
2	9,10,14	12	0	0	0	12	0	0.0000	0.0000	14
3	11,12,13	30	0	0	0	30	0	0.0000	0.0000	14
4	15 - 19	14	0	0	2	16	6	0.1250	0.3750	8.5
5	20,21,24	20	1	1	0	22	3	0.0909	0.1364	10
6	22,23	15	1	3	3	22	16	0.3182	0.7273	4.5
7	25	16	0	0	4	20	12	0.2500	0.6000	6
8	26,27	12	1	0	2	15	7	0.2000	0.4667	7
9	28,29	8	0	1	0	9	2	0.1111	0.2222	8.5
10	30,31,32	14	0	1	0	15	2	0.0667	0.1333	11
11	33,36	15	2	4	5	26	25	0.4231	0.9615	2
12	37	9	1	4	3	17	18	0.4706	1.0588	1
13	39,40,41	29	1	1	0	31	3	0.0645	0.0968	12
14	44,45,49	12	0	2	3	17	13	0.2941	0.7647	4.5
15	1,50	16	0	0	0	16	0	0.0000	0.0000	14
September:										
1	6,7	8	1	0	0	9	1	0.1111	0.1111	9.5
2	9,10,14	7	0	0	2	9	6	0.2222	0.6667	6.5
3	11,12,13	6	1	0	1	8	4	0.2500	0.5000	6.5
4	15 - 19	0	0	1	2	3	8	1.0000	2.6667	1
5	20,21,24	2	0	0	1	3	3	0.3333	1.0000	8.5
6	22,23	14	0	0	5	19	15	0.2632	0.7895	5
7	25	6	0	2	6	14	22	0.5714	1.5714	2
8	26,27	2	0	0	0	2	0	0.0000	0.0000	12.5
9	28,29					0				
10	30,31,32	10	0	0	0	10	0	0.0000	0.0000	12.5
11	33,36	16	0	0	1	17	3	0.0588	0.1765	9.5
12	37	14	4	2	3	23	17	0.3913	0.7391	3.5
13	39,40,41	24	0	0	0	24	0	0.0000	0.0000	12.5
14	44,45,49	14	1	1	0	16	3	0.1250	0.1875	8
15	1,50	12	0	0	0	12	0	0.0000	0.0000	12.5
October and November:										
1	6,7	14	0	0	2	16	6	0.1250	0.3750	4.5
2	9,10,14	2	0	0	0	2	0	0.0000	0.0000	8.5
3	11,12,13					0				
4	15 - 19					0				
5	20,21,24	1	0	1	2	4	8	0.7500	2.0000	1.5
6	22,23	9	0	0	0	9	0	0.0000	0.0000	8.5
7	25	5	1	3	8	17	31	0.7059	1.8235	1.5
8	26,27					0				
9	28,29					0				
10	30,31,32	19	0	0	0	19	0	0.0000	0.0000	8.5
11	33,36	32	1	7	0	40	15	0.2000	0.3750	4.5
12	37	10	0	0	0	10	0	0.0000	0.0000	8.5
13	39,40,41	42	0	0	0	42	0	0.0000	0.0000	8.5
14	44,45,49	3	0	0	1	4	3	0.2500	0.7500	3
15	1,50	9	0	0	0	9	0	0.0000	0.0000	8.5

