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Gull and Tern Breeding Colonies on the North Arm of Great Slave Lake, Northwest Territories: 1986-2010

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Prairie and Northern Region

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GULL AND TERN BREEDING COLONIES ON THE NORTH ARM OF GREAT SLAVE LAKE, NORTHWEST TERRITORIES: 1986-2010

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ABSTRACT

Great Slave Lake in the Northwest Territories is one of the most important areas for inland breeding gulls and terns (larids) in northern Canada. Numerous rocky islands on the North Arm provide breeding habitat for a number of colonially-nesting larid species. Great Slave Lake is the only known breeding site for Caspian Terns in the Northwest Territories and the North Arm is the northernmost known breeding range for the species in North America. Given its importance to a variety of migrating, nesting and staging birds, various portions of the area have been recognized as; a Key Migratory Bird Terrestrial Habitat site, an Important Bird Area, and an International Biological Program site (Figure 1). The Canadian Wildlife Service has agreed to sponsor the western part of the North Arm for consideration as a National Wildlife Area under the Northwest Territories Protected Areas Strategy.

This report summarizes data and information on active larid breeding colonies collected between 1986 and 2010 on the portion of the North Arm west of Yellowknife. Most data were collected through ground surveys, with travel by boat, between mid June to early July. Information recorded at each colony included species, numbers of nests, clutch size, presence of chicks, and habitat characteristics (vegetation cover). A series of maps displaying the distribution and density (shown as nests/km^2) of larid colonies on the North Arm was created for each species and year of surveys.

The majority of larid colonies were located on islands along the northeastern shoreline. The southwest shoreline saw limited use by nesting larids due to the reduced number and different characteristics of the islands in that area. The most regularly occurring species were Herring Gull, Mew Gull, Ring-billed Gull, California Gull, Common Tern, Arctic Tern, and Caspian Tern.

Herring Gulls nested throughout the study area, most often in single pairs or small colonies (<10 pairs). Mew Gulls nested at low densities throughout the area and were more likely to nest as single pairs than any other species. Ring-billed Gulls were somewhat restricted in distribution, often occurred in large colonies (>100 pairs) on small islands close to the

mainland, and frequently nested in association with other species. California Gulls typically nested in relatively large colonies located on larger islands further from the mainland.

Terns were more likely to be found in the western part of the North Arm, where the water is shallower and more turbid and there are more extensive near-shore wetlands than in the eastern section. Arctic Terns tended to nest in smaller colonies and were more likely to nest as single pairs than Common Terns, although the two tern species were often found nesting within the same colony site. Most Caspian Terns were observed in one general location (Trout Rock area) in all years.

Within Great Slave Lake, the section of the North Arm west of Yellowknife was of particular importance to Ring-billed Gull, Common Tern, Caspian Tern, and to a lesser extent Herring Gull and Arctic Tern. Great Slave Lake as a whole may support nationally significant numbers (>1% of the national breeding population) of five larid species: Herring Gull (>2,800 adults, 1.7%), Mew Gull (>900 adults, 0.8% - 1.9%), California Gull (>5,000 adults, 2.4% - 4.0%), Common Tern (>1,800 adults, 1%), and Caspian Tern (>470 adults, 1.4% - 2.4%). We recommend that the North Arm be included in future monitoring programs for inland-breeding larids in Canada.

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1. INTRODUCTION

Located in the Northwest Territories in northern Canada, Great Slave Lake is one of North America's largest lakes (approximately 28 000 km^2) and its deepest (maximum depth of 614 m). Differences in water depth, climate, geology, and plant communities create distinct habitats around the lake. The lake's varied habitats attract a diversity of birds, many of which nest on its numerous islands, in its marshes, and along its shorelines.

The North Arm constitutes about 17% (approximately 4700 km^2) of the total area of Great Slave Lake, and is important for a variety of nesting, staging, and migrating waterfowl and other waterbirds (Latour et al. 2008). The numerous rocky islands on the northeast shore of the North Arm provide breeding habitat for a variety of colonially nesting gulls and terns (larids), including Caspian Terns, which historically have nested in nationally significant numbers in the area (McCormick and Sirois 1988; Sirois and Seddon 1990). It is also used by thousands of geese, swans and ducks for feeding and resting during migration, including nationally significant numbers of Canada and Cackling geese (Shortgrass Prairie Population) and Tundra Swans (Eastern Population). Portions of the North Arm have been recognized as a Key Migratory Bird Terrestrial Habitat Site by the Canadian Wildlife Service (CWS) (Latour et al. 2008) and as an Important Bird Area in Canada by Birdlife International (IBA Canada 2012) (Figure 1). The West Mirage Islands, located within the North Arm at the mouth of Yellowknife Bay, have been designated as an International Biological Program site (La Roi and Babb 1974) (Figure 1).

Historical records of larids breeding on the North Arm are limited, with detailed observations being primarily restricted to the West Mirage Islands (Weller et al. 1969; Trauger and Bromley 1976). Surveys to determine the distribution and abundance of larids nesting in other areas of the North Arm were first conducted in 1986 by McCormick and Sirois (1988). Subsequent surveys occurred in 1988 (Sirois and Seddon 1990), 1990-1995 (Sirois et al. 1995; this report), and 2000-2002 and 2010 (this report). Surveys conducted in 2010 were done as part of the ecological assessment of a proposed Candidate Protected Area under the Northwest Territories Protected Areas Strategy (NWT PAS 2002). CWS has agreed to sponsor parts of the North Arm for consideration as a National Wildlife Area. The study area boundary for the Candidate Protected Area includes most of the shoreline, islands, and open water sections

of the North Arm between Boundary Creek and the Behchokömunicipal boundary (Figure 1). Additional information regarding the importance of the area to birds and other wildlife can be found in “Ecological Assessment of the Kwets'ootł'àà Candidate Protected Area: Phase II” (Canadian Wildlife Service 2011).

This report summarizes data and information on larids collected between 1986 and 2010 for sections of the North Arm located west of Yellowknife. Data for 1986 and 1988 have been obtained directly from McCormick and Sirois (1988) and Sirois and Seddon (1990), respectively. Additionally, some of the data from 1990-1994 have previously been reported by Sirois et al. (1995), but have undergone additional analysis for inclusion in this report. Information on larids nesting on the North Arm to the east of Yellowknife, as well as other sections of Great Slave Lake, is documented elsewhere (e.g., Sirois et al. 1989; Sirois et al. 1995). This report contributes to fulfilling CWS’s obligations as a sponsoring agency for the Candidate Protected Area. The information will help wildlife managers to monitor population trends, identify conservation priorities, and make informed decisions regarding the management of the Candidate Protected Area in the future.

2. STUDY AREA

The study area includes the western portion of the North Arm bordered by Yellowknife Bay (62°22' N, 114°20' W) to the east, and Frank Channel (62°48' N, 115°58' W) to the west (Figure 2). There is a transition from deep (upwards of 60 m) and relatively clear waters in Yellowknife Bay to shallow (approximately 1-m deep) and highly turbid waters near Frank Channel (Rawson 1950). The northeast shoreline is situated within the Taiga Shield ecozone and can be characterized by its myriad rocky islands, numerous shallow bays and extensive wetlands (Figure 1). Islands range in size from small outcrops less than 0.01 ha, to large, well-vegetated islands upwards of 475 ha. The exposed outer islands are typically the most barren, with the degree of vegetation coverage increasing with island size and proximity to the mainland (P. Woodard, pers. obs.). Numerous bare and sparsely vegetated rocky outcrops throughout this area provide an abundance of habitat for breeding larids and other waterbirds. Waite Island, the largest in the study area (1290 ha), and its surrounding islands, are also located within the Taiga Shield ecozone (Figure 1). The southwest shoreline is located within the Taiga Plains ecozone

and has a sandy shore bordered by dense boreal forest with well-developed soils (Figure 1). It contains relatively few islands, which tend to be low-lying and heavily vegetated. As such, habitat for breeding larids on the southwest shoreline is limited. Additional descriptions of the physiography and plant communities of the North Arm can be found in Porsild and Cody (1980), Sirois et al. (1995), and Fournier and Hines (2001).

The region typically experiences short, cool summers; snow typically remains on the ground into April and mean daily temperatures in Yellowknife, the nearest weather station, averaged 17°C in July from 1986-2010 (Environment Canada 2012). From early May until mid-August, the sun is above the horizon for 16-20 hours per day. Annual precipitation is low and averaged less than 300 mm/year from 1986-2010; half of the yearly precipitation typically falls between July and October (Environment Canada 2012).

Great Slave Lake is completely covered with ice for five to six months of the year, with much of the lake still having ice in June (Sirois et al. 1995). The North Arm is among the first areas of Great Slave Lake to be free of ice in spring. Ice-free water typically appears near the shore and around islands in early May, with most bays clear of ice and ice-free channels along the shorelines by the end of May (Sirois et al. 1995). In recent years average spring air temperatures have increased, resulting in earlier melting; however, annual snowfall near Yellowknife has also increased and the extra snow cover prolongs the melt period on Great Slave Lake (Mackenzie River Basin Board 2004).

Most of the area surrounding the North Arm remains relatively pristine. There are three nearby communities: Behchokǫ̀, Dettah and the city of Yellowknife (Figure 1). The North Arm is culturally significant and is used by local Dene for traditional activities such as subsistence fishing and hunting. Recreational boating, camping, fishing and sport hunting also occur in the area, especially in Yellowknife Bay and nearby areas. Licensed outfitters operating on the North Arm provide fishing, hunting and ecotourism opportunities. Although the western part of the North Arm is closed to commercial fishing, this activity occurs elsewhere on Great Slave Lake.

3. METHODS

3.1 DATA COLLECTION

3.1.1 Colony Surveys

Surveys were conducted by boat to locate potential larid breeding colonies on islands of the North Arm of Great Slave Lake, and field crews of 2-3 observers on foot examined all islands where breeding larids were observed or suspected. Islands containing one or more confirmed larid nests were generally defined as an individual colony site, although in some cases small island clusters in close proximity were considered together. Navigation and the identification of islands were facilitated using 1:50 000 scale topographic maps. Surveys were initiated shortly after ice breakup in mid to late June, and completed by early July in order to minimize disturbance when increased numbers of vulnerable young were present. To limit disturbance, visits were kept as short as possible and individual colonies were visited only once per survey year.

In all years, surveys were focused along the northeast shoreline between Frank Channel and Yellowknife because of the abundance of habitat and obvious preference of larids for this area (although the entire area was not surveyed in all years). This area comprises approximately half of the North Arm Key Migratory Bird Terrestrial Habitat Site as described by Latour et al. (2008). To facilitate reporting and the interpretation of results, the study area was divided into seven survey zones: Stagg River (51 km^2), Old Fort Rae (65 km^2), Trout Rock (60 km^2), Enodah (103 km^2), Yellowknife Bay (100 km^2), West Mirage Islands (11 km^2), and Southwest Shoreline (118 km^2) (Figure 2).

Focal species in 1986, 1988, and 2010 were predominantly larids (McCormick and Sirois 1988; Sirois and Seddon 1990; this report), whereas focal species during 1990-2002 were both larids and nesting waterfowl (Fournier and Hines 2001). Observations of other species were taken opportunistically during many surveys, and observations of larids from zones that were not thoroughly surveyed in a given year were recorded. Larid data collected from zones that were not fully surveyed were included in the maps and tables for the sake of completeness, but were excluded from calculations when appropriate (e.g., calculations of the average number of nests per zone).

More thorough examination was given to the outer islands in most years, as experience from the earlier surveys had shown limited use of the inner bays and nearshore islands by breeding larids (Sirois and Seddon 1990). Some potential nesting sites located in these areas may have been overlooked in some years as a result. Although particular effort was given in 2010 to thoroughly cover these areas as well, low water levels and/or the prevalence of emergent vegetation restricted access to some sites. The Southwest Shoreline, including Waite Island and surrounding islands, was surveyed only in 1988 (by foot with travel by boat) and in 2010 (aerial survey by helicopter). Yellowknife Bay was fully surveyed only in 1986, with observations in subsequent years recorded on an incomplete or opportunistic basis. A summary indicating which sections were surveyed during each survey period can be found in Table 1.

We consider surveys to have been sufficient in locating the majority of colonies for the seven regularly occurring larid species: Herring Gull, Mew Gull, Ring-billed Gull, California Gull, Common Tern, Arctic Tern, and Caspian Tern (see Appendix 1 for scientific names). Colony sites were often conspicuous and typically located on relatively open, poorly-vegetated islands. However, species with a propensity for nesting in small or single pair colonies (i.e., Mew Gull, Arctic Tern, and Herring Gull) were more likely to have been missed than those nesting in larger colonies.

Bonaparte's Gulls were sometimes encountered, but the methodology used was not sufficient to adequately assess their populations on the North Arm. They were typically found nesting on heavily vegetated nearshore islands and mainland areas throughout the area. Nests were found in trees 2-10 m from the ground, and often required intensive searches to locate. Thus, observations of Bonaparte's Gulls were taken opportunistically and our results do not represent a complete survey for the species in the area.

3.1.2 Colony Census

The number of nests of each larid species was determined through systematic ground searches at each suspected colony site, and the number of eggs and young in each nest were recorded. Nests or scrapes containing eggs or young were defined as active nests in all years, and were included in the nest tally for the species at a given colony. Apparently occupied nests (AON), those that were empty but freshly built or that had contained eggs or young during that breeding season (previously fledged or depredated, as evidenced by eggshell fragments,

membranes, or egg/chick remains), were also included in the tally in 2010 as they are considered indicative of a current breeding attempt. This designation was used for gull species only, as the scrapes and nests used by terns are more inconspicuous and identification of a nest without eggs or young is likely to be difficult and inconsistent. Further detail on the data collection protocol used during the 2010 census can be found in Morris et al. (2003) and Morris et al. (2008). Only nests containing eggs or young at the time of observation were included in the tally for all species from 1986-2002.

3.1.3 Common and Arctic Terns

Common and Arctic terns can be difficult to differentiate, and their nests especially so, with visual identification of the nest alone not possible in many cases. Thus, attribution of colony sites was generally done through visual identification of the adults present at the site. In many cases, these two species were found breeding in close association with each other or in mixed colonies. As a result, encounters with colonies where the apparent predominant species could not be determined, and mixed colonies where the nests could not reliably be attributed to a given species, were common. In such instances, a proportion estimate was determined by examining a subset of the adults present at the colony and was applied to the total number of nests at the site. This was done under the assumption that the composition of adults present at the colony was proportional to that of the nests. A weighted average based on a sample of 10 mixed colonies in 2010 (60.2% Common Tern, 39.8% Arctic Tern) was applied to all such sites for 2010, as well as 1986 and 1991 (where no estimates were recorded). A proportion estimate of 90% Common Terns derived from observations of individuals flying above active nests was applied to mixed colonies from 1988 (Sirois and Seddon 1990). From 1990-2002, particular effort was made to identify individual nests to the species level at the time of observation. Nests were identified based on their construction characteristics and underlying substrates. Common Tern nests tended to be found in more vegetated areas and were often well-lined with grasses and other materials. Arctic Terns most often nested in cracks and depressions on bare rock with no or little vegetation, and were often lined only with dirt and/or lichens.

Given the relative difficulty of achieving accurate and consistent identification of these species and the improbability of identifying all adults at a colony, it is possible that sites attributed to only one tern species may have contained undetected nests of the other.

Additionally, misidentification of individual nests at mixed colonies at the time of observation remains a possibility, as some overlap exists in the characteristics used to distinguish between them. Therefore, Common and Arctic tern data were combined for a number of statistics presented in this report.

3.1.4 Observations of Non-target Species

Nests of waterfowl, shorebird, landbird, and other waterbird species encountered during surveys were also recorded. Data from all survey years were pooled, although no data are available for 1986 and 1988. Observations of non-larid species were largely opportunistic or were collected during studies of waterfowl taking place concurrently with the larid surveys (Fournier and Hines 2001). As such, these data provide an indication of the number of avian species using the North Arm, but they do not represent a complete survey.

3.2 DENSITY MAPS

We created a series of maps displaying the distribution and density of larid nests on the North Arm for each species and year of survey. Density values were calculated as the number of nests per square kilometre (nest/km^2). Maps were created using the kernel density function of the Spatial Analyst 9.3 extension for ArcGIS 9.3 (Environmental Research Systems Institute 2009). Although alternative methods are available, this method was chosen as the most appropriate, given the nature of our data (a series of non-evenly-distributed individual points consisting only of positive integers). The kernel density function in Spatial Analyst 9.3 is based on the quadratic kernel function described by Silverman (1986, pg. 76, equation 4.5). This method calculates the density of features within a neighbourhood around those features. It creates a "smooth, curved surface fitted over each point with values highest at the point and diminishing with increasing distance from the centre." Cell densities are calculated by adding the values of all kernel surfaces where they overlay the raster cell centre. In order to complete the calculation, two parameter inputs are required from the user: cell size and search radius. The same cell size and search radius values were used for all density maps in this report.

Cell size refers to the size of each individual pixel from the resulting raster layer. This value has little effect on the computed cell densities in the resulting output, but does influence the map's resolution and degree of pixilation. We selected a cell size corresponding to 50 m

of ground distance (50 m x 50 m pixels), which resulted in raster layers with manageable file sizes and an aesthetically pleasing resolution without compromising the map's level of detail.

Search radius refers to the size of the neighbourhood in which features will have influence on each other when calculating cell densities. A larger search radius will consider more points around a neighbourhood when calculating the cell density, but will result in a more generalized output. We chose a search radius of 1000 m for all maps. This value is largely arbitrary and was chosen because it resulted in an output that was easy to interpret at the scale depicted on our maps, while still providing a high level of site-specific detail. Given the focal nature of the colony sites used as our unit of measure, we believed that this approach was warranted.

Density maps are intended to display areas of relative importance to nesting birds and are based on the number of nests in the area. It is worth noting that adult birds may utilize much larger areas than depicted on the maps, particularly while foraging or engaging in other activities while away from the nest.

3.3 BREEDING INFORMATION

We examined breeding information for the seven main larid species for 1986 and 1990-2010; 1988 was not included, as records for individual nests were not available. Results from all surveys, including those from zones that were only partially covered, were included.

Instances where nests or young could not be attributed to a particular species or individual nest at a given site have been excluded. These exclusions consist primarily of nests from mixed colonies of Common and Arctic terns where identification of the nest was not possible, and occasions where chicks had become mobile and could not be attributed to a given nest. Nests given an AON designation were also excluded. Additionally, approximately 9% of nest records from surveys conducted from 1990-2002 were not available. Therefore, the number of nest records with associated breeding information may differ from the total number of nests tallied for each species.

3.3.1 Clutch Size

Clutch size was determined by examining individual nests at each colony site. We define clutch size as the sum of eggs plus chicks contained within an individual nest at the time of

observation. We did not account for eggs added as a result of intraspecific egg dumping or nest parasitism, eggs that may have rolled into adjacent nests, or chicks that may have wandered into nearby nests. We report only the number of eggs and/or young present at the nest at the time of observation for each species, regardless of origin.

3.3.2 Hatch Phenology

As colonies were visited only once during each survey year, we infer the relative hatch dates for each species by the proportion of nests that had hatched at least one chick at the time of observation. Results are presented for each day of surveys from 1990-2010; information from 1986 and 1988 was not available.

3.4 SPECIES ASSOCIATIONS

Colonies containing nests of multiple larid species were common in all zones. We present species associations as the proportion of colony sites for each species that also contained at least one nest of another larid species. Data from all years have been pooled for each zone. Results are displayed for each species individually.

3.5 COLONY CHARACTERISTICS

3.5.1 Physical Parameters

Island size (ha) and distance to the mainland (m) were estimated for each colony site using ArcGIS 10 (Environmental Systems Research Institute 2012). We determined island size by overlaying the colony point locations on a 1:50 000 scale, National Topographic System land cover polygon layer. Area of the overlapping polygons was then calculated using the calculate areas spatial statistics tool for ArcGIS 10. Colonies on islands that were too small to be included in the polygon file were assigned an arbitrary value of 0.01 ha. This is roughly the median value between zero and the smallest island depicted in the spatial file used. We used the point-distance function of the ET GeoWizards extension (ET Spatial Techniques 2012) to calculate the distance between colony sites and the mainland. Values represent the minimum distance from the colony site to the nearest shoreline of the mainland.

3.5.2 Vegetation Cover

The amount and type of vegetation cover were visually estimated at colonies surveyed from 1990-1995. Vegetation was classified into one of five categories: grass/sedge; forb; low shrub (shrub species typically < 1 m in height, i.e., ground juniper, Labrador tea, etc.); high shrub (shrub species typically > 1 m in height, i.e., willow, alder, etc.); and tree (tree species, i.e., white birch, black spruce, etc.). Results are presented for each larid species as the average percentage of the colony site covered by each vegetation type.

3.6 KEY HABITAT SITE

If a site supports at least 1% of the national population of a migratory bird species or subspecies at any time of year, it is considered a key habitat site under criteria used by CWS (Latour et al. 2008). To determine whether the study area supports nationally significant numbers of any larid species, we compared the results of the surveys to recently published estimates of the national breeding populations (i.e., Milko et al. 2011; Morris et al. 2012). As the entire study area was not fully surveyed in any one year, we calculated the average number of nests found within each zone for each species utilizing data from all years in which the entire zone was surveyed. The total breeding population in the study area was estimated as the sum of averages from each zone. This was done under the assumption that each nest observed represents two breeding adults.

To estimate the proportion nesting within the study area of the proposed Candidate Protected Area, the national estimate for each species was compared against the sum of averages from the areas of Stagg River, Old Fort Rae, Trout Rock, and the Southwest Shoreline only, the boundaries of which closely match that of the Candidate Protected Area (Figure 1).

Population estimates for areas of Great Slave Lake outside of the study area were calculated by incorporating numbers of breeding birds found during a lake-wide census conducted from 1986-1994, as reported in Sirois et al. (1995), with the North Arm data. The 1986-1994 data are the most recent information available for sections of the lake outside the North Arm. Estimates for the area within the existing North Arm Key Migratory Bird Terrestrial Habitat Site are the sum of averages from all zones except the Southwest Shoreline, plus values from sites located within the key habitat site boundary and outside the study area as reported by

Sirois et al. (1995). Estimates for Great Slave Lake as a whole are the sum of averages from all zones, plus values from all other sections of the lake located outside the study area as reported by Sirois et al. (1995).

4. RESULTS

4.1 DENSITY MAPS

Maps displaying the density of nests at colonies for each species for each year can be found in Figures 3-96. Areas that were not thoroughly surveyed in a given year are shaded on each map. Density data are presented in some of these areas, but these observations represent partial surveys or incidental observations only and should be interpreted as such. A map summarizing the density information and outlining general high-use areas by species can be found in Figure 97.

4.2 LARID SPECIES RESULTS

Information on the size and distribution of colonies, clutch size, species associations, and habitat characteristics is presented for each of the seven focal larid species. Summary tables displaying the number of nests and sites found in each zone for each species and survey year can be found in Appendices 2-9.

4.2.1 Herring Gull

Herring Gulls nested on many islands along much of the northeast shoreline, with the highest numbers occurring in the areas of Yellowknife Bay, Enodah, and the West Mirage Islands (Table 2). They most often nested in single pairs (49.9% of sites) or small colonies (2-10 pairs, 40.4% of sites) (Table 3). Larger colonies of 11-50 pairs were present in Yellowknife Bay, Enodah, and the West Mirage Islands. All colonies located in the Stagg River, Old Fort Rae, and Trout Rock areas during all years of surveys contained fewer than 15 nests.

The majority of clutches consisted of 1-3 eggs or chicks (average: 2.00 ± 0.02 SE), with less than 1% of clutches having 4-5 eggs or chicks and no clutches having more than 5 (Table 4). Herring Gull chicks were often observed earlier in the season than any other species. Chicks were seen in mid to late June in most years, often on the first survey day (Appendix 10).

However, some Herring Gull pairs were still incubating eggs into early July. Herring Gull chicks were observed in all years.

Herring Gull breeding colonies were most closely associated with terns; 19.3% of colonies also contained nests of Common Tern, 15.3% Arctic Tern, and 23.1% either Common Tern, Arctic Tern, or both (Table 5). Overall, only 35.1% of Herring Gull colony sites contained nests of other larid species, the lowest rate of any species reported in this study.

Islands containing Herring Gull colonies were 0.31 ha (± 0.02 SE) in size, and located 3888 m (± 136 SE) from the mainland, on average (Appendices 11 and 12). They had an average vegetation cover of 13.5%, with grass/sedge (4.8%) and low shrub (3.4%) providing the most cover (Table 6).

4.2.2 Mew Gull

Mew Gulls nested in low densities on islands along most of the northeast shoreline of the North Arm, with no clearly definable areas of particular importance (Table 2). They were more likely to nest in single-pair colonies than any other species (75.6% of sites), and all but two sites contained fewer than 10 nests (99.3% of sites) (Table 7).

All clutches had 1-3 eggs or chicks (average: 2.27 ± 0.04 SE) (Table 8). Chicks were observed in late June in many years, and pipped eggs were observed as early as June 21 in 1994 (Appendix 10).

Mew Gull colonies were most frequently associated with terns; 58.4% of colony sites also contained Common Tern, 45.4% Arctic Tern, and 71.4% either Common Tern, Arctic Tern, or both (Table 9). Overall, 79.2% of Mew Gull colony sites also contained nests of other larid species.

Islands containing Mew Gull colonies were 0.36 ha (± 0.05 SE) in size, and located 2056 m (± 135 SE) from the mainland, on average (Appendices 11 and 12). Average vegetation cover was 16.2%, with grass/sedge (4.2%), low shrub (3.8%), and tree (3.5%) being most abundant (Table 10). Mew Gull sites had more total cover on average than those used by any other species examined, and the highest amount of cover provided by low shrubs, high shrubs, and trees.

4.2.3 Ring-billed Gull

Ring-billed Gull nests were only observed in the areas of Stagg River, Old Fort Rae, Trout Rock, and Enodah (Table 2). Ring-billed Gulls often nested in relatively large colonies, with some colonies having >100 pairs (average: 31.5 ± 3.9 SE) (Table 11). The largest colony observed of any species in any survey year was a colony of Ring-billed Gulls in the Old Fort Rae area in 1986 (132 nests). No Ring-billed Gull colonies were observed in Yellowknife Bay or the West Mirage Islands in any year.

The majority of clutches had 1-3 eggs or chicks (average: 2.37 ± 0.02 SE), with less than 2% of nests containing 4-6 eggs or chicks (Table 12). Chicks were observed in mid to late June in three out of ten survey years where Ring-billed Gull nests were observed (Appendix 10).

Ring-billed Gulls were frequently found in association with other species (85.2% of colonies) (Table 13). They were most frequently associated with terns, as 74.1% of colony sites also contained nests of Common Tern, 35.8% Arctic Tern, and 77.8% either Common Tern, Arctic Tern, or both. Caspian Terns also frequently nested at the same sites as Ring-billed Gulls, with 30.9% of sites containing both species.

Islands containing Ring-billed Gull colonies were smaller and located closer to the mainland on average than any other species examined, at 0.20 ha (± 0.02 SE) and 1969 m (± 97 SE), respectively (Appendices 11 and 12). Sites were relatively barren, with an average vegetation cover of 9.8%; grass/sedge (3.5%) and low shrub (2.3%) provided the most cover (Table 14).

4.2.4 California Gull

California Gull nests were only observed on islands in the areas of Yellowknife Bay, Enodah and the West Mirage Islands (Table 2). California Gulls typically nested in relatively large colonies, with 59.2% of colonies having greater than 10 nests (average: 19.7 ± 3.1 SE) (Table 15). The largest single colony observed during the course of surveys contained 49 nests, and was found in the Enodah region in 1990.

Clutches consisted of 1-3 eggs or chicks, except one clutch that had 4 eggs (average: 2.05 ± 0.05 SE) (Table 16). Chicks were observed in late June in some years, but generally not as early as those of other species of gulls and terns (Appendix 10).

California Gulls were most frequently associated with Herring Gulls, with 63.0% of California Gull colony sites containing both species (Table 17). California Gulls were also often associated with Caspian Terns (29.6% of colony sites). Overall, 70.1% of California Gull colony sites also contained nests of other larid species.

Islands containing California Gull colonies were, on average, larger and located further from the mainland than any other species, at 0.71 ha (± 0.15 SE) and 6400 m (± 312 SE), respectively (Appendices 11 and 12). Vegetation cover averaged 9.2%, the lowest of any species examined (Table 18).

4.2.5 Common Tern

Common Terns nested on islands from Yellowknife Bay to Frank Channel, with the highest numbers occurring in the areas of Trout Rock, Old Fort Rae, and Stagg River (Table 2). Colonies contained 13.8 (± 0.7 SE) nests on average (Table 19), and the largest colony contained 95 nests and was observed in the Stagg River area in 2002.

The majority of clutches had 1-3 eggs or chicks (average: 2.36 ± 0.01 SE), with less than 1% of clutches having more than three eggs or chicks (Table 20). Chicks were observed in late June in many years, with Common Tern chicks more likely to be seen earlier than Arctic Tern chicks (Appendix 10).

Common Terns were most frequently associated with Arctic Terns and Mew Gulls, with 47.5% and 31.3% of colony sites also containing those species, respectively (Table 21). Overall, 74.5% of Common Tern colony sites also contained nests of other larid species.

Average size of islands containing Common Tern colonies was 0.29 ha (± 0.03 SE), with a mean distance to the mainland of 2106 m (± 96 SE) (Appendices 11 and 12). Sites were relatively well vegetated at 13.7%, with most cover consisting of grasses/sedges (3.9%) and low shrubs (3.2%) (Table 22).

4.2.6 Arctic Tern

Arctic Terns nested on islands throughout the North Arm, with the highest numbers occurring in the Trout Rock area (Table 2). They tended to nest in smaller colonies and were

more likely to nest at single pair sites than Common Terns, with 94.0% of colonies containing 10 nests or less and 42.0% consisting of a single pair (Table 23).

Clutches had 1-3 eggs or chicks, except one clutch that had 4 eggs (average: 1.97 ± 0.03 SE) (Table 24). Chicks were seen in late June and early July in 6 of 10 years in which Arctic Terns were observed (Appendix 10).

Arctic Terns were most frequently associated with Common Terns and Mew Gulls, with 74.8% and 38.4% of colony sites also containing those species, respectively (Table 25). Overall, 89.9% of Arctic Tern colonies also contained nests of other larid species.

Islands containing Arctic Tern colonies were 0.34 ha (± 0.05 SE) in size, and located 2175 m (± 134 SE) from the mainland, on average (Appendices 11 and 12). Sites were relatively well vegetated on average (13.1%), with most cover consisting of grasses/sedges (3.9%) and low shrubs (3.3%) (Table 26).

4.2.7 Common/Arctic Tern

Terns (Common Tern and/or Arctic Tern) were found in all zones within the study area. The section between Frank Channel and Boundary Creek was most important, and the Trout Rock area was consistently home to the highest number of nesting terns (Table 2, Appendix 8). Tern colonies contained 13.5 (± 0.6 SE) nests on average (Table 27), the largest of which contained 112 nests and was found in the Stagg River area in 2001 (88 Common Tern, 24 Arctic Tern).

The majority of tern clutches consisted of 1-3 eggs or chicks (average: 2.31 ± 0.01 SE), with less than 1% containing more than 3 (Table 28). Chicks were observed in late June and early July in 7 of 10 survey years (Appendix 10).

Terns were most frequently associated with Mew Gulls and Herring Gulls (33.1% and 15.8% of sites, respectively) (Table 29). When considered together, Common and Arctic Terns shared 56.8% of their colony sites with other larid species.

Islands containing tern colonies were 0.31ha (± 0.03 SE) in size, and located 2109 m (± 92 SE) offshore, on average (Appendices 11 and 12).

4.2.8 Caspian Tern

Caspian Terns nested at offshore islands along the northeast shoreline. Large colonies (> 25 nests) occurred most frequently in the Trout Rock area (Table 31). Single-pair sites were common and accounted for 64.4% of Caspian Tern colonies observed during surveys.

All clutches had 1-3 eggs or chicks (average: 2.02 ± 0.02 SE) (Table 32). Hatch dates were relatively late, with small numbers of chicks observed in late June and July in 4 of 10 survey years (Appendix 10).

Caspian Terns were the most likely of any species studied to nest in association with other larids (95.2% of colony sites) (Table 33). Of these, terns (60.6% Common Tern, 31.7% Arctic Tern, 68.3% either Common Tern, Arctic Tern, or both) and Herring Gulls (40.4%) were most common (Table 33).

Islands containing Caspian Tern colonies were 0.30 ha (± 0.04 SE) in size, and located 4111 m (± 282 SE) from the mainland, on average (Appendices 11 and 12). Average vegetation cover was 10.1% and consisted primarily of grass/sedge (3.7%) and low shrubs (2.5%) (Table 34).

4.3 NON-TARGET SPECIES

We observed 1259 nests of non-target species during surveys from 1990-2010. Scaup were most common (Greater Scaup–349, Lesser Scaup–164, Scaup spp.–368), followed by Red-breasted Merganser (90), Mallard (72), Northern Pintail (69), Red-throated Loon (34), Parasitic Jaeger (23), unidentified duck (22), Gadwall (17), Northern Shoveler (14), Bonaparte's Gull (9), Canada Goose (9), Spotted Sandpiper (7), Canvasback (5), American Green-winged Teal (2), American Wigeon (2), Savannah Sparrow (2), and Red-necked Phalarope (1). Maps showing the distribution of nests of non-target species can be found in Figures 98 and 99.

5. DISCUSSION

5.1 TRENDS IN ABUNDANCE AND DISTRIBUTION

The West Mirage Islands are the only section of the North Arm to have undergone detailed scientific observation prior to initiation of this study. Observations of birds nesting on

the islands were first recorded by Yellowknife resident and amateur ornithologist William L. McDonald from 1922-1970. His pioneering work was later expanded upon through more rigorous surveys by Weller et al. (1969), and Trauger and Bromley (1976). Insights on trends in abundance and distribution of larids outside the West Mirage Islands are limited to the time frame covered by this study.

We observed a higher number of Herring Gull, Mew Gull, and Arctic Tern nests in the Stagg River and Old Fort Rae areas during the 2010 surveys than had been recorded previously (Appendices 2, 3, and 7). Particular effort was given that year to thoroughly cover all sections and locate all larid nests within the survey area. Species with a propensity to nest at small or single-pair sites, such as those listed above, were more likely to be overlooked during surveys than those at larger colonies. Given that greater effort was given in 2010 to locate all nests, we suspect that the increased numbers of these species seen in that year may be the result of increased survey effort, particularly in locating small colonies, rather than a true expansion of the populations in those areas.

The distribution of larid colony sites on the North Arm appears to show a high degree of inter-annual variability. This is particularly apparent for species whose distribution tends to be restricted to a small number of relatively large colonies (i.e., Ring-billed Gull, Caspian Tern). Colony sites may be occupied and support a large number of nesting birds one year, while remaining vacant in subsequent years. We hypothesize that this variation in site selection may be influenced by the wide availability of suitable nesting sites, and variable ice conditions at the time of arrival and nest initiation.

The numerous islands along the northeast shoreline provide an abundance of suitable nesting habitat and potential colony sites for nesting larids. The majority of apparently suitable islands in the area remain unoccupied in a given year, and so the availability of potential colony sites is not thought to be a significant factor limiting the distribution of larids on the North Arm (P. Woodard, pers. obs.). As such, the individual island chosen as the colony site in a given year may be relatively unimportant given the abundance of alternative sites available at the time of colony initiation.

The quantity and distribution of suitable nesting sites may vary between years as a result of ice conditions in spring. In years of late ice cover, access to the islands by mammalian

predators can persist into the laying season, and widespread nest failure and colony abandonment may occur as a result of increased predation pressure during this sensitive time period. Additionally, extensive ice cover may limit the availability of suitable foraging areas within the vicinity of individual islands, thus lessening their attractiveness as a colony site to breeding larids. The effect of ice cover on colony site selection is a factor largely unique to larids nesting at higher latitudes, and may explain some of the inter-annual variation in the distribution, and apparent lack of site tenacity observed at the North Arm for species that are known to exhibit a high degree of site fidelity elsewhere.

5.1.1 Herring Gull

Herring Gulls were found in all sections of the northeast shoreline, but were generally most abundant in the areas of the West Mirage Islands, Enodah, and Yellowknife Bay (Figures 3-14).

The West Mirage Islands regularly supported 40-60 pairs from 1969-1973 (Trauger and Bromley 1976), and the average number reported during this study (47.9 ± 9.2 SE) is comparable. However, from a maximum of 117 pairs in 1989 (Sirois et al. 1995) to a minimum of 1 pair in 1991 (this study), fluctuations between years can be substantial (Appendix 2).

Numbers of Herring Gulls nesting in the Enodah area may have experienced the greatest degree of change. An average of 116 nests was observed during the first three years of surveys (1986, 1990-1991), declined to an average of only 7 nests during the most recent three surveys in the area (2000-2002) (Appendix 2). Whether this change represents a decline in numbers or a shift in distribution is unknown. The lack of recent surveys in the adjacent Yellowknife Bay area precludes us from adequately assessing this apparent change.

It is unclear whether the population increase and expansion of the city of Yellowknife has influenced the distribution of Herring Gull colonies. Herring Gulls frequent the Yellowknife landfill, and aggregations upwards of 1500 birds have been observed there (Beacon Environmental 2008). The importance of refuse in the diet of locally nesting Herring Gulls is unknown, but garbage seen at colonies in Yellowknife Bay suggests that some refuse feeding does occur (P. Woodard, pers. obs.). An aerial survey in the spring of 2007 showed that 95% of the Herring Gulls observed within a 20-km radius of Yellowknife were found within 4-km of the

solid waste facility, although the survey did not distinguish between migrants and locally breeding birds (Beacon Environmental 2008). Additional study will be required to determine if a change in the distribution of locally nesting Herring Gulls has occurred, and to what extent it is influenced by anthropogenic factors.

5.1.2 Mew Gull

Mew Gulls occurred at low densities in all zones, and no apparent changes to their abundance or distribution were detected during the course of surveys (Figures 15-26).

5.1.3 Ring-billed Gull

Ring-billed Gulls generally nested in relatively large colonies when compared to other larid species on the North Arm. The majority of nests observed in a given year were often located at only a handful of colony sites, resulting in a distribution that was relatively localized (Figures 28-39). As a result, inter-annual variation in the distribution of colonies was generally more apparent for Ring-billed Gulls than the other species examined. We observed a relatively high degree of variation in the location of Ring-billed Gull colonies between years (Figures 27-38).

Substantial degradation of vegetation at sites supporting large colonies of this species in consecutive years has been observed (M. Fournier, pers. obs.), similar to other Ring-billed Gull colonies elsewhere (Shugart 1976; Hogg and Morton 1983). Observations during visits to former colony sites following abandonment initially indicated that much of the vegetation at the site had been killed. One hypothesis that might explain these observations is high levels of nutrients, particularly nitrogen, as a result of the deposition of guano over time. This is supported by the very dry "sunburned" appearance of the dead vegetation observed at these sites. Furthermore, the potential inability of the vegetation to absorb high amounts of nitrogen may be consistent with the relatively small size and barren nature of Ring-billed Gull nesting islands seen in this study. Interestingly, during subsequent visits to some of these same islands, unusually luxuriant growth of certain plant species was noted (M. Fournier, pers. obs.). More study is required to support or disprove this hypothesis.

No change in the status of Ring-billed Gulls nesting on the West Mirage Islands was detected during this study; no observations of nests exist from previous studies (Weller et

al. 1969; Trauger and Bromley 1976), and none were found during this study. However, the presence of Ring-billed Gulls within the city of Yellowknife has increased dramatically in recent years (M. Fournier, pers. obs.), and a colony of Ring-billed Gulls now appears to be established on a lake within Yellowknife municipal boundaries (Canadian Wildlife Service, unpubl. data). Whether similar colonies have become established on the West Mirage Islands since it was last surveyed in 2002, or in other areas in the vicinity of Yellowknife, is unknown. Additional surveys of the West Mirage Islands and greater Yellowknife Bay area are needed to determine whether an expansion of Ring-billed Gulls into these areas, similar to apparent increases around Yellowknife in recent years, has occurred.

5.1.4 California Gull

Distribution of nesting California Gulls was quite consistent among years, with colonies observed only in the West Mirage Islands, Yellowknife Bay, and a portion of the Enodah area. Site tenacity appeared relatively high, as colonies were frequently located on the same islands from year to year (Figures 39-48).

Numbers of California Gulls nesting on the West Mirage Islands appear to have declined substantially compared to historic records. They were the most abundant breeding bird on the islands from 1969-1973, with an estimated 150-200 breeding pairs nesting there annually (Trauger and Bromley 1976). In June 1956, McDonald estimated 250 pairs on the westernmost island alone (unpub. data cited in Trauger and Bromley 1976). There were only 22.8 (± 8.3 SE) nesting pairs on average during this study, with a maximum number of 87 in 1995 and several years in which no California Gull nests were observed (1990, 1991, 2002) (Appendix 5). It has been suggested that competition with Herring Gulls may be contributing to the decline of California Gulls on the West Mirage Islands, although evidence demonstrating a clear causal relationship is lacking (McCormick and Sirois 1988).

5.1.5 Common Tern

During a lake-wide census of breeding larids on Great Slave Lake from 1986-1994, Sirois et al. (1995) reported that 74% of Common Terns nesting on the lake did so on the North Arm. We found Common Terns in all zones, but they were most abundant in the Trout Rock, Old Fort Rae, and Stagg River areas (Figures 49-60). Common Terns were particularly prevalent on the

islets west of Smith Island, and the islands at Trout Rock (Figure 97). They were the only species to have been observed nesting along the Southwest Shoreline, with two small colonies observed south of Waite Island in 1988.

Historical observations of Common Terns on the West Mirage Islands are limited to two nests discovered by McDonald prior to 1968. No nests were found by either Weller et al. (1969) or Trauger and Bromley (1976) from 1968-1973. Likewise, no Common Terns were observed during our initial survey in 1986. Subsequent surveys have yielded increasing numbers of nests since 1990 (8), peaking at 43 in 2001 (average: 23.2 ± 4.0 SE).

Outside of the West Mirage Islands, distribution of Common Terns in areas along the northeast shoreline appears to have been relatively stable. Our results indicate a small increasing trend in all zones (other than the Southwest Shoreline) from 1986-2010.

5.1.6 Arctic Tern

Arctic Terns were found in all zones along the northeast shoreline, with the highest numbers occurring in the Trout Rock area in most survey years (Figures 61-72, Appendix 7). They exhibited a relatively high amount of inter-annual variation in numbers compared to Common Terns, with the greatest degree of change occurring in the area of Old Fort Rae. Initial surveys in the area in 1986 and 1988 yielded only 1 and 0 nests, respectively, increasing to 75 during the most recent survey in 2010. Arctic Terns appear to have been increasing in the section of the North Arm west of Boundary Creek since the early 1990s. More nests were observed in this area in 2010 than during any other survey year.

Arctic Terns have historically been among the most abundant nesting birds on the West Mirage Islands. Weller et al. (1969) observed 48 nests on the 73 islands examined (~ 75% of total islands) in 1968. Trauger and Bromley (1976) estimated 75-100 pairs occurring on the islands annually from 1969-1973, which they considered to be a “noticeable decline” from numbers documented previously by Weller et al. (1969) and McDonald (unpub. data cited in Trauger and Bromley 1976). Our initial survey in 1986 yielded 22 nests, with subsequent surveys locating fewer than 10 in most years (average: 7.9 ± 1.9 SE) (Appendix 7). Causes of this apparent decline are unknown, but the timing seems to correspond with the rise of Common

Terns in the area. Further study would be necessary to determine whether competition between the two species is occurring, and if this is influencing Arctic Tern numbers.

5.1.7 Caspian Tern

Great Slave Lake is the only known breeding site for Caspian Terns in the Northwest Territories, and the North Arm is the northernmost known breeding area for the species in North America (Cuthbert and Wires 1999). Of the 236 nests censused on the lake from 1986-1994, 77 occurred within our area of study on the North Arm (Sirois et al. 1995). A significant number of these birds were observed at a single colony in the Trout Rock area in 1988 (56 nests). Trout Rock has consistently been home to significant numbers of nesting Caspian Terns in each year that it has been surveyed (avg. 48.8 nests ± 5.4 SE, n = 11, range 16-76), making it one of the most important areas for the species in northern Canada. The island selected as the main colony site has varied between years, but was always found within a relatively small area at Trout Rock (Figures 85-96). This area falls within the study area boundary of the proposed Candidate Protected Area under the Northwest Territories Protected Areas Strategy.

Use of the other sections of the North Arm by breeding Caspian Terns was typically low (< 5 nests), but higher use did occur on occasion, often due to the presence of a single large colony (> 10 nests). These exceptions were: Stagg River in 2002 (22 nests), Old Fort Rae in 1994 (35) and 1995 (43), Enodah in 1990 (44) and 1992 (26), and West Mirage Islands in 2001 (39) and 2002 (43). These colonies have occurred concurrently with the main colony in the Trout Rock area, and are unlikely to represent a shift in the location of that colony. It is unknown whether they represent newly established colonies by birds from outside areas, such as the large colony at Northwest Point (110 nests, located 80 km southwest of the West Mirage Islands, Sirois et al. 1995), or are a group of birds that have moved from the main Trout Rock colony.

There were three nests present annually on the West Mirage Islands from 1968-1973 (Weller et al. 1969; Trauger and Bromley 1976). Numbers reported by our surveys were similarly low until 2001, when a large single colony of 39 nests was observed in the area for the first time (Appendix 9). This colony was present in 2001 and 2002, the last two years that the West Mirage Islands were surveyed. Whether this colony has persisted since is unknown. If so, its presence may represent an expansion in numbers in the area.

5.2 NON-TARGET SPECIES

The North Arm is an area of known importance to waterfowl; it supports several thousand pairs of breeding ducks, tens of thousands of ducks, geese, and swans during spring and fall migration, and large flocks of moulting mergansers and scaup (Sirois 1987; Sirois and McCormick 1987; Sirois and Cameron 1989; Sirois 1993; Canadian Wildlife Service, unpubl. data). This study supports the importance of the North Arm to nesting waterfowl. Waterfowl were the most commonly encountered non-target species group (94% of non-target nests). A total of 1183 nests of 12 waterfowl species were observed during surveys, primarily ducks. Nests of scaup, and in particular Greater Scaup, predominated (Figures 98 and 99).

Although no nests were located during this study, evidence of Black Terns breeding in the vicinity of the North Arm was observed in most years. Adults have been seen foraging in near-shore shallows and inland marshes from late May through early July, and were joined by fledgling birds by late July and early August. A flock of approximately 400 fledged young and 30 adults was seen at Trout Rock on August 02, 1995 (Sirois et al. 1995), representing the largest aggregation of this species observed in the region to date. Additionally, small colonies of Black Terns have been observed on small lakes and ponds located inland from the North Arm during surveys of breeding waterfowl along Highway 3 outside of Yellowknife (Sirois and Fournier 1993). Black Terns regularly breed in the vicinity of the North Arm in nearby lakes and ponds not adequately covered by existing surveys. It is possible that they nest in shoreline marshes of the North Arm as well, but this remains to be proven. Shoreline marshes of the North Arm are subject to significant fluctuations in water levels due to wind seiches (M. Fournier, pers. obs.), which may make them less suitable nesting habitat for this overwater nesting species. Additionally, shoreline marshes support large populations of predatory Northern Pike (*Esox lucius*). Further study is required to determine if these or other factors limit the distribution of this species on the North Arm.

Bonaparte's Gulls are relatively common and can be found nesting on inland lakes and ponds throughout the region. On the North Arm, they were often seen on the larger, well-vegetated, near-shore islands and sections of the mainland. It is likely that this species occurs at low densities throughout the study area.

Small numbers of Parasitic Jaegers were occasionally observed from the West Mirage Islands to Trout Rock. They always nested at single-pair colonies, although sometimes in association with other species. They were most commonly found at the West Mirage Islands.

Small numbers of breeding Red-necked Phalaropes occur on the West Mirage Islands. McDonald observed nests in 1947, 1949, and 1956; Weller et al. (1969) observed one nest in 1968; and Trauger and Bromley (1976) reported 5-10 nests annually from 1969-1973. We observed only a single nest in 1993. No Red-necked Phalaropes were seen in other areas of the North Arm in any year.

Although we encountered only a few nests, Spotted Sandpipers were a common sight on islands throughout the North Arm and are likely regular breeders throughout the area.

5.3 HUMAN DISTURBANCE

The North Arm is becoming an increasingly popular destination for residents engaging in recreational activities, due to its proximity to the city of Yellowknife. The increased availability of technology such as GPS units, personal satellite locators, and satellite phones is allowing people to venture further into areas that were previously difficult to navigate or presented safety concerns, and that were thus infrequently used. Most recreational use occurs in the section between Yellowknife and Boundary Creek, with areas closer to town being utilized most often. A number of permanent and seasonal cabins and campsites can be found throughout this area, and a large facility hosts commercial outfitting opportunities year-round. The section between Boundary Creek and Frank Channel has less human use during the summer due to the highly turbid, shallow water with limited visibility, and the abundance of boating hazards such as shoals and rocks that limit access to the area. A large, permanent camp facility exists on Rae Point.

Increased human presence in the area during the summer may lead to potential conflicts with wildlife, both directly and indirectly. Larids are most vulnerable to disturbance during their breeding season (late May through August), which also coincides with the period of peak human use. Human presence at or near a colony can lead adult birds to engage in defensive mobbing behaviours for as long as a perceived threat is present. This in turn can result in increased susceptibility of eggs and young to exposure to adverse weather and to nest predators such as

gulls and ravens. As well, adults expending time and energy on defensive behaviours have less time and energy to provision and brood chicks.

Larids may also be affected indirectly by anthropogenic factors. Anthropogenic inputs, such as increased refuse generated by a growing human population and structures used for nesting or denning, can subsidize and artificially inflate local predator populations through increased survival and reproductive rates (Eberhardt et al. 1983; Day 1998; Marzluff and Neatherlin 2006). This can result in increased predation pressure on prey species in the area, such as birds and their nests. Predatory species such as Common Ravens are prolific refuse feeders, and their relative abundance on the landscape has been shown to be closely linked with that of the human population (Marzluff and Neatherlin 2006; Kristan and Boarman 2007). Increased numbers of anthropogenically subsidized predators, particularly Common Ravens in the Yellowknife area, may be contributing to higher rates of nest predation for larids and other birds nesting on the North Arm.

5.4 IMPORTANCE AS A KEY MIGRATORY BIRD HABITAT SITE

Any area that supports at least 1% of the Canadian population of a migratory bird species or subspecies at any time of the year is considered a key habitat site under the criteria used by CWS (Latour et al. 2008). The section of the North Arm along the northeast shoreline from Frank Channel to Francois Bay was first added to the list of key migratory bird terrestrial habitat sites in the Northwest Territories in the early 1990s (Alexander et al. 1991). The area was designated because of the presence of large numbers of waterfowl utilizing the area as a stopover site during spring migration, and the importance of the area to nesting Caspian Terns. Numbers that were nationally significant at the time of observation for Tundra Swans (2% of eastern population), Canada Geese (10% of mid-winter index of Shortgrass Prairie Canada and Cackling geese), and Caspian Terns (1% of national population) were observed on the North Arm in the late 1980s and early 1990s. The North Arm is one of the most important areas of Great Slave Lake to larids; approximately 40% of the overall larid population on the lake nests there (Sirois et al. 1995).

5.4.1 North Arm Study Area / Proposed Protected Area

Within Great Slave Lake, the section of the North Arm west of Yellowknife (our study area) is of particular importance to Ring-billed Gulls, Common Terns, Caspian Terns, and to a lesser extent Herring Gulls and Arctic Terns (Table 35). Although California and Mew Gulls utilize the area as well, their numbers on the North Arm represent a smaller proportion of their total Great Slave Lake populations. No species exceeded the 1% criteria within the study area, but two species approached this threshold: Common Tern and Caspian Tern (Table 35).

Morris et al. (2012) recently placed an estimate of the national breeding population of Common Terns at between 82 000 and 89 500 pairs (164 000-179 000 adults). With an average of 694 nests (1388 breeding adults) observed in the study area from 1986-2010, it is estimated that the North Arm supports approximately 0.8% of the national breeding population for the species (Table 35). The area within the study area boundary of the Candidate Protected Area was most important, and supports approximately 0.6% of the national breeding population.

Population estimates for breeding Caspian Terns in North America have increased substantially since the 1960s and 1970s (Cuthbert and Wires 1999; Wires and Cuthbert 2000). The current estimate for the Canadian population is between 19 800 and 35 000 breeding individuals (Milko et al. 2011). The reported average from this study of 83 nests (166 breeding adults) from 1986-2010 suggests that the section of the North Arm west of Yellowknife currently supports between 0.5% and 0.8% of the Canadian breeding population (Table 35). Most nests were observed within the study area boundary of the Candidate Protected Area (0.4-0.6% of the national population). The reduction of the proportion of the national population supported by the North Arm to below the 1% threshold is a reflection of increasing populations elsewhere, rather than a local decline.

5.4.2 Existing Key Habitat Site

The area within the boundary of the existing North Arm Key Migratory Bird Habitat Site does not appear to support > 1% of the national populations of any larid species, but approaches that threshold for four species: Caspian Tern (0.6 - approximately 1%), California Gull (0.6 - approximately 1%), Common Tern (0.8-0.9%), and Herring Gull (0.8%) (Table 35).

5.4.3 Great Slave Lake

Great Slave Lake as a whole may support nationally significant numbers for five species: Herring Gull (1.7%), Mew Gull (0.8-1.9%), California Gull (2.4-4.0%), Common Tern (1%), and Caspian Tern (1.4-2.4%) (Table 35). Arctic Tern is below, but approaches the 1% threshold at 0.9%. Of our seven focal species, only Ring-billed Gull is not thought to be found in numbers that exceed or approach national significance on Great Slave Lake.

6. CONCLUSIONS AND RECOMMENDATIONS

Great Slave Lake is one of the most important areas for inland breeding larids in northern Canada, and supports nationally significant numbers of multiple species. The North Arm is perhaps the most important region for larids within Great Slave Lake, and is particularly important for Common Terns and Caspian Terns. We recommend that the North Arm become a site included in future monitoring programs for inland waterbirds in Canada.

The North Arm is an ideal site for the study and monitoring of larids during the breeding season because of its proximity to Yellowknife, relatively low operational costs compared to other northern sites, the existence of baseline data from previous studies, and the diversity of gulls and terns breeding in the area. Surveys have the greatest utility when all zones are covered within the same breeding season. We recommend that effort be made during future surveys to thoroughly cover all areas between Yellowknife and Frank Channel whenever possible. Recent data are particularly lacking in the Yellowknife Bay area and should be considered a priority for future surveys. The Southwest Shoreline is used relatively infrequently by breeding larids, and thus the primary focus should be directed towards the area along the northeast shoreline. Additionally, a complete survey in a single season that covers all areas in which major Caspian Tern colonies have been observed on Great Slave Lake (i.e., including the colony at Northwest Point) would provide a more accurate census and determination of the current status of this important species in the region.

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Table 1. Summary of dates and geographic zones surveyed for breeding larids on the North Arm of Great Slave Lake, 1986-2010 (C = complete survey, P = partial survey)

Year	Survey Period	Stagg River	Old Fort Rae	Trout Rock	Enodah	Yellowknife Bay	West Mirage Islands	Southwest Shoreline
1986	June 23-26	C	C	C	C	C	C	–
1988	June 24-26	C	C	C	–	P[1]	–	C
1990	June 19-22	–	–	C	C	P[2]	C	–
1991	June 20-27	C	C	C	C	P[2]	C	–
1992	June 20-30	C	C	C	C	P[2]	C	–
1993	June 18-24	C	C	C	C	P[2]		–
	June 29-30						C	
1994	June 18-24	C	C	C	C	P[2]		–
	June 28-29						C	
1995	June 16-22	C	C	C	P[3]	P[2]		–
	June 28-30						C	
2000	June 22-23	–	P[4]	C	C	P[2]		–
	June 26-29						C	
2001	June 20-26	C	C	C	C	P[2]		–
	June 28-29						C	
2002	June 25-28	C	C	–	C	P[2]		–
	July 08-12						C	
2010	June 22-29	C	C	C	–	–	–	
	July 02							C[5]

[1] Revisited sites discovered in 1986 only.
[2] Only recorded observations opportunistically.
[3] Only surveyed northern 1/3 of zone.
[4] Only surveyed southern 1/3 of zone.
[5] Surveyed by helicopter.

Table 2. Average number (± standard error) of nests observed by zone on islands of the North Arm of Great Slave Lake

	Stagg River	**Old Fort Rae**	**Trout Rock**	**Enodah**	**Yellowknife Bay**[1]	**West Mirage Islands**	**Southwest Shoreline**
Zone Area	51 km^2	65 km^2	60 km^2	103 km^2	100 km^2	11 km^2	118 km^2
n	10	10	11	9	1	10	2
Herring Gull	11.5 ± 5.2	4.2 ± 1.8	15.6 ± 2.7	61.2 ± 16.7	147.0	47.9 ± 9.2	0
Mew Gull	8.0 ± 1.8	7.6 ± 3.5	14.3 ± 2.5	7.1 ± 0.9	25.0	2.3 ± 0.8	0
Ring-billed Gull	34.5 ± 23.6	146.8 ± 30.0	50.1 ± 14.5	17.6 ± 6.1	0	0 ± 0	0
California Gull	0	0	0	25.6 ± 8.3	44.0	22.8 ± 8.7	0
All Gulls[2]	**54.0 ± 24.1**	**158.6 ± 28.3**	**80.0 ± 15.0**	**111.4 ± 18.8**	**216**	**73.4 ± 14.5**	**0**
Common Tern	140.0 ± 15.3	166.2 ± 16.9	215.6 ± 19.8	82.7 ± 7.9	55.0	23.2 ± 4.0	11.0 ± 11.0
Arctic Tern	19.7 ± 5.5	18.1 ± 6.9	45.5 ± 12.5	19.9 ± 7.6	1.0	7.9 ± 1.9	0
Tern spp.[3]	159.7 ± 15.1	184.3 ± 17.2	261.1 ± 24.4	102.6 ± 7.6	56.0	31.1 ± 3.8	11.0 ± 11.0
Caspian Tern	3.6 ± 2.1	9.4 ± 5.0	48.8 ± 5.4	8.8 ± 5.2	1.0	11.1 ± 5.1	0
All Terns	**163.3 ± 16.3**	**193.7 ± 18.6**	**309.9 ± 27.0**	**111.3 ± 10.6**	**57**	**42.6 ± 7.6**	**11.0 ± 11.0**

[1] Based on only one year of data, so no standard error was calculated.
[2] Includes four unidentified gull nests at the West Mirage Islands in 1995.
[3] Common and/or Arctic terns.

Table 3. Herring Gull colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	70	72.9	51	27.1	19	0.0	0	0.0	0	0.0	0	1.6 ± 0.2	1 – 9
Old Fort Rae	40	95.0	38	5.0	2	0.0	0	0.0	0	0.0	0	1.1 ± 0.0	1 – 2
Trout Rock	63	63.5	40	30.2	19	6.3	4	0.0	0	0.0	0	2.7 ± 0.4	1 – 14
Enodah	118	33.9	40	55.1	65	9.3	11	1.7	2	0.0	0	4.8 ± 0.5	1 – 32
Yellowknife Bay	27	11.1	3	63.0	17	18.5	5	7.4	2	0.0	0	8.8 ± 1.7	1 – 37
West Mirage Islands	81	33.3	27	48.1	39	13.6	11	4.9	4	0.0	0	5.9 ± 0.8	1 – 40
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	399	49.9	199	40.4	161	7.8	31	2.0	8	0.0	0	4.1 ± 0.3	1 – 40

Table 4. Herring Gull clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986	88	128	75	-	-	-	291	1.96	0.04
1990	36	118	91	1	-	-	246	2.23	0.03
1991	32	40	19	1	-	-	92	1.88	0.08
1992	38	49	26	-	-	-	113	1.89	0.07
1993	25	21	16	-	-	-	62	1.85	0.10
1994	75	54	35	4	2	-	170	1.85	0.07
1995	28	28	19	-	-	-	75	1.88	0.09
2000	8	17	11	-	-	-	36	2.08	0.12
2001	16	30	21	-	-	-	67	2.07	0.09
2002	5	2	8	1	1	-	17	2.47	0.29
2010	13	31	26	-	-	-	70	2.19	0.09
Total (%)	364 (29)	518 (42)	347 (28)	7 (1)	3 (<1)	0 (0)	1239	2.00	0.02

Table 5. Herring Gull colony species associations by zone, 1986-2010

	Herring Gull	Mew Gull		Ring-billed Gull		California Gull		Common Tern		Arctic Tern		Tern spp.[1]		Caspian Tern		All Larid	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	70	11.4	8	0.0	0	0.0	0	21.4	15	10.0	7	25.7	18	0.0	0	27.1	19
Old Fort Rae	40	7.5	3	7.5	3	0.0	0	27.5	11	15.0	6	30.0	12	5	2	37.5	15
Trout Rock	63	14.3	8	20.6	13	0.0	0	47.6	30	42.9	27	55.6	35	23.8	15	66.7	42
Enodah	118	7.6	8	0.0	0	4.2	5	6.8	8	7.6	9	8.5	10	7.6	9	19.5	23
Yellowknife Bay	27	7.4	2	0.0	0	7.4	2	11.1	3	0.0	0	11.1	3	7.4	2	18.5	5
West Mirage Islands	81	13.6	11	0.0	0	12.3	10	12.3	10	14.8	12	17.3	14	17.3	14	44.4	36
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-
Total	399	10.5	42	4.0	16	4.3	17	19.3	77	15.3	61	23.1	92	10.5	42	35.1	140

[1] Common Tern and/or Arctic Tern

Table 6. Composition of vegetation cover (%) at Herring Gull colony sites on the North Arm, 1990-1995

		Total Cover		Grass / Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	25	23.2	3.7	4.1	0.7	2.1	0.3	6.3	1.2	5.8	1.4	4.9	0.9
Old Fort Rae	18	11.4	1.8	3.8	0.5	1.6	0.3	2.3	0.5	2.2	0.4	1.5	0.4
Trout Rock	35	7.4	0.7	3.6	0.3	1.3	0.2	1.9	0.3	0.4	0.1	0.2	0.1
Enodah	96	12.3	1.2	5.0	0.4	1.5	0.1	2.7	0.5	1.5	0.2	1.6	0.5
Yellowknife Bay	3	16.7	6.7	16.7	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Mirage Islands	55	15.8	2.4	5.2	0.5	1.5	0.2	5.0	0.9	1.4	0.3	2.8	0.8
Total	232	13.5	0.9	4.8	0.3	1.5	0.1	3.4	0.3	1.8	0.2	2.0	0.3

Table 7. Mew Gull colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	47	68.1	32	31.9	15	0.0	0	0.0	0	0.0	0	1.7 ± 0.2	1 – 6
Old Fort Rae	56	80.4	45	19.6	11	0.0	0	0.0	0	0.0	0	1.4 ± 0.1	1 – 5
Trout Rock	82	68.3	56	31.7	26	0.0	0	0.0	0	0.0	0	1.9 ± 0.2	1 – 10
Enodah	58	84.5	49	15.5	9	0.0	0	0.0	0	0.0	0	1.2 ± 0.1	1 – 3
Yellowknife Bay	5	40	2	20.0	1	40.0	2	0.0	0	0.0	0	10.4 ± 5.6	1 – 24
West Mirage Islands	21	90.5	19	9.5	2	0.0	0	0.0	0	0.0	0	1.1 ± 0.1	1 – 2
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	270[1]	75.6	204[1]	23.7	64	0.7	2	0.0	0	0.0	0	1.7 ± 0.1	1 – 24

[1]Includes one site where zone is unknown.

Table 8. Mew Gull clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986	3	9	27	-	-	-	39	2.62	0.10
1990	1	5	11	-	-	-	17	2.59	0.15
1991	9	9	11	-	-	-	29	2.07	0.16
1992	4	9	8	-	-	-	21	2.19	0.16
1993	10	16	17	-	-	-	43	2.16	0.12
1994	7	16	15	-	-	-	38	2.21	0.12
1995	10	9	36	-	-	-	55	2.47	0.11
2000	3	9	6	-	-	-	18	2.17	0.17
2001	7	18	12	-	-	-	37	2.14	0.12
2002	3	7	2	-	-	-	12	1.92	0.19
2010	12	26	22	-	-	-	60	2.17	0.10
Total (%)	69 (19)	133 (36)	167 (45)	0 (0)	0 (0)	0 (0)	369	2.27	0.04

Table 9. Mew Gull colony species associations by zone, 1986-2010

	Mew Gull	Herring Gull		Ring-billed Gull		California Gull		Common Tern		Arctic Tern		Tern spp.[1]		Caspian Tern		All Larids	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	47	17.0	8	0.0	0	0.0	0	55.3	26	40.4	19	70.2	33	4.3	2	72.3	34
Old Fort Rae	56	5.4	3	0.0	0	0.0	0	44.6	25	50.0	28	69.6	39	5.4	3	73.2	41
Trout Rock	82	11.0	9	11.0	9	0.0	0	69.5	57	56.1	46	80.5	66	9.8	8	82.9	68
Enodah	58	15.5	9	3.4	2	0.0	0	65.5	38	39.7	23	70.7	41	5.2	3	82.8	48
Yellowknife Bay	5	40.0	2	0.0	0	0.0	0	80.0	4	20.0	1	80.0	4	0.0	0	80.0	4
West Mirage Islands	21	52.4	11	0.0	0	4.8	1	33.3	7	23.8	5	42.9	9	14.3	3	85.7	18
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	270[2]	15.6	42	4.1	11	0.4	1	58.7	158[2]	45.7	123[2]	71.7	193[2]	7.1	19	79.6	214[2]

[1] Common Tern and/or Arctic Tern.
[2] Includes one site also containing Common Tern and Arctic Tern where zone is unknown.

Table 10. Composition of vegetation cover (%) at Mew Gull colony sites on the North Arm, 1990-1995

		Total Cover		Grass / Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	20	22.0	3.5	2.9	0.4	2.7	0.3	5.1	0.9	5.1	1.0	6.2	1.4
Old Fort Rae	19	10.7	2.0	2.6	0.4	1.4	0.2	2.0	0.5	2.5	0.7	2.3	0.7
Trout Rock	32	12.0	1.4	4.1	0.5	1.5	0.2	2.3	0.4	2.1	0.4	2.0	0.6
Enodah	38	13.6	1.6	4.7	0.7	1.7	0.3	3.0	0.5	1.8	0.2	2.5	0.5
Yellowknife Bay	0	-	-	-	-	-	-	-	-	-	-	-	-
West Mirage Islands	14	32.5	6.9	7.7	1.6	4.5	1.7	9.6	2.3	3.1	0.8	7.6	2.3
Total	123	16.2	1.3	4.2	0.3	2.1	0.2	3.8	0.4	2.6	0.3	3.5	0.5

Table 11. Ring-billed Gull colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	8	0.0	0	37.5	3	12.5	1	0	0	50.0	4	43.1 ± 12.8	6 – 99
Old Fort Rae	32	6.3	2	28.1	9	6.3	2	15.6	5	43.8	14	45.9 ± 7.6	1 – 132
Trout Rock	32	12.5	4	34.4	11	31.3	10	18.8	6	3.1	1	17.2 ± 3.9	1 – 116
Enodah	9	11.1	1	33.3	3	0.0	0	55.6	5	0.0	0	20.7 ± 5.0	1 – 39
Yellowknife Bay	0	-	-	-	-	-	-	-	-	-	-	-	-
West Mirage Islands	0	-	-	-	-	-	-	-	-	-	-	-	-
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	81	8.6	8.6	32.1	26	16.0	13	19.8	16	23.5	19	31.5 ± 3.9	1 – 132

Table 12. Ring-billed Gull clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986	34	68	137	-	2	-	241	2.45	0.05
1990	9	17	16	-	1	-	43	2.23	0.13
1991	31	88	105	1	3	-	228	2.37	0.05
1992	70	93	75	-	-	-	238	2.02	0.05
1993	28	58	114	1	1	-	202	2.45	0.05
1994	40	66	154	5	1	1	267	2.49	0.05
1995	23	73	134	7	3	1	241	2.57	0.05
2000	-	-	-	-	-	-	-	-	-
2001	61	115	224	1	1	-	402	2.42	0.04
2002	9	23	23	-	-	-	55	2.25	0.10
2010	11	10	5	-	-	-	26	1.77	0.15
Total (%)	316 (16)	611 (31)	987 (51)	15 (<1)	12 (<1)	2 (<1)	1943	2.38	0.02

Table 13. Ring-billed Gull colony species associations by zone, 1986-2010

	Ring-billed Gull	Herring Gull		Mew Gull		California Gull		Common Tern		Arctic Tern		Tern spp.[1]		Caspian Tern		All Larids	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	8	0.0	0	0.0	0	0.0	0	75.0	6	37.5	3	100.0	8	50.0	4	100.0	8
Old Fort Rae	32	9.4	3	0.0	0	0.0	0	68.8	22	15.6	5	68.8	22	25.0	8	78.1	25
Trout Rock	32	40.6	13	28.1	9	0.0	0	78.1	25	50.0	16	81.2	26	37.5	12	90.6	29
Enodah	9	0.0	0	22.2	2	0.0	0	77.8	7	55.6	5	77.8	7	11.1	1	77.8	7
Yellowknife Bay	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West Mirage Islands	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	81	19.8	16	13.6	11	0.0	0	74.1	60	35.8	29	77.8	63	30.9	25	85.2	69

[1] Common Tern and/or Arctic Tern.

Table 14. Composition of vegetation cover (%) at Ring-billed Gull colony sites on the North Arm, 1990-1995

		Total Cover		Grass/Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	3	11.7	1.7	5.0	1.0	3.3	0.3	3.0	1.7	0.3	0.3	0.0	0.0
Old Fort Rae	20	8.0	1.2	2.4	0.3	1.6	0.1	1.6	0.4	1.3	0.3	1.1	0.3
Trout Rock	14	8.2	1.0	3.9	0.5	1.8	0.2	1.9	0.4	0.5	0.2	0.1	0.1
Enodah	4	22.5	1.4	6.5	0.9	3.5	0.9	6.8	0.4	3.3	0.4	2.5	1.4
Yellowknife Bay	0	-	-	-	-	-	-	-	-	-	-	-	-
West Mirage Islands	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	41	9.8	1.0	3.5	0.3	2.0	0.2	2.3	0.4	1.1	0.2	0.8	0.2

Table 15. California Gull colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	0	-	-	-	-	-	-	-	-	-	-	-	-
Old Fort Rae	0	-	-	-	-	-	-	-	-	-	-	-	-
Trout Rock	0	-	-	-	-	-	-	-	-	-	-	-	-
Enodah	13	15.4	2	38.5	5	23.1	3	23.1	3	0.0	0	17.7 ± 4.7	1 – 49
Yellowknife Bay	2	0.0	0	0.0	0	0.0	0	100.0	2	0.0	0	36.5 ± 7.5	29 – 44
West Mirage Islands	12	16.7	2	16.7	2	41.7	5	25.0	3	0.0	0	19.0 ± 4.3	1 – 42
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	27	14.8	4	25.9	7	29.6	8	29.6	8	0.0	0	19.7 ± 3.1	1 – 49

Table 16. California Gull clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986	17	40	30	-	-	-	87	2.15	0.08
1990	9	38	28	-	-	-	75	2.25	0.08
1991	2	5	3	-	-	-	10	2.10	0.23
1992	3	0	1	-	-	-	4	1.50	0.50
1993	2	4	2	-	-	-	8	2.00	0.27
1994	11	27	28	1	-	-	67	2.28	0.09
1995	44	28	15	-	-	-	87	1.67	0.08
2000	-	1	-	-	-	-	1	2.00	0.00
2001	4	9	9	-	-	-	22	2.23	0.16
2002	-	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	-
Total (%)	92 (25)	152 (42)	116 (32)	1 (<1)	0 (0)	0 (0)	361	2.07	0.04

Table 17. California Gull colony species associations by zone, 1986-2010

	California Gull	Herring Gull		Mew Gull		Ring-billed Gull		Common Tern		Arctic Tern		Tern spp.[1]		Caspian Tern		All Larids	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**n**
Stagg River	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Old Fort Rae	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trout Rock	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enodah	13	38.5	5	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	30.8	4	46.2	6
Yellowknife Bay	2	100.0	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0	2	100.0	2
West Mirage Islands	12	83.3	10	8.3	1	0.0	0	8.3	1	0.0	0	8.3	1	16.7	2	91.7	11
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	27	63.0	17	3.7	1	0.0	0	3.7	1	0.0	0	3.7	1	29.6	8	70.4	19

[1] Common Tern and/or Arctic Tern.

Table 18. Composition of vegetation cover (%) at California Gull colony sites on the North Arm, 1990-1995

		Total Cover		Grass/Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	0	-	-	-	-	-	-	-	-	-	-	-	-
Old Fort Rae	0	-	-	-	-	-	-	-	-	-	-	-	-
Trout Rock	0	-	-	-	-	-	-	-	-	-	-	-	-
Enodah	10	5.9	1.9	3.4	1.5	1.3	0.4	0.8	0.4	0.2	0.1	0.2	0.1
Yellowknife Bay	0	-	-	-	-	-	-	-	-	-	-	-	-
West Mirage Islands	8	13.3	6.2	4.1	1.0	1.3	0.6	2.6	1.2	1.3	0.6	4.0	2.7
Total	18	9.2	3.0	3.7	0.9	1.3	0.3	1.6	0.6	0.7	0.3	1.9	1.3

Table 19. Common Tern colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 – 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	80	8.8	7	35.0	28	38.8	31	12.5	10	5.0	4	17.2 ± 2.2	1 – 95
Old Fort Rae	119	15.1	18	34.5	41	32.8	39	16.8	20	0.8	1	14.3 ± 1.2	1 – 51
Trout Rock	169	11.8	20	46.2	78	24.9	42	12.4	21	4.7	8	15.0 ± 1.4	1 – 69
Enodah	86	17.4	15	47.7	41	29.1	25	4.7	4	1.2	1	9.6 ± 1.2	1 – 66
Yellowknife Bay	10	10.0	1	20.0	2	50.0	5	20.0	2	0.0	0	19.2 ± 4.6	2 – 46
West Mirage Islands	35	17.1	6	57.1	20	25.7	9	0.0	0	0.0	0	6.6 ± 1.0	1 – 23
Southwest Shoreline	2	0.0	0	50.0	1	50.0	1	0.0	0	0.0	0	11.0 ± 3.0	8 – 14
Total	502[1]	13.3	67	42.0	211	30.3	152	11.6	58[1]	2.8	14	13.8 ± 0.7	1 – 95

[1]Includes one site where zone is unknown.

Table 20. Common Tern clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986[1]	-	-	-	-	-	-	-	-	-
1990	12	41	31	-	-	-	84	2.23	0.07
1991	123	300	196	1	-	-	620	2.12	0.03
1992	106	244	198	-	-	-	548	2.17	0.03
1993	74	286	420	2	-	-	782	2.45	0.02
1994	51	220	492	3	-	-	766	2.58	0.02
1995	71	196	415	-	-	-	682	2.50	0.03
2000	67	158	48	-	-	-	273	1.93	0.04
2001	103	350	412	1	-	-	866	2.36	0.02
2002	68	139	257	1	-	1	466	2.42	0.03
2010	26	61	130	-	-	-	217	2.48	0.05
Total (%)	701 (13)	1995 (38)	2599 (49)	8 (<1)	0 (0)	1 (<1)	5304	2.36	0.01

[1] Did not distinguish between Common and Arctic Terns.

Table 21. Common Tern colony species associations by zone, 1986-2010

	Common Tern	Herring Gull		Mew Gull		Ring-billed Gull		California Gull		Arctic Tern		Tern spp.[1]		Caspian Tern		All Larids	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	80	18.8	15	32.5	26	7.5	6	0.0	0	33.8	27	n/a		13.8	11	73.8	59
Old Fort Rae	119	9.2	11	21.0	25	18.5	22	0.0	0	41.2	49	n/a		14.3	17	72.3	86
Trout Rock	169	17.8	30	33.7	57	14.8	25	0.0	0	58.6	99	n/a		12.4	21	79.3	134
Enodah	86	9.3	8	44.2	38	8.1	7	0.0	0	46.5	40	n/a		4.7	4	69.8	60
Yellowknife Bay	10	30.0	3	40.0	4	0.0	0	0.0	0	20.0	2	n/a		0.0	0	60.0	6
West Mirage Islands	35	28.6	10	20.0	7	0.0	0	2.9	1	60.0	21	n/a		28.6	10	80.0	28
Southwest Shoreline	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	n/a		0.0	0	0.0	0
Total	502[2]	15.3	77	31.5	158[2]	12.0	60	0.2	1	47.6	239[2]	n/a		12.5	63	74.5	374[2]

[1] Common Tern and/or Arctic Tern.
[2] Includes one site also containing Arctic Tern and Mew Gull where zone is unknown.

Table 22. Composition of vegetation cover (%) at Common Tern colony sites on the North Arm, 1990-1995

		Total Cover		Grass/Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	41	18.8	2.3	2.9	0.3	2.5	0.2	4.1	0.6	4.3	1.0	5.1	1.1
Old Fort Rae	59	9.1	0.7	2.9	0.3	1.6	0.1	1.6	0.2	1.8	0.2	1.2	0.2
Trout Rock	83	11.2	0.8	3.9	0.3	1.9	0.1	2.4	0.3	1.7	0.2	1.3	0.3
Enodah	48	17.0	1.6	5.5	0.6	2.1	0.3	4.0	0.5	2.5	0.3	3.0	0.6
Yellowknife Bay	3	15.0	0.0	4.5	0.0	3.0	0.0	6.0	0.0	0.0	0.0	1.5	0.0
West Mirage Islands	19	19.2	4.8	4.7	0.5	3.8	1.7	6.9	1.9	1.3	0.3	2.8	1.1
Total	253	13.7	0.7	3.9	0.2	2.1	0.2	3.2	0.2	2.2	0.2	2.3	0.3

Table 23. Arctic Tern colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	47	57.4	27	34.0	16	4.3	2	4.3	2	0.0	0	4.2 ± 1.0	1 – 30
Old Fort Rae	73	46.6	34	50.7	37	2.7	2	0.0	0	0.0	0	2.6 ± 0.3	1 – 16
Trout Rock	120	30.0	36	62.5	75	6.7	88	0.8	1	0.0	0	4.2 ± 0.4	1 – 27
Enodah	47	40.4	19	55.3	26	2.1	1	2.1	1	0.0	0	4.1 ± 0.8	1 – 37
Yellowknife Bay	2	50.0	1	50.0	1	0.0	0	0.0	0	0.0	0	2.0 ± 1.0	1 – 3
West Mirage Islands	29	58.6	17	34.5	10	6.9	2	0.0	0	0.0	0	2.7 ± 0.5	1 – 11
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	319	40.0	134	52.0	166	4.7	15	1.3	4	0.0	0	3.7 ± 0.3	1 – 37

Table 24. Arctic Tern clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986[1]	-	-	-	-	-	-	-	-	-
1990	3	25	11	-	-	-	39	2.21	0.09
1991	11	14	1	-	-	-	26	1.62	0.11
1992	23	21	8	-	-	-	52	1.71	0.10
1993	16	24	14	-	-	-	54	1.96	0.10
1994	20	34	22	-	-	-	76	2.03	0.09
1995	18	36	25	1	-	-	70	2.13	0.10
2000	28	48	9	-	-	-	85	1.78	0.07
2001	34	91	45	-	-	-	170	2.06	0.05
2002	9	13	15	-	-	-	37	2.16	0.13
2010	23	51	13	-	-	-	87	1.89	0.07
Total (%)	185 (27)	347 (50)	163 (23)	1 (<1)	0 (0)	0 (0)	696	1.97	0.03

[1] Did not distinguish between Common and Arctic Terns

Table 25. Arctic Tern colony species associations by zone, 1986-2010

	Arctic Tern	Herring Gull		Mew Gull		Ring-billed Gull		California Gull		Common Tern		Tern spp.[1]		Caspian Tern		All Larids	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	47	14.9	7	40.4	19	6.4	3	0.0	0	57.4	27	n/a		2.1	1	80.9	38
Old Fort Rae	73	8.2	6	38.4	28	6.8	5	0.0	0	67.1	49	n/a		4.1	3	87.7	64
Trout Rock	120	22.5	27	38.3	46	13.3	16	0.0	0	82.5	99	n/a		11.7	14	92.5	111
Enodah	47	19.1	9	48.9	23	10.6	5	0.0	0	85.1	40	n/a		8.5	4	93.6	44
Yellowknife Bay	2	0.0	0	50.0	1	0.0	0	0.0	0	100.0	2	n/a		0.0	0	100.0	2
West Mirage Islands	29	41.4	12	17.2	5	0.0	0	0.0	0	72.4	21	n/a		37.9	11	93.1	27
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	n/a		-	-	-	-
Total	319[2]	19.1	61	38.6	123[2]	9.1	29	0.0	0	74.9	239[2]	n/a		10.3	33	90.0	287[2]

[1] Common Tern and/or Arctic Tern.
[2] Includes one site also containing Common Tern and Mew Gull where zone is unknown.

Table 26. Composition of vegetation cover (%) at Arctic Tern colony sites on the North Arm, 1990-1995

		Total Cover		Grass/Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	20	16.1	2.9	2.8	0.5	2.3	0.3	3.7	0.9	3.9	1.0	3.4	1.0
Old Fort Rae	26	8.7	1.3	2.7	0.3	1.7	0.1	1.5	0.4	1.4	0.3	1.3	0.4
Trout Rock	46	9.8	0.9	3.9	0.3	1.8	0.1	2.2	0.4	1.2	0.3	0.8	0.3
Enodah	27	16.6	2.1	5.3	0.6	2.0	0.3	4.5	0.7	2.2	0.3	2.6	0.7
Yellowknife Bay	1	15	0.0	4.5	0.0	3.0	0.0	6.0	0.0	0.0	0.0	1.5	0.0
West Mirage Islands	15	20.7	5.7	4.9	0.5	4.3	2.1	7.1	2.2	0.9	0.3	3.3	1.3
Total	135	13.1	1.0	3.9	0.2	2.2	0.3	3.3	0.4	1.8	0.2	1.9	0.3

Table 27. Common and/or Arctic Tern colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	100	22.0	27	31.0	31	29.0	29	13.0	13	5.0	5	16.0 ± 2.1	1 – 112
Old Fort Rae	143	20.3	34	35.7	51	28.0	40	15.4	22	0.7	1	13.0 ± 1.1	1 – 52
Trout Rock	190	12.1	36	43.2	82	24.7	47	14.2	27	5.8	11	15.1 ± 1.2	1 – 71
Enodah	95	18.9	19	45.3	43	26.3	25	8.4	8	1.1	1	10.7 ± 1.2	1 – 67
Yellowknife Bay	8	0.0	0	37.5	3	50.0	4	12.5	1	0.0	0	15.1 ± 4.9	2 – 46
West Mirage Islands	44	27.3	17	43.2	19	29.5	13	0.0	0	0.0	0	7.1 ± 1.0	1 – 23
Southwest Shoreline	2	0.0	0	50.0	1	50.0	1	0.0	0	0.0	0	11.0 ± 3.0	8 – 14
Total	583[1]	17.8	104	39.5	230	27.3	159	12.2	71	3.1	19[1]	13.5 ± 0.6	1 – 112

[1]Includes one site where zone is unknown.

Table 28. Common and/or Arctic Tern clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986	88	214	243	-	-	-	545	2.28	0.03
1990	34	151	67	1	-	-	253	2.14	0.04
1991	134	314	197	1	-	-	646	2.10	0.03
1992	129	265	206	-	-	-	1277	2.13	0.03
1993	90	310	434	2	-	-	836	2.42	0.02
1994	71	254	514	3	-	-	842	2.53	0.02
1995	89	222	440	1	-	-	752	2.49	0.03
2000	95	206	57	-	-	-	358	1.89	0.03
2001	137	441	457	1	-	-	1036	2.31	0.02
2002	79	152	272	1	-	1	505	2.39	0.03
2010	104	301	351	-	-	-	756	2.33	0.03
Total (%)	1050 (15)	2830 (40)	3238 (45)	10 (<1)	0 (0)	1 (<1)	7129	2.31	0.01

Table 29. Common and/or Arctic Tern colony species associations by zone, 1986-2010

	Tern spp.[1]	Herring Gull		Mew Gull		Ring-billed Gull		California Gull		Common Tern		Arctic Tern		Caspian Tern		All Larid	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	100	18.0	18	33.0	33	0.0	0	0.0	0	n/a		n/a		12.0	12	58.0	58
Old Fort Rae	143	8.4	12	27.3	39	15.4	22	0.0	0	n/a		n/a		11.9	17	53.1	76
Trout Rock	190	18.4	35	34.7	66	13.7	26	0.0	0	n/a		n/a		12.1	23	57.9	110
Enodah	95	10.5	10	43.2	41	7.4	7	0.0	0	n/a		n/a		5.3	5	56.8	54
Yellowknife Bay	8	37.5	3	50.0	4	0.0	0	0.0	0	n/a		n/a		0.0	0	62.5	5
West Mirage Islands	44	31.8	14	20.5	9	0.0	0	2.3	1	n/a		n/a		31.8	14	61.4	27
Southwest Shoreline	2	0.0	0	0.0	0	0.0	0	0.0	0	n/a		n/a		0.0	0	0.0	0
Total	583[2]	15.8	92	33.1	193[2]	9.4	55	0.2	1	n/a		n/a		12.2	71	56.8	331[2]

[1] Common Tern and/or Arctic Tern.
[2] Includes one site also containing Mew Gull where zone is unknown.

Table 30. Composition of vegetation cover (%) at Common and/or Arctic Tern colony sites on the North Arm, 1990-1995

		Total Cover		Grass/Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	49	19.0	2.0	2.9	0.3	2.5	0.2	4.2	0.5	4.5	0.9	4.9	0.9
Old Fort Rae	62	9.7	0.8	2.9	0.3	1.6	0.1	1.8	0.3	1.9	0.2	1.4	0.2
Trout Rock	85	11.0	0.8	3.9	0.2	1.9	0.1	2.4	0.3	1.7	0.2	1.3	0.3
Enodah	53	17.1	1.6	5.4	0.6	2.1	0.2	4.2	0.5	2.4	0.3	3.0	0.6
Yellowknife Bay	3	15.0	0.0	4.5	0.0	3.0	0.0	6.0	0.0	0.0	0.0	1.5	0.0
West Mirage Islands	22	20.5	4.8	4.7	0.4	4.4	1.8	7.4	1.8	0.9	0.3	3.1	1.1
Total	274	14.1	0.7	3.9	0.2	2.2	0.2	3.4	0.2	2.3	0.2	2.4	0.2

Table 31. Caspian Tern colony size by zone, 1986-2010

		Number of Nests at Colony											
		1		2 - 10		11 - 25		26 - 50		> 50			
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**Mean ± SE**	**Range**
Stagg River	12	66.7	8	25.0	3	8.3	1	0.0	0	0.0	0	3.0 ± 1.7	1 – 22
Old Fort Rae	19	78.9	15	10.5	2	0.0	0	10.5	2	0.0	0	4.9 ± 2.6	1 – 41
Trout Rock	34	44.1	15	14.7	5	17.6	6	14.7	5	8.8	3	15.8 ± 3.6	1 – 73
Enodah	13	76.9	10	7.7	1	7.7	1	7.7	1	0.0	0	6.2 ± 3.6	1 – 43
Yellowknife Bay	2	100.0	2	0.0	0	0.0	0	0	0	0.0	0	1.0 ± 0.0	1 – 1
West Mirage Islands	24	70.8	17	20.8	5	0.0	0	8.3	2	0.0	0	4.6 ± 2.1	1 – 39
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	104	64.4	67	15.4	16	7.7	8	9.6	10	2.9	3	8.3 ± 1.5	1 – 73

Table 32. Caspian Tern clutch size

	Clutch Size								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**n**	**Mean**	**SE**
1986	16	42	7	-	-	-	65	1.86	0.07
1990	14	54	17	-	-	-	85	2.04	0.07
1991	2	13	2	-	-	-	16	2.00	0.13
1992	25	50	5	-	-	-	79	1.73	0.06
1993	16	45	12	-	-	-	63	1.97	0.08
1994	7	53	30	-	-	-	89	2.27	0.06
1995	5	51	34	-	-	-	89	2.33	0.06
2000	8	5	0	-	-	-	13	1.38	0.14
2001	22	92	24	-	-	-	137	2.01	0.05
2002	9	30	3	-	-	-	41	1.88	0.08
2010	10	34	16	-	-	-	60	2.10	0.08
Total (%)	134 (18)	469 (62)	150 (20)	0 (0)	0 (0)	0 (0)	753	2.02	0.02

Table 33. Caspian Tern colony species associations by zone, 1986-2010

	Caspian Tern	Herring Gull		Mew Gull		Ring-billed Gull		California Gull		Common Tern		Arctic Tern		Tern spp.[1]		All Larids	
Zone	**# Colonies**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Stagg River	12	0.0	0	16.7	2	33.3	4	0.0	0	91.7	11	8.3	1	100.0	12	100.0	12
Old Fort Rae	19	10.5	2	15.8	3	42.1	8	0.0	0	89.5	17	15.8	3	89.5	17	100.0	19
Trout Rock	34	44.1	15	23.5	8	35.3	12	0.0	0	61.8	21	41.2	14	67.6	23	91.2	31
Enodah	13	69.2	9	23.1	3	7.7	1	30.8	4	30.8	4	30.8	4	38.5	5	100.0	13
Yellowknife Bay	2	100.0	2	0.0	0	0.0	0	100.0	2	0.0	0	0.0	0	0.0	0	100	2
West Mirage Islands	24	58.3	14	12.5	3	0.0	0	8.3	2	41.7	10	45.8	11	58.3	14	91.7	22
Southwest Shoreline	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	104	40.4	42	18.3	19	24.0	25	7.7	8	60.6	63	31.7	33	68.3	71	95.2	99

[1] Common Tern and/or Arctic Tern.

Table 34. Composition of vegetation cover (%) at Caspian Tern colony sites on the North Arm, 1990-1995

		Total Cover		Grass/Sedge		Forb		Low Shrub		High Shrub		Tree	
Zone	**n**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stagg River	6	14.2	0.8	5.3	0.8	2.9	0.3	4.3	1.1	1.3	1.3	0.5	0.5
Old Fort Rae	13	6.5	1.2	2.3	0.3	1.6	0.2	1.0	0.3	1.3	0.3	0.5	0.3
Trout Rock	20	6.3	0.5	2.8	0.2	1.3	0.1	1.8	0.4	0.2	0.1	0.2	0.1
Enodah	8	10.6	2.2	4.5	0.8	1.7	0.2	2.7	0.9	1.4	0.6	0.4	0.2
Yellowknife Bay	0	-	-	-	-	-	-	-	-	-	-	-	-
West Mirage Islands	13	17.5	5.0	5.3	1.0	1.7	0.5	4.3	0.9	2.0	0.8	4.2	2.1
Total	60	10.1	1.3	3.7	0.3	1.6	0.1	2.5	0.3	1.1	0.2	1.2	0.5

Table 35. Proportion of the Canadian breeding populations of larid species nesting on sections of Great Slave Lake

		Herring Gull	Mew Gull	Ring-billed Gull	California Gull	Common Tern	Arctic Tern	Caspian Tern
Canadian Population Estimate[1,2]	Low	172 200	48 000	850 000	124 200	164 000	>100 000	19 800
	High	n/a	120 000	1 190 000	207 000	179 000	n/a	35 000
Great Slave Lake[3]	# Nests	1421	454	306	2508	929	464	236
	# Adults	2842	908	612	5016	1858	928	472
	% Low	1.65	1.89	0.07	4.04	1.13	0.93	2.38
	% High	-	0.76	0.05	2.42	1.04	-	1.35
North Arm Key Migratory Bird Habitat Site[4]	Avg. Nests	652	159	248	600	741	276	97
	Avg. Adults	1304	318	496	1200	1482	552	194
	% Low	0.76	0.66	0.06	0.97	0.90	0.55	0.98
	% High	-	0.27	0.04	0.58	0.83	-	0.55
North Arm Study Area	Avg. Nests	287	62	248	92	694	111	83
	Avg. Adults	574	128	496	184	1388	222	166
	% Low	0.33	0.27	0.06	0.15	0.85	0.22	0.84
	% High	-	0.11	0.04	0.09	0.78	-	0.47
Candidate Protected Area	Avg. Nests	31	30	0	0	533	83	62
	Avg. Adults	62	60	0	0	1066	166	124
	% Low	0.04	0.12	0.00	0.00	0.65	0.17	0.62
	% High	-	0.05	0.00	0.00	0.60	-	0.35

[1] National population estimates for Herring Gull, Mew Gull, Ring-billed Gull, California Gull, Arctic Tern and Caspian Tern from Milko et al. 2011.
[2] National population estimate for Common Tern from Morris et al. 2012.
[3] Great Slave Lake population estimates are the sum of averages from all zones in the North Arm Study Area (this study) plus values for other sections of Great Slave Lake as reported in Sirois et al. 1995.
[4] Key Migratory Bird Habitat Site estimates are the sum of averages from zones in the North Arm Study Area excluding the Southwest Shoreline (this study), plus values from sites east of Yellowknife and within the Key Habitat Site boundary as reported in Sirois et al. 1995.