APPENDIX 37

Observer network results x month x shipboard section for pilot whales
Column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Obsr'd Freq (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n. mi)	No. of Whales	Sight. Freq.	Sight. Rate	Over -all Rank
May:											
5	50°-51°,57°-58°	59	0	0	0	59	1541	0	0.0000	0.0000	5.5
9	48°-50°,53°-54°	9	0	0	0	9	224	0	0.0000	0.0000	5.5
10	48°-49°,52°-53°	4	0	0	0	4	71	0	0.0000	0.0000	5.5
11	47°-48°,52°-53°	7	0	0	0	7	20	0	0.0000	0.0000	5.5
12	47°-48°,53°-54°	13	0	0	0	13	178	0	0.0000	0.0000	5.5
14	46°-47°,52°-55°	2	0	0	0	2	51	0	0.0000	0.0000	5.5
16	45°-48°,54°-59°	7	0	1	0	8	210	15	0.1250	0.0714	1
17	46°-51°,58°-60°	7	0	0	0	7	277	0	0.0000	0.0000	5.5
June:											
3	53°-55°,56°-59°	2	0	0	0	2	47	0	0.0000	0.0000	9.5
5	50°-51°,57°-58°	58	0	0	0	58	974	0	0.0000	0.0000	9.5
6	51°-52°,56°-58°	22	0	0	0	22	257	0	0.0000	0.0000	9.5
8	49°-50°,54°-56°	1	0	0	0	1	12	0	0.0000	0.0000	9.5
9	48°-50°,53°-54°	9	0	0	0	9	210	0	0.0000	0.0000	9.5
10	48°-49°,52°-53°	37	0	0	0	37	998	0	0.0000	0.0000	9.5
11	47°-48°,52°-53°	49	1	4	0	54	944	0	0.0926	0.0604	1
12	47°-48°,53°-54°	32	1	0	0	33	397	4	0.0303	0.0101	4
13	45°-48°,49°-52°	28	2	0	0	30	1022	4	0.0667	0.0039	2
14	46°-47°,52°-55°	25	1	0	0	26	804	4	0.0385	0.0050	4
15	43°-45°,49°-51°	20	1	0	0	21	715	2	0.0476	0.0028	4
16	45°-48°,54°-59°	16	0	0	0	16	489	0	0.0000	0.0000	9.5
17	46°-51°,58°-60°	2	0	0	0	2	24	0	0.0000	0.0000	9.5
July:											
1	55°-57°,60°-62°	20	1	0	0	21	785	1	0.0476	0.0013	8.5
2	54°-56°,55°-58°	20	0	0	0	20	708	0	0.0000	0.0000	13.5
3	53°-55°,56°-59°	41	2	0	0	43	958	2	0.0465	0.0021	8.5
4	50°-52°,55°-56°	12	1	0	0	13	632	3	0.0769	0.0047	6.5
5	50°-51°,57°-58°	24	0	0	0	24	622	0	0.0000	0.0000	13.5
6	51°-52°,56°-58°	27	0	0	0	27	494	0	0.0000	0.0000	13.5
7	50°-52°,55°-57	13	0	0	0	13	552	0	0.0000	0.0000	13.5
8	49°-50°,54°-56°	20	0	1	0	21	525	16	0.0476	0.0305	6.5
9	48°-50°,53°-54°	43	3	0	1	47	856	57	0.0851	0.0666	4.5
10	48°-49°,52°-53°	45	0	3	5	53	1407	436	0.1509	0.3099	1