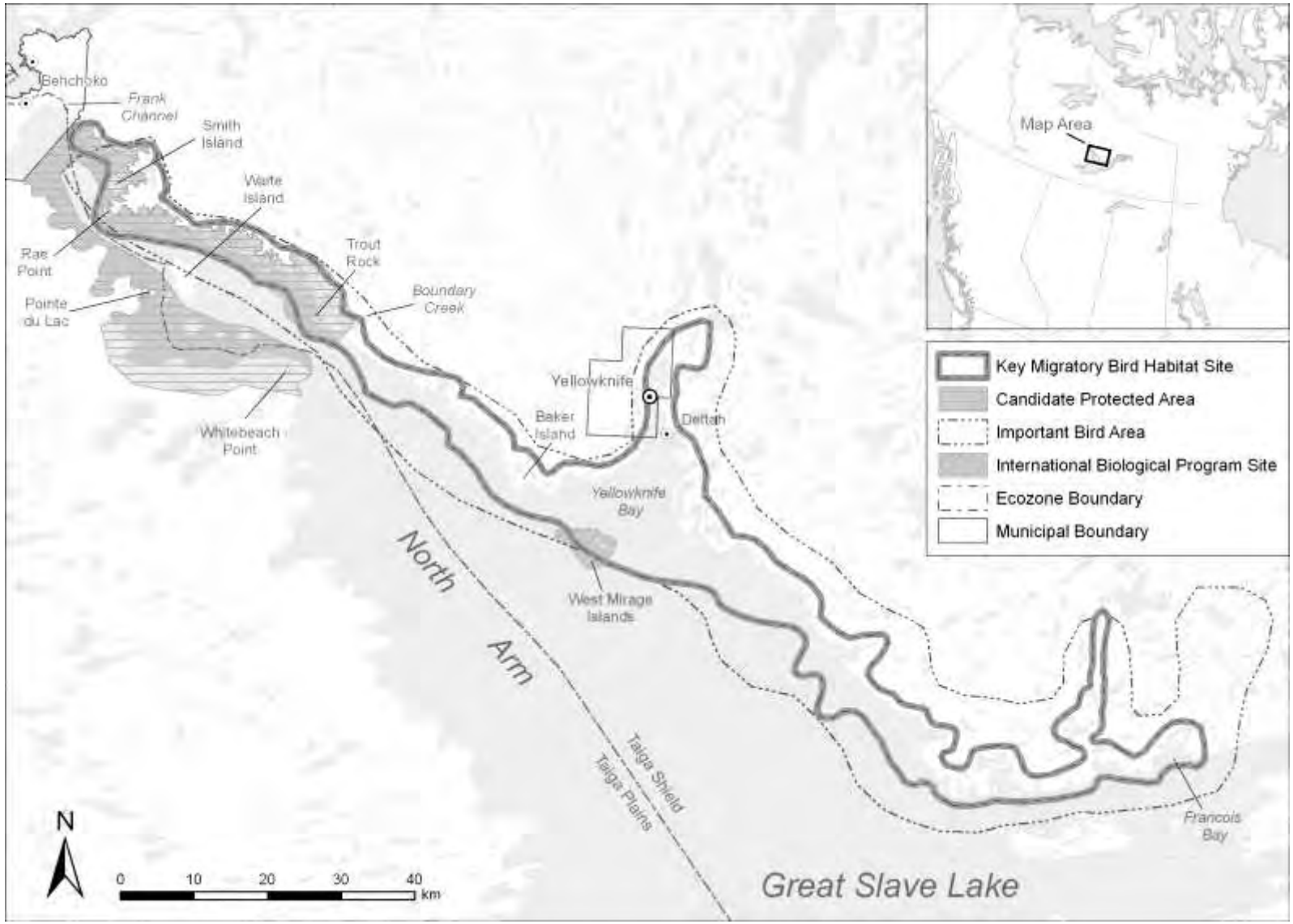

Figure 1. Location of the Candidate Protected Area and other designated areas on the North Arm of Great Slave Lake, Northwest Territories

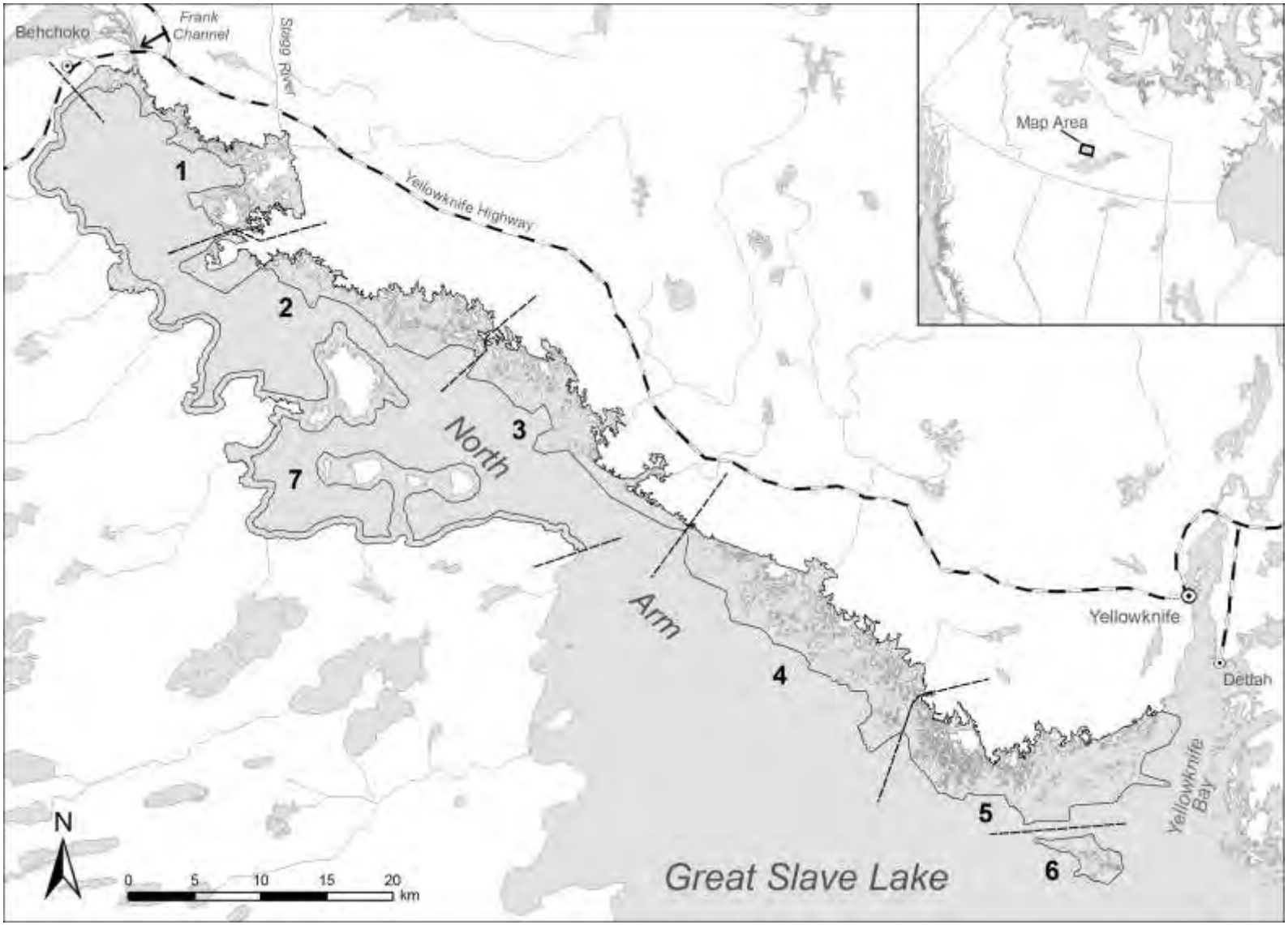

Figure 2. The study area separated into seven survey zones: 1) Stagg River, 2) Old Fort Rae, 3) Trout Rock, 4) Enodah, 5) Yellowknife Bay, 6) West Mirage Islands, and 7) Southwest Shoreline

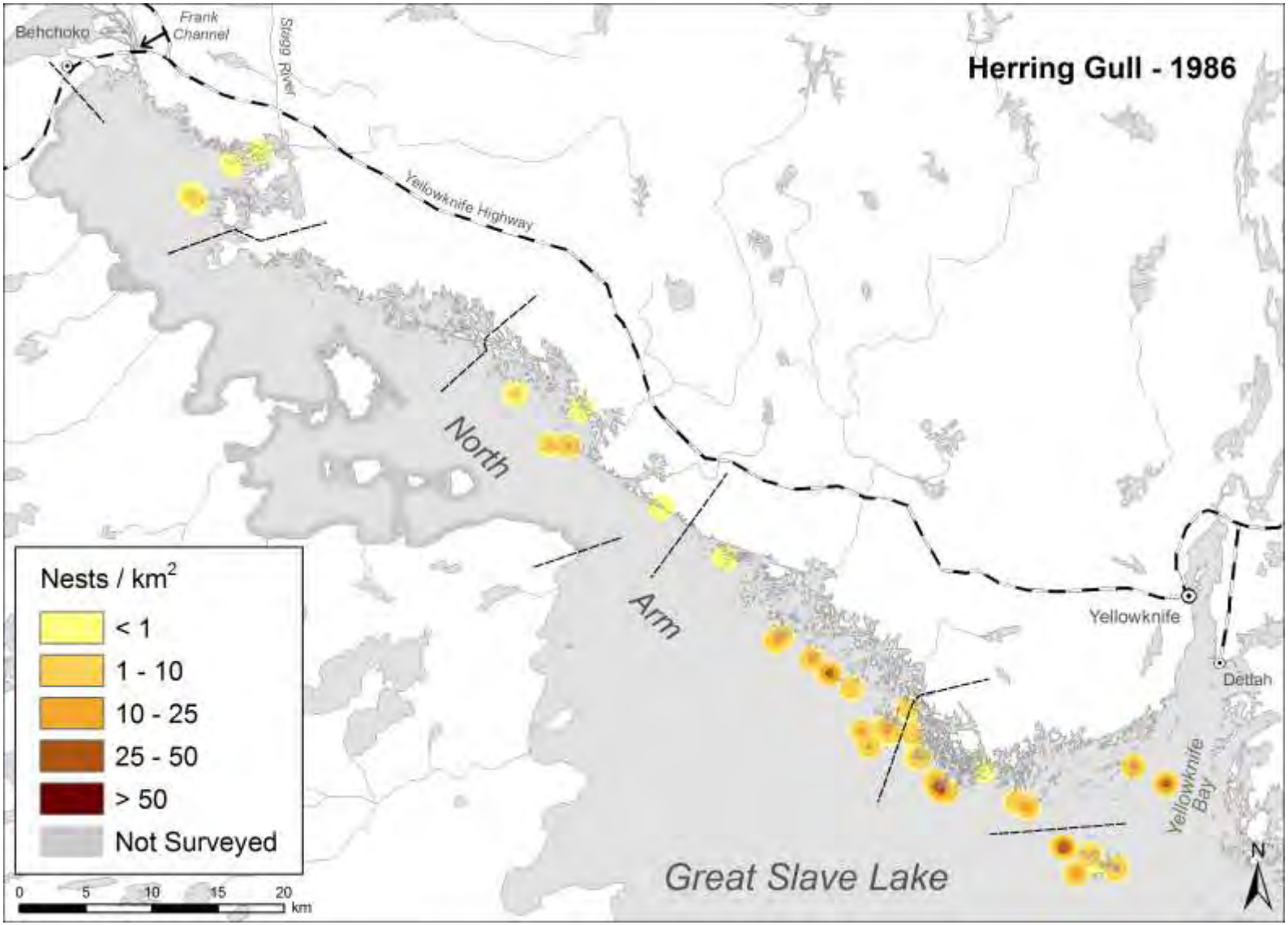

Figure 3. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1986

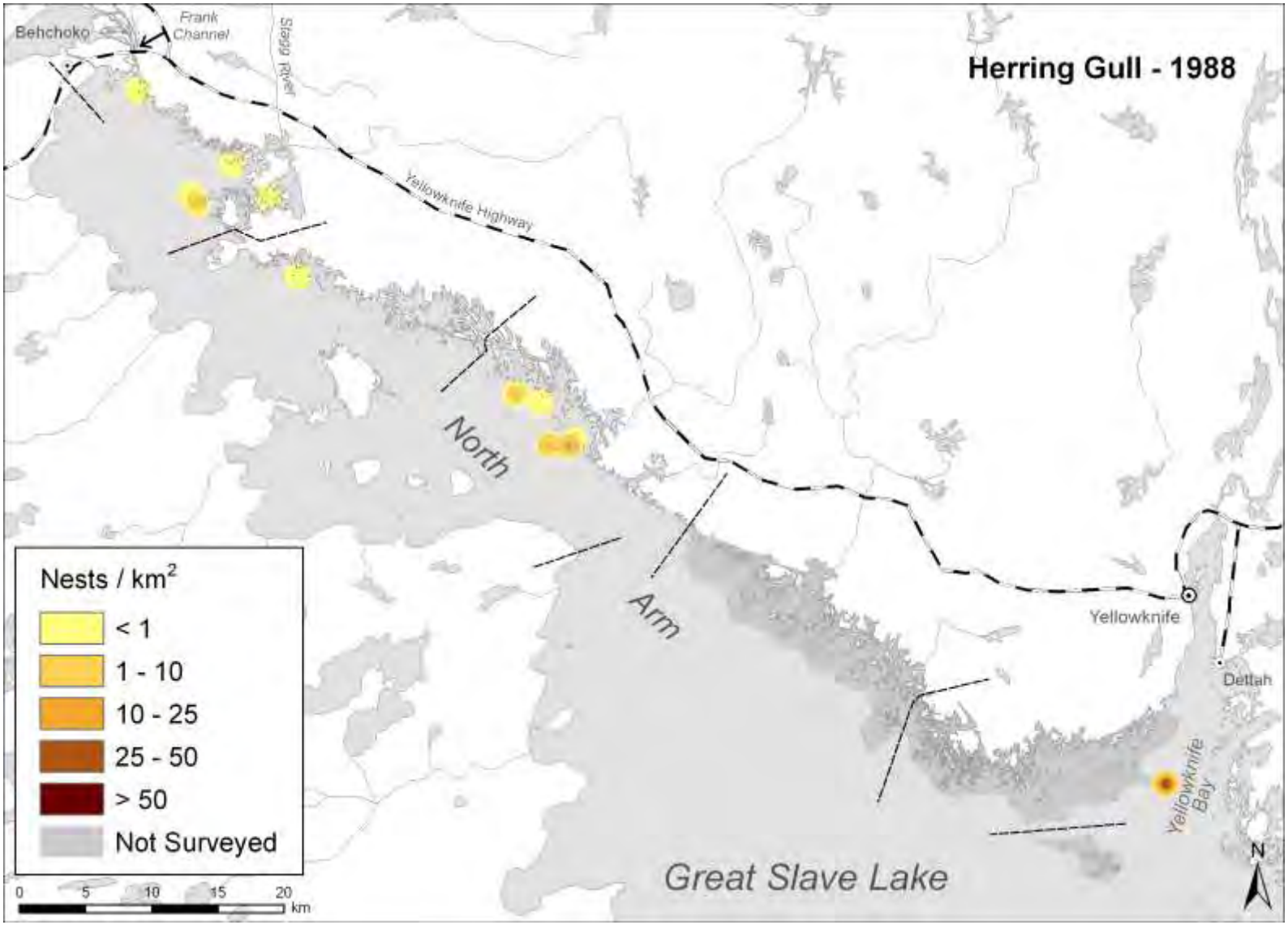

Figure 4. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1988

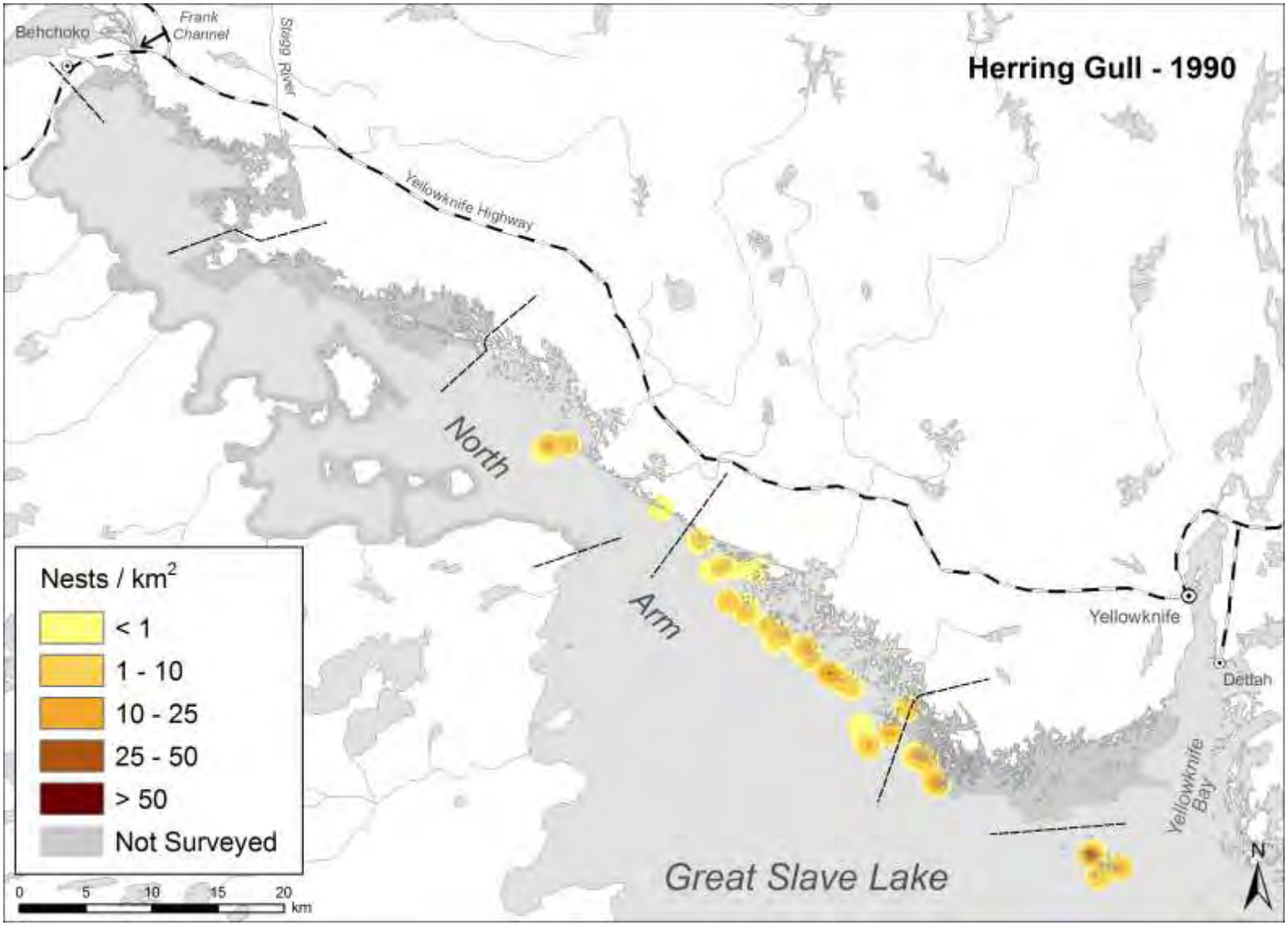

Figure 5. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1990

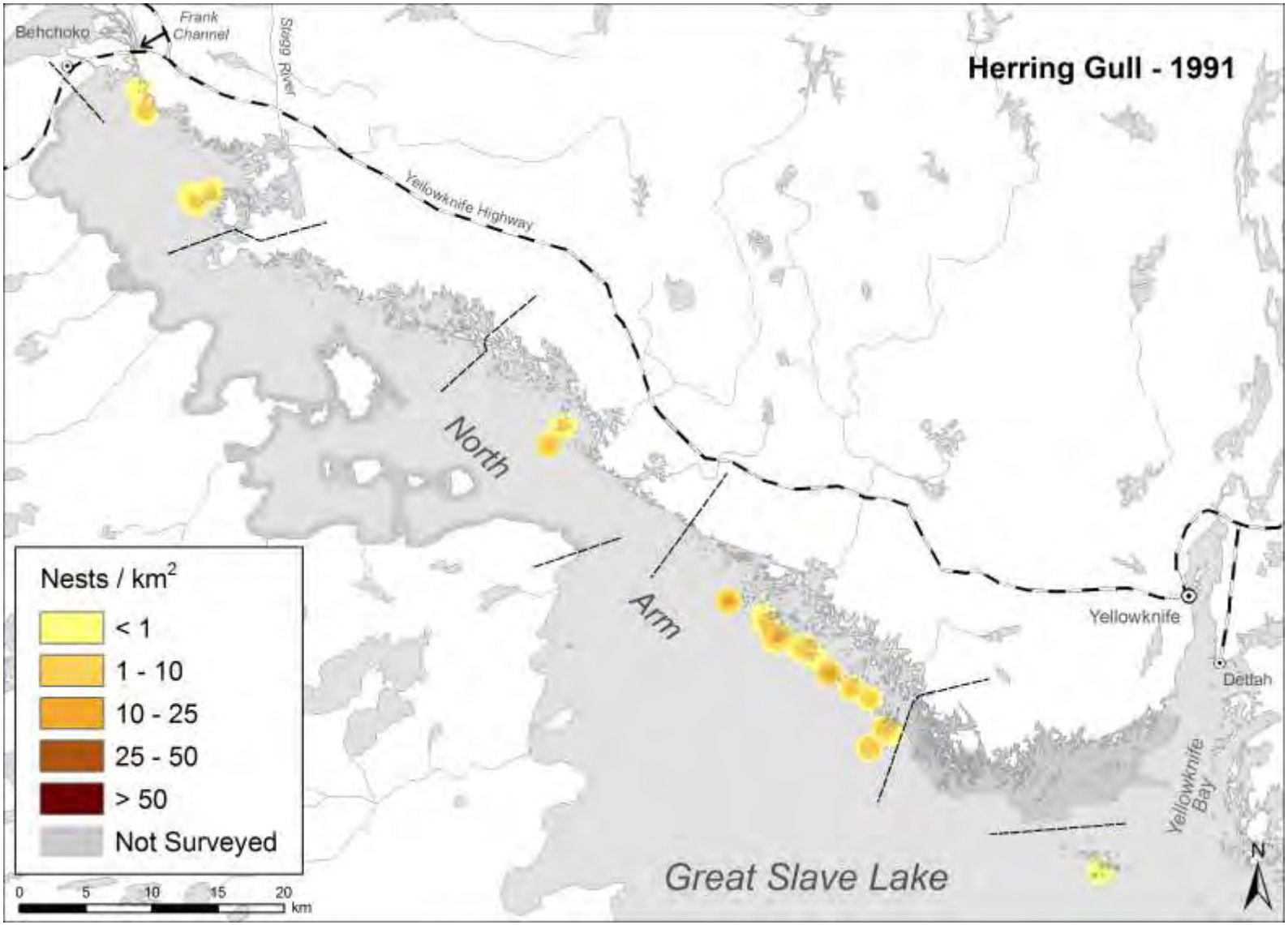

Figure 6. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1991

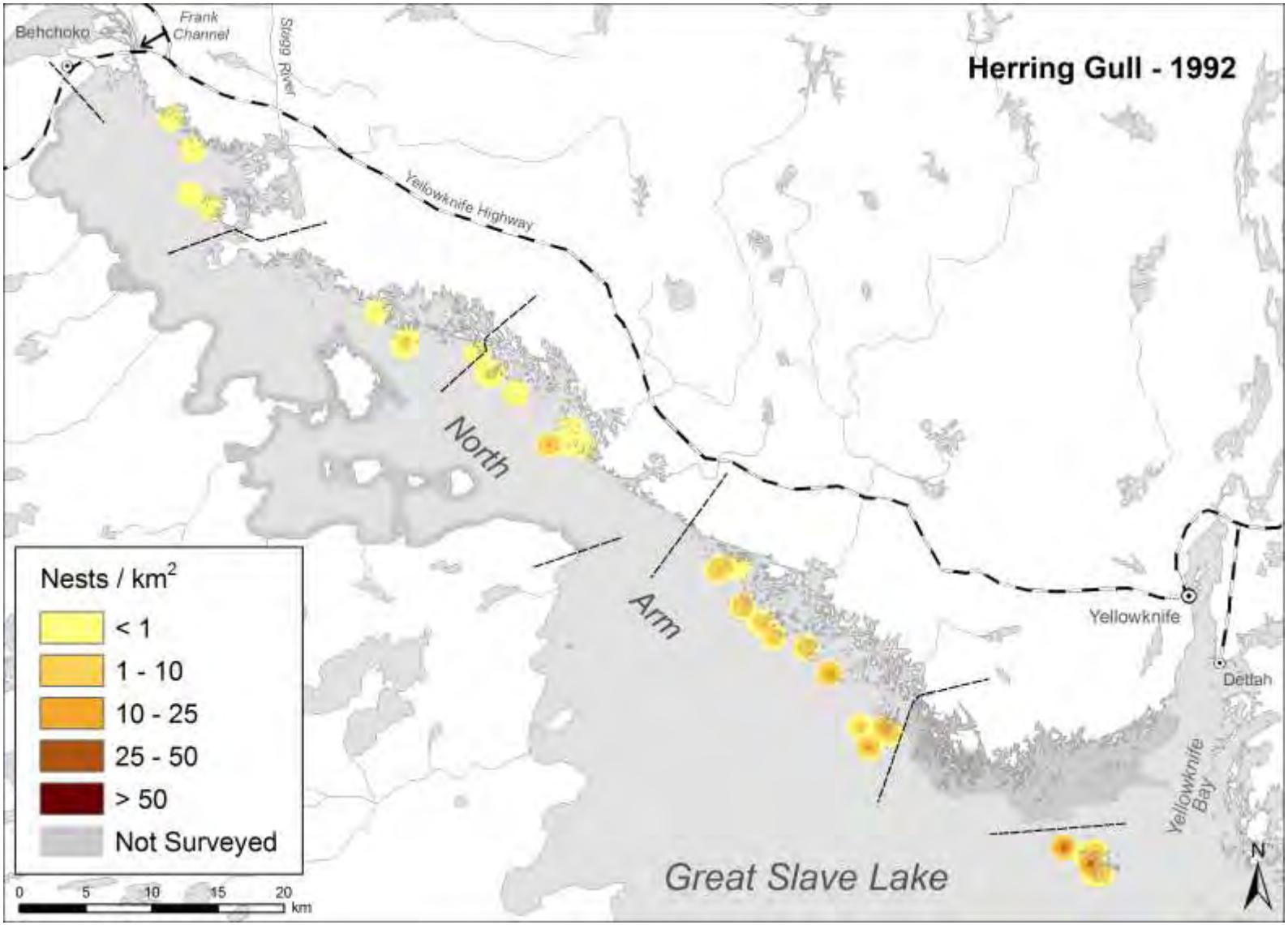

Figure 7. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1992

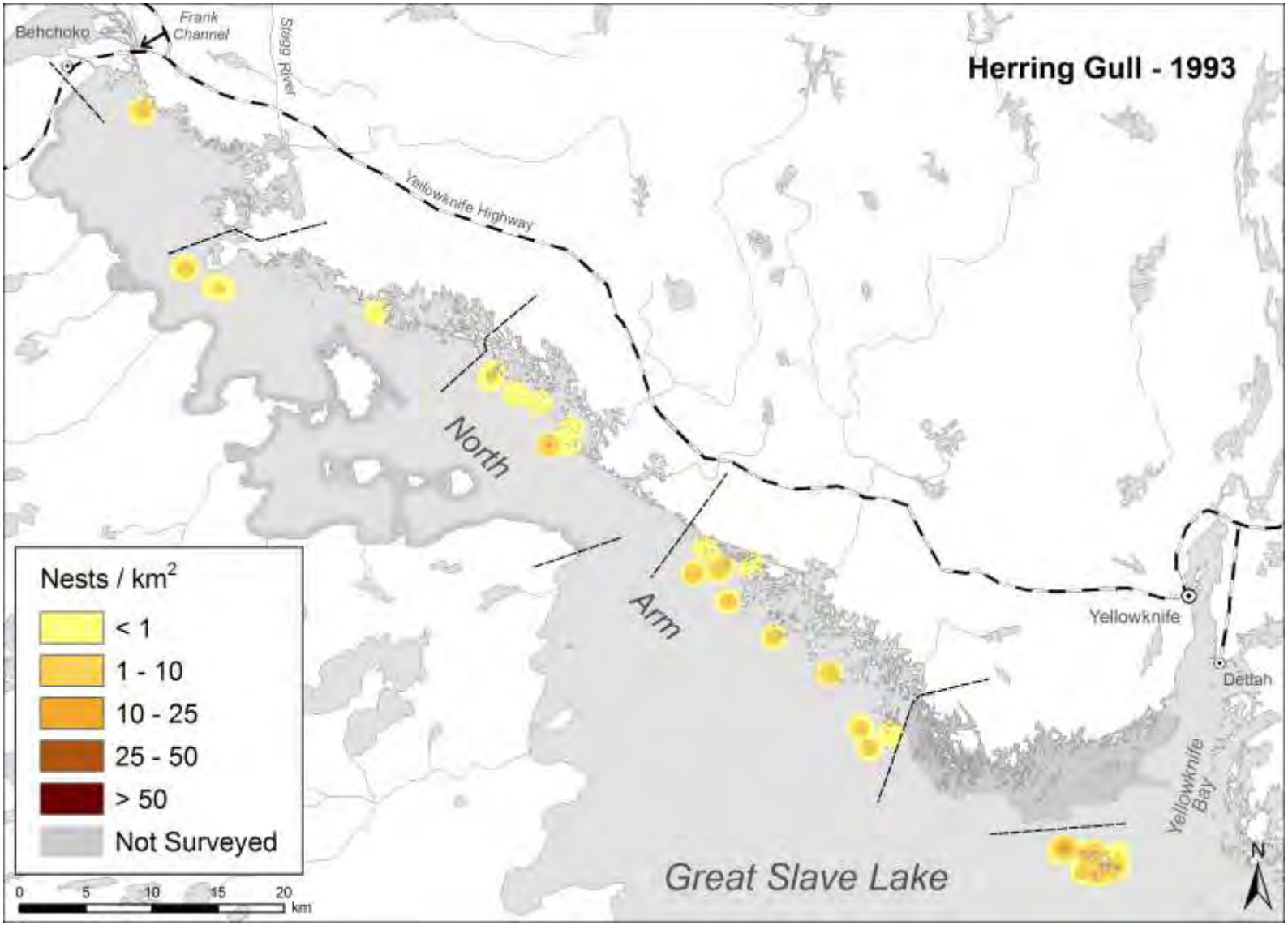

Figure 8. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1993

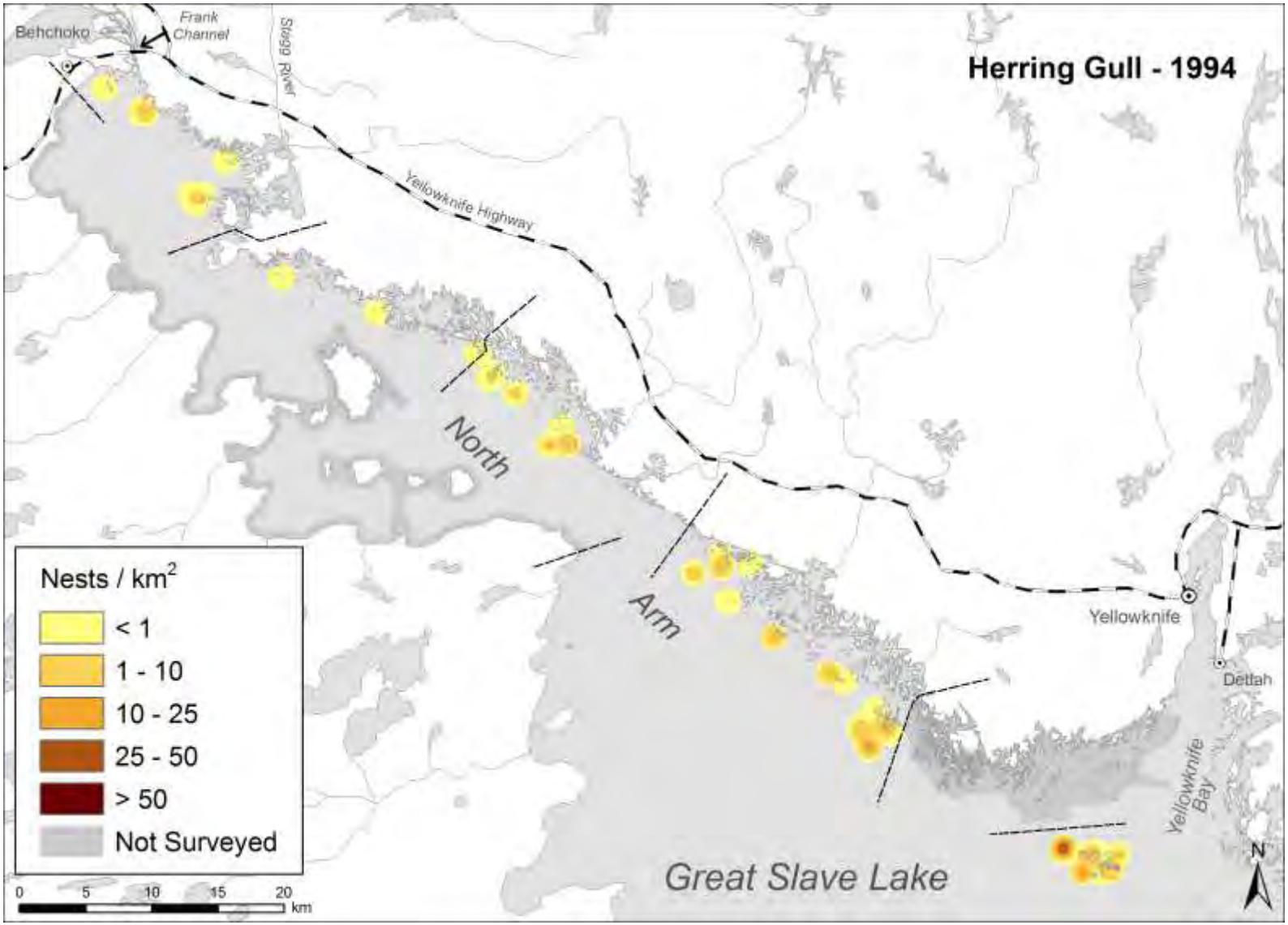

Figure 9. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1994

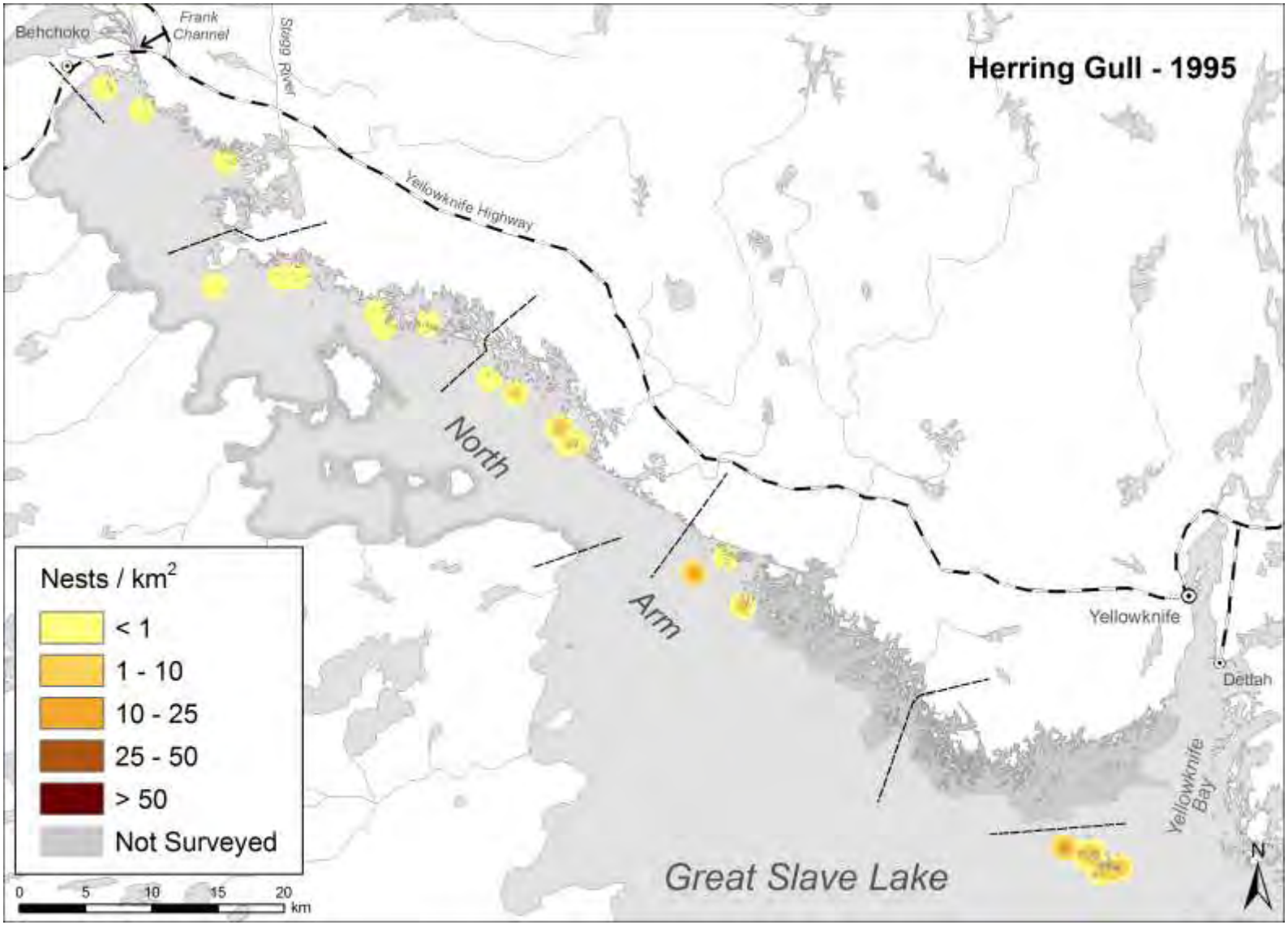

Figure 10. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 1995

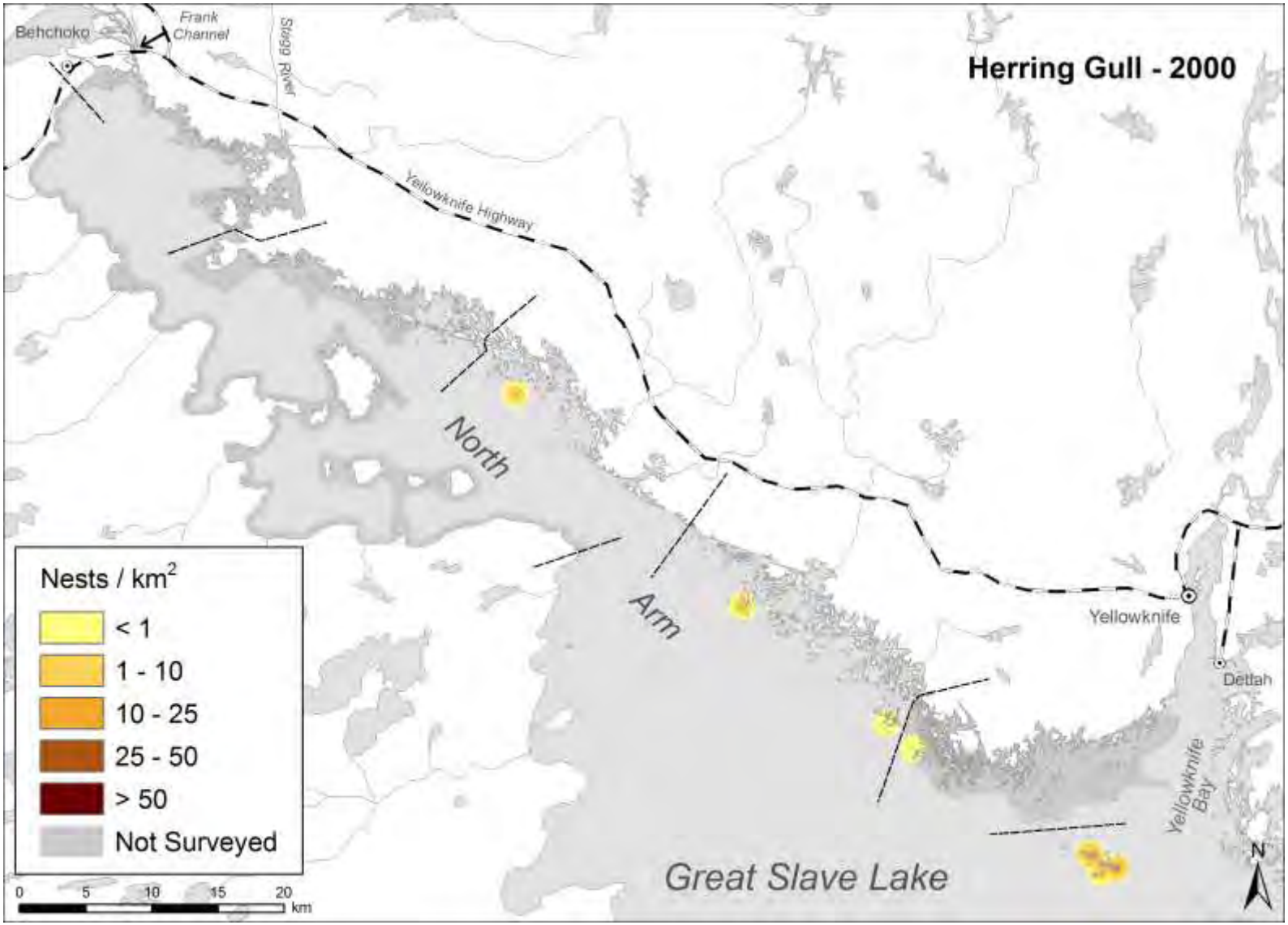

Figure 11. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 2000

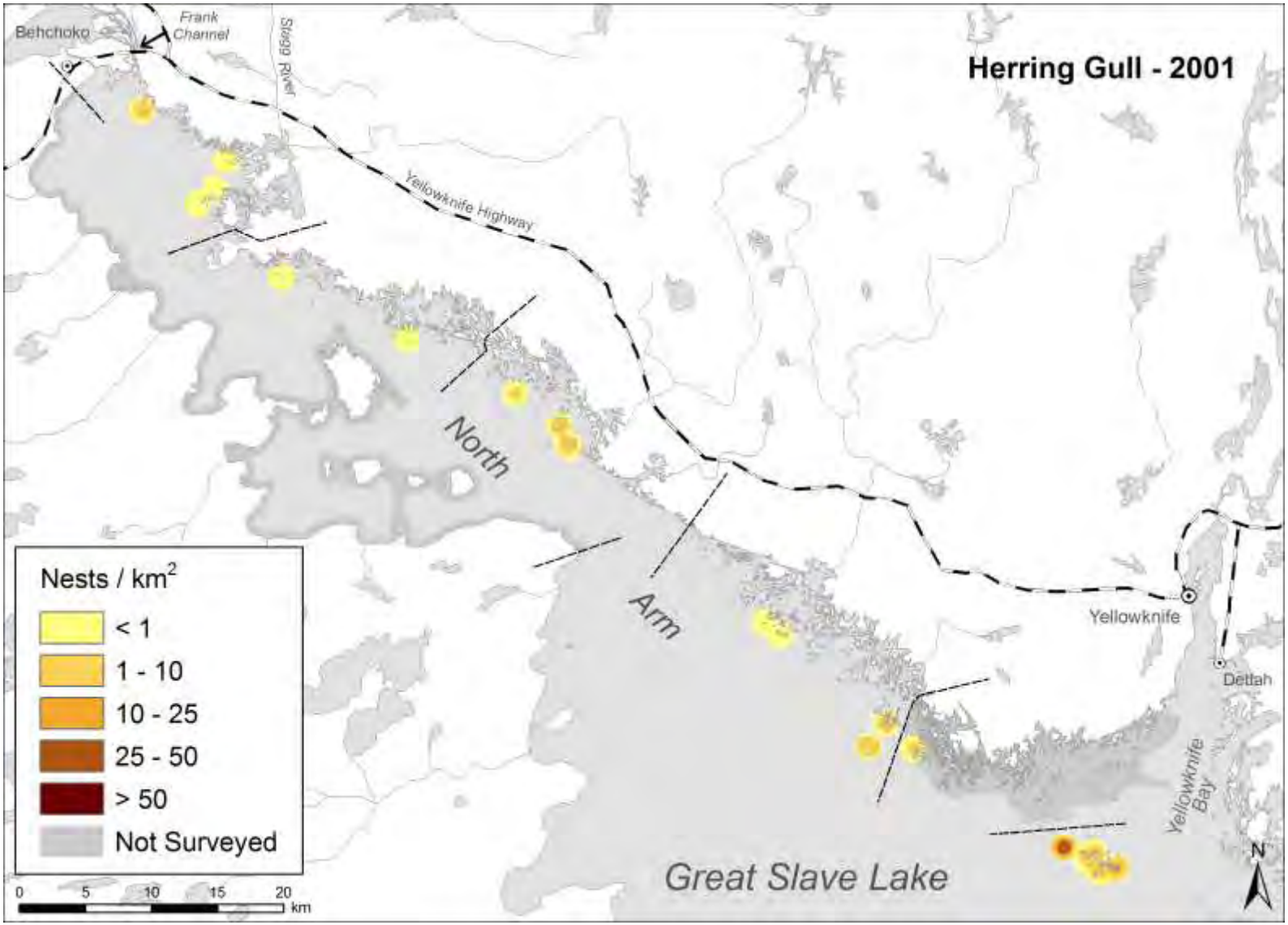

Figure 12. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 2001

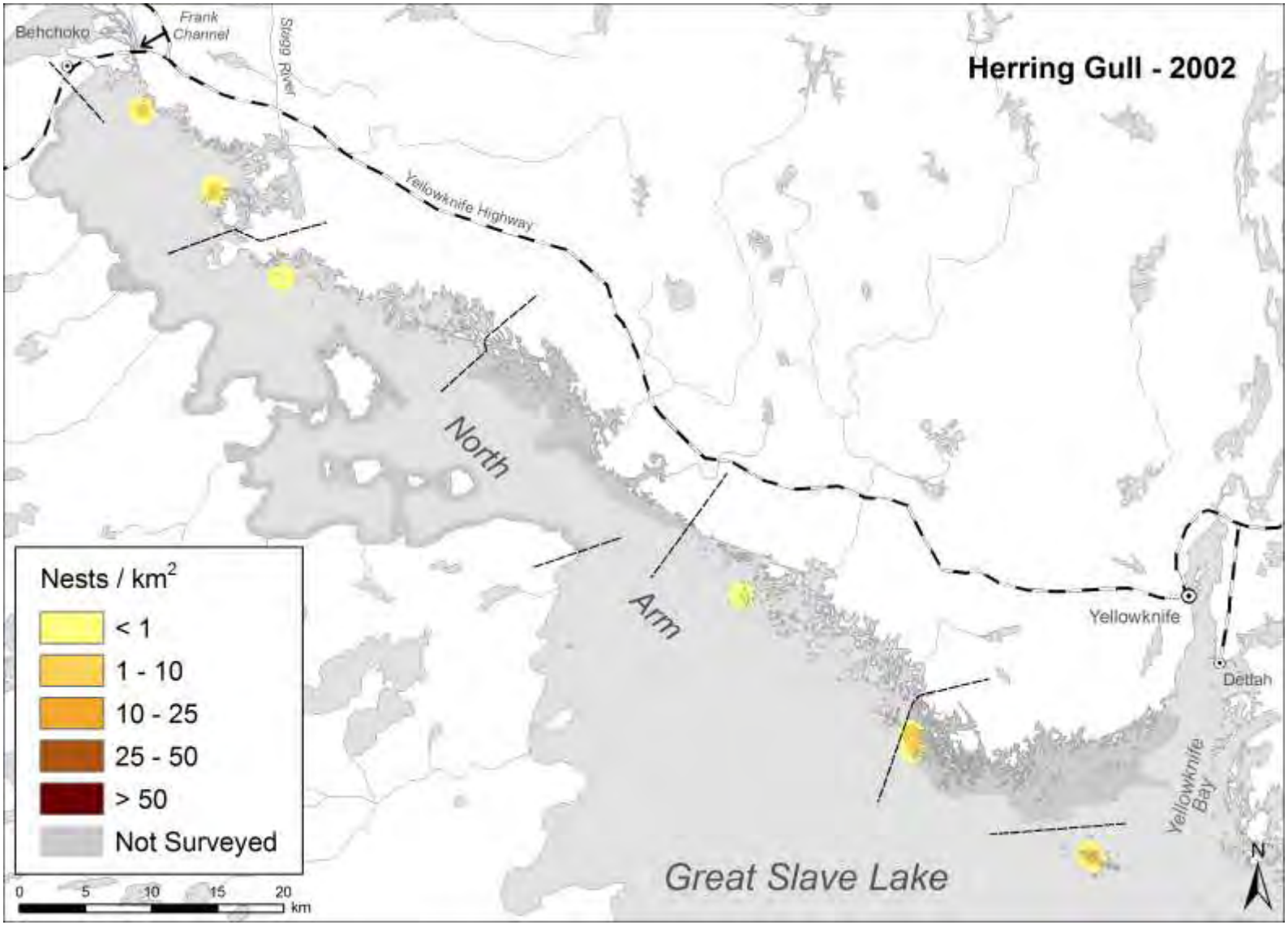

Figure 13. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 2002

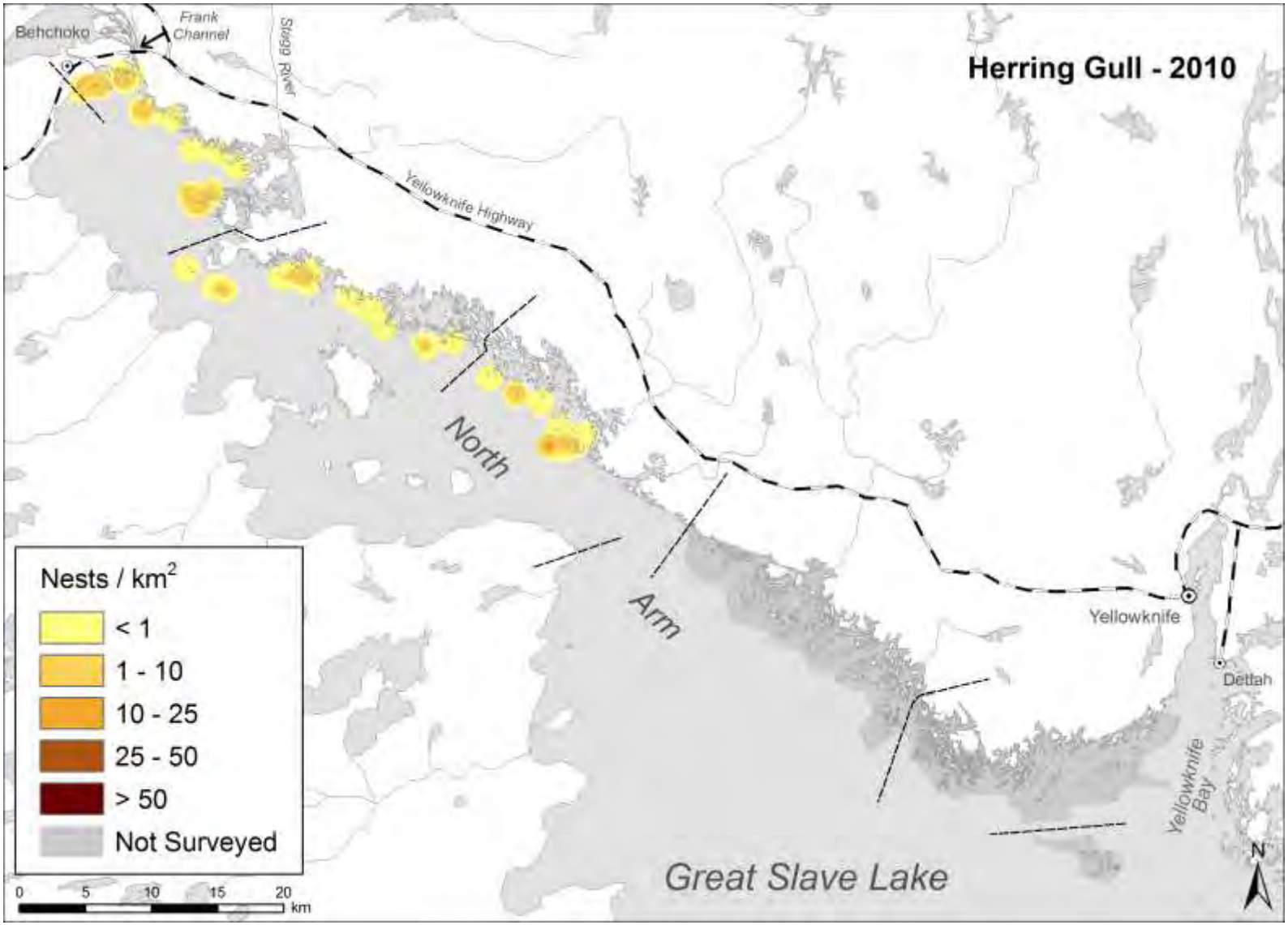

Figure 14. Distribution and density of Herring Gulls nesting on the North Arm of Great Slave Lake, 2010

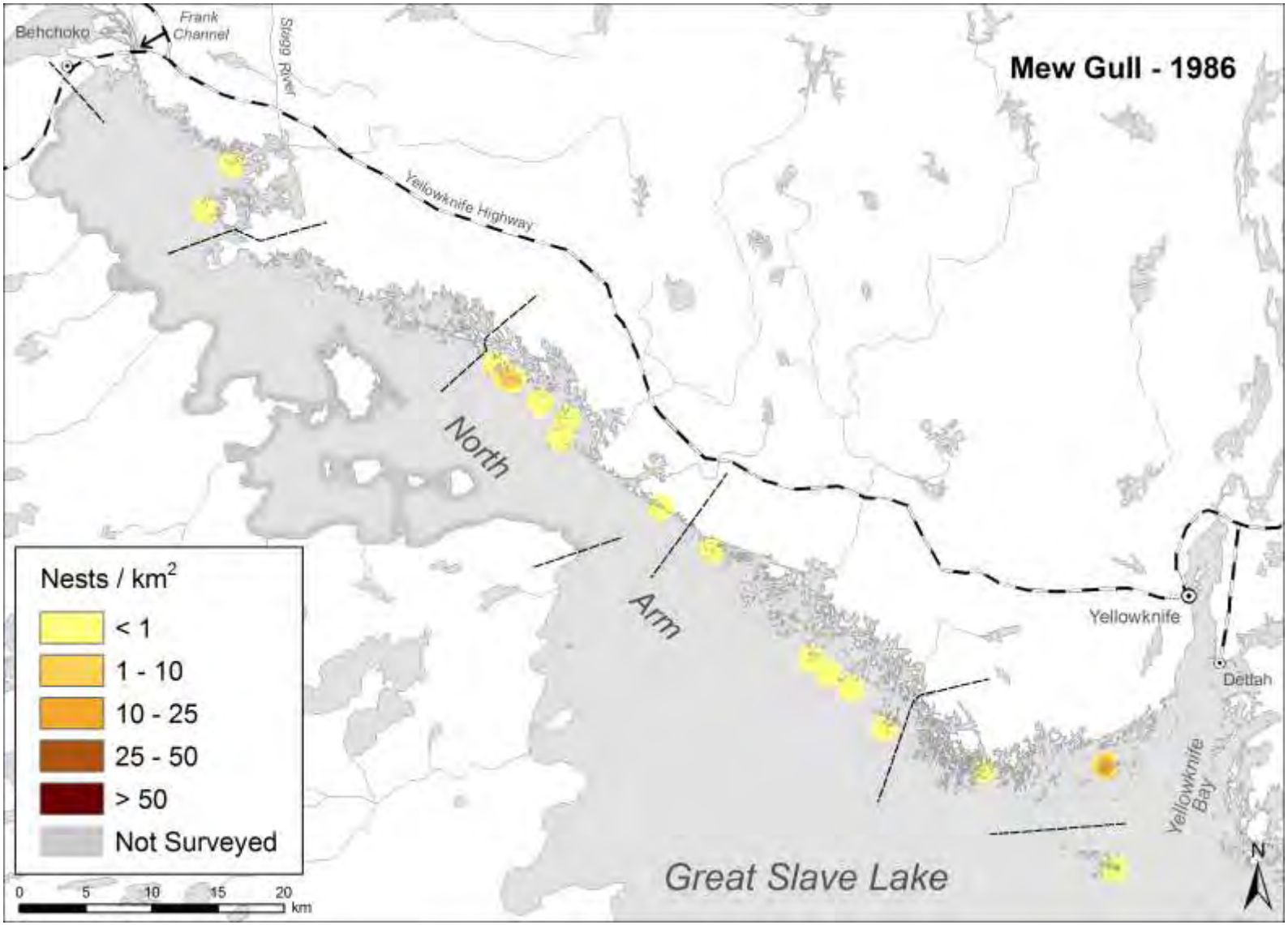

Figure 15. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1986

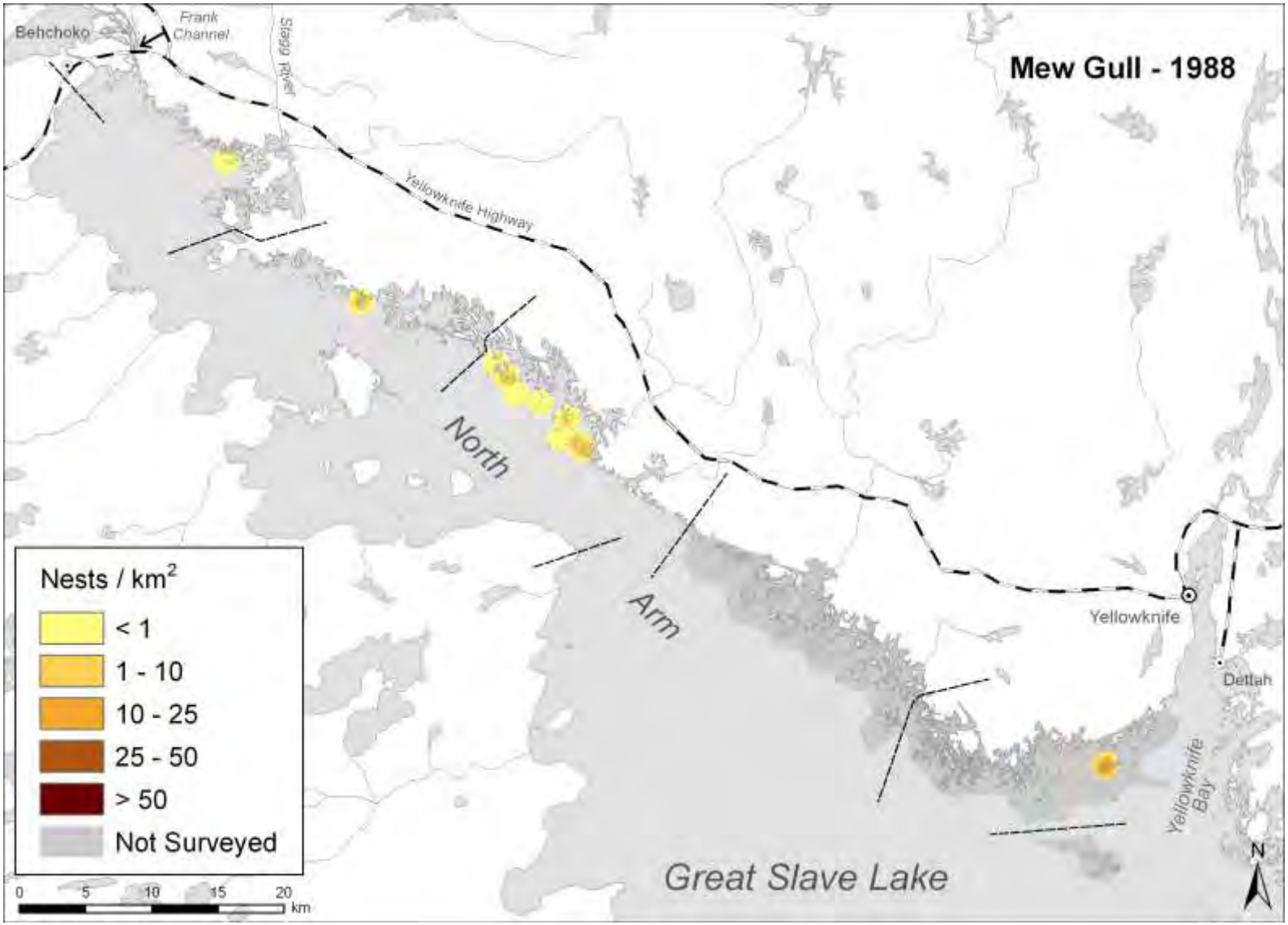

Figure 16. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1988

Figure 17. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1990

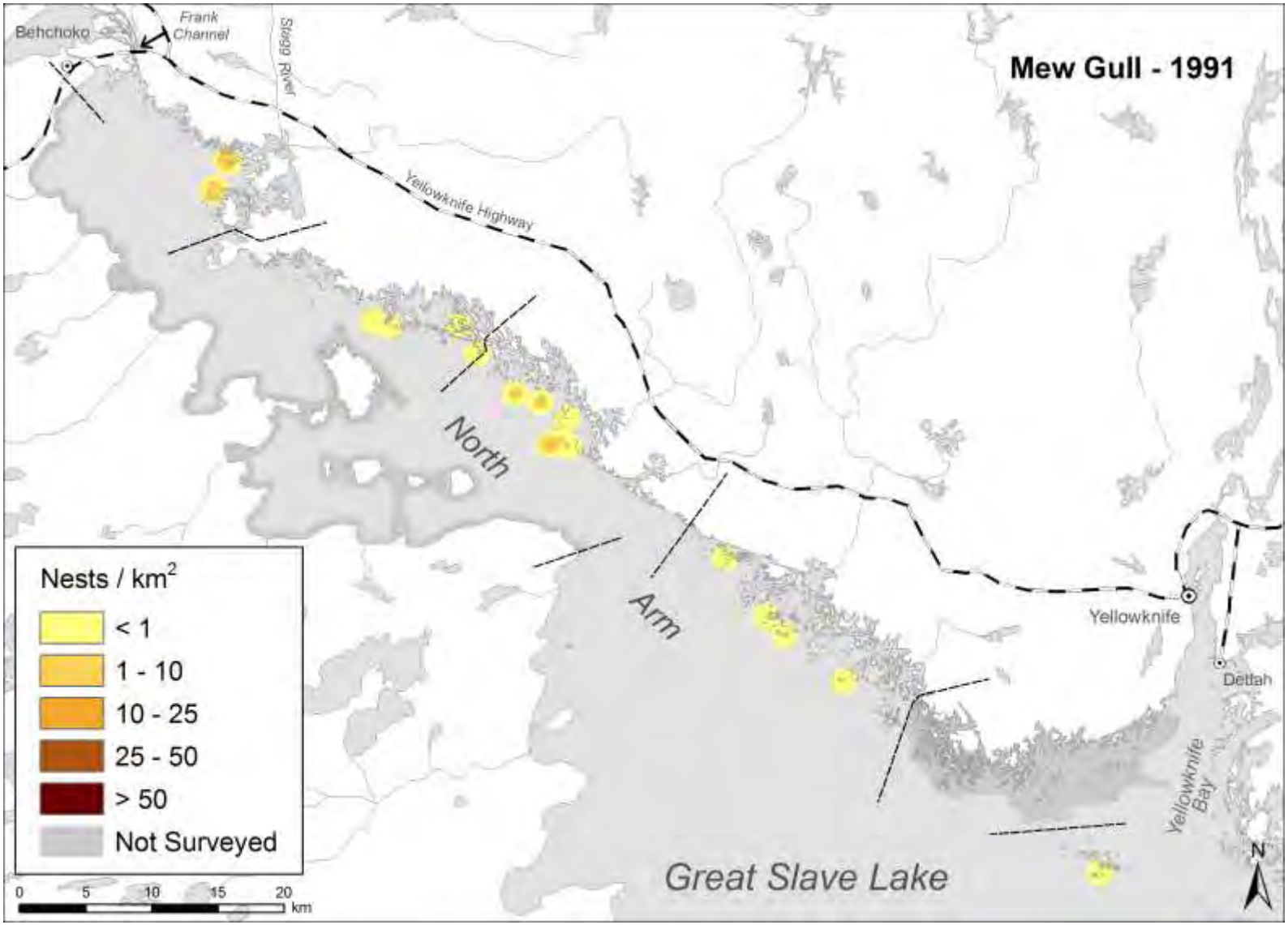

Figure 18. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1991

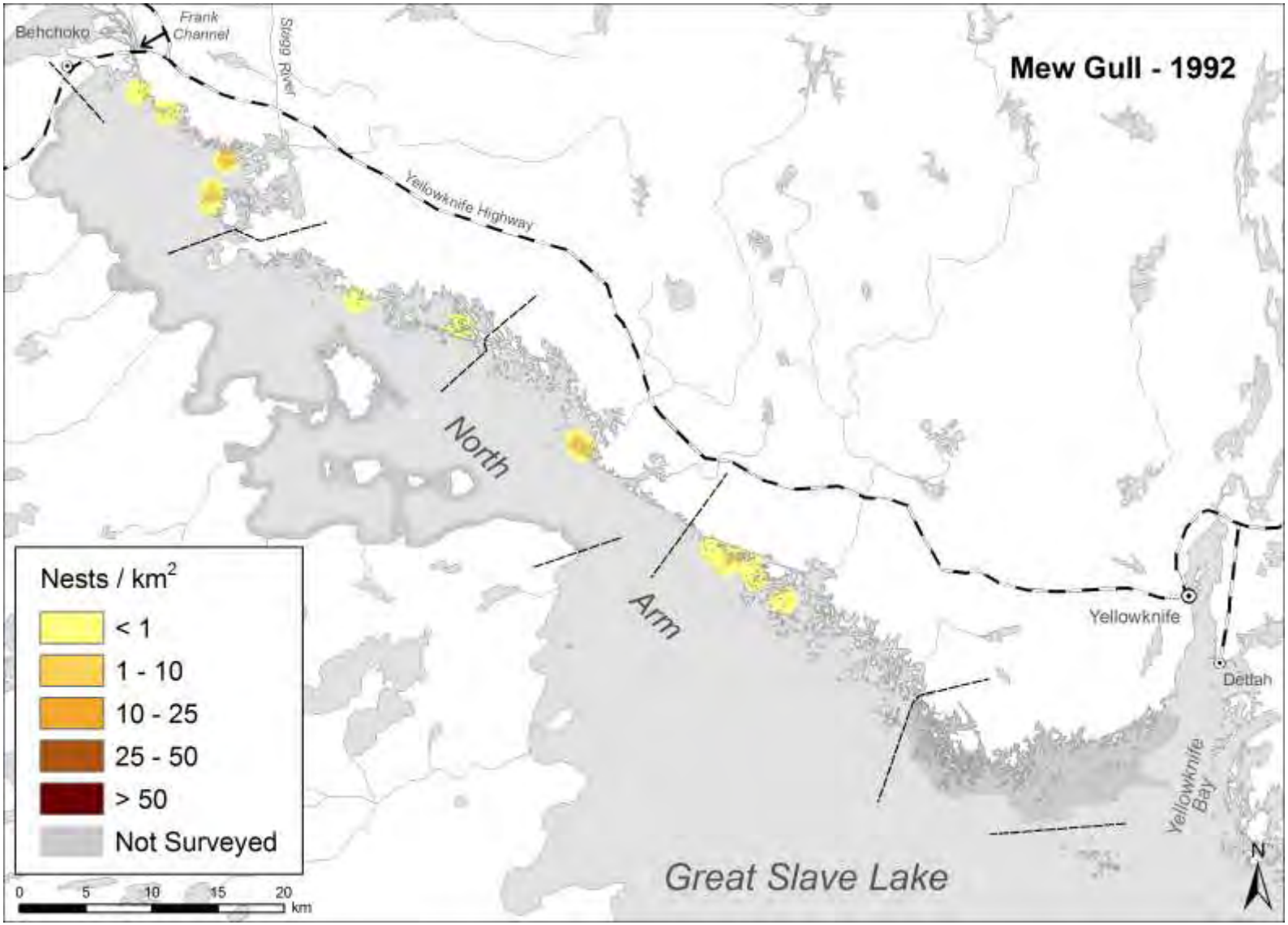

Figure 19. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1992

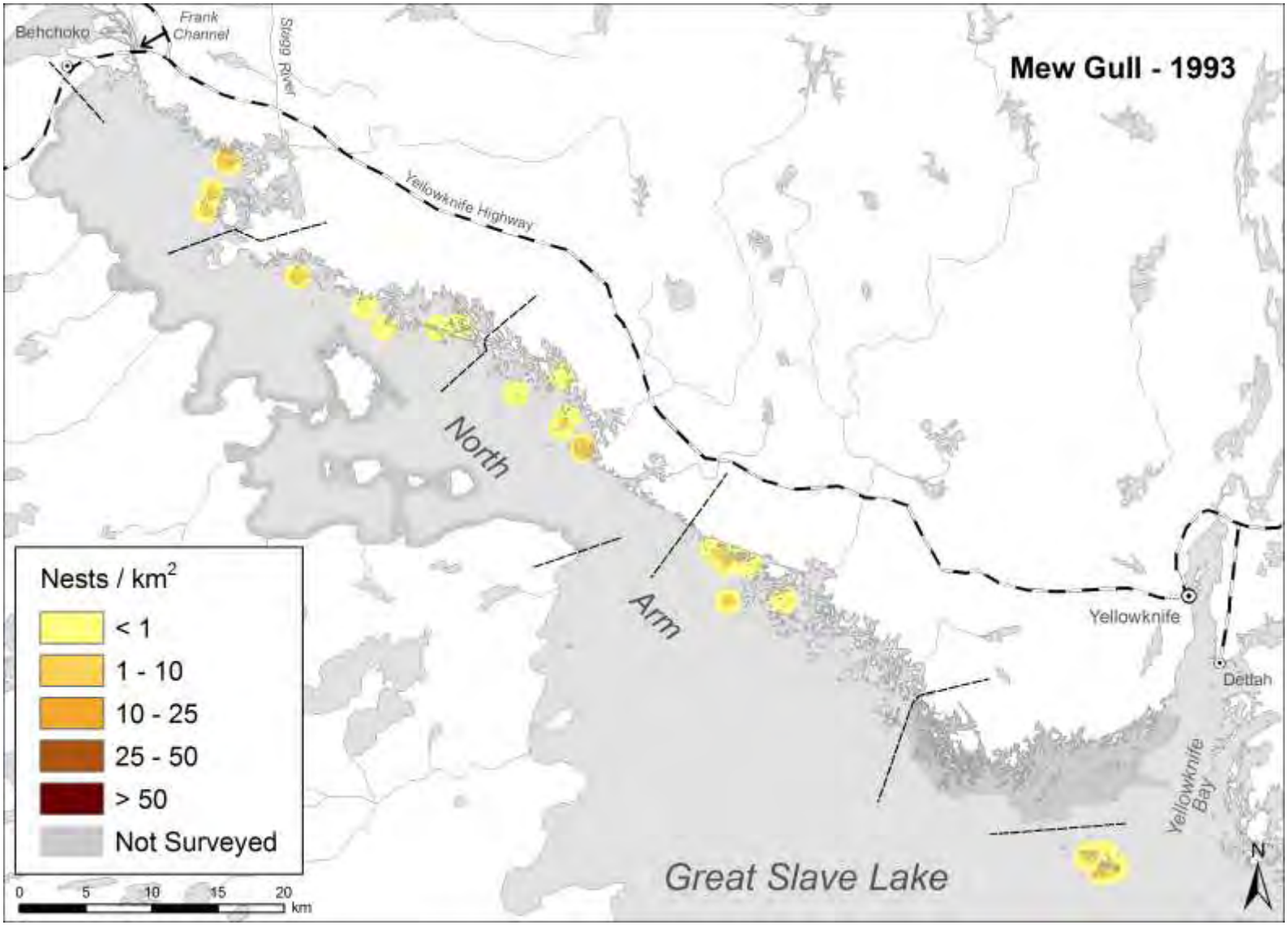

Figure 20. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1993

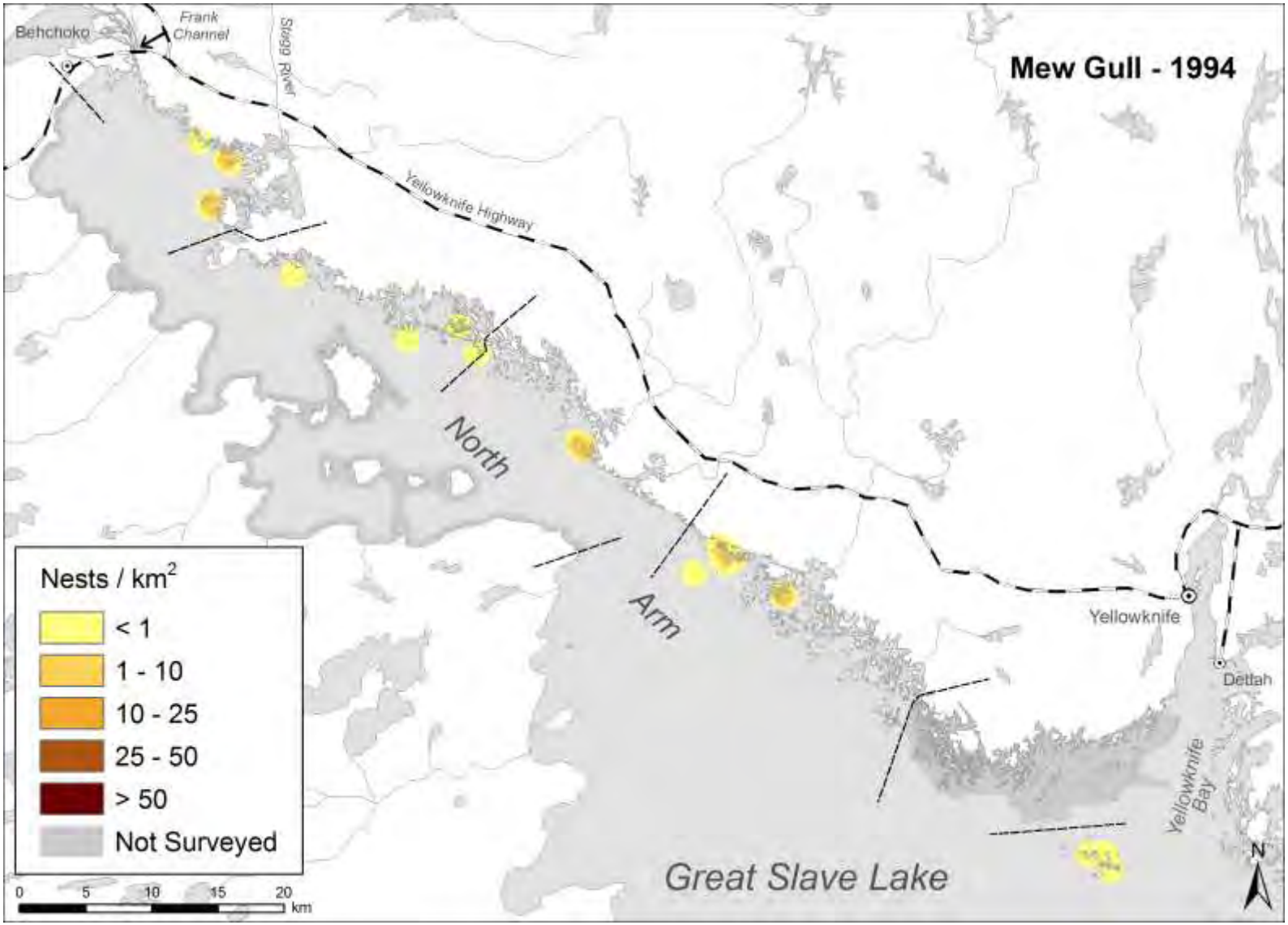

Figure 21. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1994

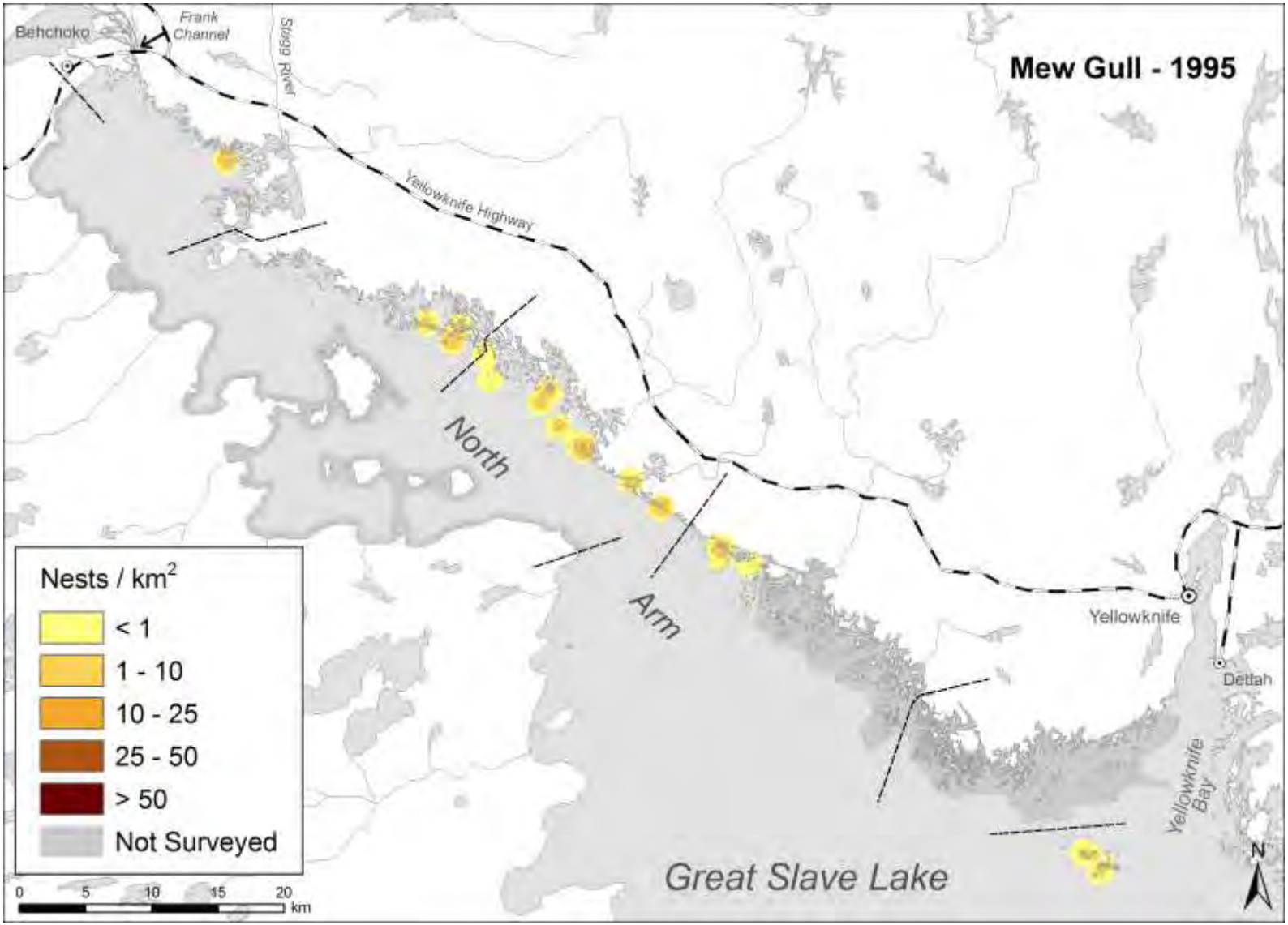

Figure 22. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 1995

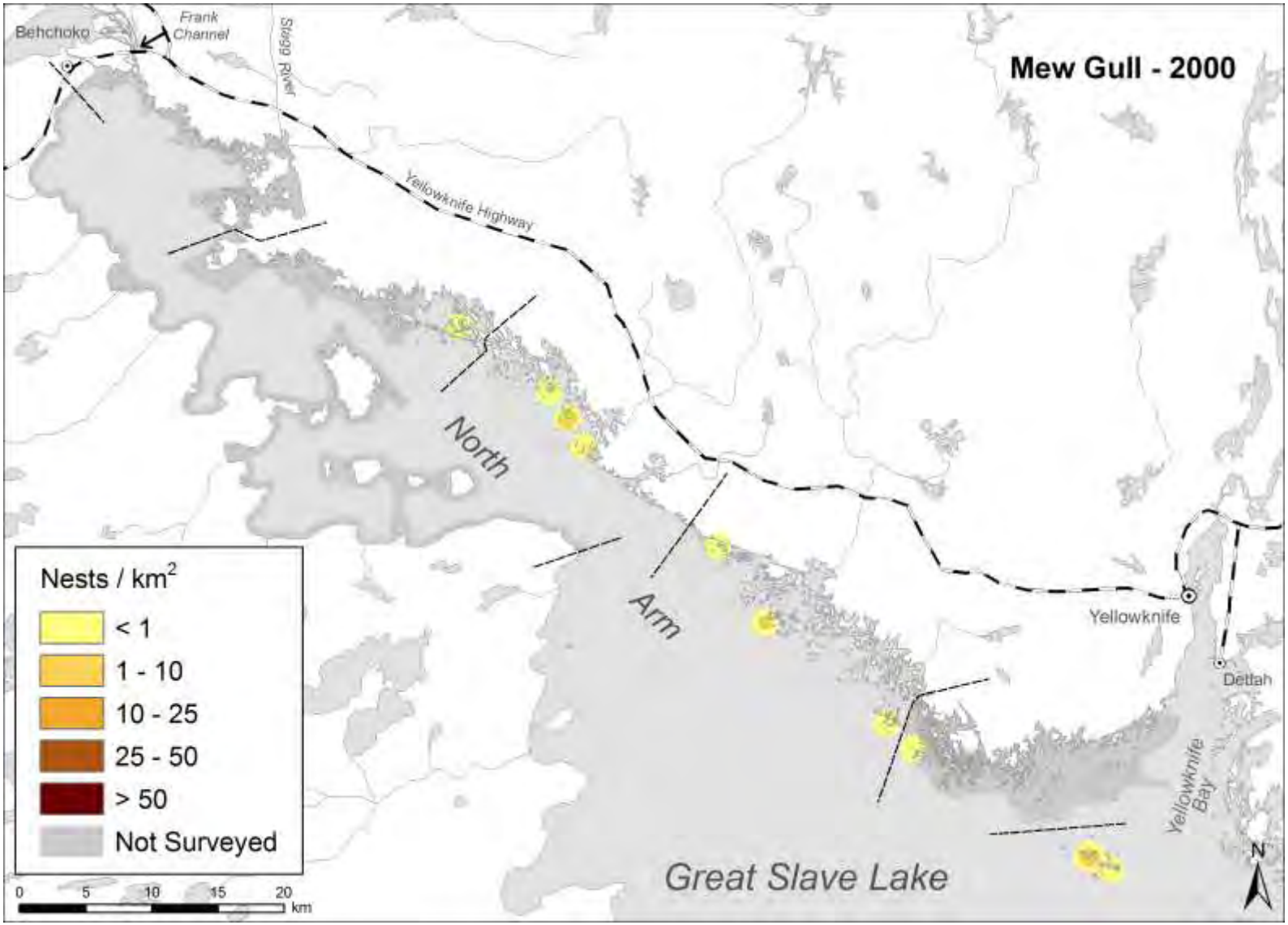

Figure 23. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 2000

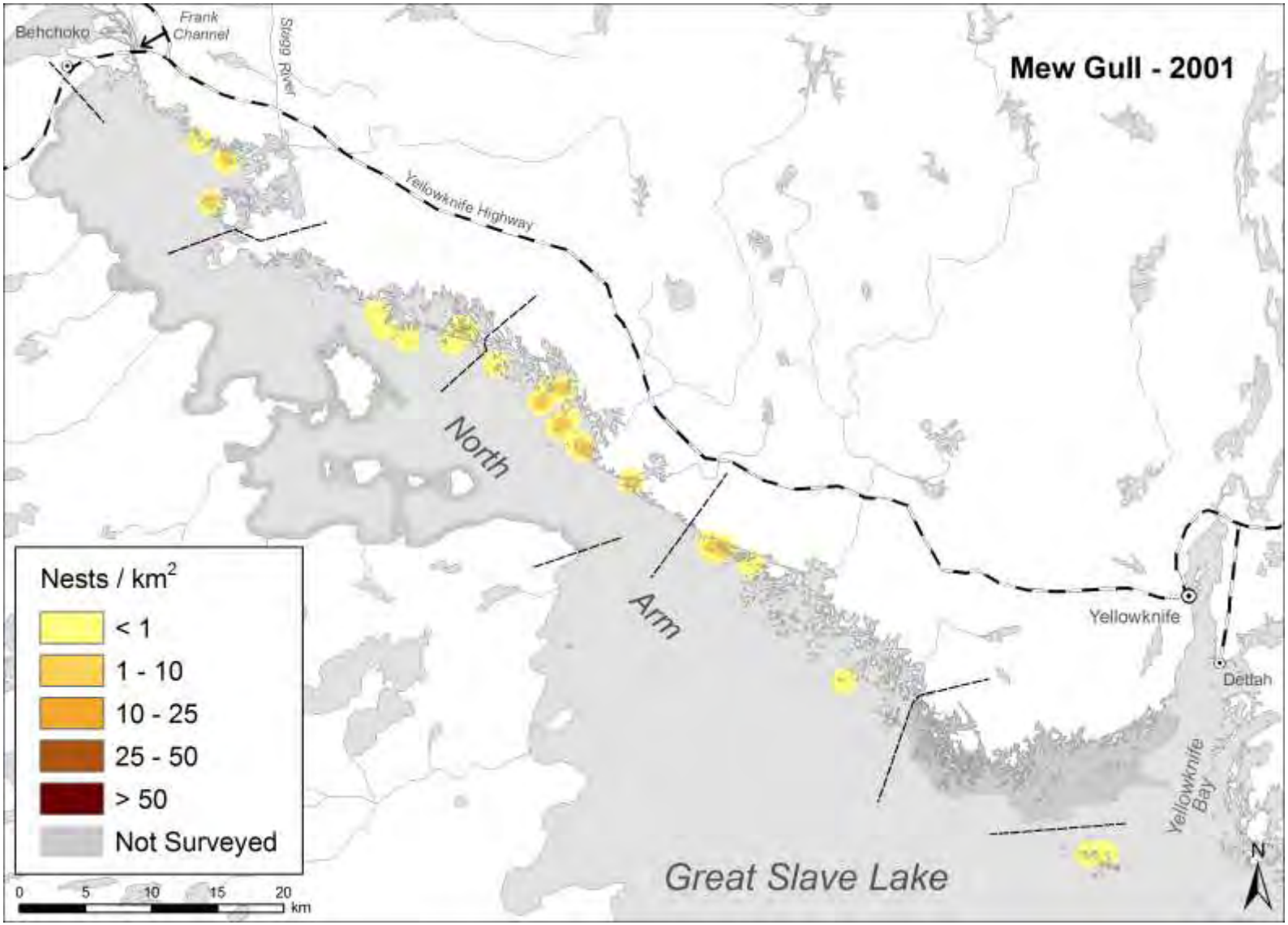

Figure 24. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 2001

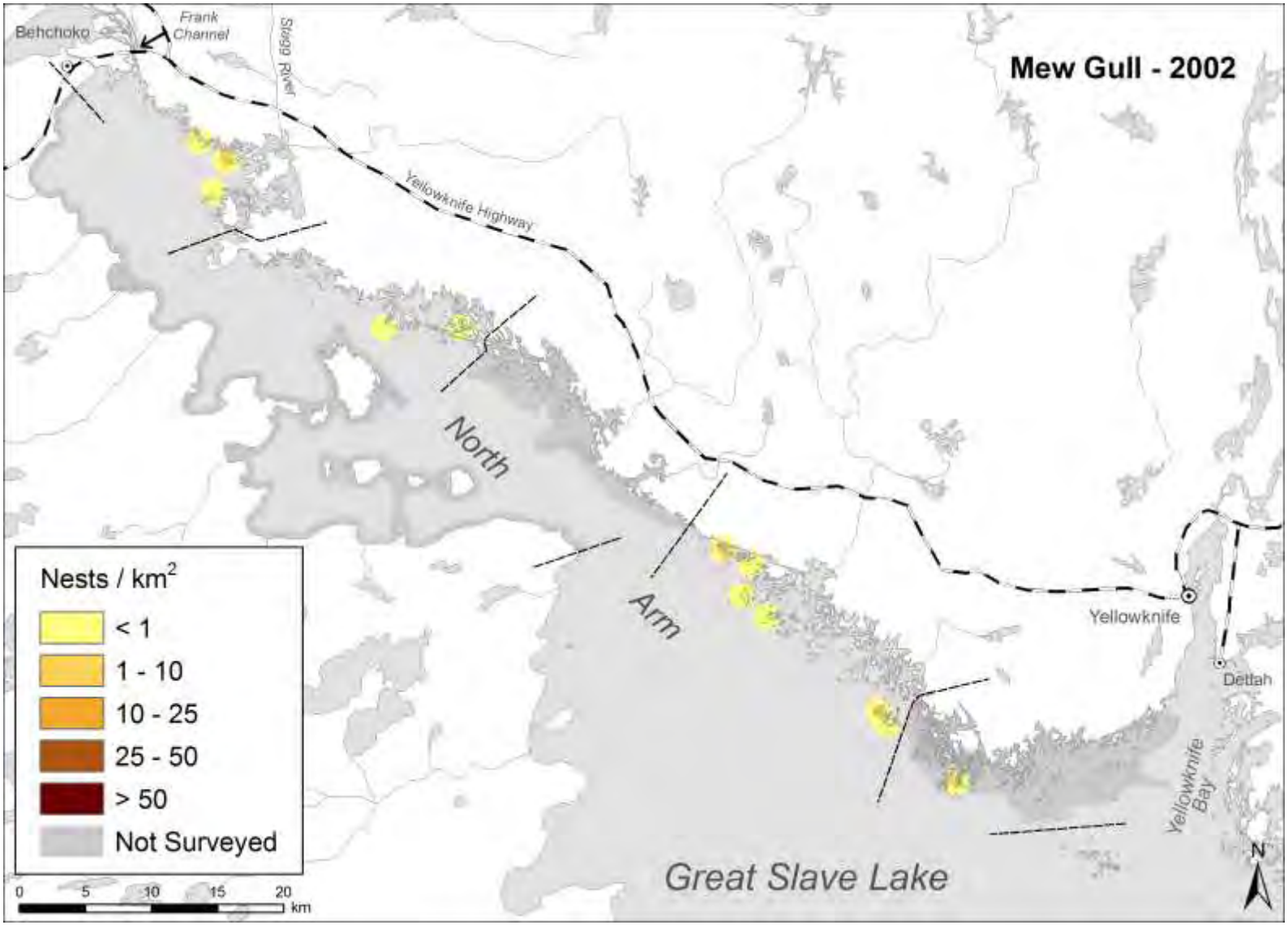

Figure 25. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 2002

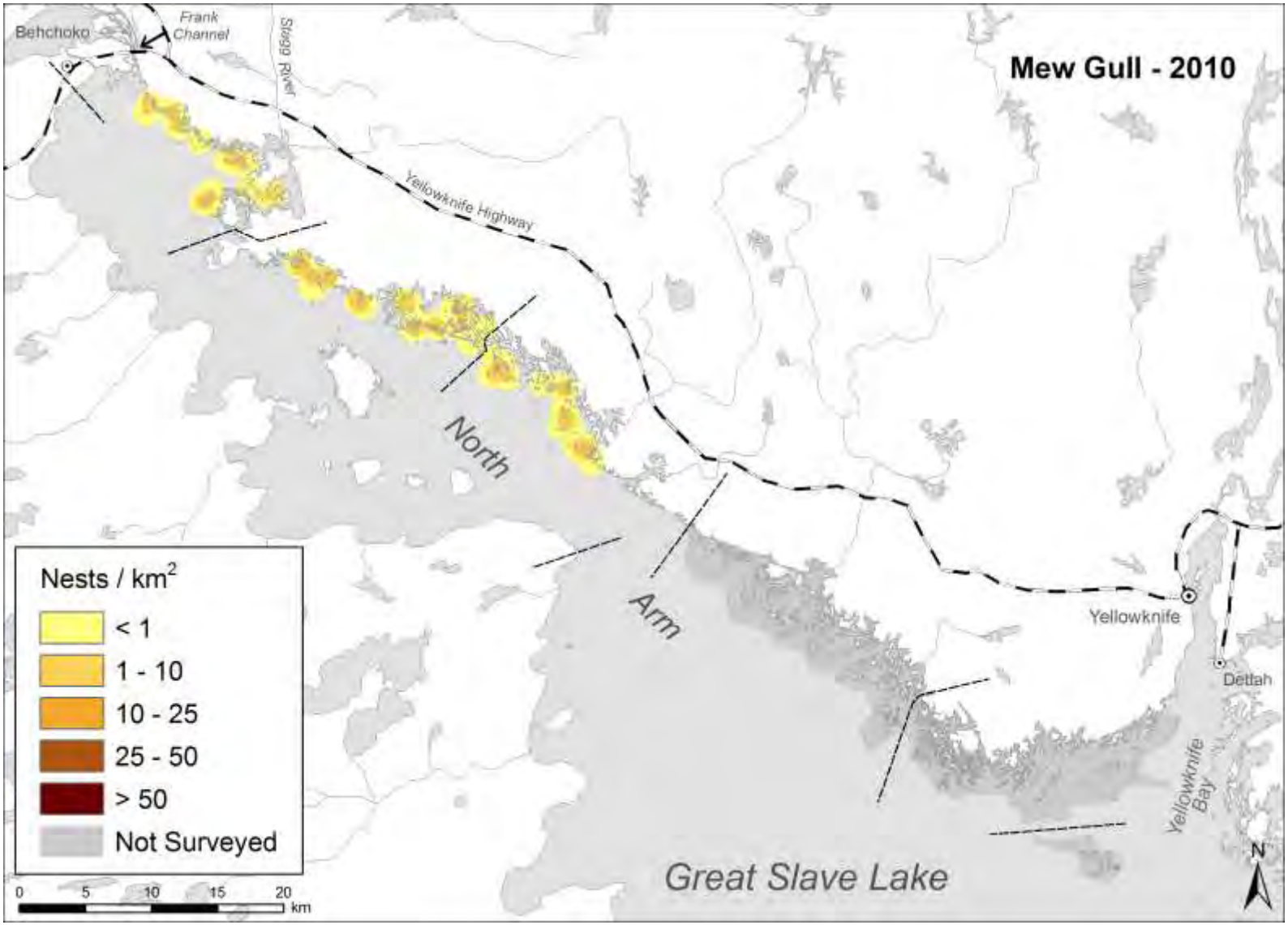

Figure 26. Distribution and density of Mew Gulls nesting on the North Arm of Great Slave Lake, 2010