11	47°-48°,52°-53°	29	1	1	1	32	601	54	0.0938	0.0900	4.5
12	47°-48°,53°-54°	15	1	1	1	18	213	36	0.1667	0.1690	2
13	45°-48°,49°-52°	7	0	0	0	7	187	0	0.0000	0.0000	13.5
14	46°-47°,52°-55°	1	0	0	0	1	10	0	0.0000	0.0000	13.5
15	43°-45°,49°-51°	12	0	0	0	12	446	0	0.0000	0.0000	13.5
16	45°-48°,54°-59°	2	1	0	0	3	120	5	0.3333	0.0417	3
17	46°-51°,58°-60°	7	0	0	0	7	288	0	0.0000	0.0000	13.5
August:											
1	55°-57°,60°-62°	22	1	1	0	24	978	22	0.0833	0.0225	9
2	54°-56°,55°-58°	22	0	0	0	22	616	0	0.0000	0.0000	13.5
3	53°-55°,56°-59°	21	1	0	0	22	754	3	0.0454	0.0040	11
4	50°-52°,55°-56°	17	0	0	0	17	907	0	0.0000	0.0000	13.5
5	50°-51°,57°-58°	11	0	0	0	11	388	0	0.0000	0.0000	13.5
6	51°-52°,56°-58°	9	0	0	0	9	252	0	0.0000	0.0000	13.5
7	50°-52°,55°-57	27	0	0	1	28	1306	28	0.0357	0.0214	10
8	49°-50°,54°-56°	17	0	2	2	21	736	72	0.1905	0.0978	5.5
9	48°-50°,53°-54°	12	1	0	2	15	671	68	0.2000	0.1013	5.5
10	48°-49°,52°-53°	10	0	1	5	16	538	247	0.3750	0.4591	1.5
11	47°-48°,52°-53°	28	1	1	2	32	515	113	0.1250	0.2194	3.5
12	47°-48°,53°-54°	11	0	2	2	15	98	232	0.2667	2.3673	1.5
14	46°-47°,52°-55°	10	0	2	1	13	339	38	0.2308	0.1121	3.5
16	45°-48°,54°-59°	20	1	1	2	24	863	106	0.0058	0.1667	8
17	46°-51°,58°-60°	22	0	1	2	25	1080	107	0.1200	0.0991	7
September:											
1	55°-57°,60°-62°	4	0	0	0	4	135	0	0.0000	0.0000	10
3	53°-55°,56°-59°	6	0	0	0	6	222	0	0.0000	0.0000	10
4	50°-52°,55°-56°	7	0	0	0	7	399	0	0.0000	0.0000	10
5	50°-51°,57°-58°	10	0	0	0	10	340	0	0.0000	0.0000	10
6	51°-52°,56°-58°	4	0	1	0	5	100	15	0.2000	0.1500	1
7	50°-52°,55°-57	15	2	0	1	18	910	33	0.1667	0.0363	4.5
8	49°-50°,54°-56°	14	1	0	0	15	634	4	0.0667	0.0063	6
9	48°-50°,53°-54°	9	0	1	0	10	489	9	0.1000	0.0184	4.5
10	48°-49°,52°-53°	4	0	0	0	4	109	0	0.0000	0.0000	10
11	47°-48°,52°-53°	16	0	0	0	16	152	0	0.0000	0.0000	10
12	47°-48°,53°-54°	11	0	0	1	12	90	31	0.0833	0.3444	2.5
16	45°-48°,54°-59°	1	0	0	0	1	36	0	0.0000	0.0000	10
17	46°-51°,58°-60°	10	0	0	1	11	226	60	0.1000	0.2655	2.5