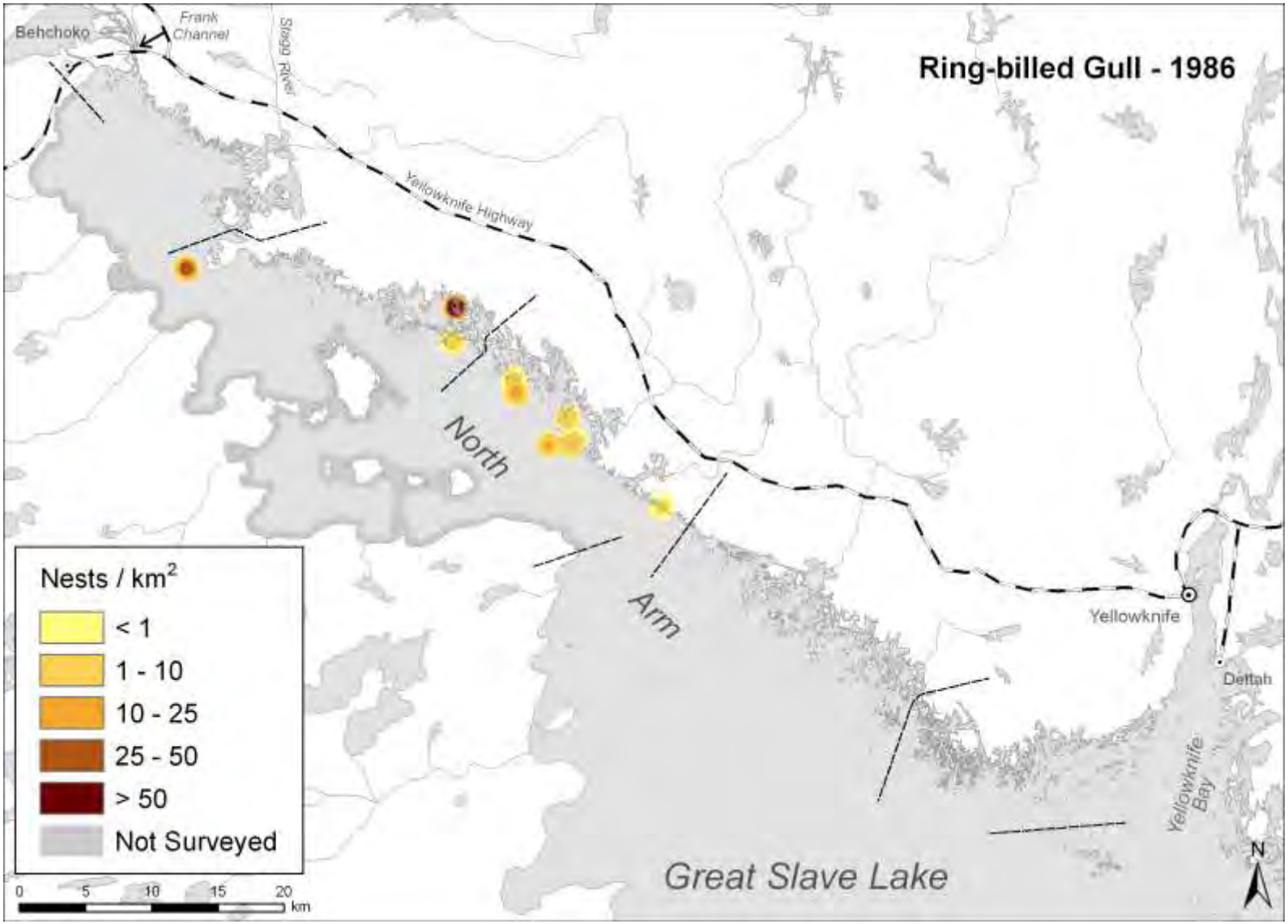

Figure 27. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1986

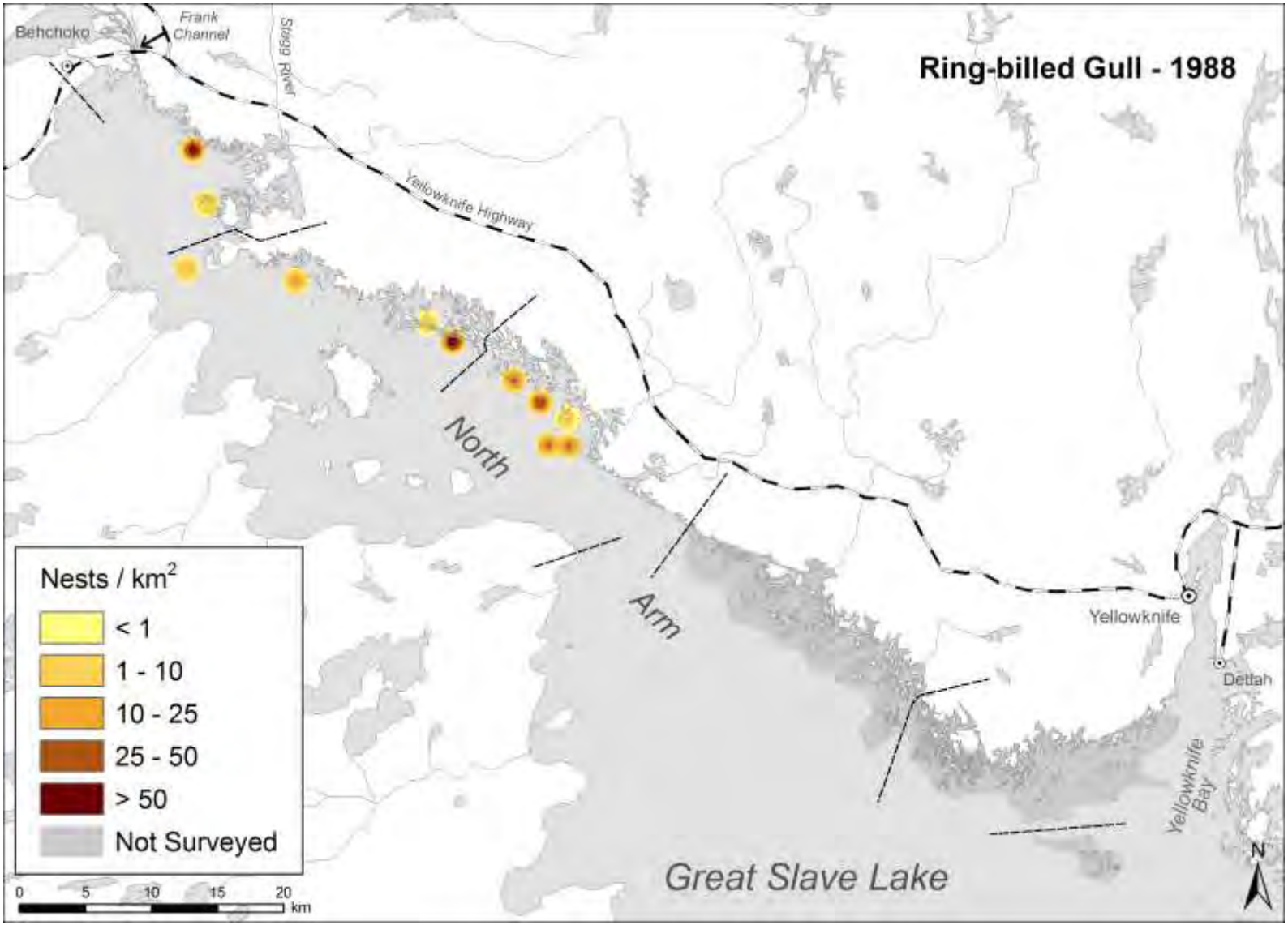

Figure 28. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1988

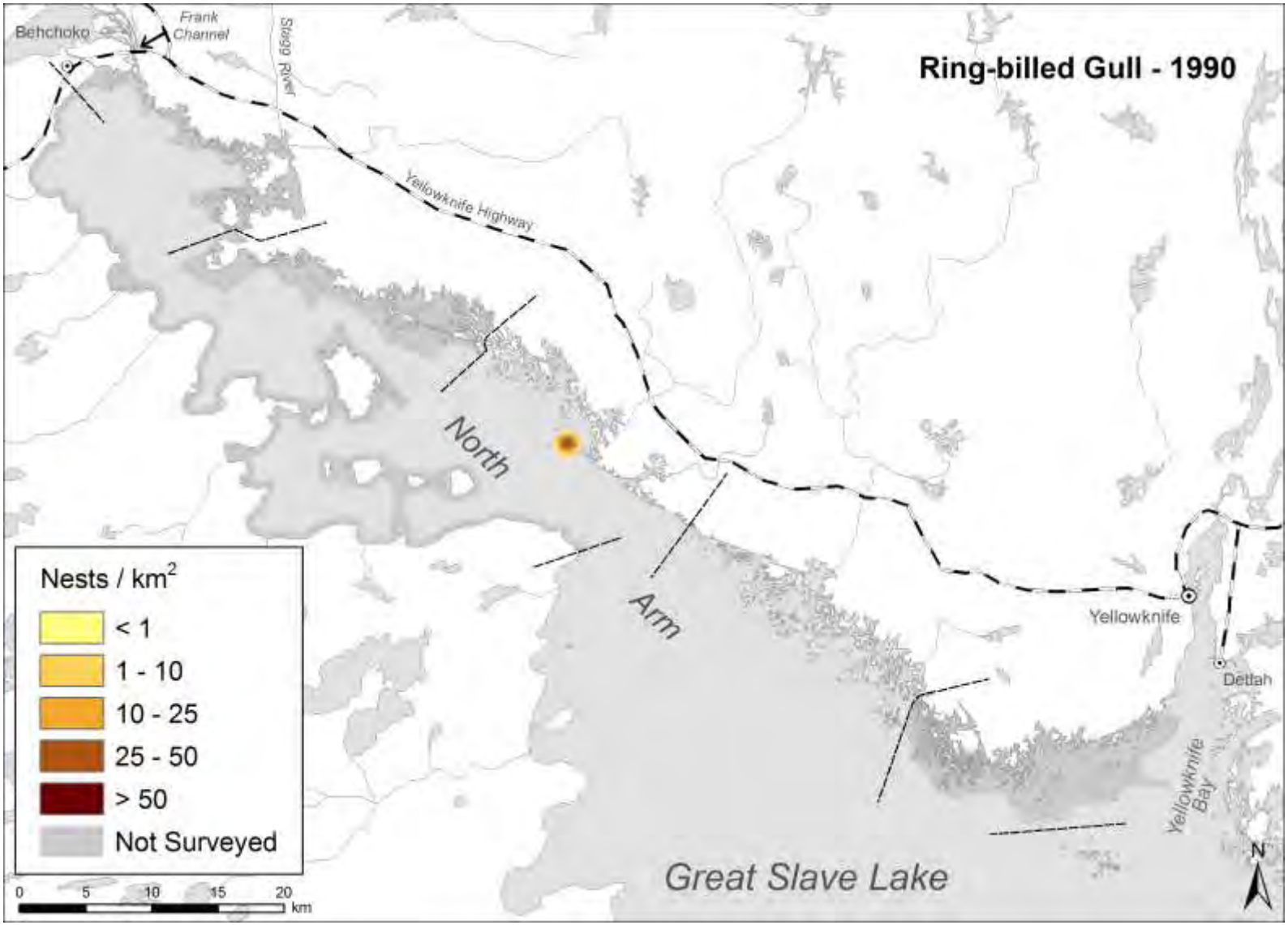

Figure 29. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1990

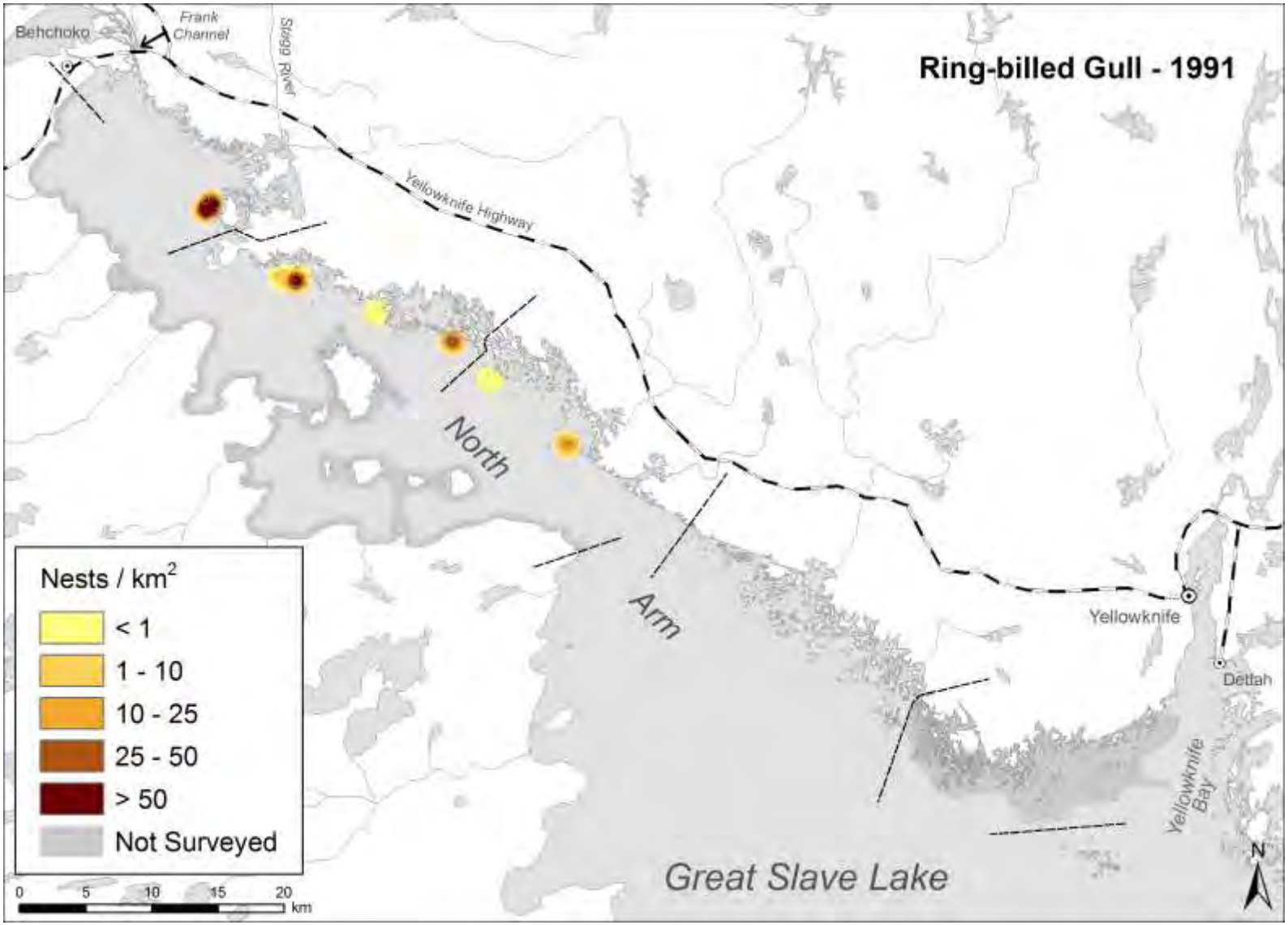

Figure 30. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1991

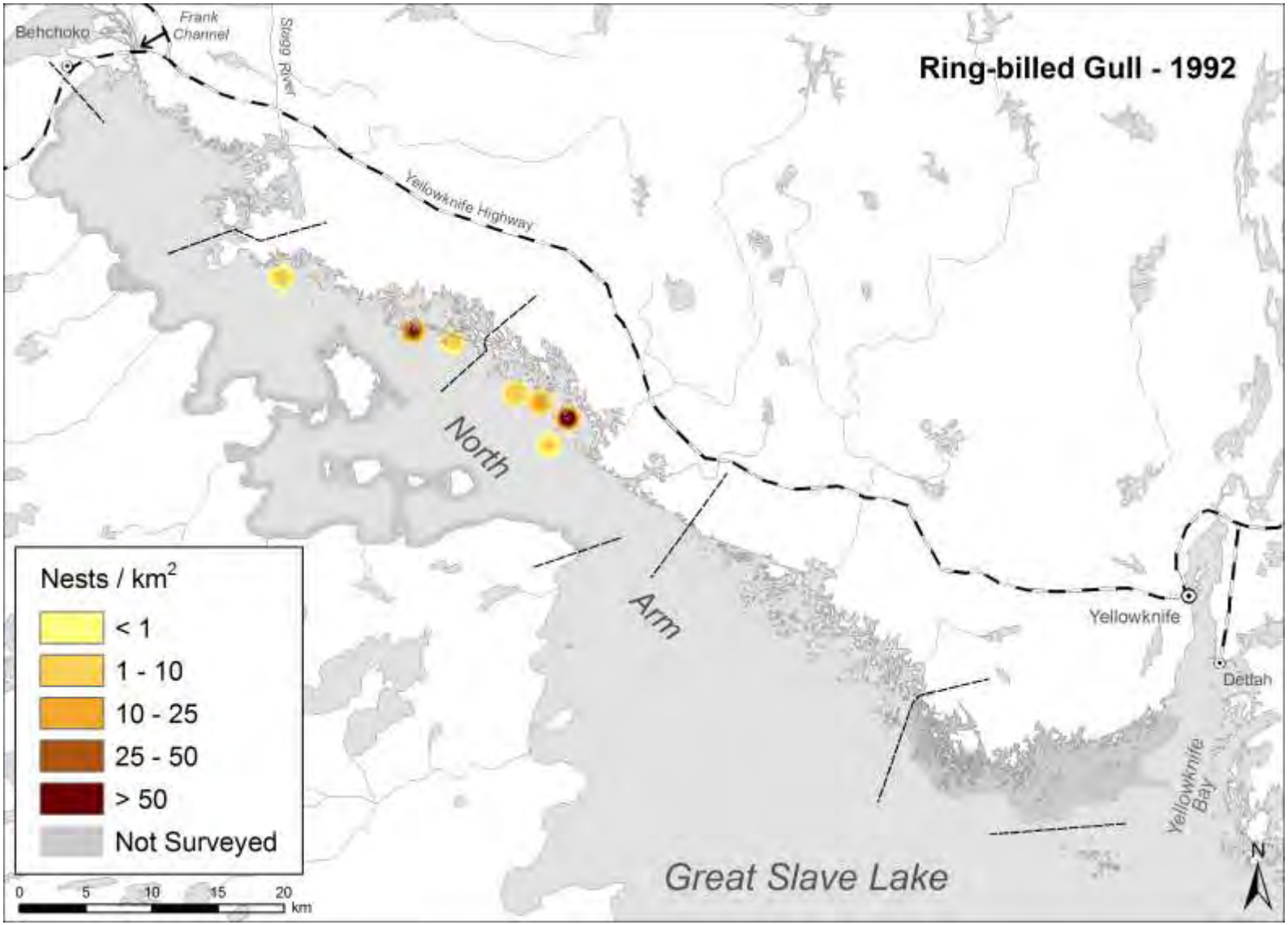

Figure 31. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1992

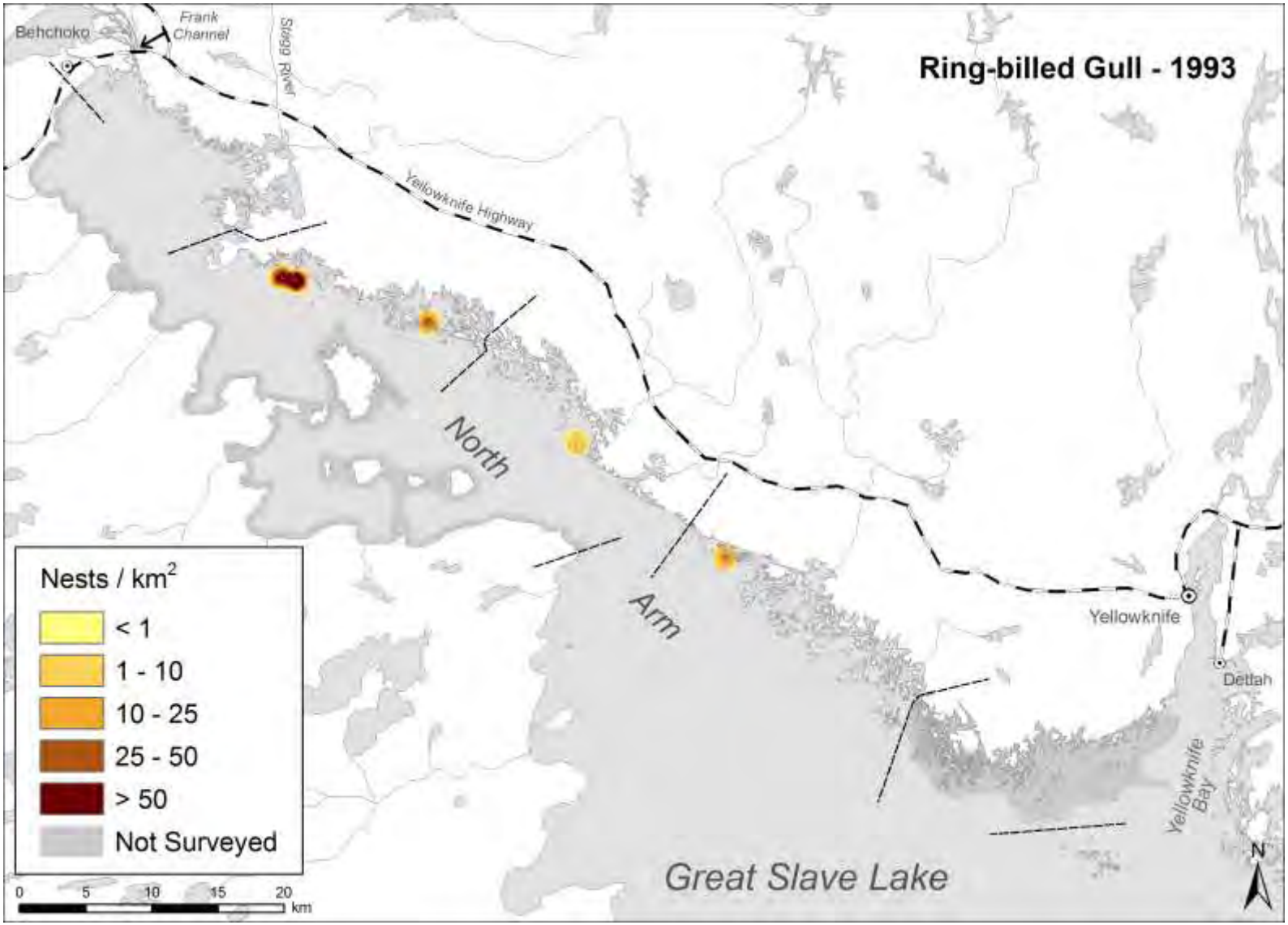

Figure 32. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1993

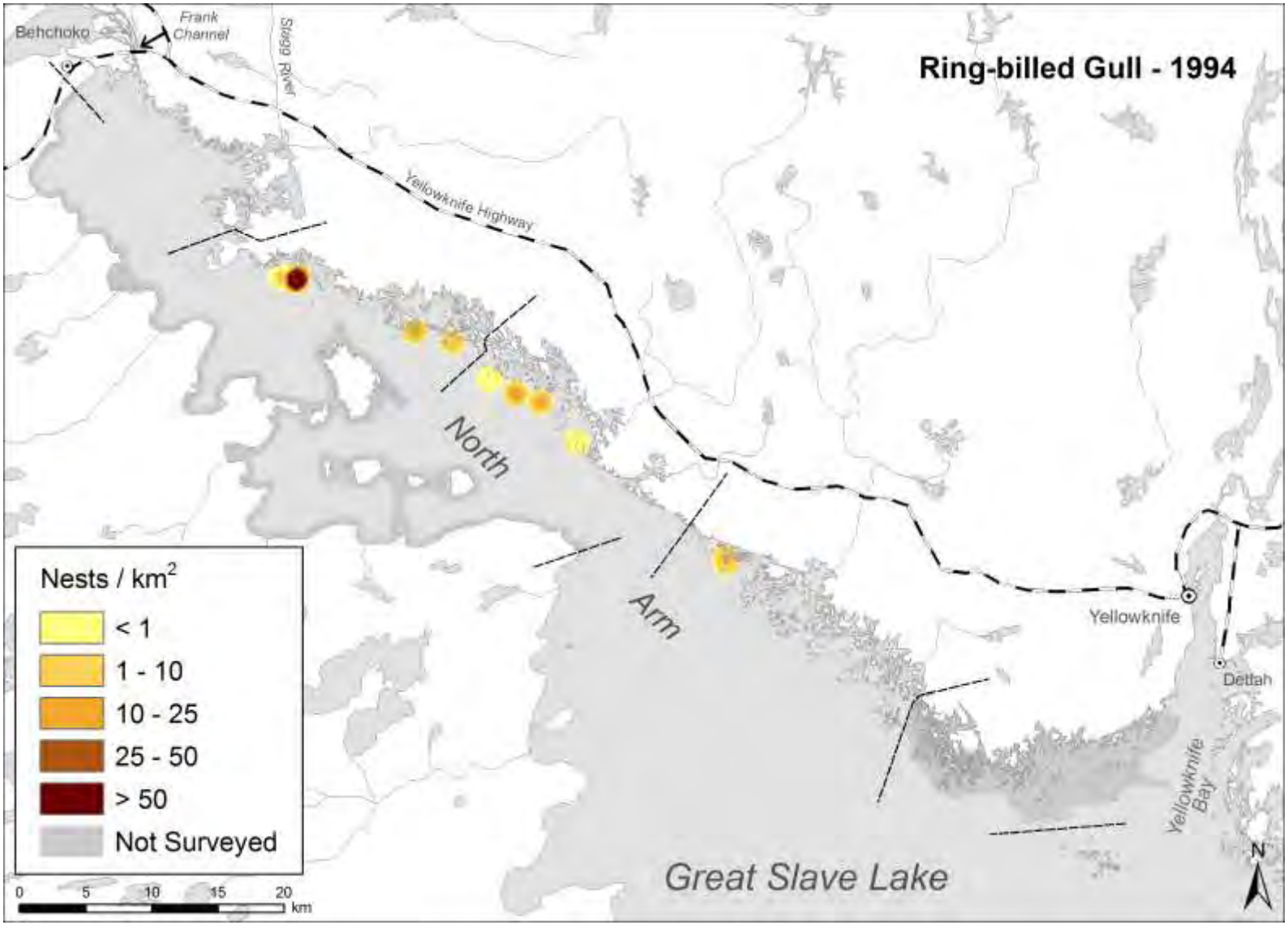

Figure 33. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1994

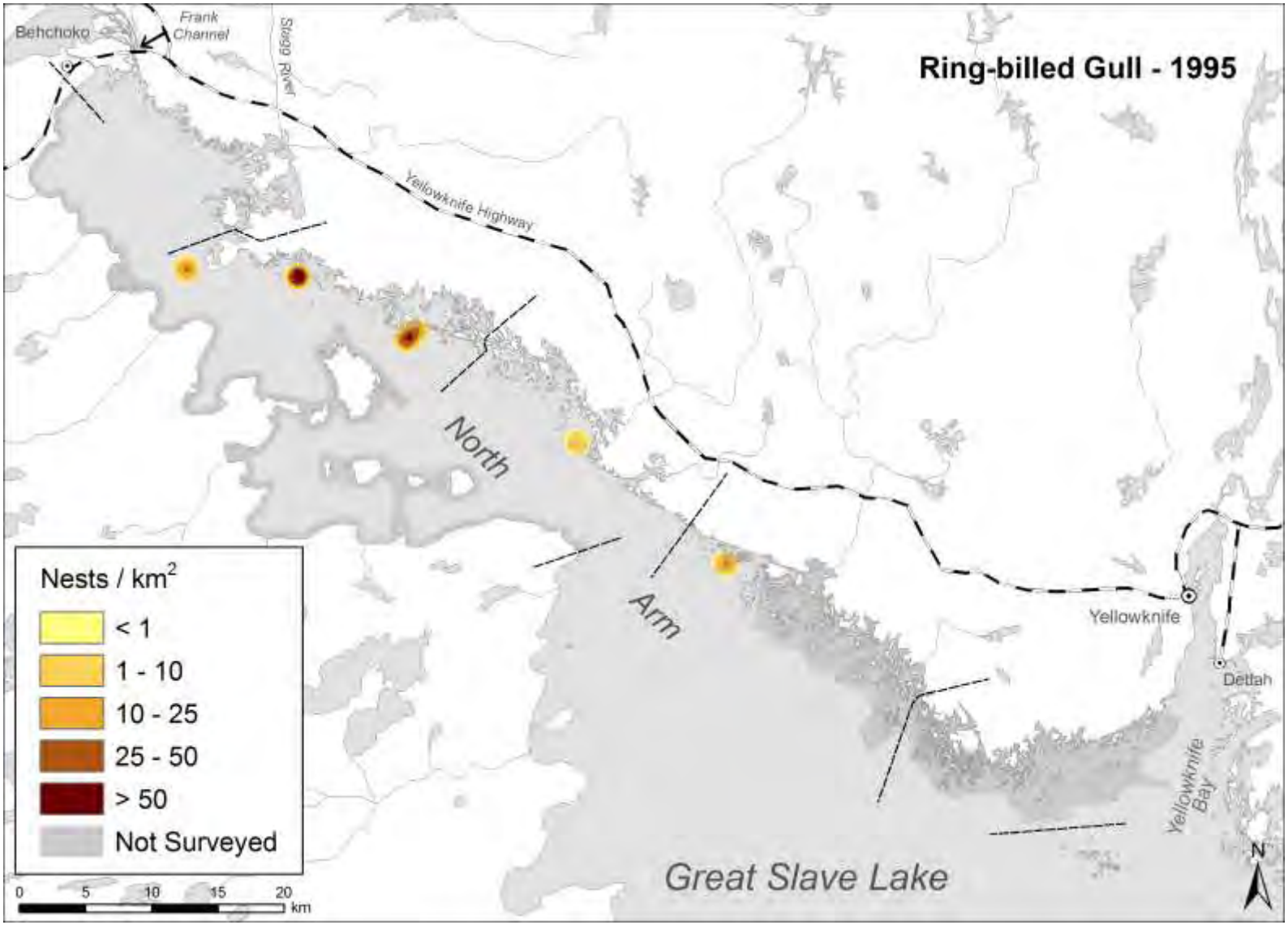

Figure 34. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 1995

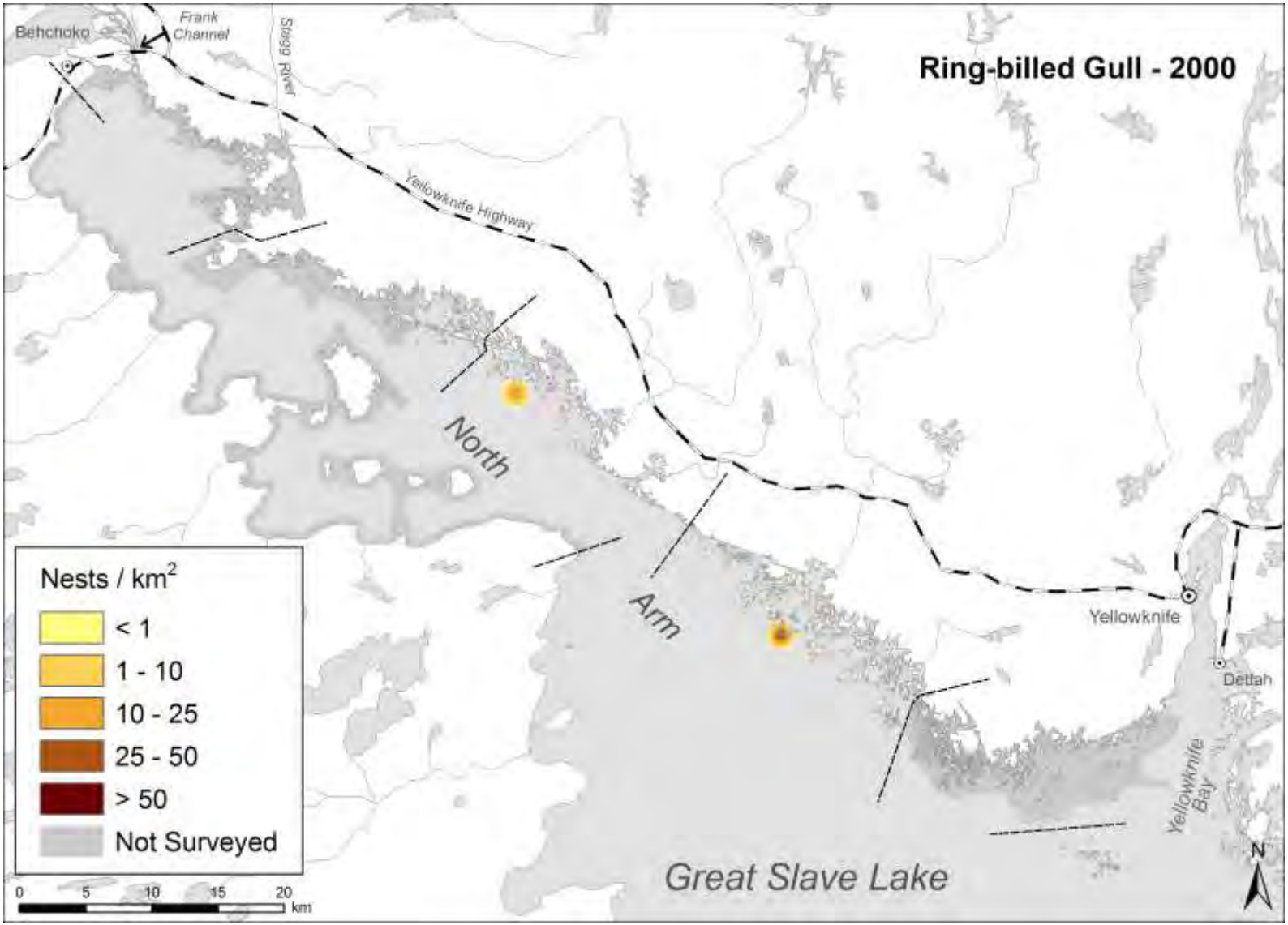

Figure 35. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 2000

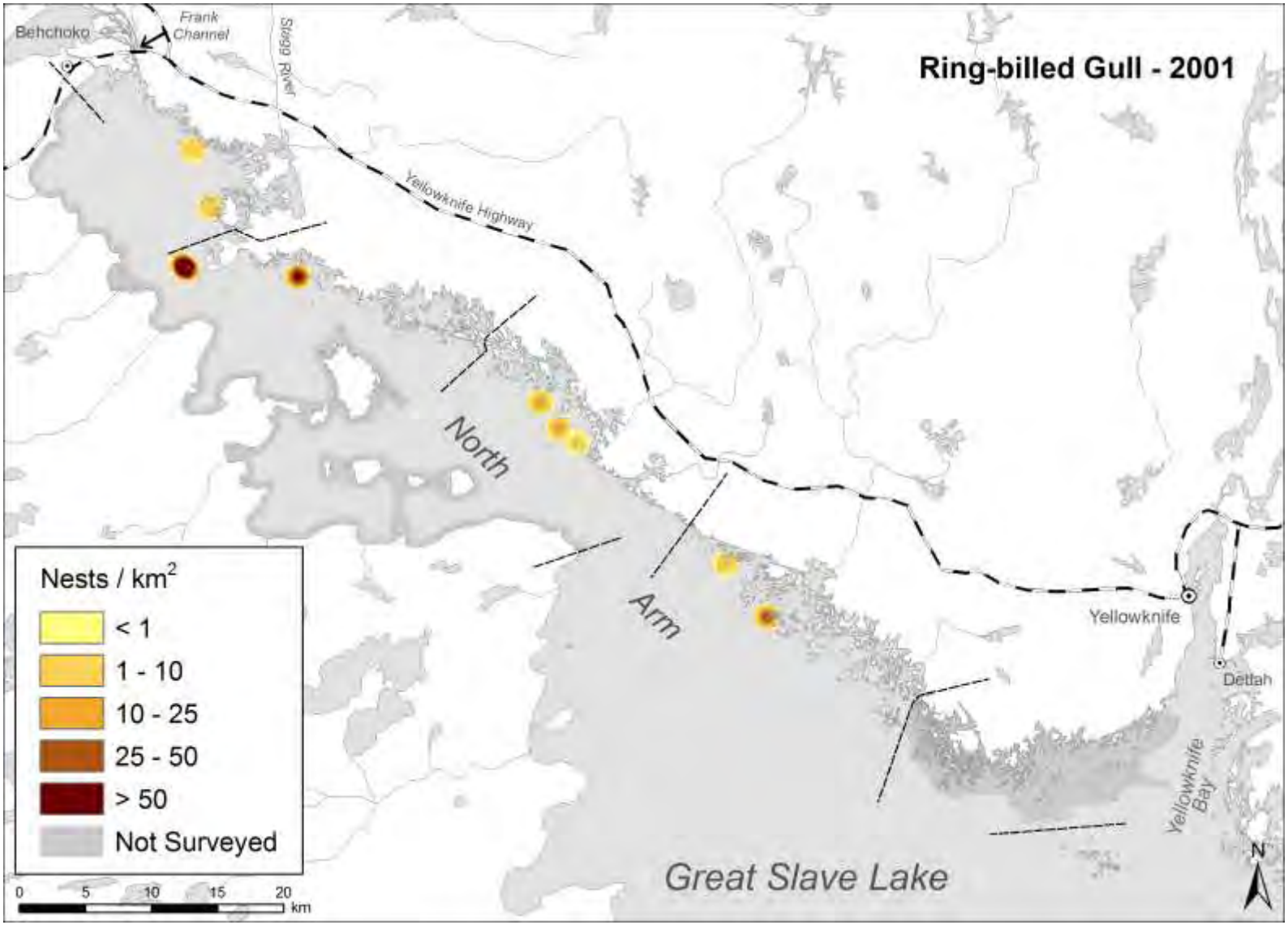

Figure 36. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 2001

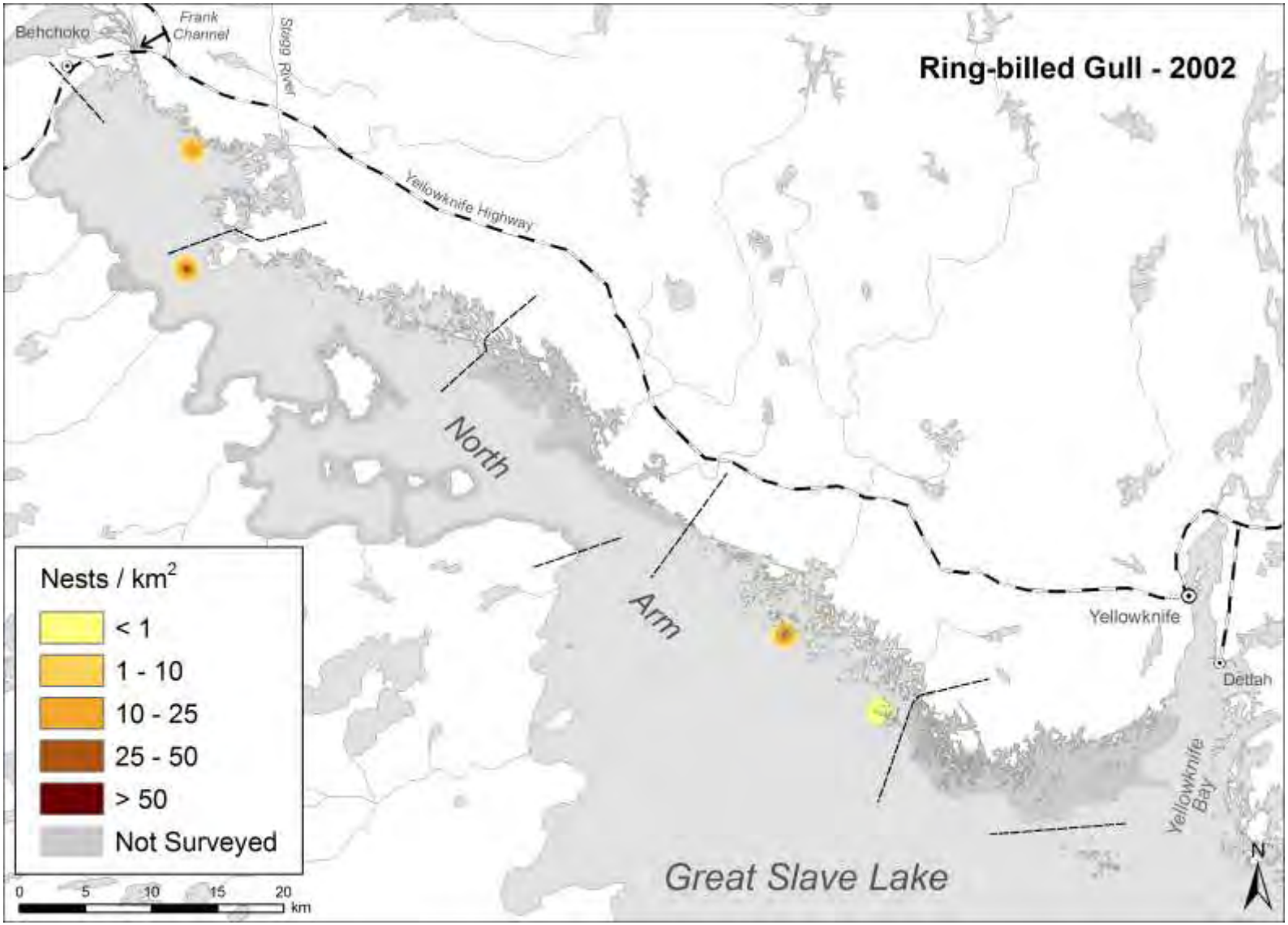

Figure 37. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 2002

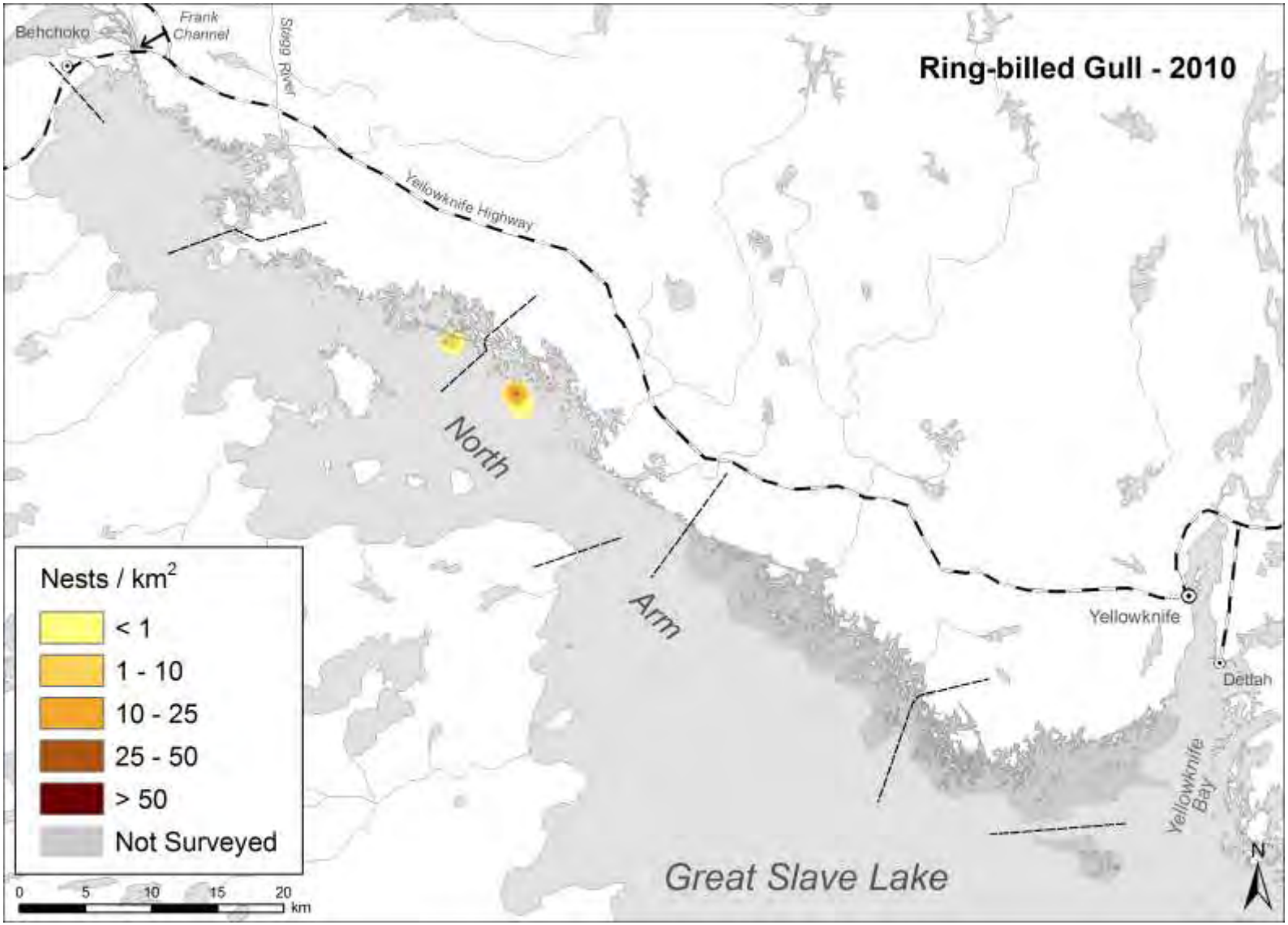

Figure 38. Distribution and density of Ring-billed Gulls nesting on the North Arm of Great Slave Lake, 2010

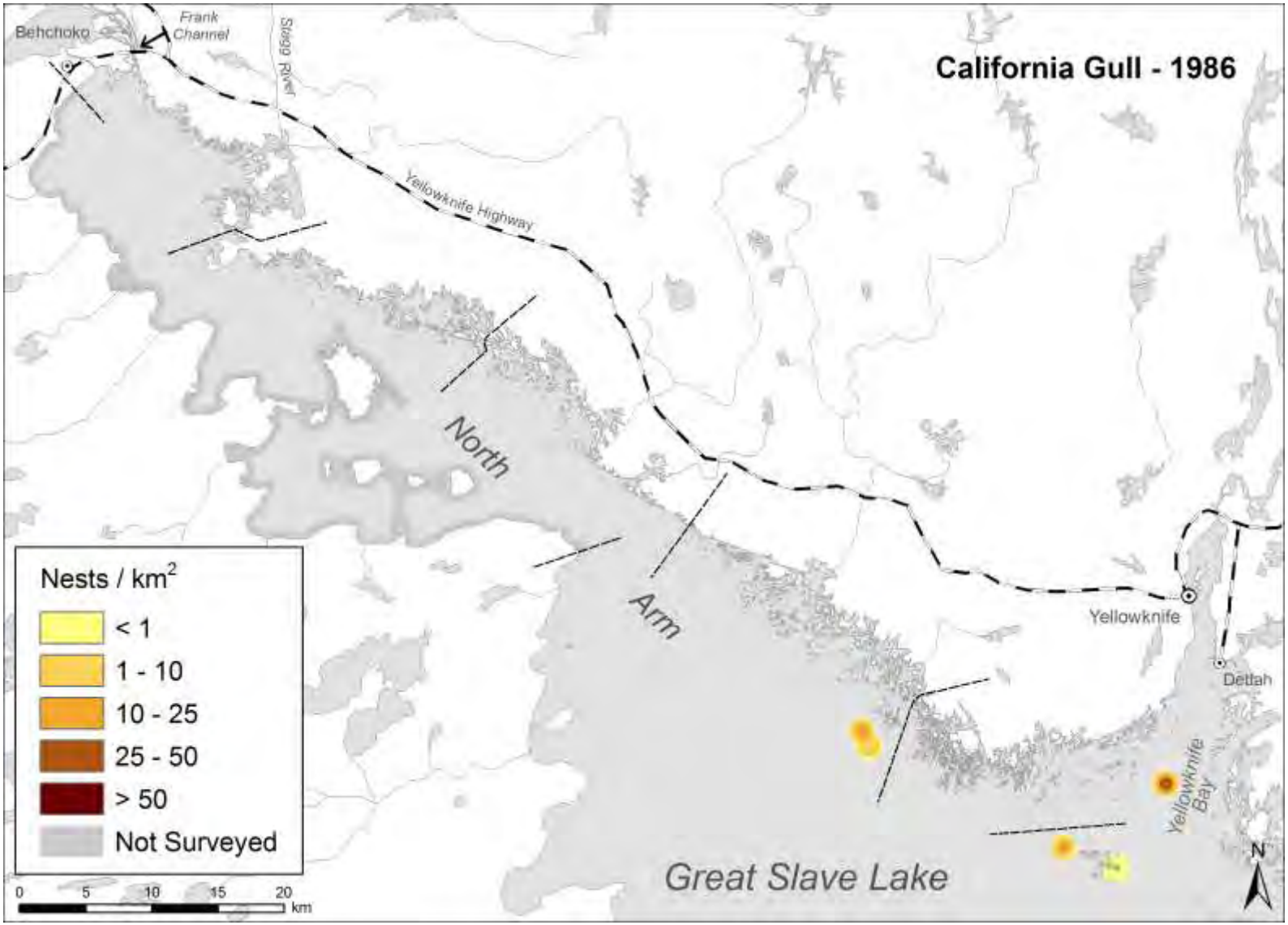

Figure 39. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1986

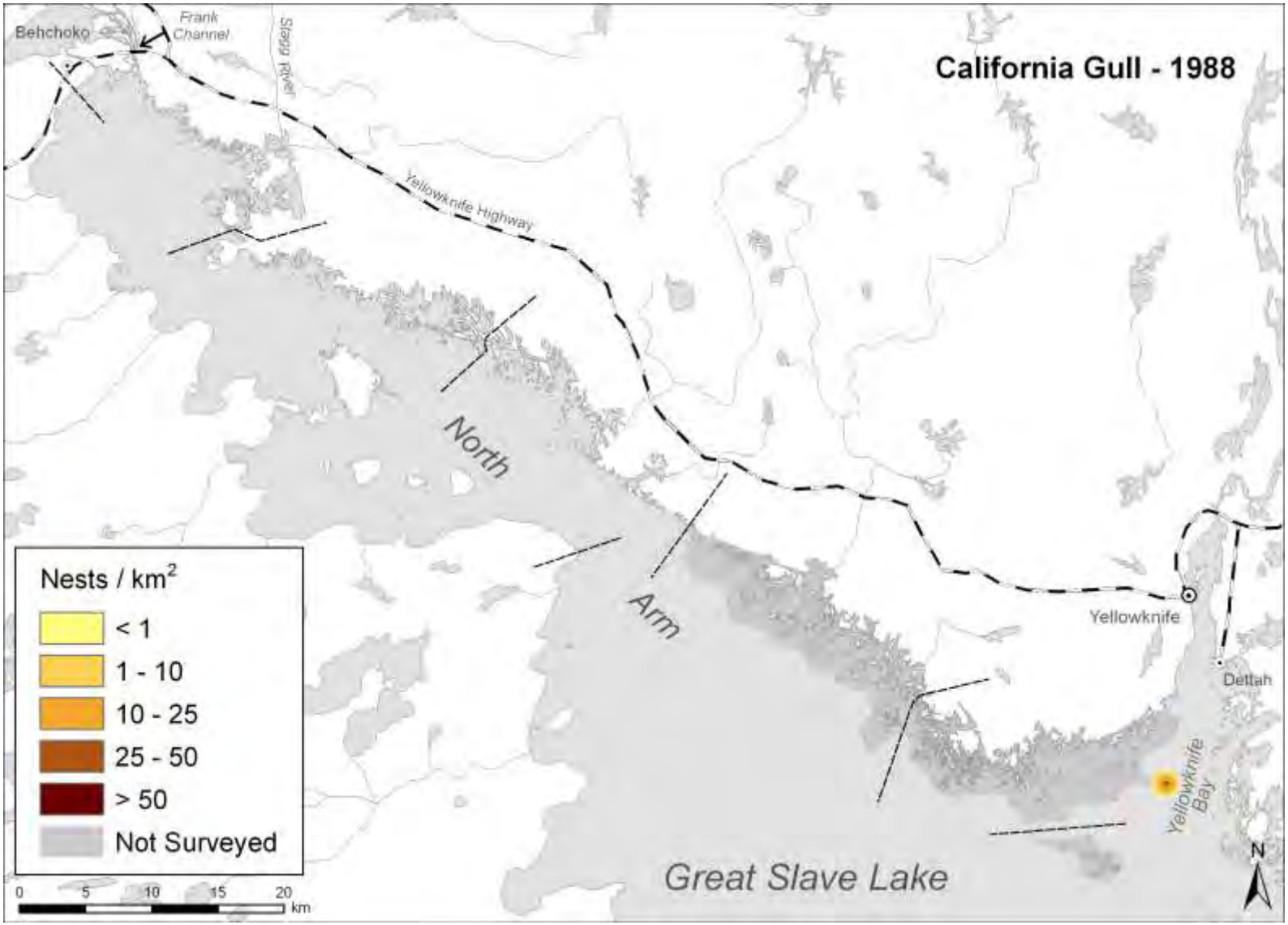

Figure 40. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1988

Figure 41. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1990

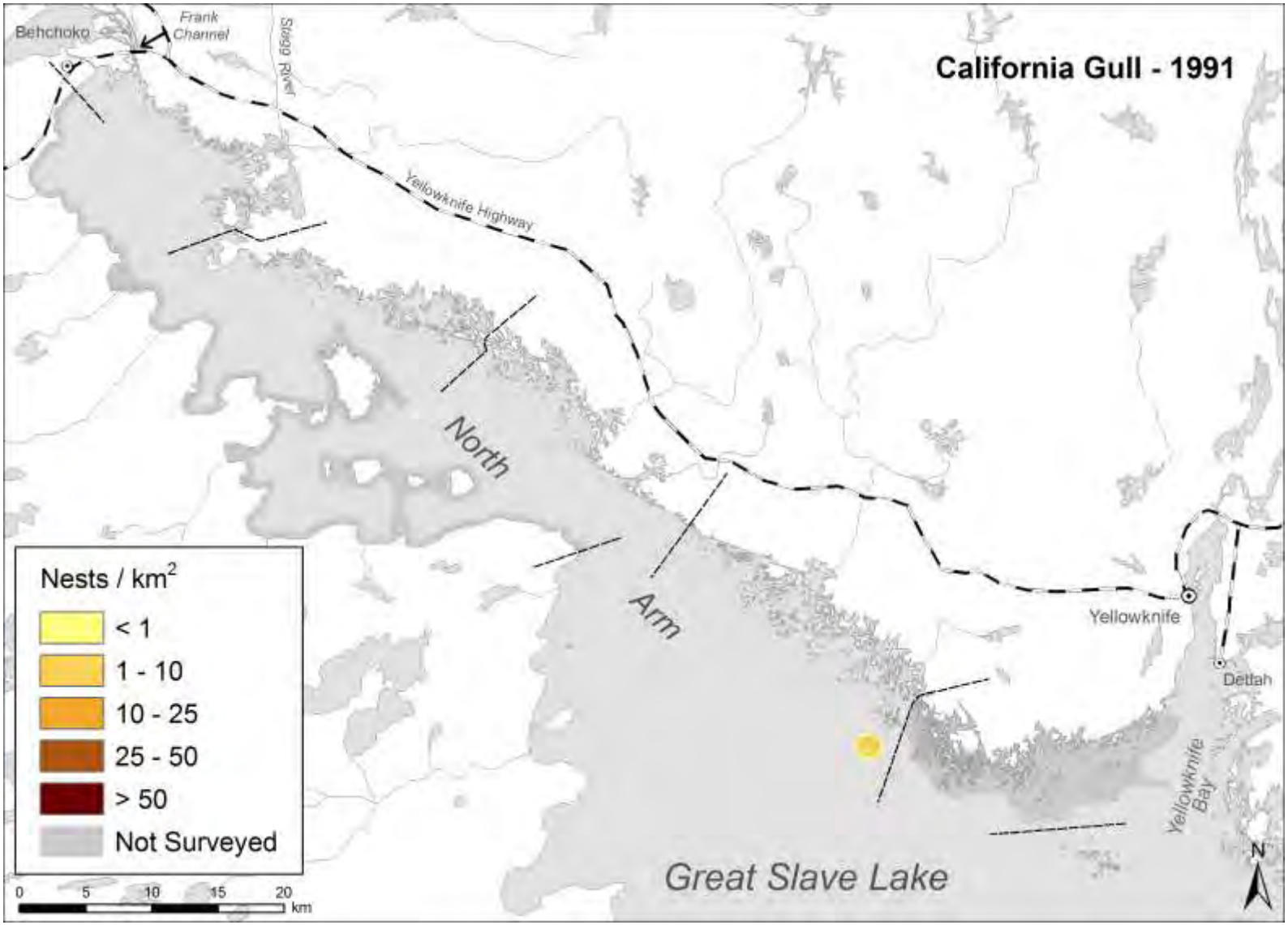

Figure 42. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1991

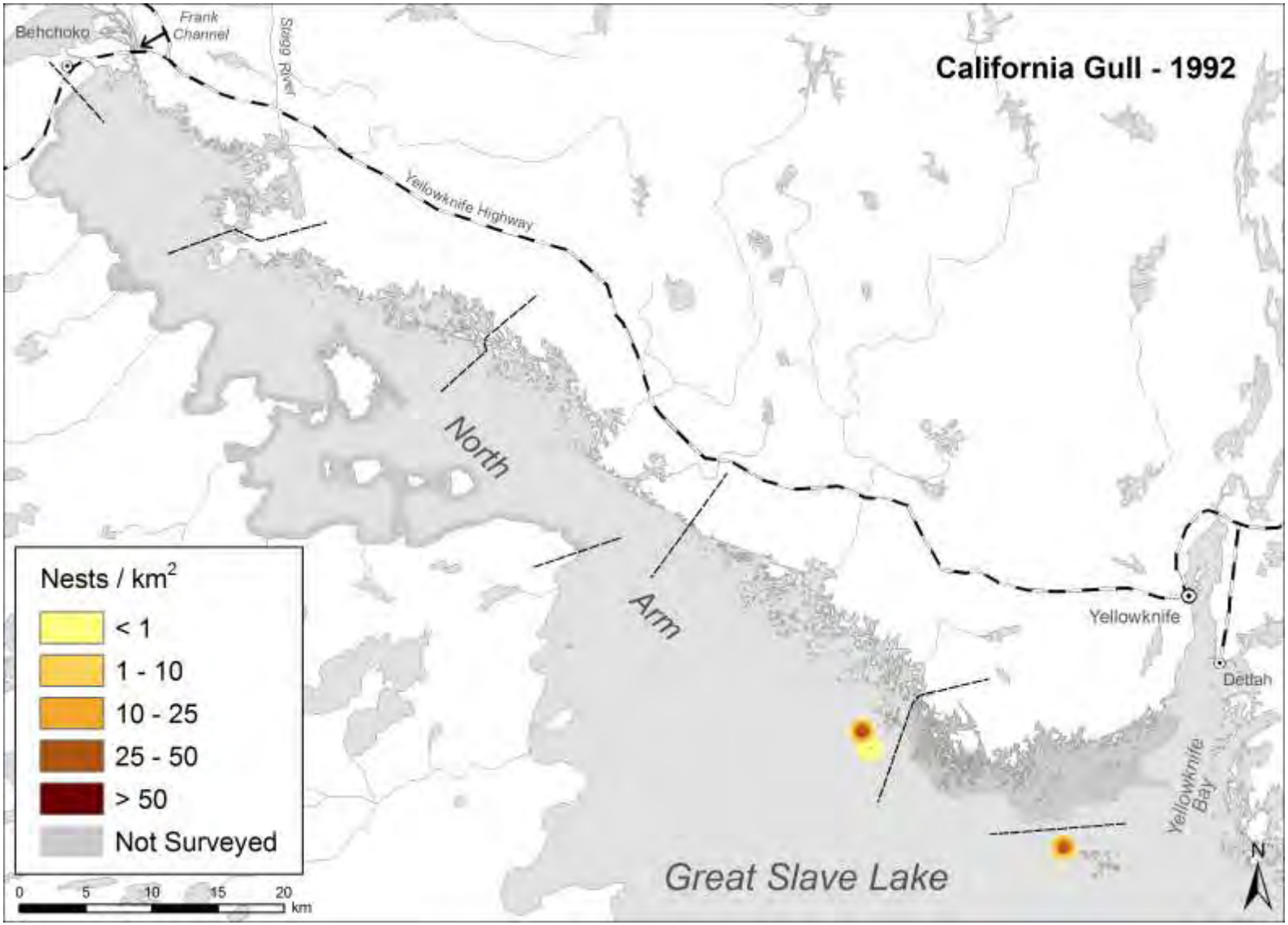

Figure 43. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1992

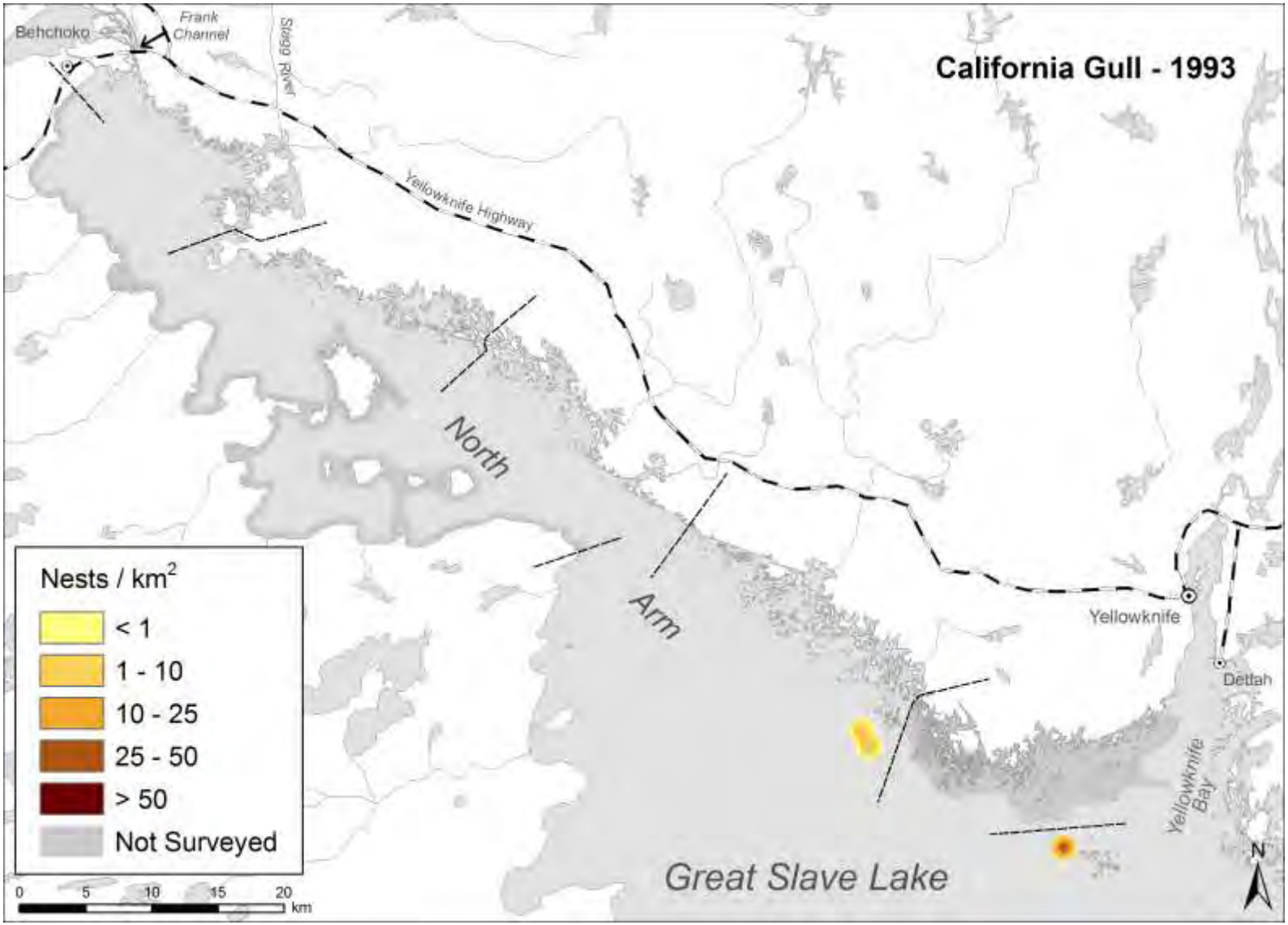

Figure 44. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1993

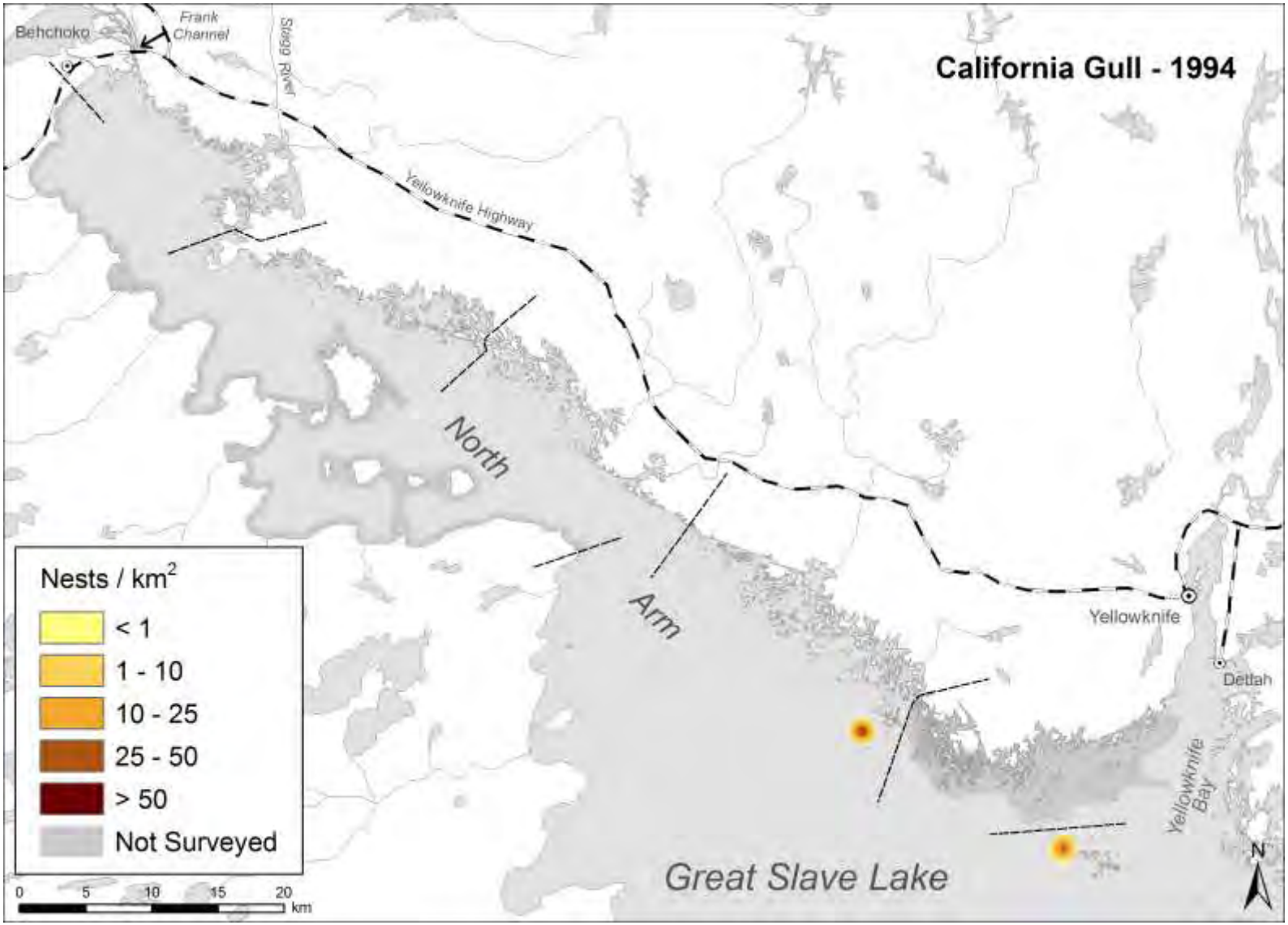

Figure 45. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1994

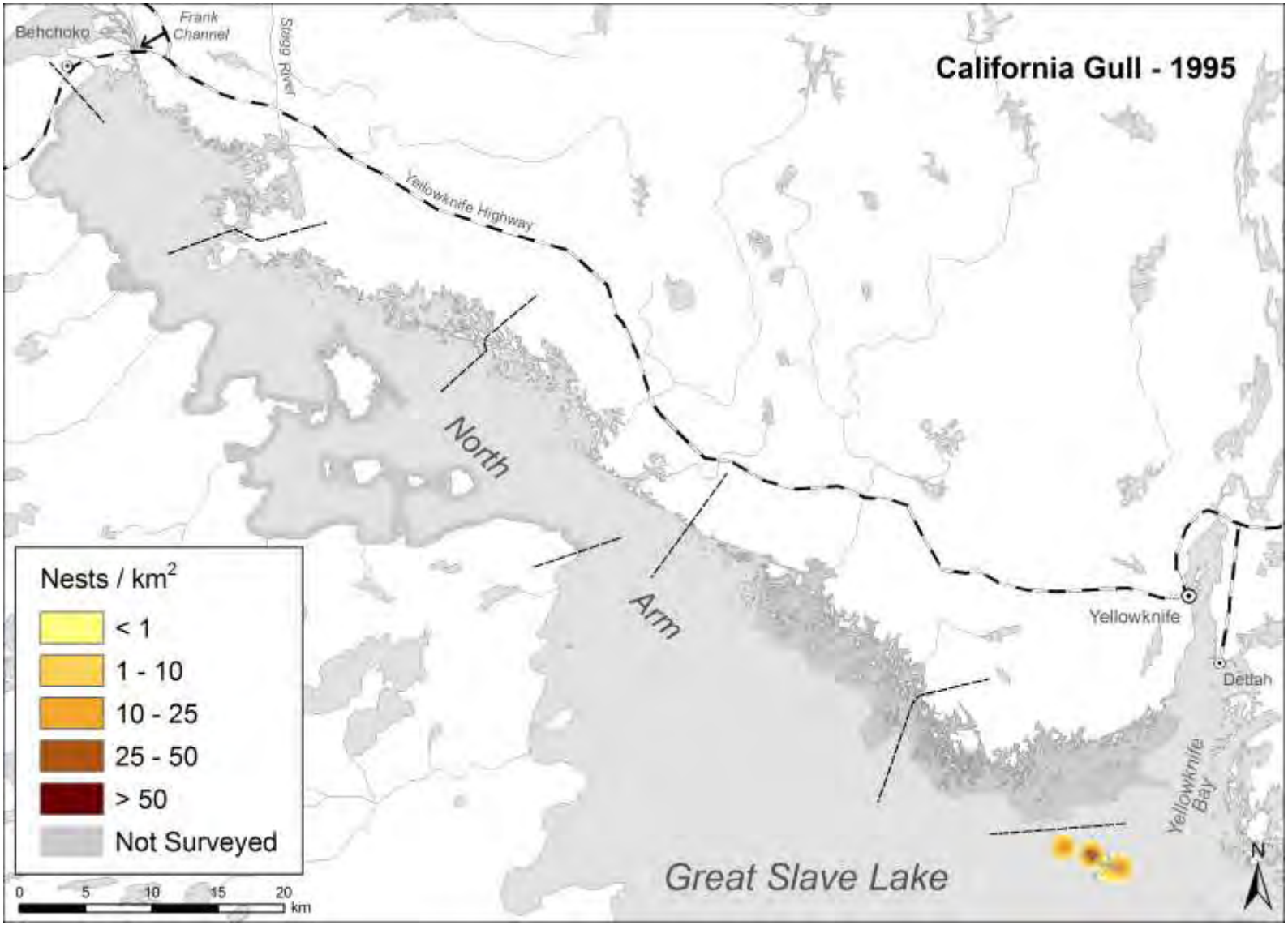

Figure 46. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 1995

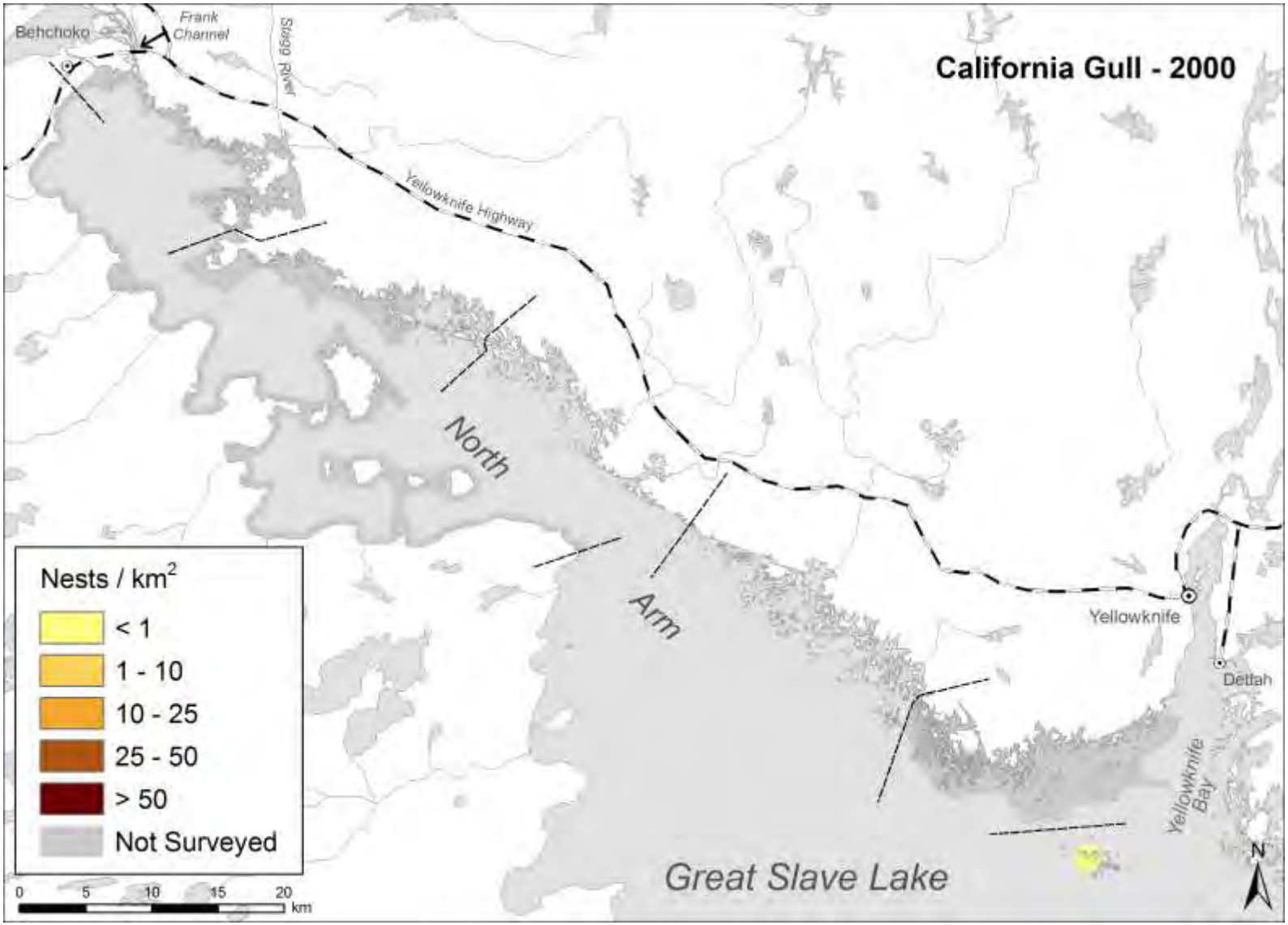

Figure 47. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 2000

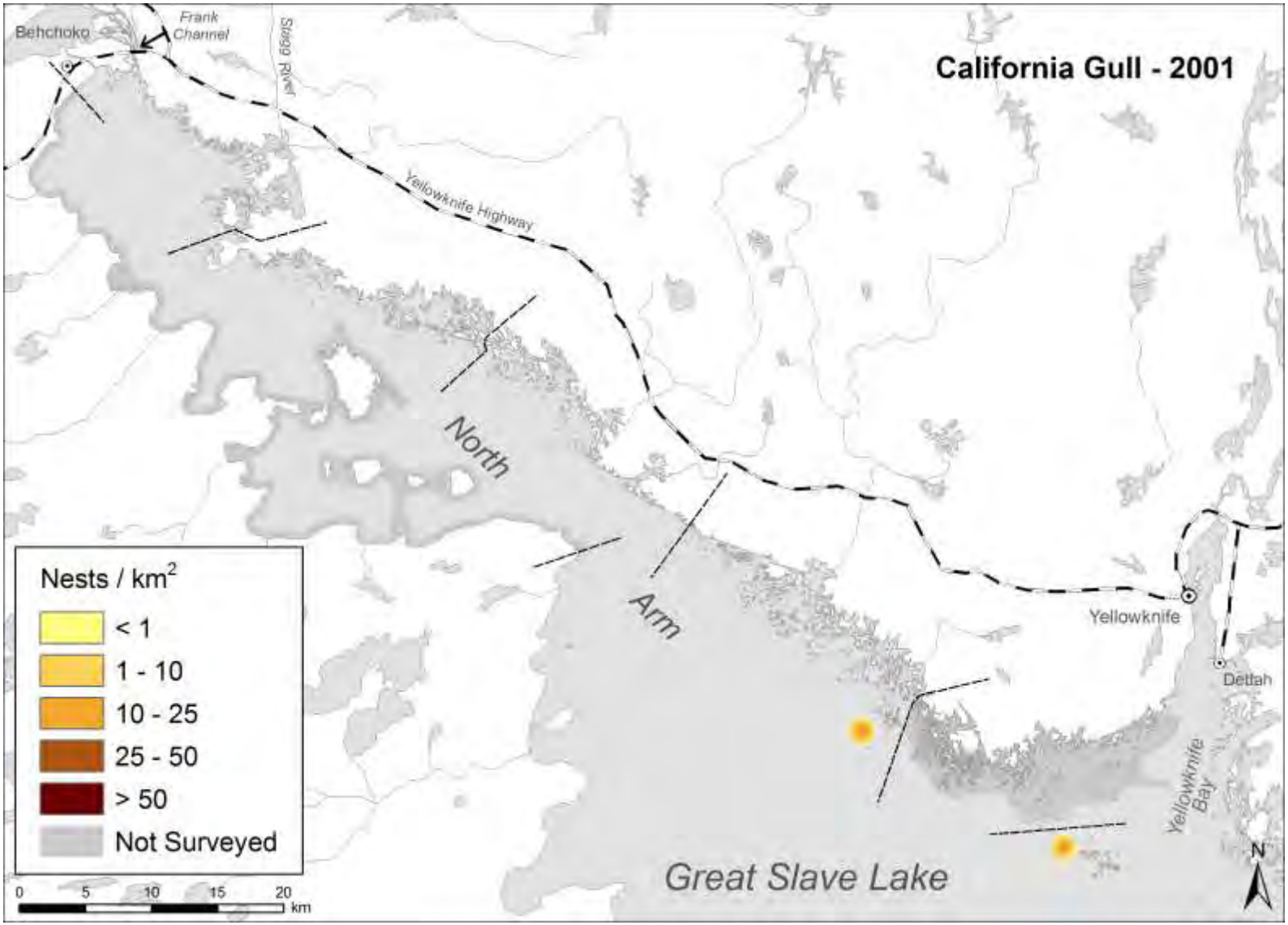

Figure 48. Distribution and density of California Gulls nesting on the North Arm of Great Slave Lake, 2001