APPENDIX 38

Annual distibution of pilot whales from land-based data.

Sections for the study area are identified in the legend for Appendix 14.

Coast	Area Section	Obsv'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate
1979:									
North	1+ 2+14					0			
East	6+ 7	28	1	1	5	35	18	0.200	0.514
South	8+10-12					0			
1980:									
North	1+ 2+14	29	0	5	1	35	13	0.171	0.371
East	6+ 7	68	1	2	1	72	8	0.056	0.111
South	8+10-12	74	6	6	5	91	33	0.187	0.363
1981:									
North	1+ 2+14	41	5	4	9	59	40	0.305	0.680
East	6+ 7	37	0	2	4	43	16	0.140	0.372
South	8+10-12	64	3	5	10	82	43	0.207	0.524
1982:									
North	1+ 2+14	30	1	0	0	31	1	0.032	0.032
East	6+ 7	20	1	2	2	25	11	0.200	0.440
South	8+10-12	66	0	4	6	76	26	0.132	0.342

APPENDIX 39

Annual distibution of pilot whales from shipboard data.

Sections of the study area are identified in the legend for Appendix 15.

Coast	Area Section	Obsv'd Freq (in tracks) 0	1	2	3	Total Tracks	Abun	Sight Freq	Sight Rate
1976-77:									
North	4+7+9	19	1	0	0	20	1	0.050	0.050
East	10+11	7	0	1	1	9	5	0.222	0.555
1978:									
North	4+7+9	11	0	0	0	11	0	0.000	0.000
East	10+11	17	0	0	3	20	9	0.150	0.450
1979:									
North	4+7+9	20	0	0	0	20	0	0.000	0.000
East	10+11	46	0	2	1	49	7	0.061	0.143
1980:									
North	4+7+9	12	2	0	0	14	2	0.143	0.143
East	10+11	53	0	2	3	58	13	0.086	0.224
1981:									
North	4+7+9	9	1	1	2	13	9	0.308	0.692
East	10+11	38	0	5	5	48	25	0.208	0.521
1982:									
North	4+7+9	16	0	0	0	16	0	0.000	0.000
East	10+11	41	3	0	0	44	0	0.068	0.068
1983:									
North	4+7+9	10	0	0	0	10	0	0.000	0.000
East	10+11	16	0	0	0	16	0	0.000	0.000

APPENDIX 40

Observer network results x year x land-based section pilot whale

Column headings are identified in the legend to Table 3, Section 3.2.1

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Rank -all Over
1979:										
1	6,7					0				
2	9,10,14					0				
3	11,12,13	8	0	0	0	8	0	0.000	0.000	7.5
4	15 - 19	36	0	0	0	36	0	0.000	0.000	7.5
5	20,21,24	14	0	0	0	14	0	0.000	0.000	7.5
6	22,23	9	1	0	2	12	7	0.250	0.583	1
7	25	24	0	2	3	29	13	0.172	0.448	3
8	26,27	25	1	0	0	26	1	0.038	0.038	4
9	28,29	42	0	0	0	42	0	0.000	0.000	7.5
10	30,31,32	14	0	0	0	14	0	0.000	0.000	7.5
11	33,36	3	0	1	0	4	2	0.250	0.500	2
12	37					0				
13	39,40,41					0				
14	44,45,49	5	0	0	0	5	0	0.000	0.000	7.5
15	1,50					0				
Total or Mean		180	2	3	5	190	23	0.071	0.157	
Std. Dev.							±	0.108	0.246	
1980:										
1	6,7	16	1	1	1	19	6	0.158	0.316	4.5
2	9,10,14	23	0	0	0	23	0	0.000	0.000	14.5
3	11,12,13	63	3	0	3	69	12	0.087	0.174	9
4	15 - 19	46	1	2	4	53	17	0.132	0.321	4.5
5	20,21,24	84	3	1	2	90	11	0.067	0.122	10
6	22,23	43	1	2	2	48	11	0.104	0.229	8
7	25	40	0	2	4	46	16	0.130	0.348	6.5
8	26,27	41	4	0	3	48	13	0.146	0.271	6.5
9	28,29	48	0	1	0	49	12	0.020	0.041	12
10	30,31,32	10	0	0	0	10	0	0.000	0.000	14.5
11	33,36	25	2	2	3	32	15	0.219	0.469	3
12	37	29	2	7	2	40	22	0.275	0.550	1
13	39,40,41	55	1	0	0	56	1	0.018	0.018	12
14	44,45,49	21	2	5	1	29	15	0.276	0.517	2
15	1,50	23	1	0	0	24	1	0.042	0.042	12
Total or Mean		567	21	23	25	636	142	0.113	0.228	
Std. Dev.							±	0.093	0.192	

APPENDIX 4O (continued)

Observer network results x year x land-based section pilot whale

Land-Bd Section	Stat Areas	Obs'd Freq (in weeks) 0	1	2	3	Total (wks)	Abun	Sight Freq	Sight Rate	Rank -all Over
1981:										
1	6,7	27	4	3	8	42	34	0.357	0.810	2
2	9,10,14	37	1	2	6	46	23	0.196	0.500	6.5
3	11,12,13					0				
4	15 - 19	15	1	0	1	17	4	0.118	0.235	9
5	20,21,24	14	0	0	1	15	3	0.067	0.200	11
6	22,23	24	0	1	5	30	17	0.200	0.567	4.5
7	25	19	0	1	4	24	14	0.208	0.583	4.5
8	26,27	12	0	0	1	13	3	0.077	0.231	10
9	28,29	8	0	1	1	10	5	0.200	0.500	6.5
10	30,31,32	35	0	0	0	35	0	0.000	0.000	13.5
11	33,36	23	0	5	5	33	25	0.303	0.758	3
12	37	16	3	2	9	30	34	0.467	1.133	1
13	39,40,41	45	1	1	0	47	3	0.043	0.064	12
14	44,45,49	14	2	2	0	18	6	0.222	0.333	8
15	1,50	33	0	0	0	33	0	0.000	0.000	13.5
Total or Mean		322	12	18	41	393	171	0.176	0.422	
Std. Dev.								± 0.137	0.333	
1982:										
1	6,7	21	2	0	0	23	2	0.087	0.087	7
2	9,10,14	20	1	0	0	21	1	0.048	0.048	7
3	11,12,13	11	0	0	0	11	0	0.000	0.000	11
4	15-19					0				
5	20,21,24	1	0	0	0	1	0	0.000	0.000	11
6	22,23	16	1	3	7	27	28	0.407	1.037	1
7	25	13	0	0	0	13	0	0.000	0.000	11
8	26,27	23	0	0	0	23	0	0.000	0.000	11
9	28,29					0				
10	30,31,32	13	0	1	0	14	2	0.071	0.143	4.5
11	33,36	39	2	2	6	49	24	0.204	0.490	3
12	37	11	0	1	0	12	2	0.083	0.167	4.5
13	39,40,41	36	1	1	0	38	3	0.053	0.079	7
14	44,45,49	14	0	3	4	21	18	0.333	0.857	2
15	1,50	33	0	0	0	33	0	0.000	0.000	11
Total or Mean		251	7	11	17	286	80	0.098	0.225	
Std. Dev.								± 0.134	0.350	

APPENDIX 41

Observer network results x year x shipboard study area x pilot whale
The column headings are identified in the legend for Table 4.