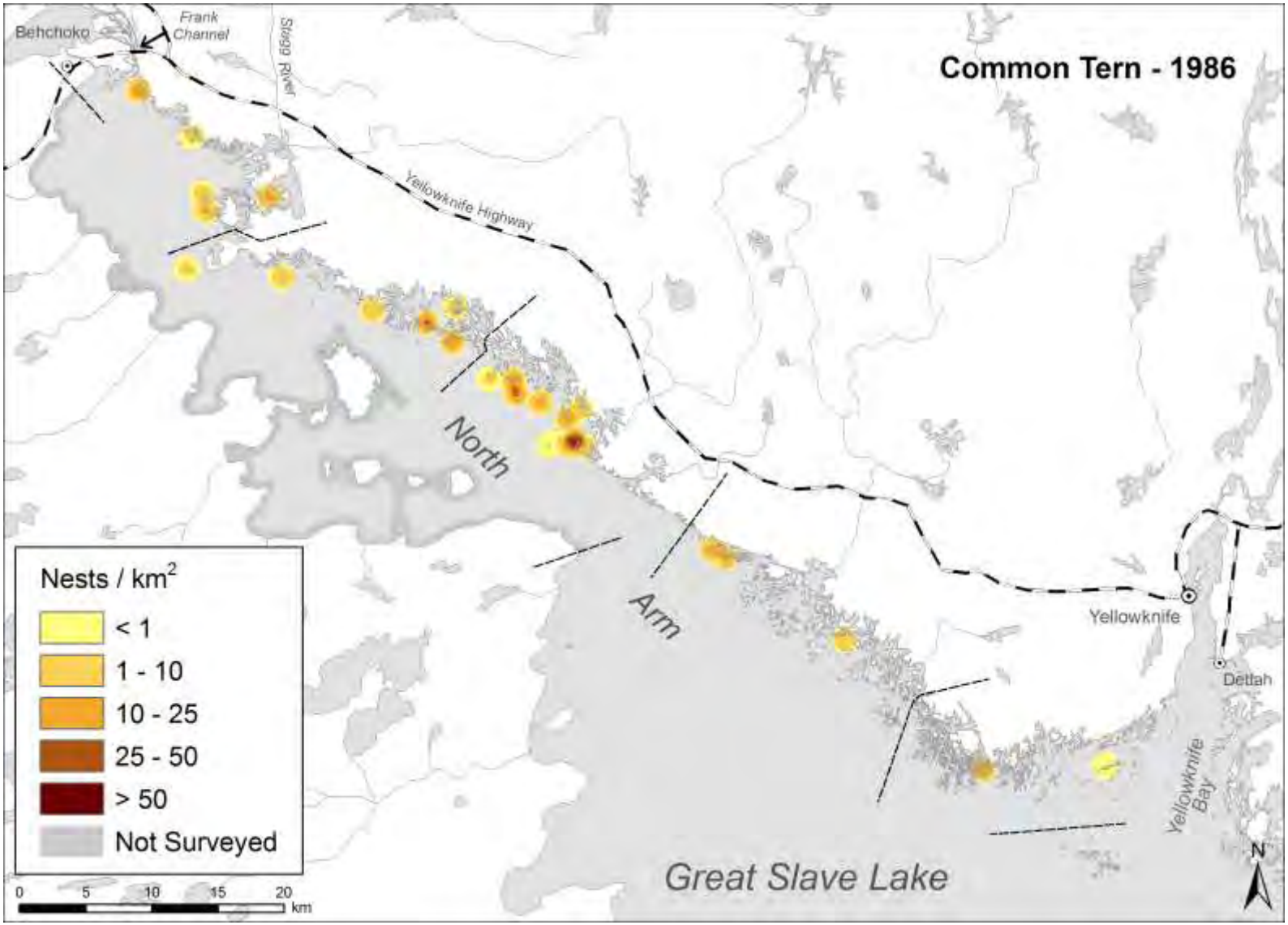

Figure 49. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1986

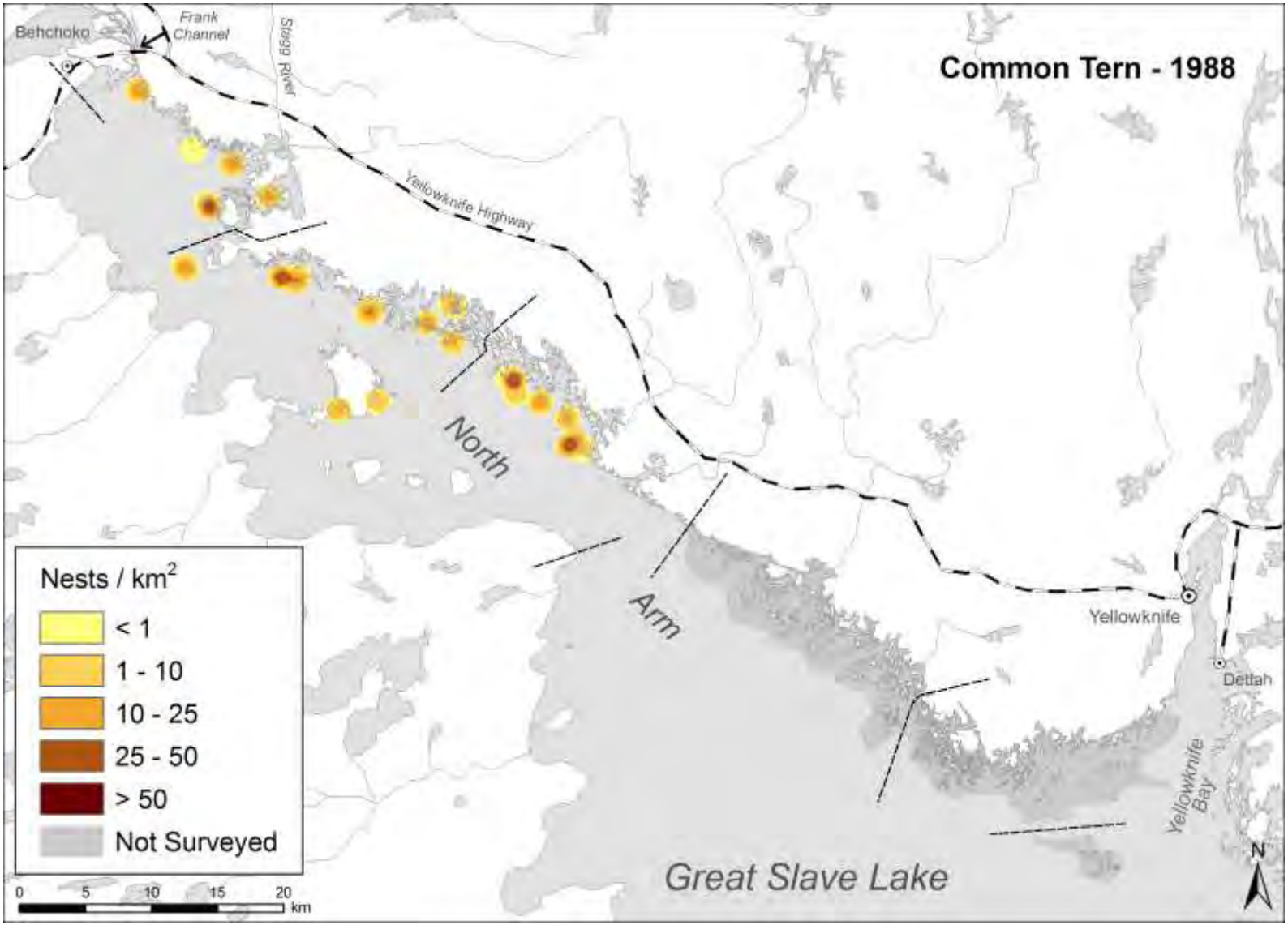

Figure 50. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1988

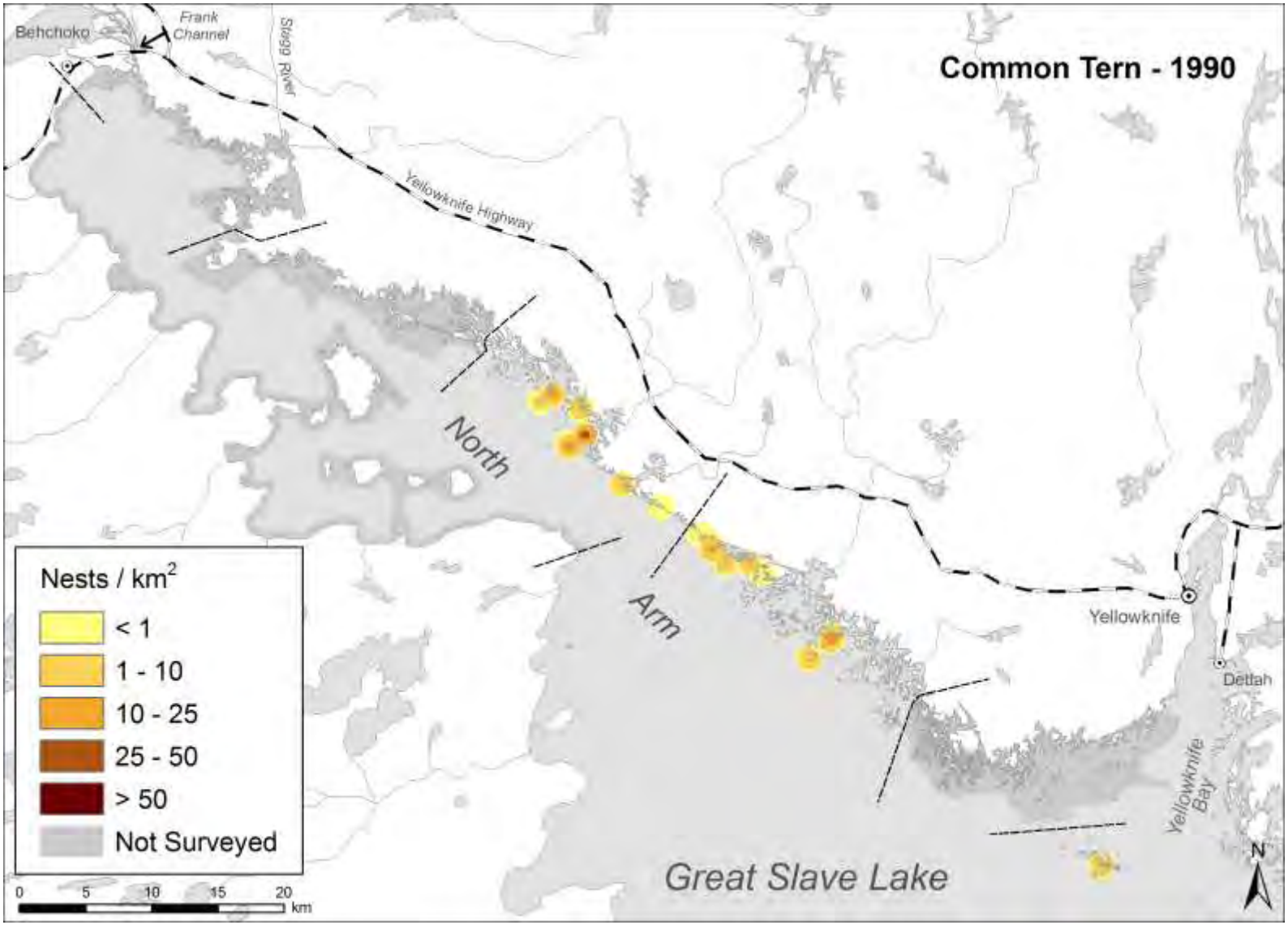

Figure 51. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1990

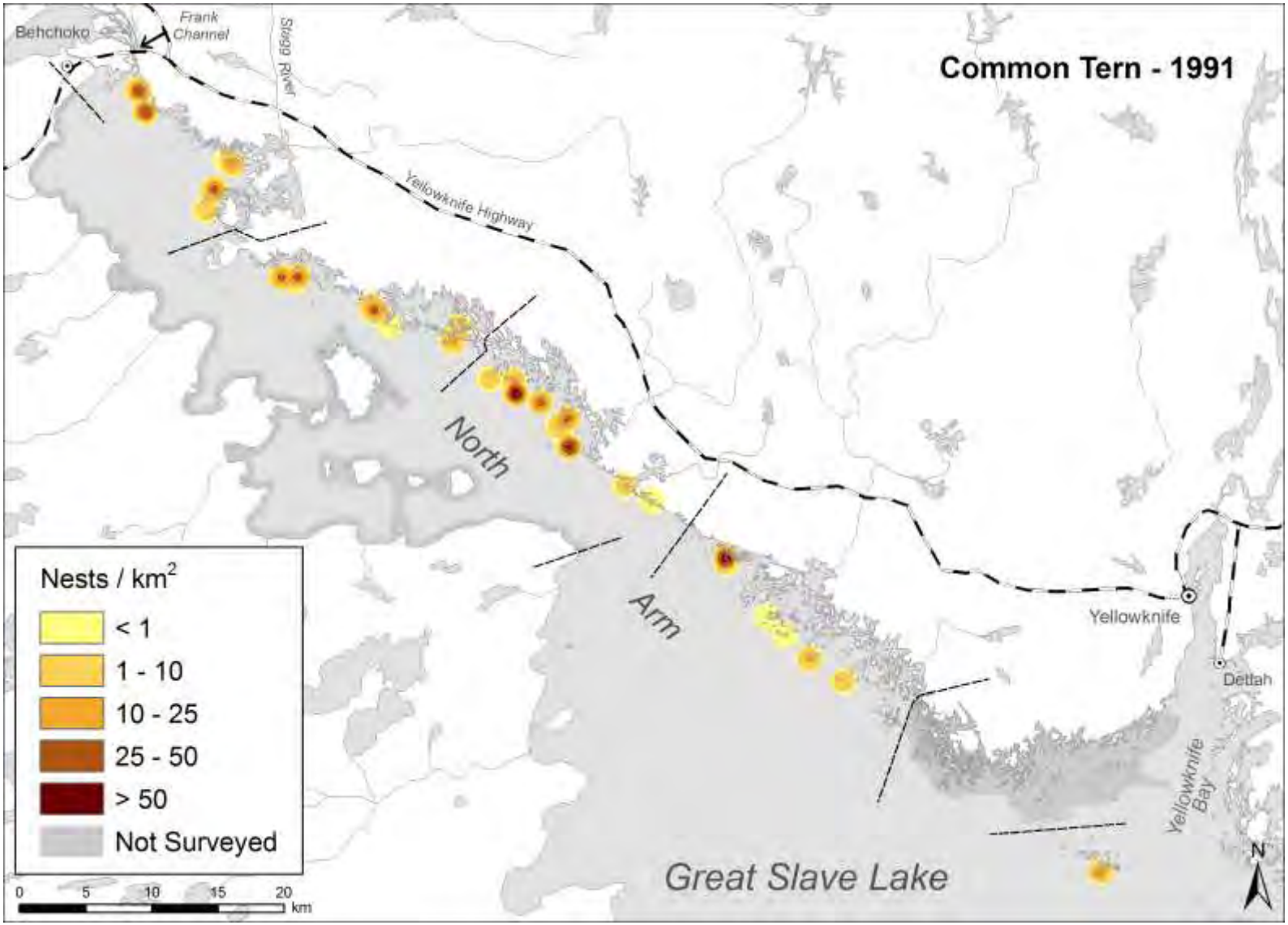

Figure 52. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1991

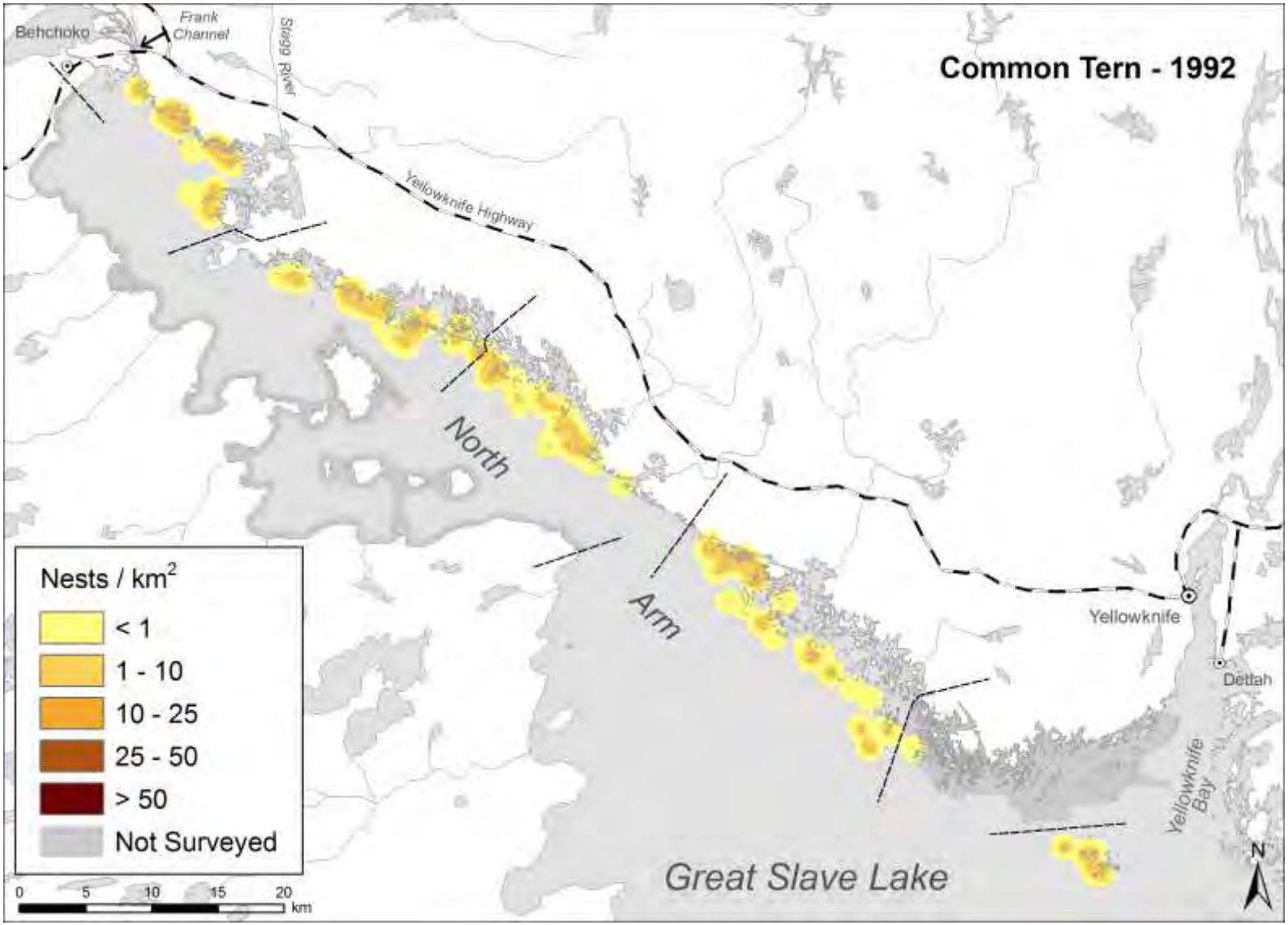

Figure 53. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1992

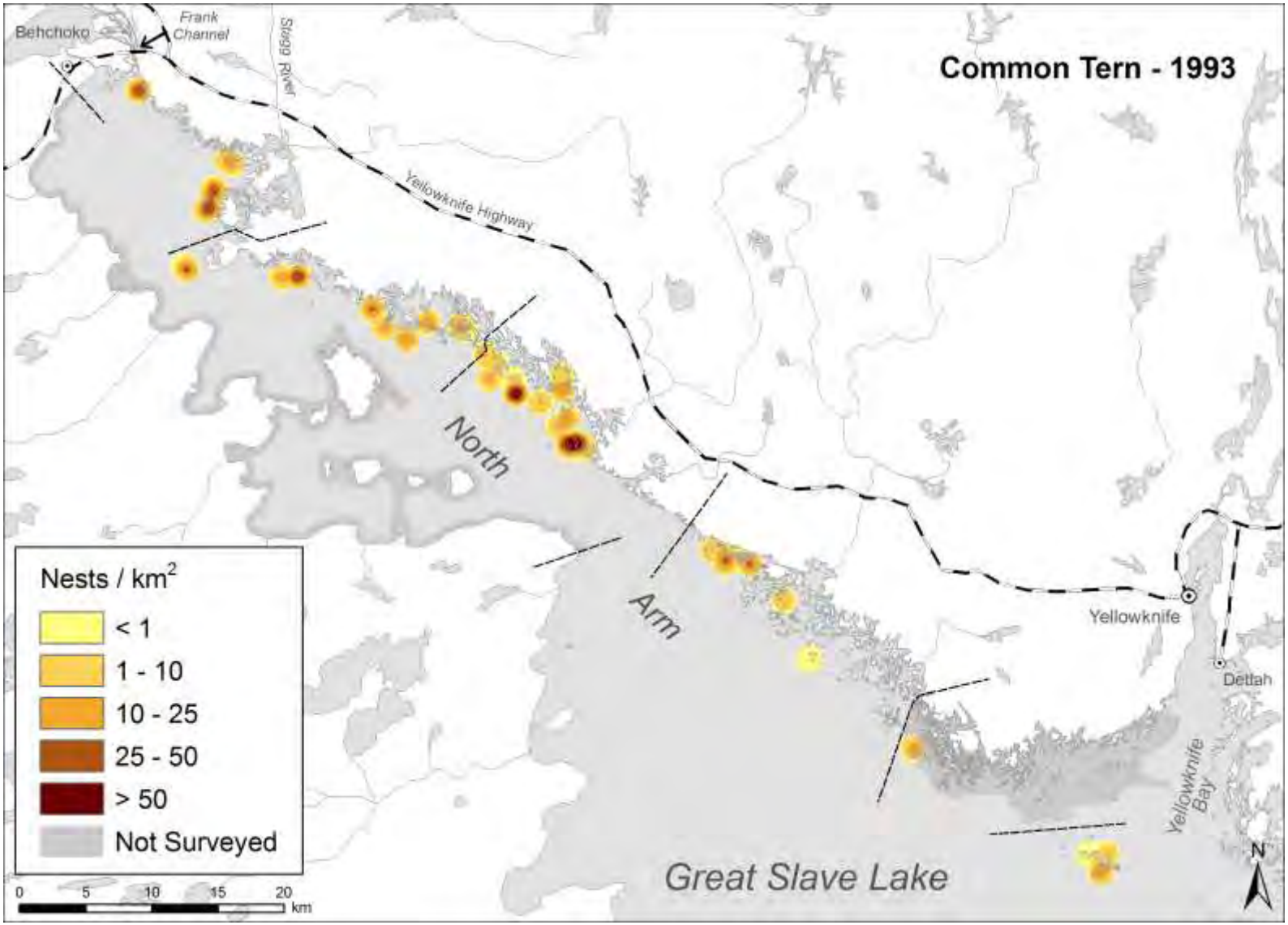

Figure 54. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1993

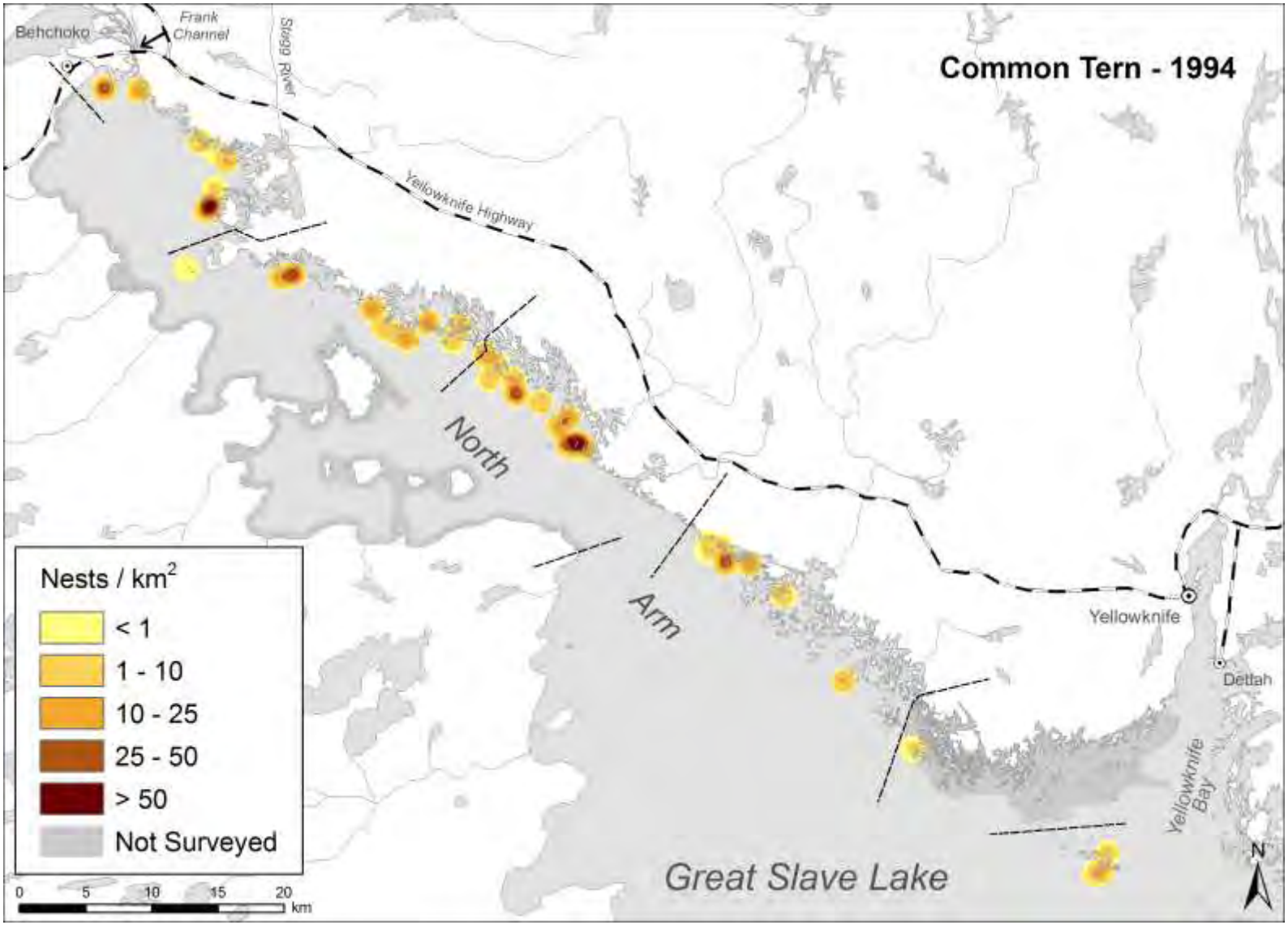

Figure 55. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1994

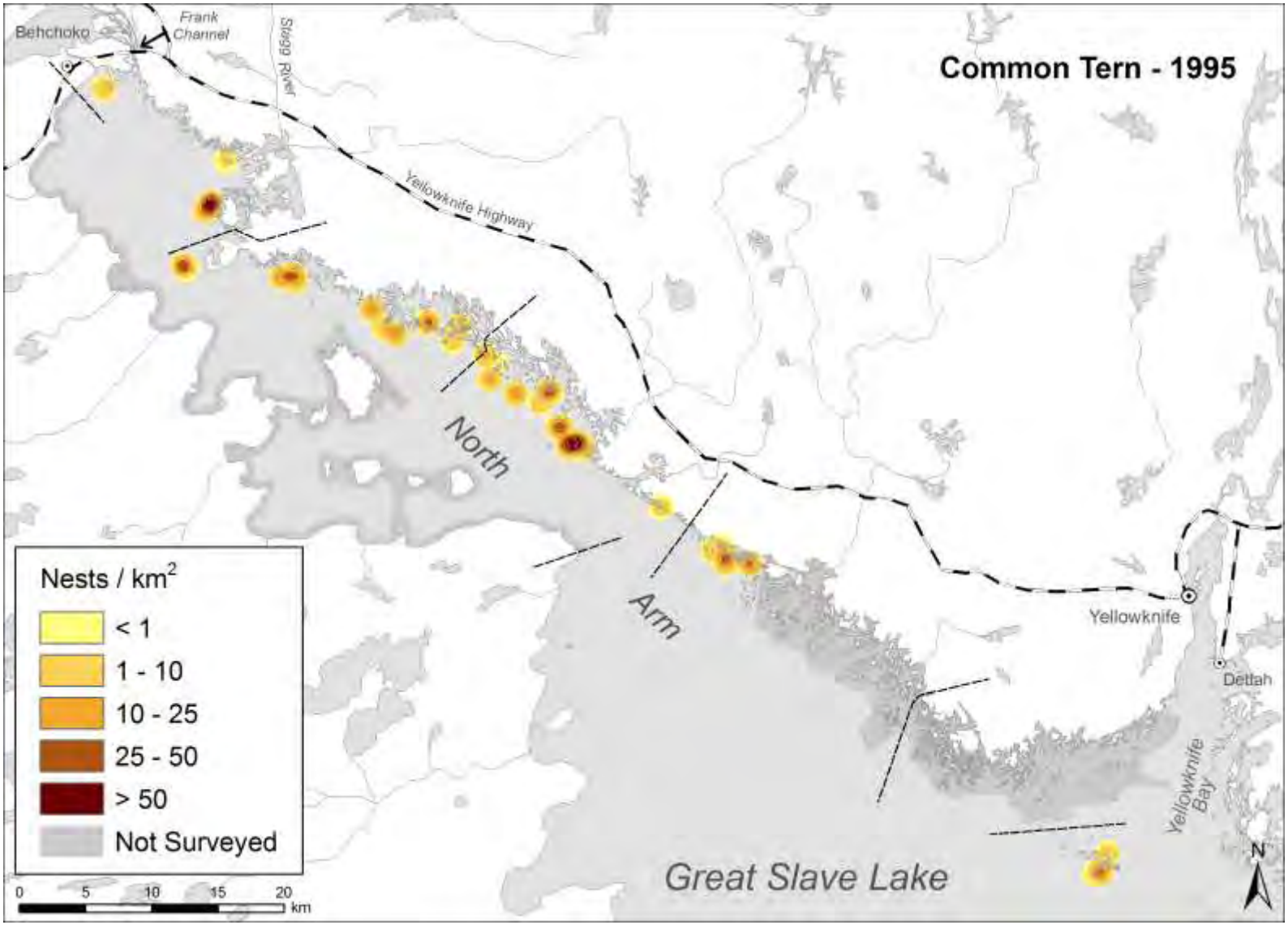

Figure 56. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 1995

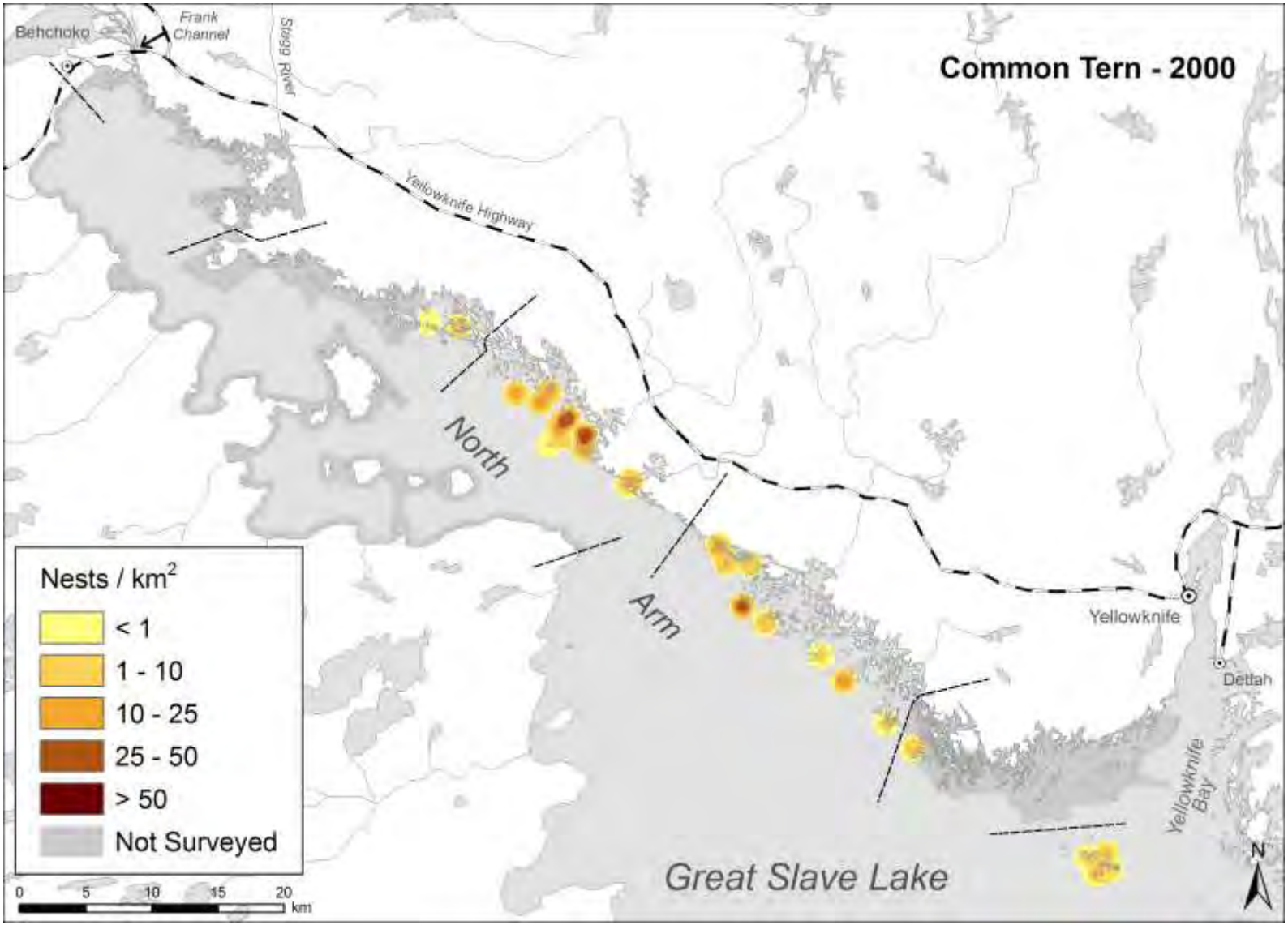

Figure 57. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 2000

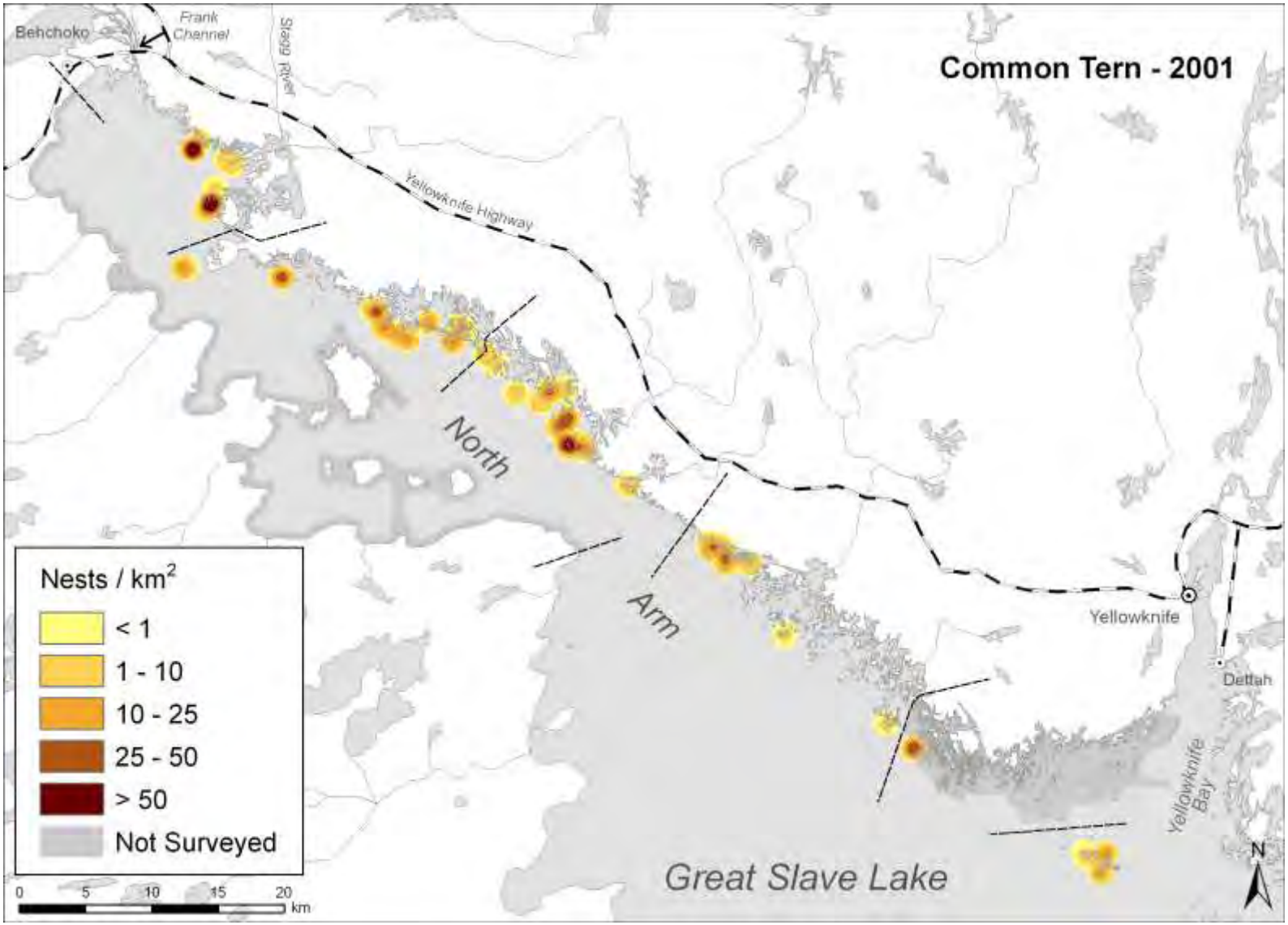

Figure 58. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 2001

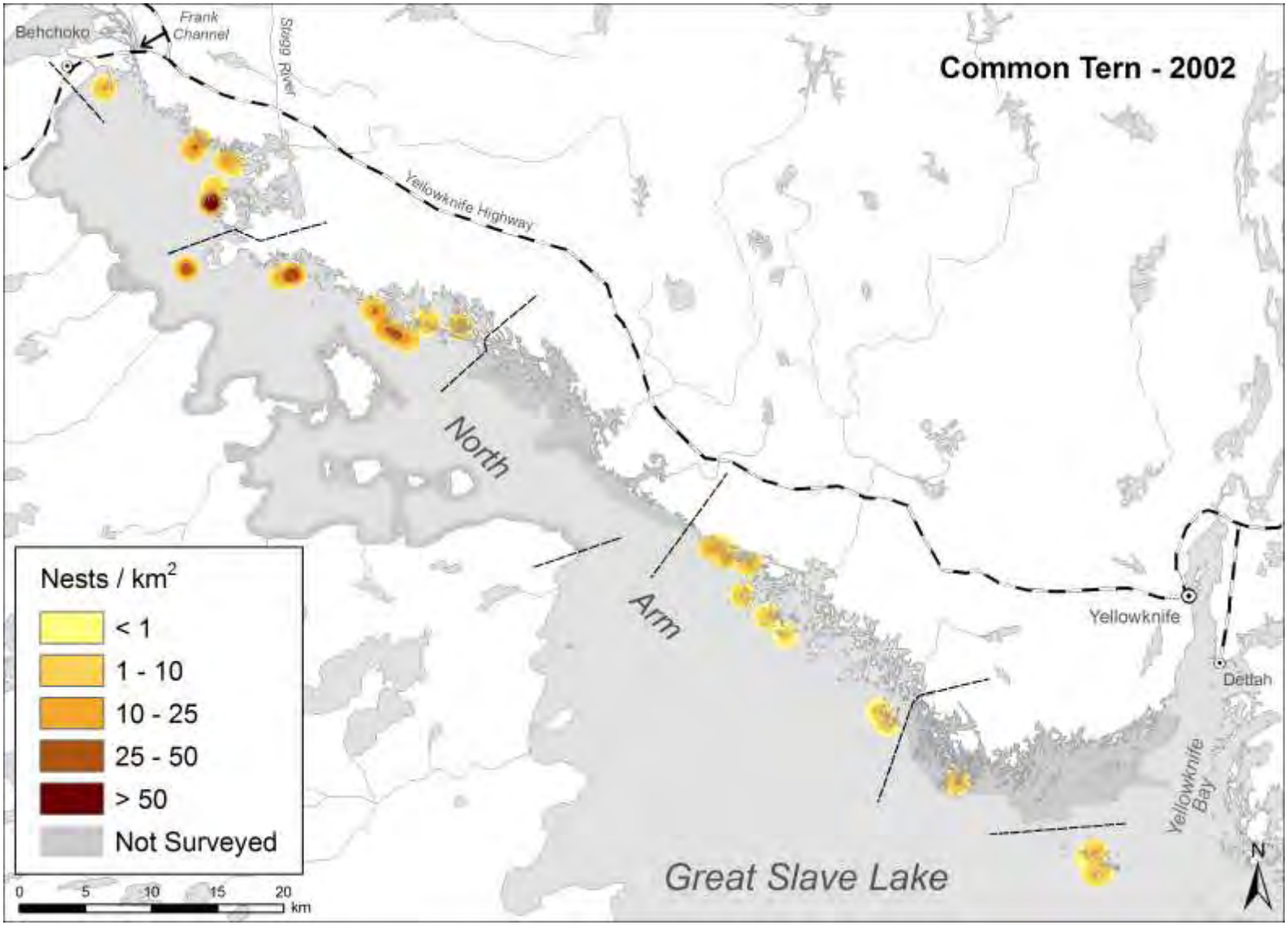

Figure 59. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 2002

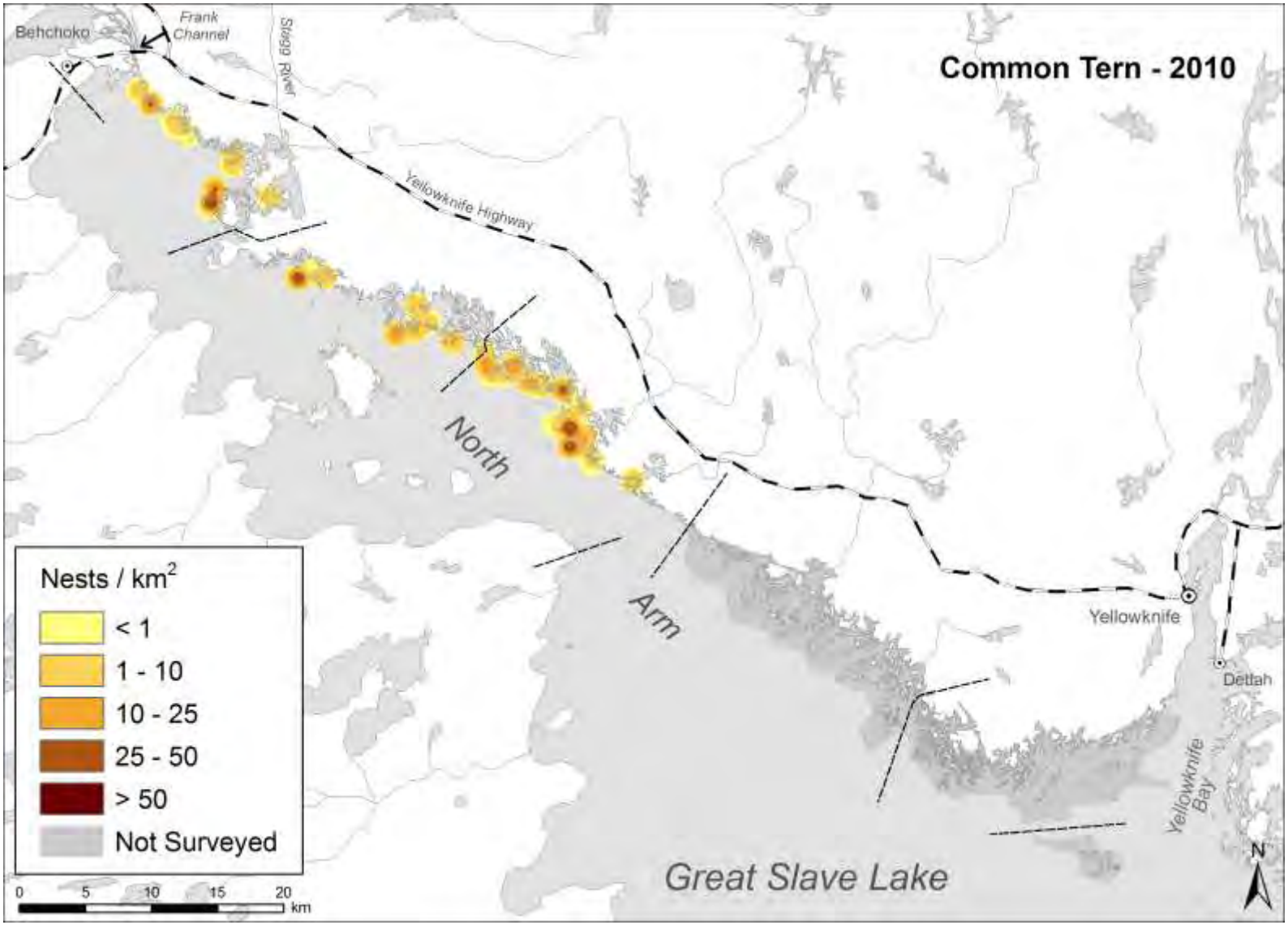

Figure 60. Distribution and density of Common Terns nesting on the North Arm of Great Slave Lake, 2010