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over -all Rank
1976-77:											
1	55°-57',60'-62°	6	0	0	0	6	193	0	0.000	0.000	8
2	54°-56',55'-58°	6	0	0	0	6	185	0	0.000	0.000	8
3	53°-55',56'-59°	3	0	0	0	3	133	0	0.000	0.000	8
4	50°-52',55'-56°	4	0	0	0	4	250	0	0.000	0.000	8
7	50°-52',55',57°	15	0	0	0	15	564	0	0.000	0.000	8
8	49°-50',54'-56°	9	0	0	0	9	437	0	0.000	0.000	8
9	48°-50',53'-54°	7	1	0	0	8	429	1	0.125	0.125	3
10	48°-49',52'-53°	2	0	1	1	4	144	5	0.500	0.500	1
11	47°-48',52'-53°	5	0	0	0	5	192	0	0.000	0.000	8
14	46°-47',52'-55°	10	0	0	0	10	259	0	0.000	0.000	8
16	45°-48',54'-59°	3	2	0	0	5	169	2	0.400	0.400	2
17	46°-51',58'-60°	1	0	0	0	1	6	0	0.000	0.000	8
Total or Std.Dev.	Mean	71	3	1	1	76	2961	8	0.085 ±0.175	0.148 ±0.366	
1978:											
4	50°-52',55'-56°	5	0	0	0	5	217	0	0.000	0.000	5
7	50°-52',55',57°	6	0	0	0	6	359	0	0.000	0.000	5
8	49°-50',54'-56°	2	1	1	0	4	208	3	0.500	0.750	1.5
9	48°-50',53'-54°	2	0	0	1	3	193	3	0.333	1.000	1.5
10	48°-49',52'-53°	16	0	0	3	19	551	9	0.158	0.474	3
11	47°-48',52'-53°	1	0	0	0	1	30	0	0.000	0.000	5
Total or Std.Dev.	Mean	32	1	1	4	38	1558	15	0.192 ±0.195	0.437 ±0.400	
1979:											
1	55°-57',60'-62°	30	2	1	0	33	1329	4	0.091	0.121	3
2	54°-56',55'-58°	15	0	0	0	15	519	0	0.000	0.000	11
3	53°-55',56'-59°	23	2	0	0	25	945	2	0.080	0.080	4.5
4	50°-52',55'-56°	9	0	0	0	9	580	0	0.000	0.000	11
5	50°-51',57'-58°	28	0	0	0	28	624	0	0.000	0.000	11
6	51°-52',56'-58°	10	0	0	0	10	110	0	0.000	0.000	11
7	50°-52',55',57°	13	0	0	0	13	673	0	0.000	0.000	11
8	49°-50',54'-56°	9	0	0	0	9	322	0	0.000	0.000	11
9	48°-50',53'-54°	16	2	0	0	18	421	0	0.000	0.000	11
10	48°-49',52'-53°	20	0	0	0	21	593	3	0.048	0.143	4.5
11	47°-48',52'-53°	26	0	2	0	28	297	4	0.071	0.143	2.5
12	47°-48',53'-54°	24	0	1	0	25	234	2	0.040	0.080	6
14	46°-47',52'-55°	4	0	1	0	5	117	2	0.200	0.400	1
16	45°-48',54'-59°	10	0	0	0	10	345	0	0.000	0.000	11
17	46°-51',58'-60°	2	0	0	0	2	28	0	0.000	0.000	11
Total or Std.Dev.	Mean	239	6	5	1	251	7137	19	0.035 ±0.057	0.064 ±0.109	
1980:											
1	55°-57',60'-62°	4	0	0	0	4	178	0	0.000	0.000	14.5
2	54°-56',55'-58°	4	0	0	0	4	126	0	0.000	0.000	14.5
3	53°-55',56'-59°	8	1	0	0	9	251	1	0.111	0.111	5.5
4	50°-52',55'-56°	5	1	0	0	6	234	1	0.167	0.167	4
5	50°-51',57'-58°	18	0	0	0	18	405	0	0.000	0.000	14.5
6	51°-52',56'-58°	26	0	1	0	27	505	2	0.037	0.074	10.5
7	50°-52',55',57°	7	1	0	0	8	363	1	0.125	0.125	5.5
8	49°-50',54'-56°	3	0	0	0	3	149	0	0.000	0.000	14.5
9	48°-50',53'-54°	13	0	0	1	14	309	3	0.071	0.214	7
10	48°-49',52'-53°	24	0	1	2	27	718	8	0.111	0.296	3
11	47°-48',52'-53°	29	0	1	1	31	740	5	0.064	0.161	8.5
12	47°-48',53'-54°	13	0	1	2	16	161	8	0.188	0.500	2
13	45°-48',49'-52°	10	0	0	0	10	332	0	0.000	0.000	14.5
14	46°-47',52'-55°	4	1	0	1	6	181	4	0.333	0.666	1
15	43°-49',49'-51°	8	0	0	0	8	373	0	0.000	0.000	14.5
16	45°-48',54'-59°	11	1	0	0	12	432	1	0.083	0.083	10.5
17	46°-51',58'-60°	16	0	0	1	17	679	3	0.059	0.176	8.5
Total or Std.Dev.	Mean	203	5	5	8	220	6136	39	0.079 ±0.089	0.151 ±0.189	

(continued next page)

APPENDIX 41 (continued)

Observer network results x year x shipboard study area x pilot whale

Ship-Bd Section	Latitude, Longitude	Frequency (# tracks) 0	1	2	3	Total ShipBd Tracks	Dist (n mi)	Abun	Sight Freq	Sight Rate	Over-all Rank
1981:											
2	54°-56°,55°-58°	2	0	0	0	2	95	0	0.000	0.000	13.5
4	50°-52°,55°-56°	3	0	0	0	3	145	0	0.000	0.000	13.5
5	50°-51°,57°-58°	33	0	0	0	33	823	0	0.000	0.000	13.5
6	51°-52°,56°-58°	9	0	0	0	9	138	0	0.000	0.000	13.5
7	50°-52°,55°-57°	6	1	0	2	9	391	7	0.333	0.778	1
8	49°-50°,54°-56°	5	0	0	1	6	232	3	0.167	0.500	6.5
9	48°-50°,53°-54°	7	0	1	1	9	284	5	0.222	0.556	3.5
10	48°-49°,52°-53°	17	0	2	3	22	595	13	0.227	0.591	3.5
11	47°-48°,52°-53°	21	0	3	2	26	551	12	0.192	0.462	6.5
12	47°-48°,53°-54°	6	1	0	1	8	103	4	0.250	0.500	3.5
13	45°-48°,49°-52°	14	1	0	0	15	505	1	0.067	0.067	11
14	46°-47°,52°-55°	8	0	1	0	9	337	2	0.111	0.222	9.5
15	43°-45°,49°-51°	4	1	0	0	5	159	1	0.200	0.200	8
16	45°-48°,54°-59°	11	0	1	2	14	454	8	0.214	0.571	3.5
17	46°-51°,58°-60°	14	0	1	1	16	532	4	0.125	0.250	9.5
Total or Mean		161	4	9	12	187	5344	58	0.140	0.313	
Std.Dev.									±0.107	±0.266	
1982:											
1	55°-57°,60°-62°	6	0	0	0	6	198	0	0.000	0.000	12
2	54°-56°,55°-58°	5	0	0	0	5	222	0	0.000	0.000	12
3	53°-55°,56°-59°	28	0	0	0	28	432	0	0.000	0.000	12
4	50°-52°,55°-56°	8	0	0	0	8	375	0	0.000	0.000	12
5	50°-51°,57°-58°	24	0	0	0	24	472	0	0.000	0.000	12
6	51°-52°,56°-58°	13	0	0	0	13	252	0	0.000	0.000	12
7	50°-52°,55°-57°	3	0	0	0	3	173	0	0.000	0.000	12
8	49°-50°,54°-56°	22	0	2	1	25	436	7	0.120	0.280	2
9	48°-50°,53°-54°	24	1	0	0	25	464	1	0.040	0.040	5
10	48°-49°,52°-53°	11	0	0	0	11	338	0	0.000	0.000	12
11	47°-48°,52°-53°	30	3	0	0	33	240	3	0.091	0.091	5
12	47°-48°,53°-54°	23	1	1	1	26	237	6	0.115	0.231	3
13	45°-48°,49°-52°	8	1	0	0	9	300	1	0.111	0.111	4
14	46°-47°,52°-55°	3	0	0	0	3	48	0	0.000	0.000	12
15	43°-45°,49°-51°	16	0	0	0	16	480	0	0.000	0.000	12
16	45°-48°,54°-59°	3	0	0	0	3	108	0	0.000	0.000	12
17	46°-51°,58°-60°	3	0	0	1	4	180	3	0.250	0.750	1
Total or Mean		230	6	3	3	242	4956	21	0.038	0.083	
Std.Dev.									±0.071	±0.192	
1983:											
2	54°-56°,55°-58°	10	0	0	0	10	178	0	0.000	0.000	
3	53°-55°,56°-59°	6	0	0	0	6	145	0	0.000	0.000	
4	50°-52°,55°-56°	4	0	0	0	4	210	0	0.000	0.000	
6	51°-52°,56°-58°	4	0	0	0	4	98	0	0.000	0.000	
7	50°-52°,55°-57°	5	0	0	0	5	245	0	0.000	0.000	
8	49°-50°,54°-56°	2	0	0	0	2	124	0	0.000	0.000	
9	48°-50°,53°-54°	4	0	0	0	4	126	0	0.000	0.000	
10	48°-49°,52°-53°	6	0	0	0	6	113	0	0.000	0.000	
11	47°-48°,52°-53°	10	0	0	0	10	162	0	0.000	0.000	
12	47°-48°,53°-54°	3	0	0	0	3	63	0	0.000	0.000	
13	45°-48°,49°-52°	3	0	0	0	3	72	0	0.000	0.000	
14	46°-47°,52°-55°	7	0	0	0	7	210	0	0.000	0.000	
15	43°-45°,49°-51°	4	0	0	0	4	150	0	0.000	0.000	
17	46°-51°,58°-60°	5	0	0	0	5	193	0	0.000	0.000	
Total or Mean		74	0	0	0	74	2091	0	0.000	0.000	
Std.Dev.									±0.000	±0.000	