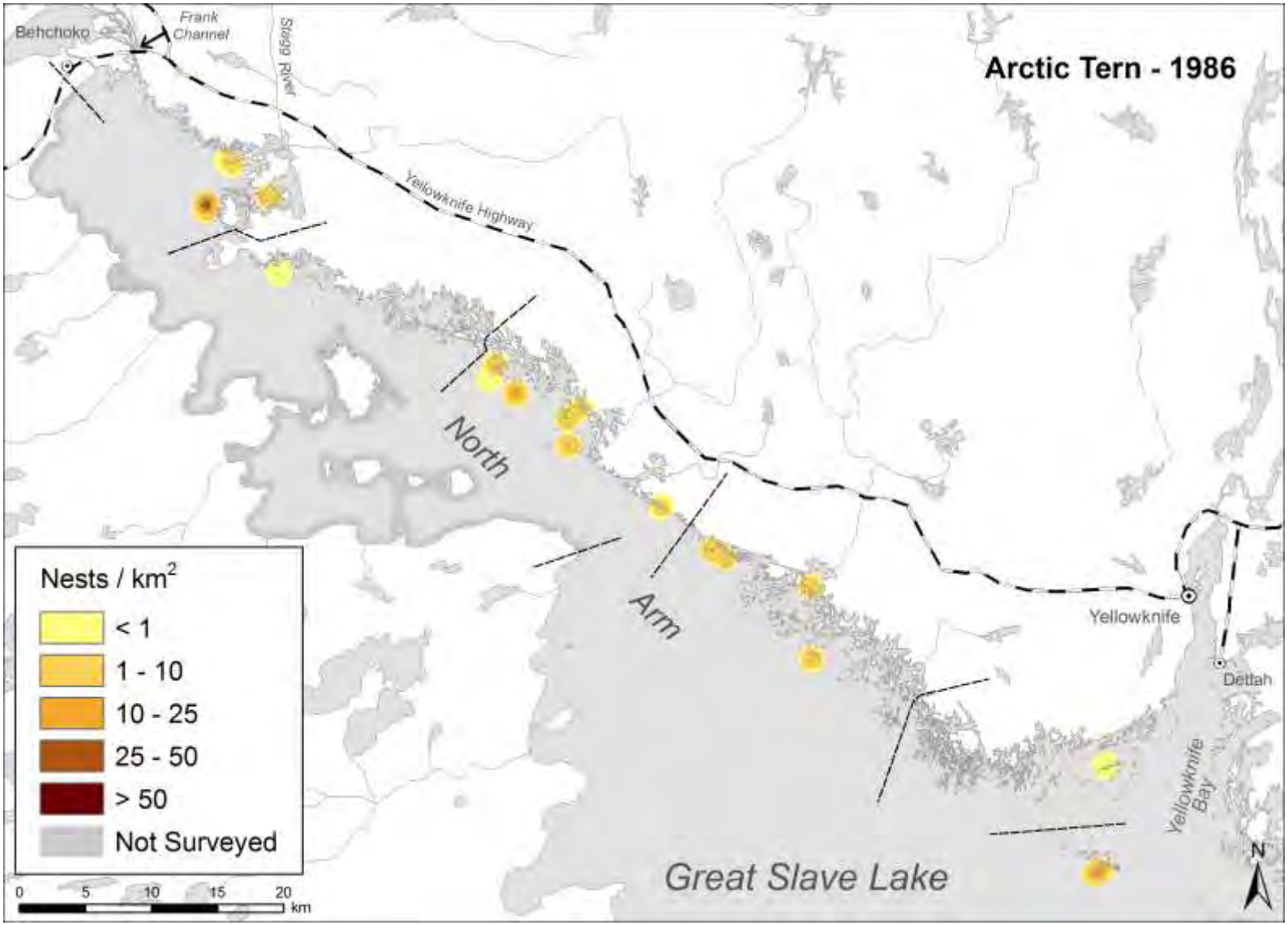

Figure 61. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1986

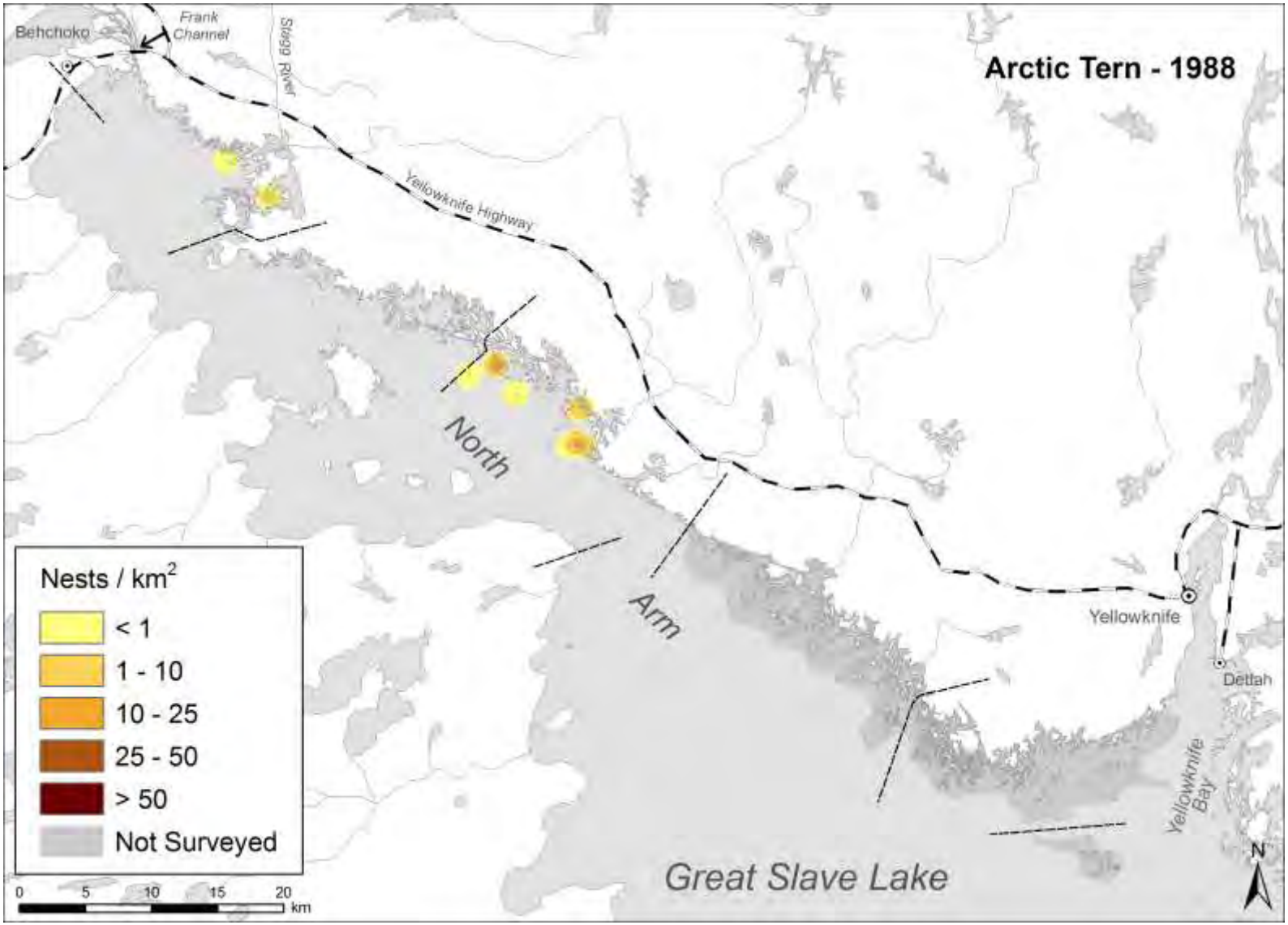

Figure 62. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1988

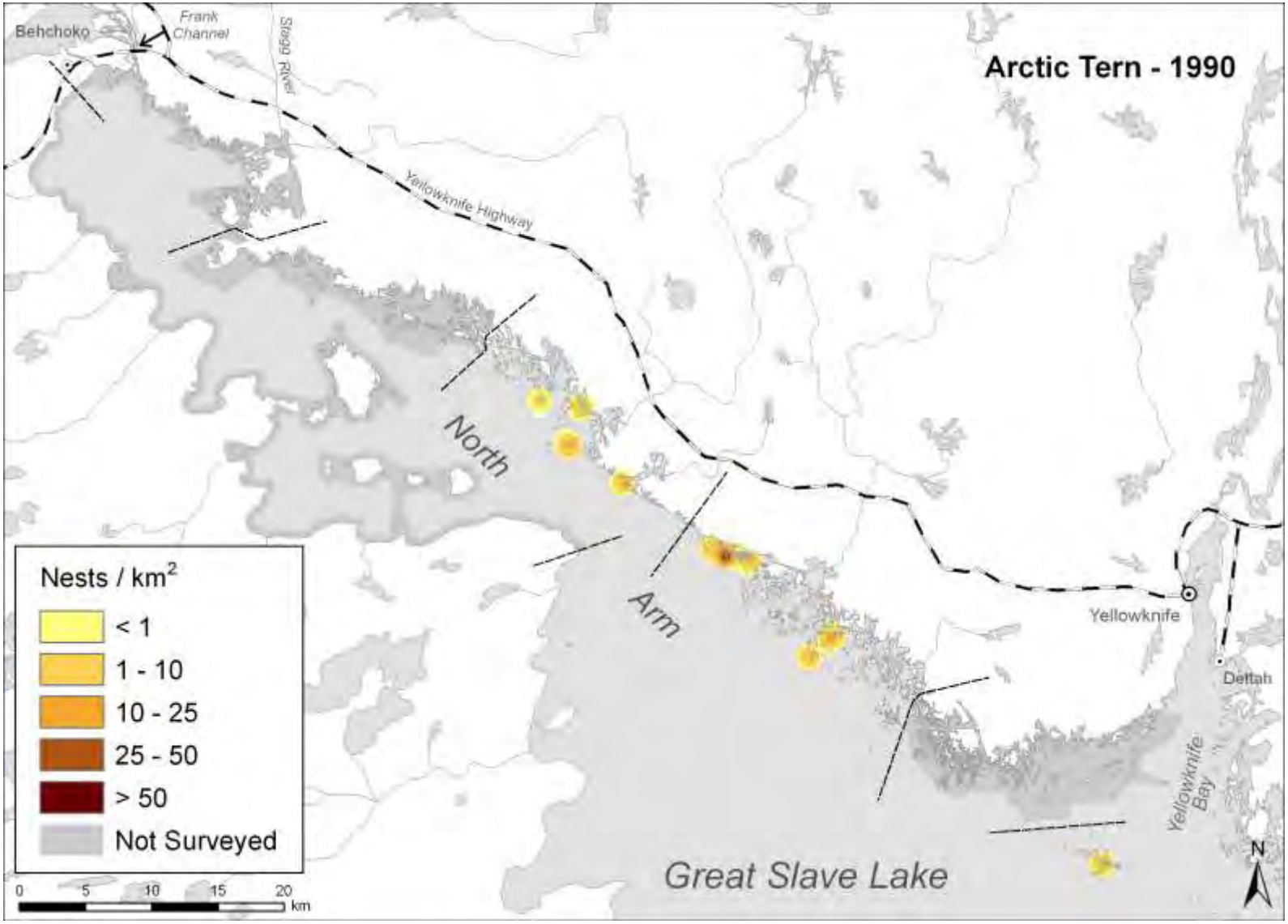

Figure 63. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1990

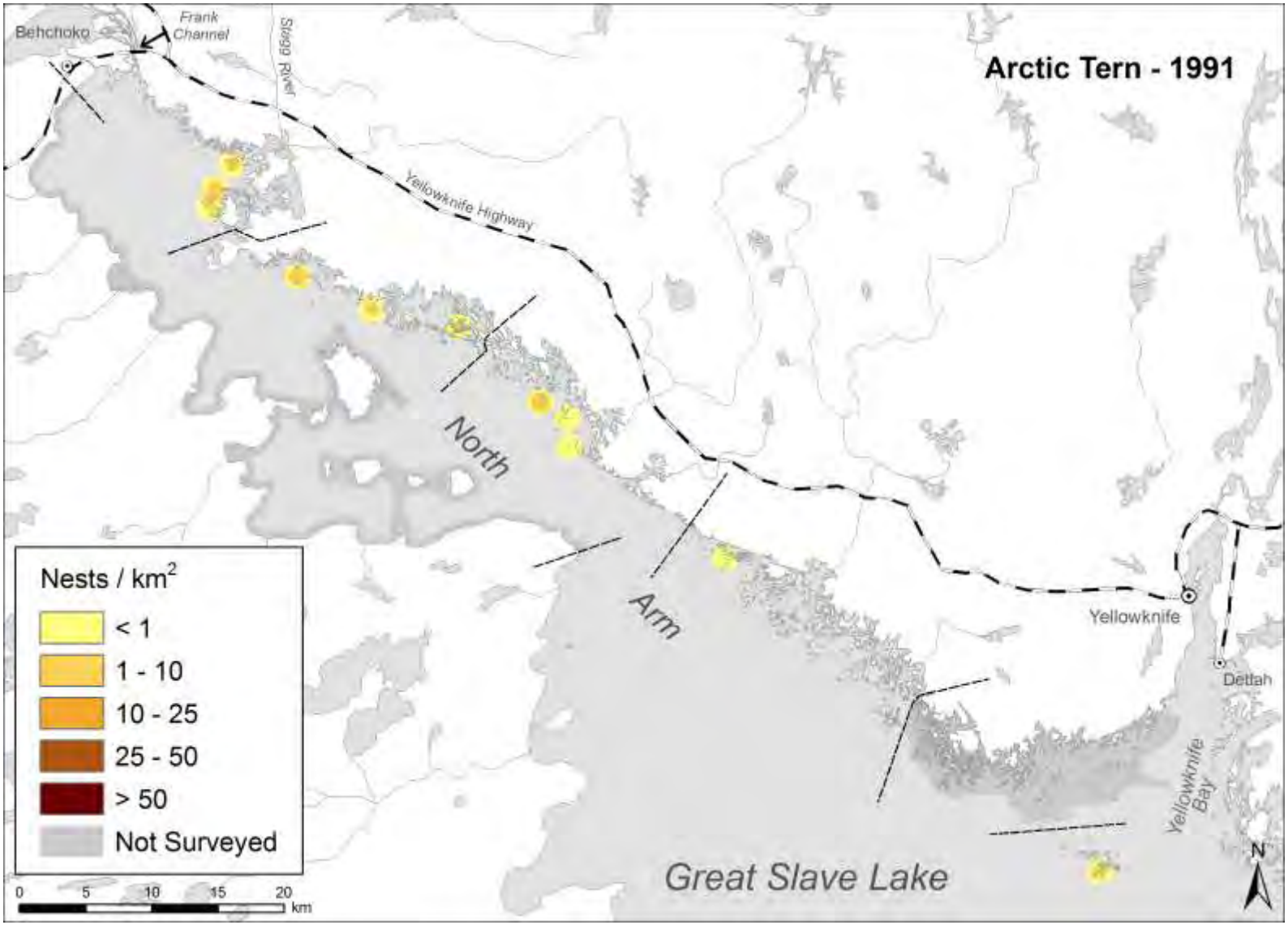

Figure 64. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1991

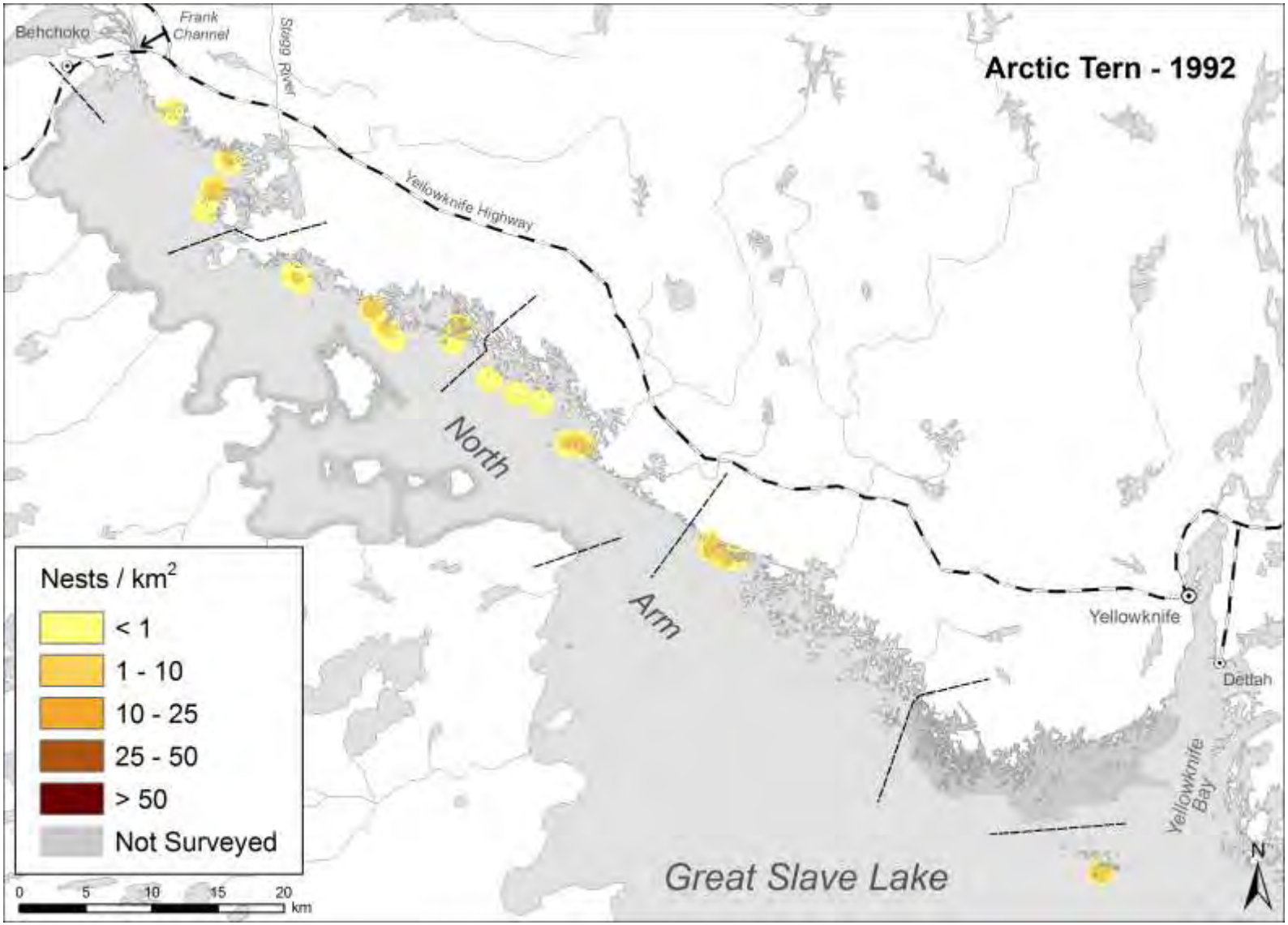

Figure 65. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1992

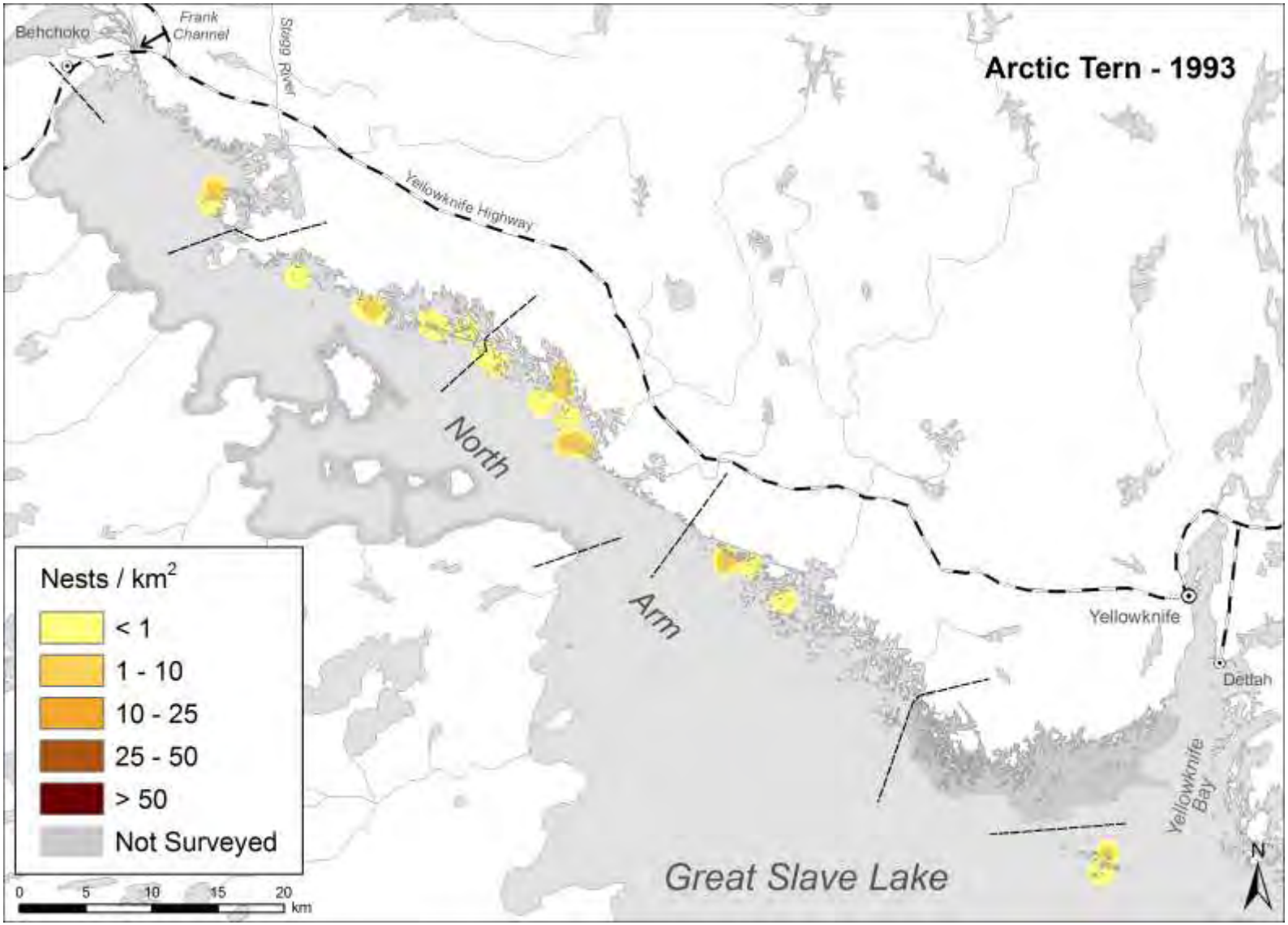

Figure 66. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1993

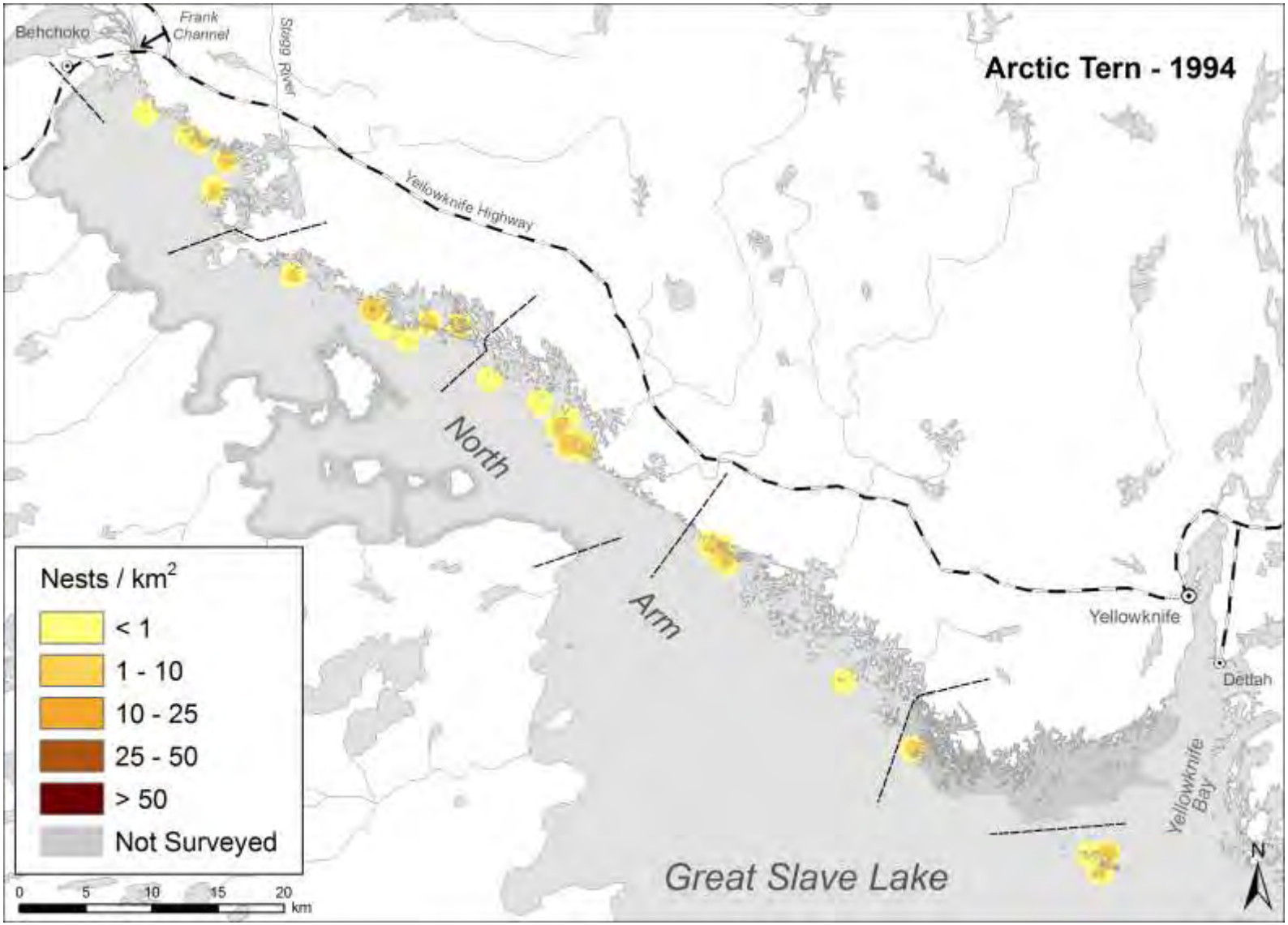

Figure 67. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1994

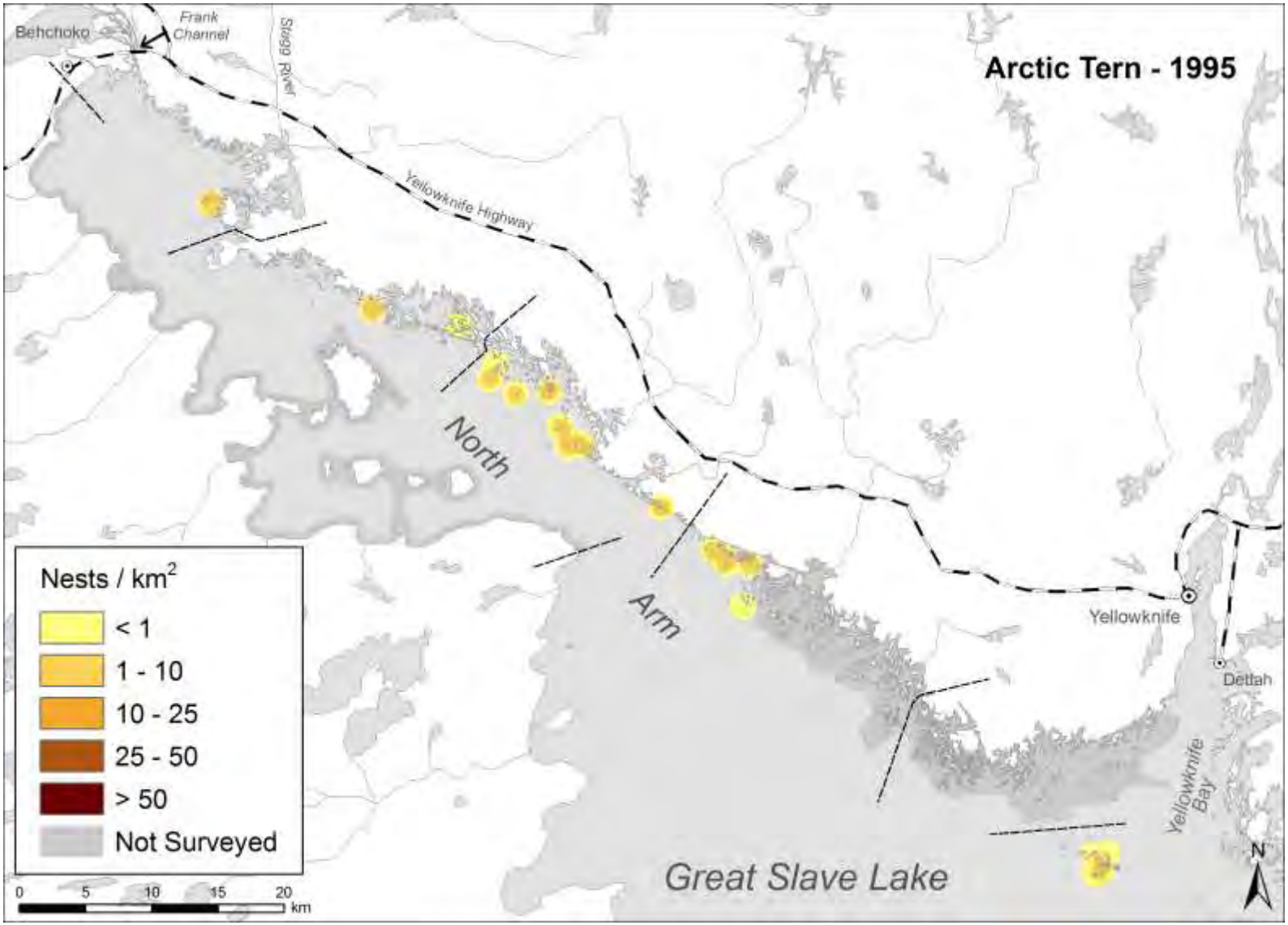

Figure 68. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 1995

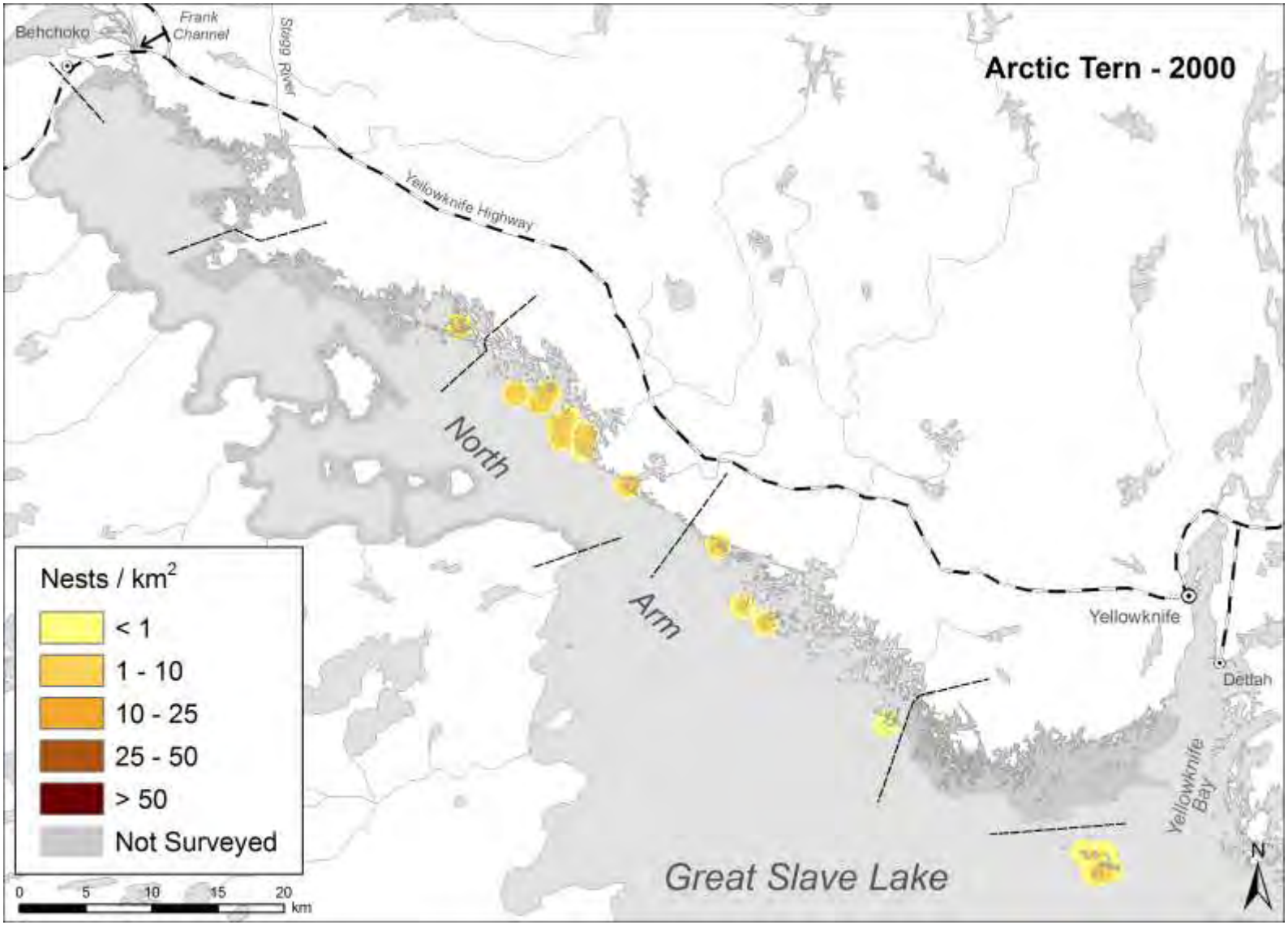

Figure 69. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 2000

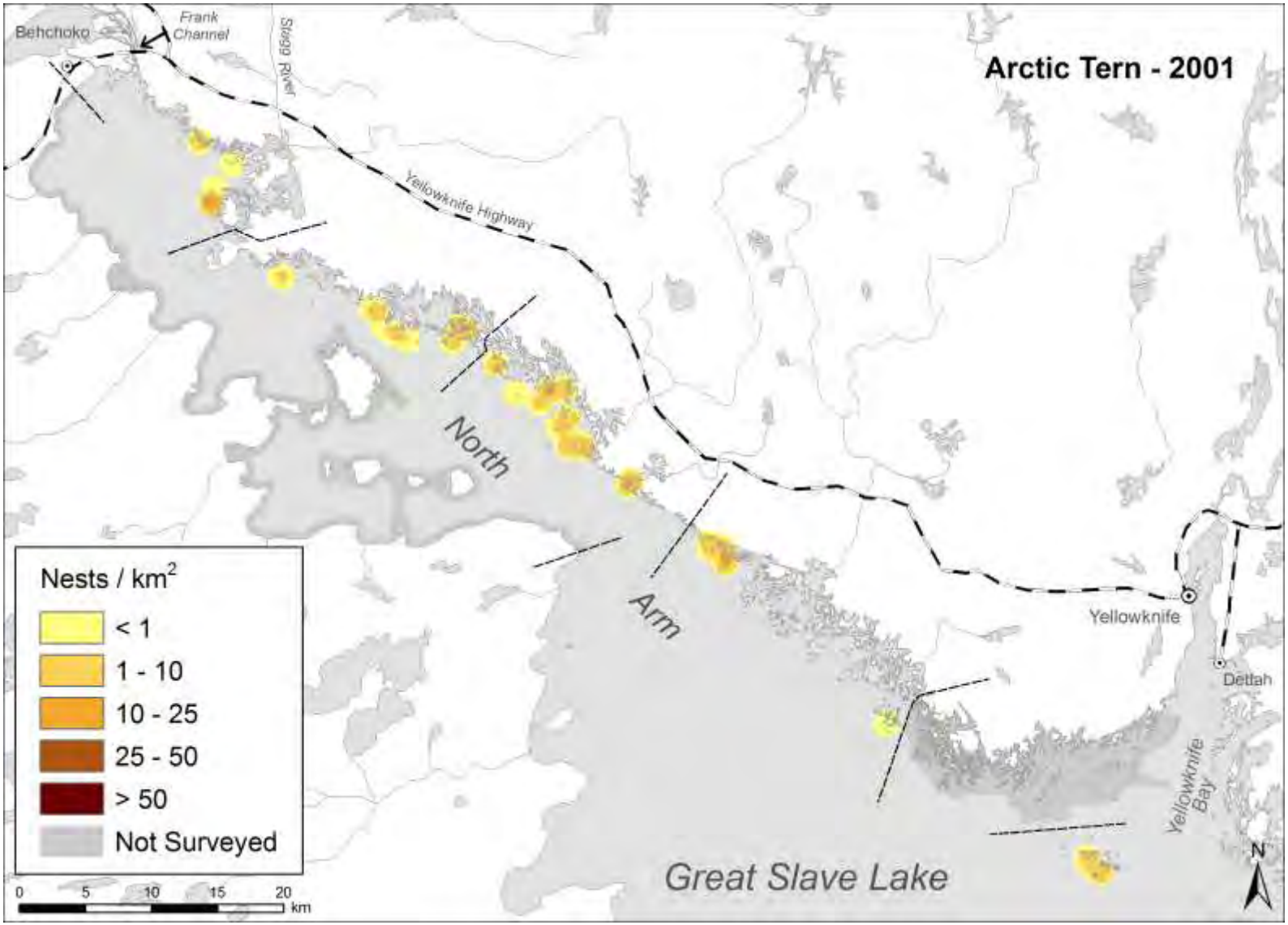

Figure 70. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 2001

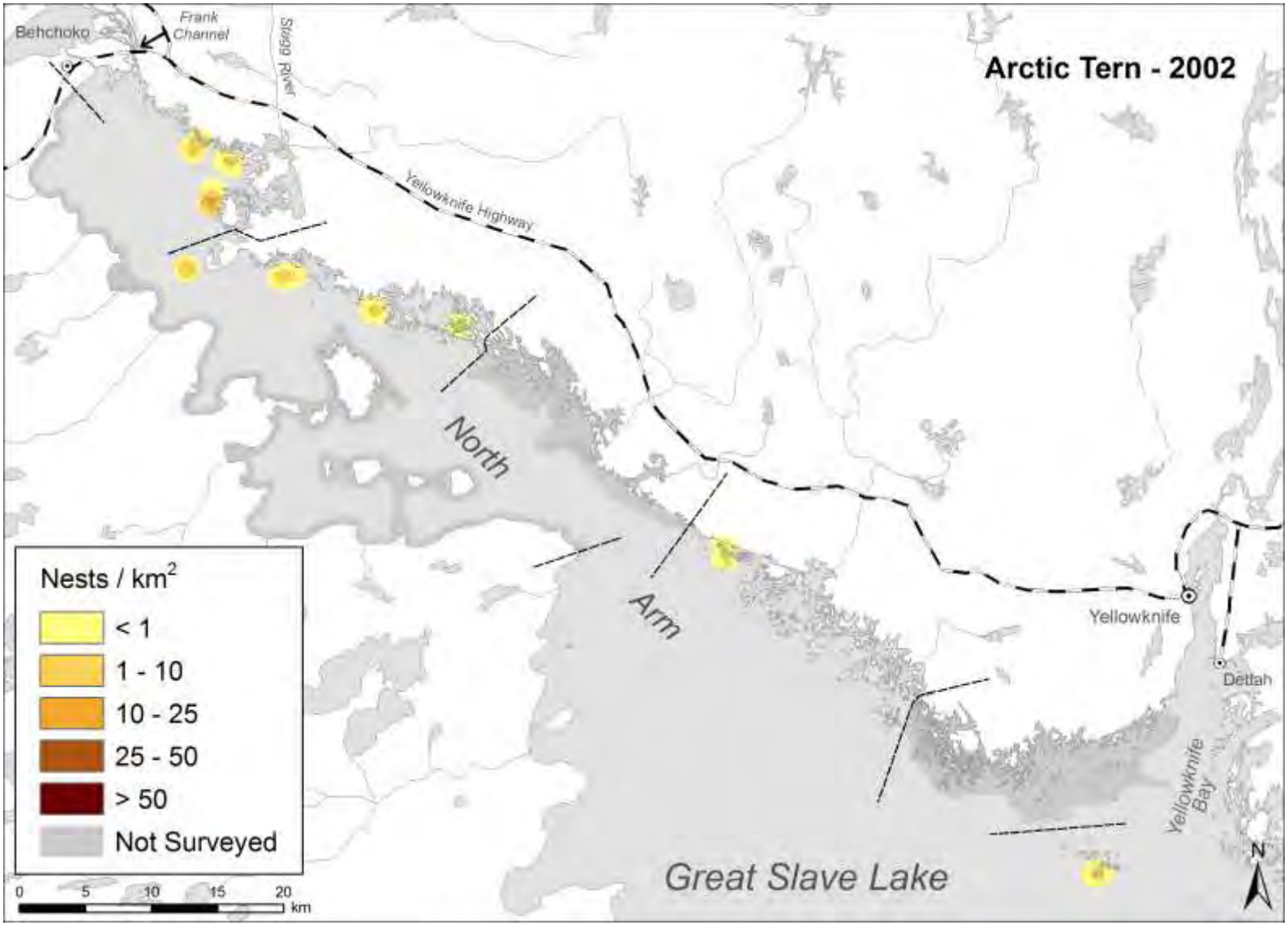

Figure 71. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 2002

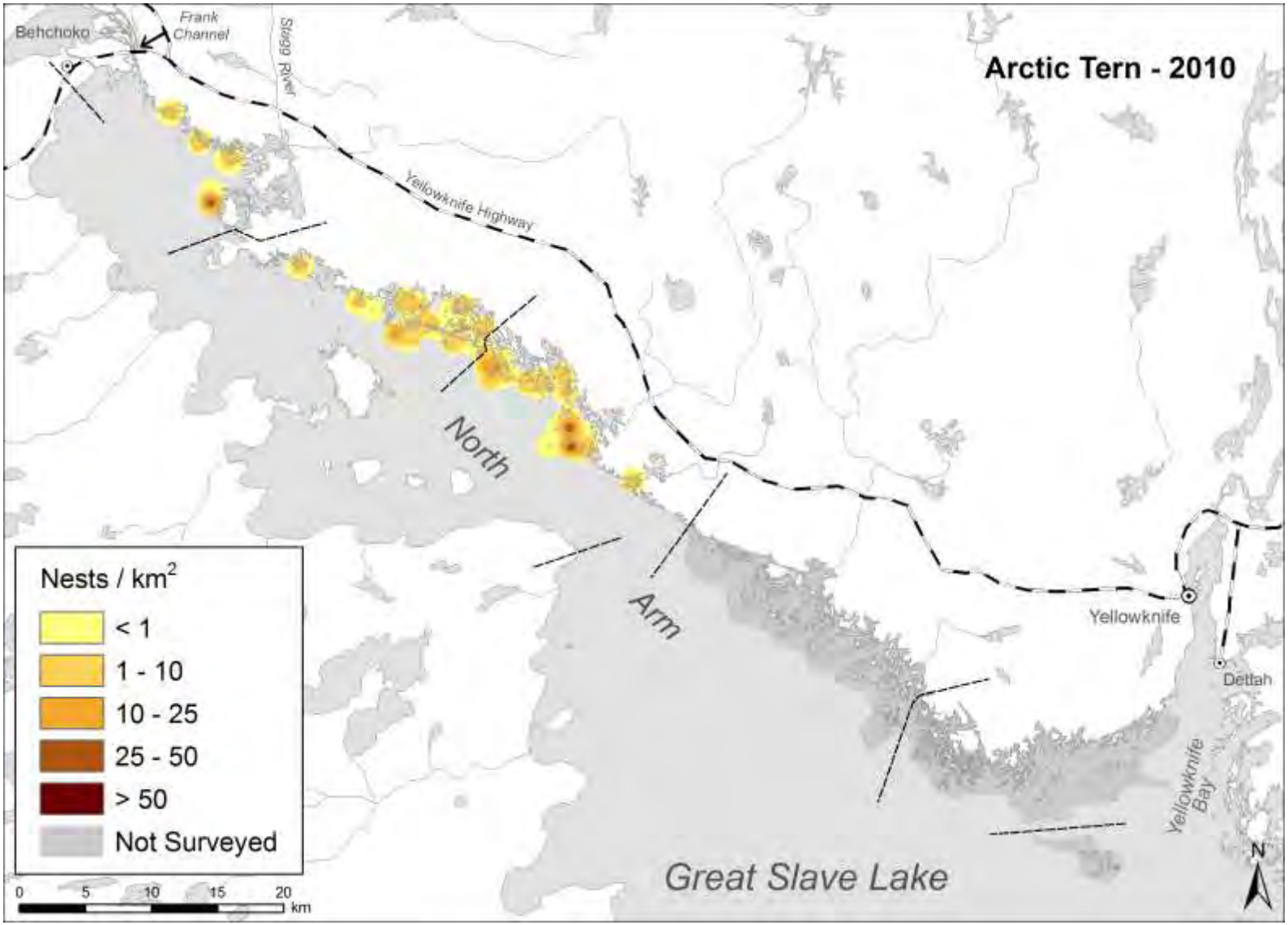

Figure 72. Distribution and density of Arctic Terns nesting on the North Arm of Great Slave Lake, 2010

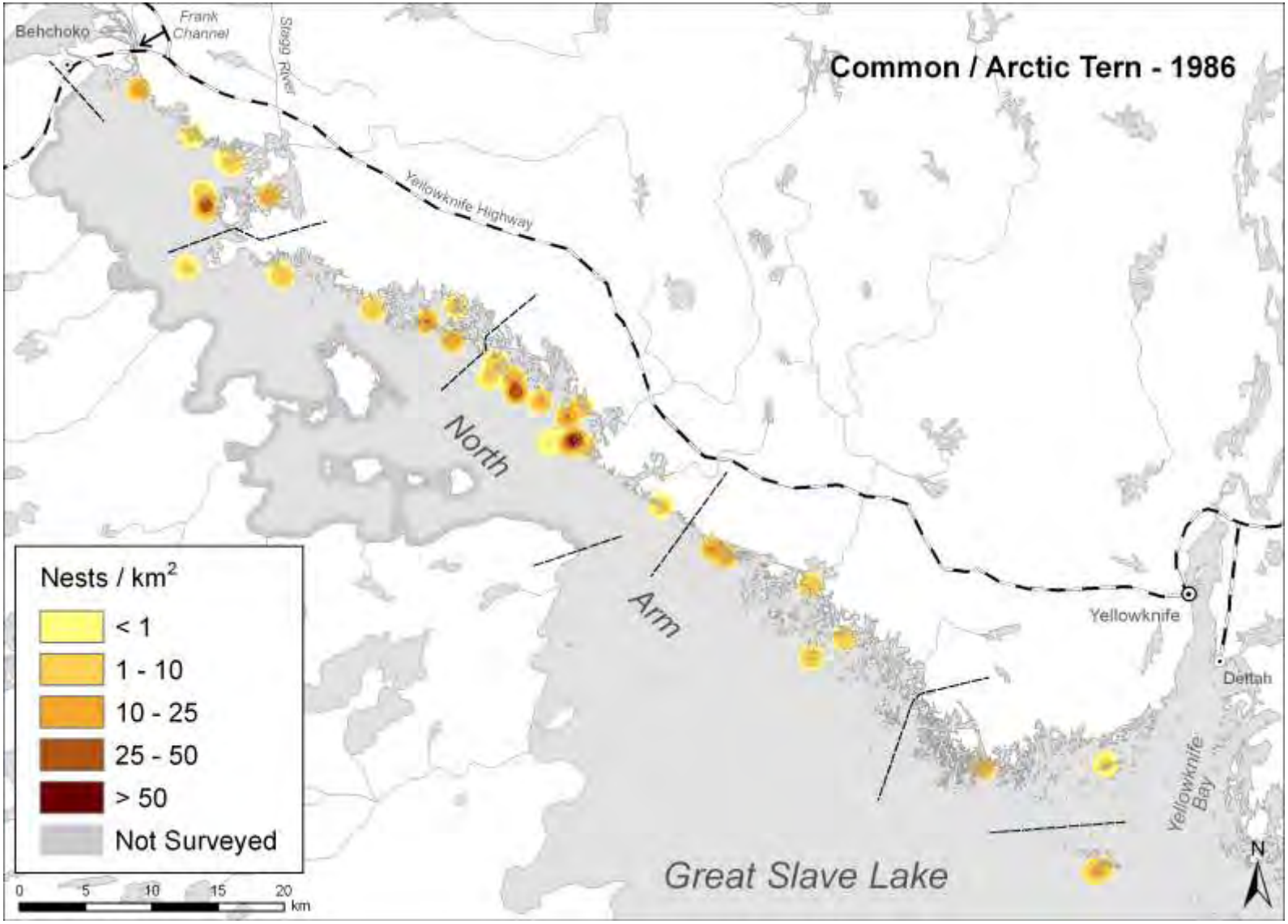

Figure 73. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1986

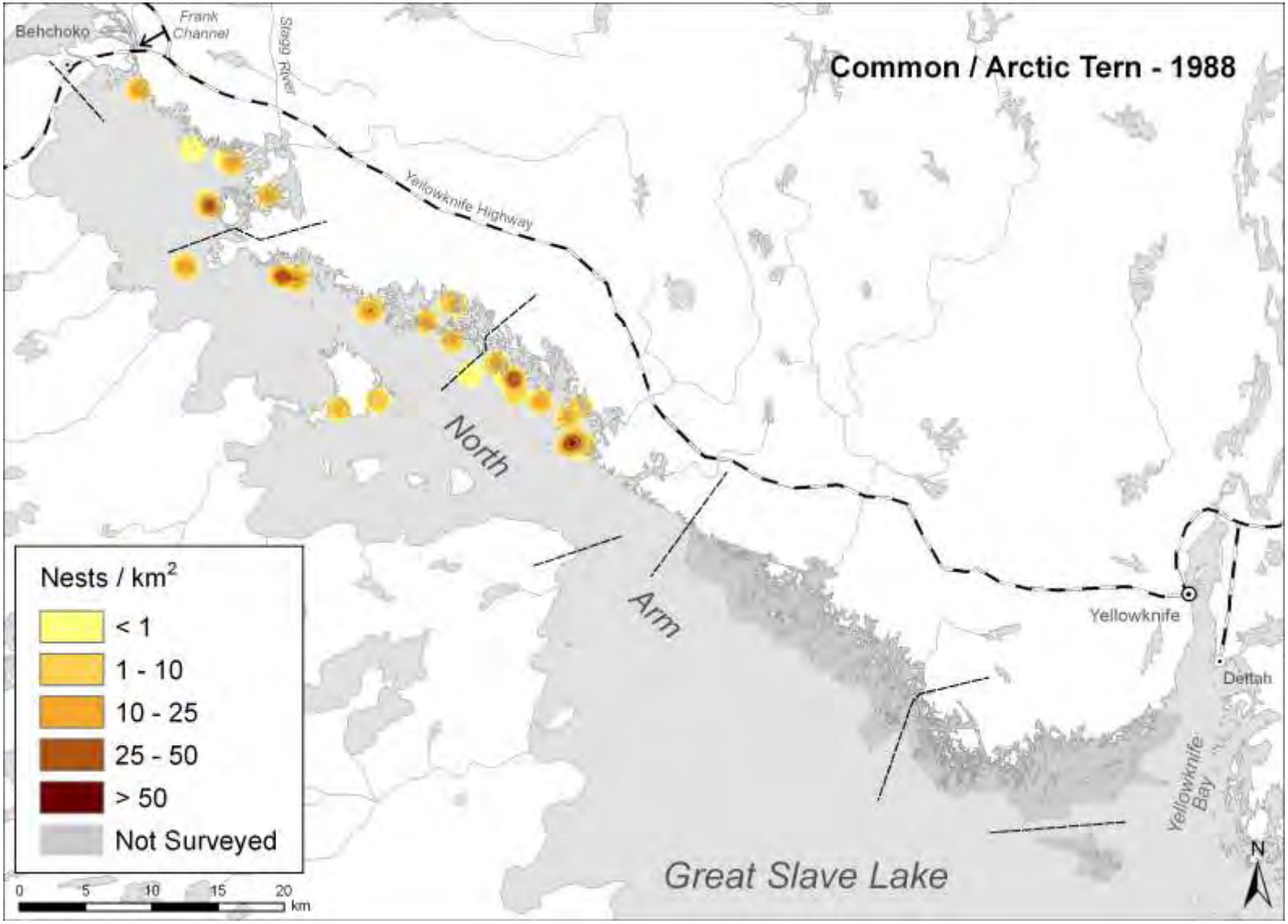

Figure 74. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1988

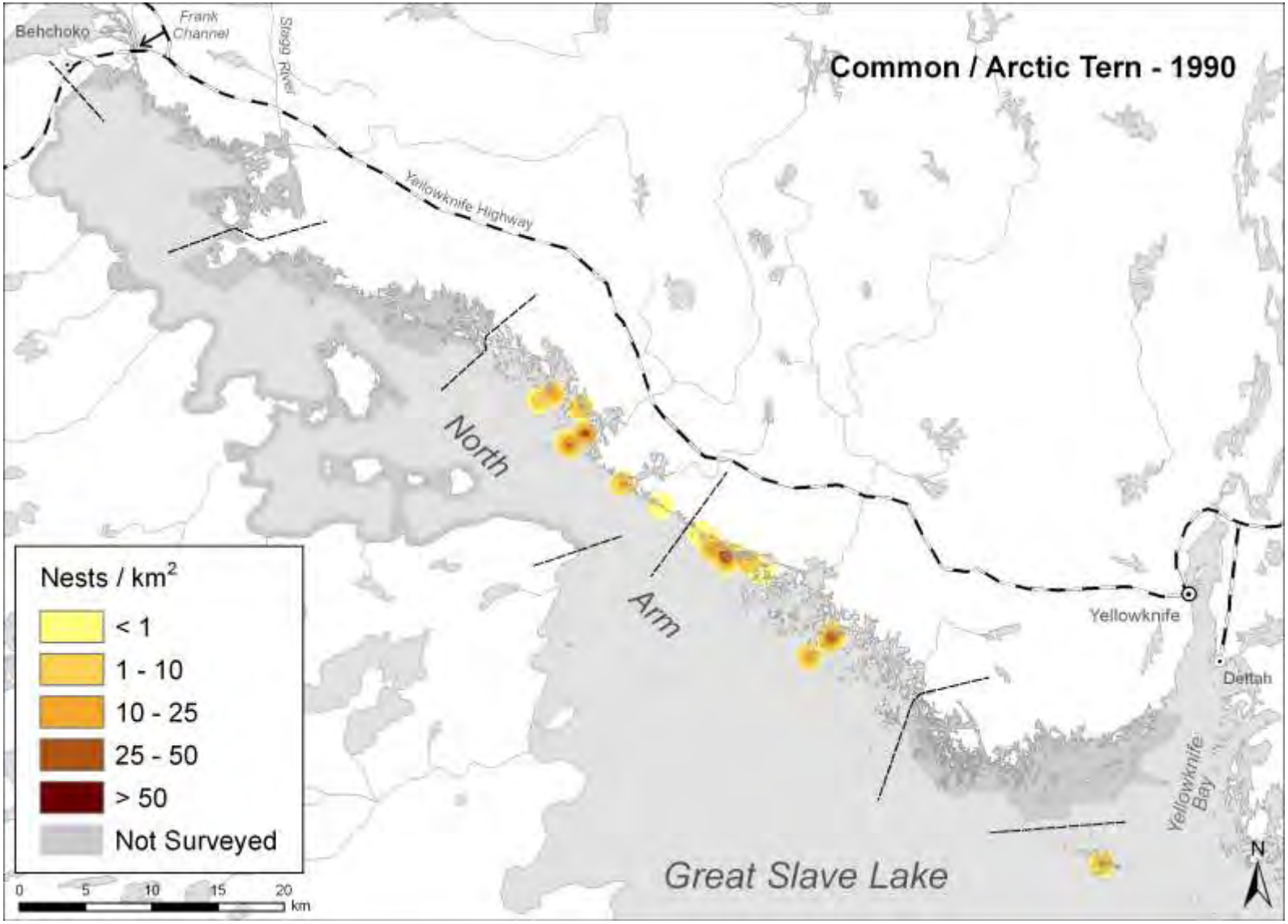

Figure 75. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1990

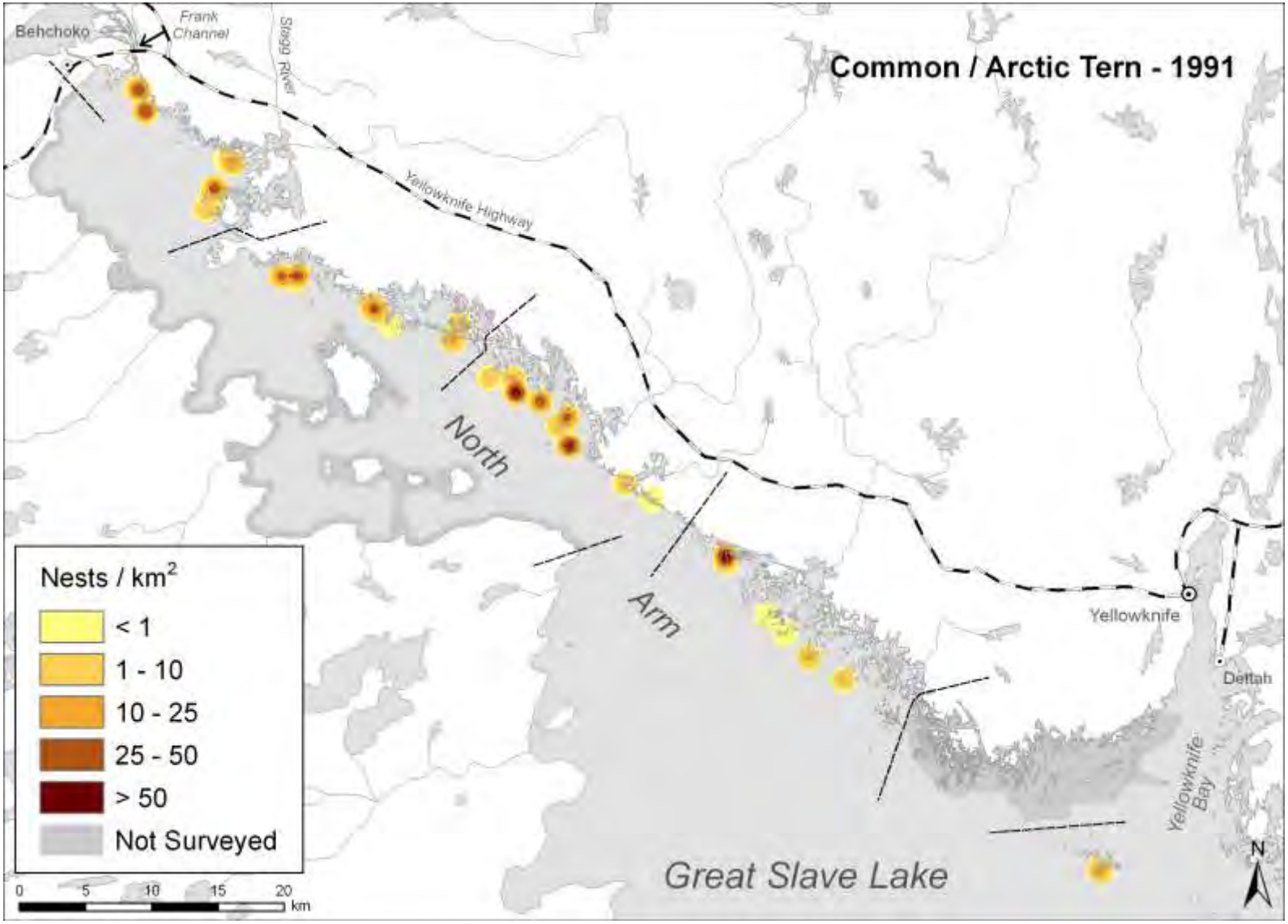

Figure 76. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1991

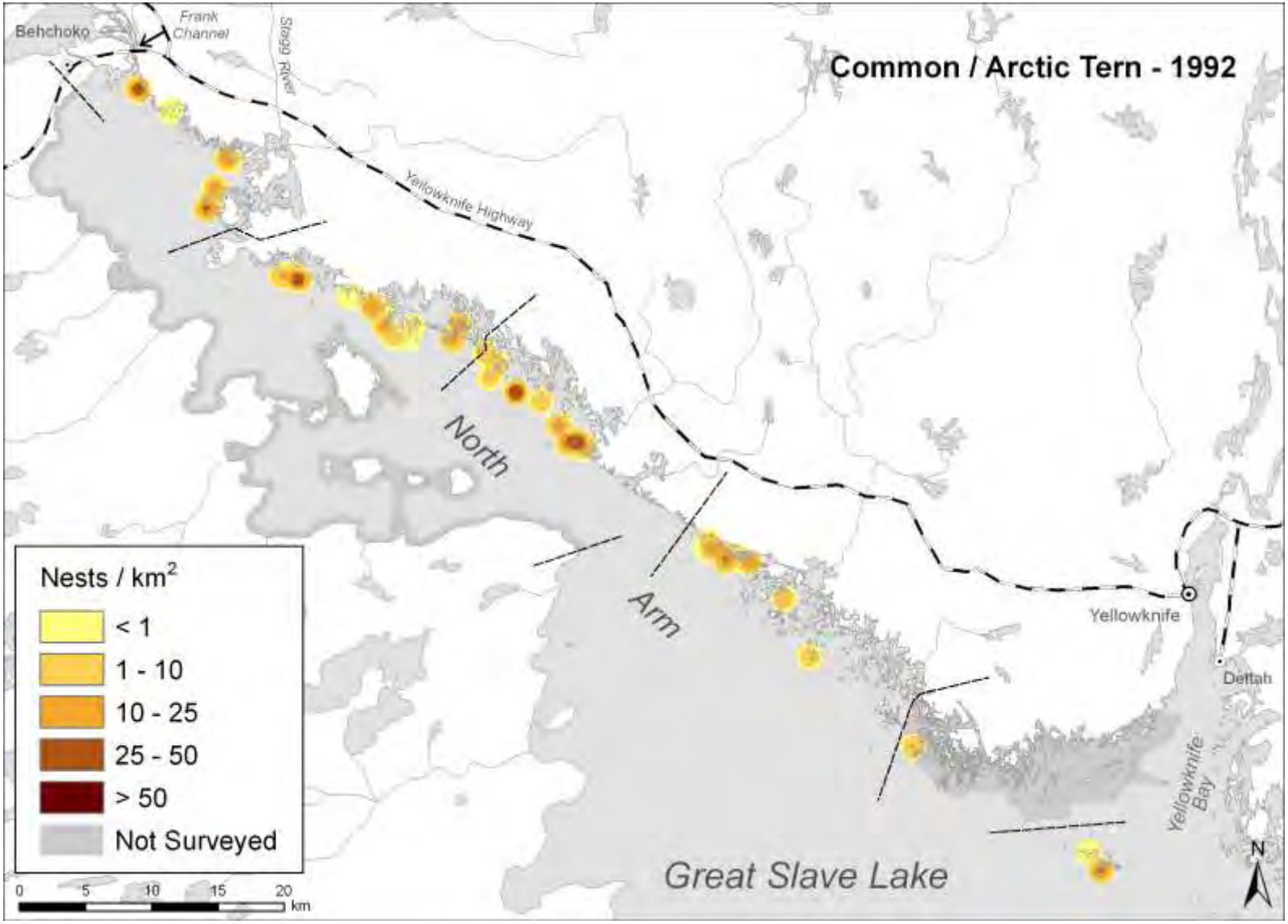

Figure 77. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1992

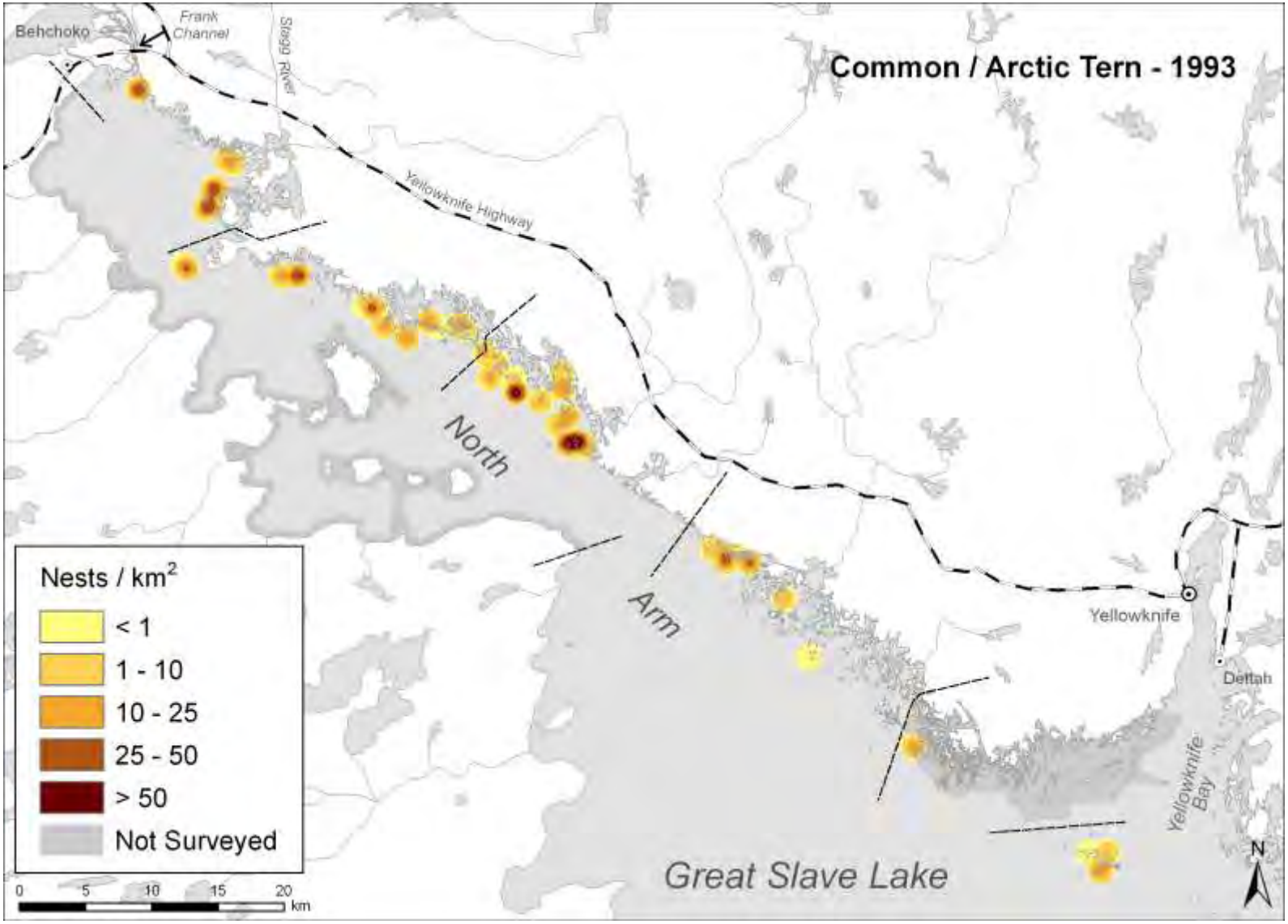

Figure 78. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1993

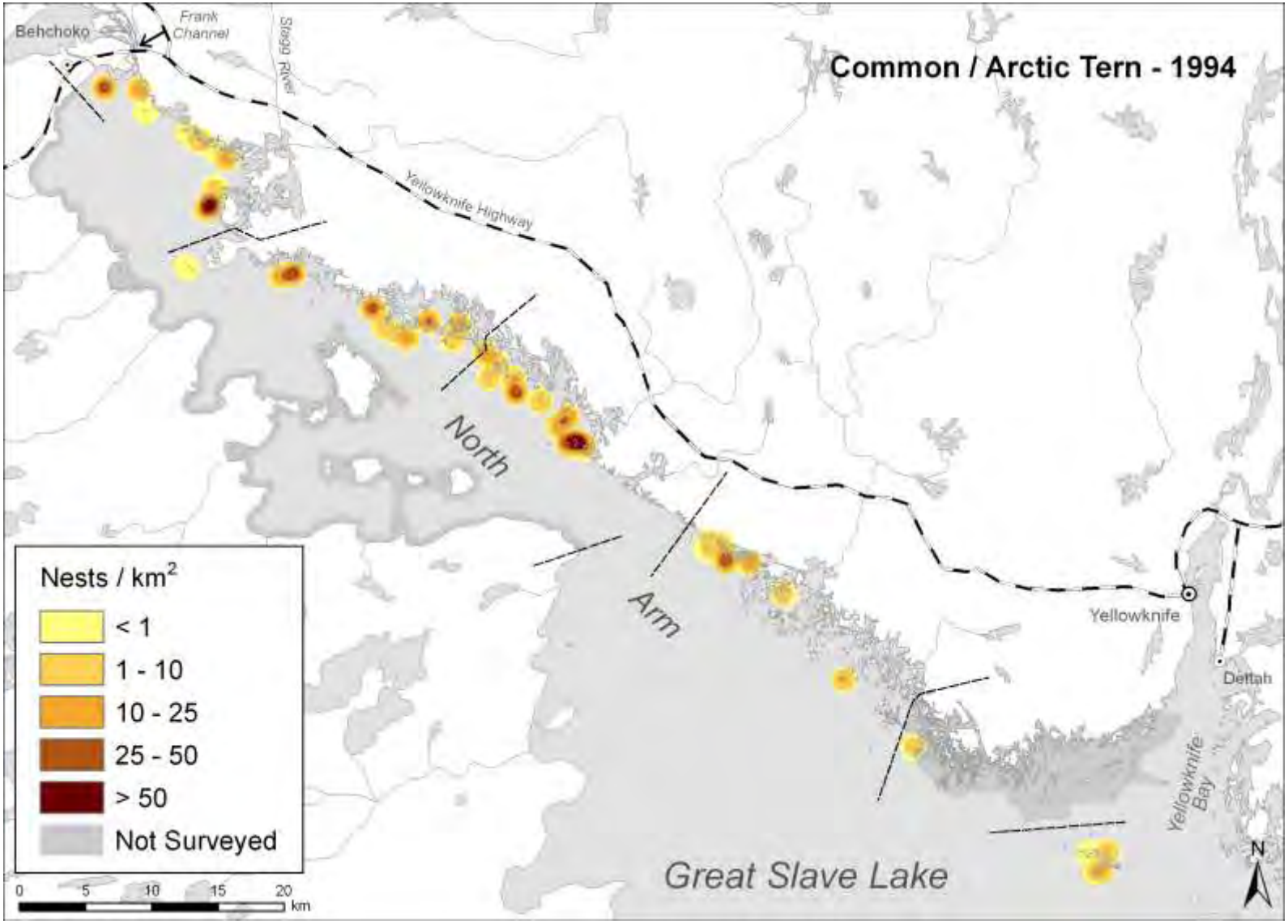

Figure 79. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1994

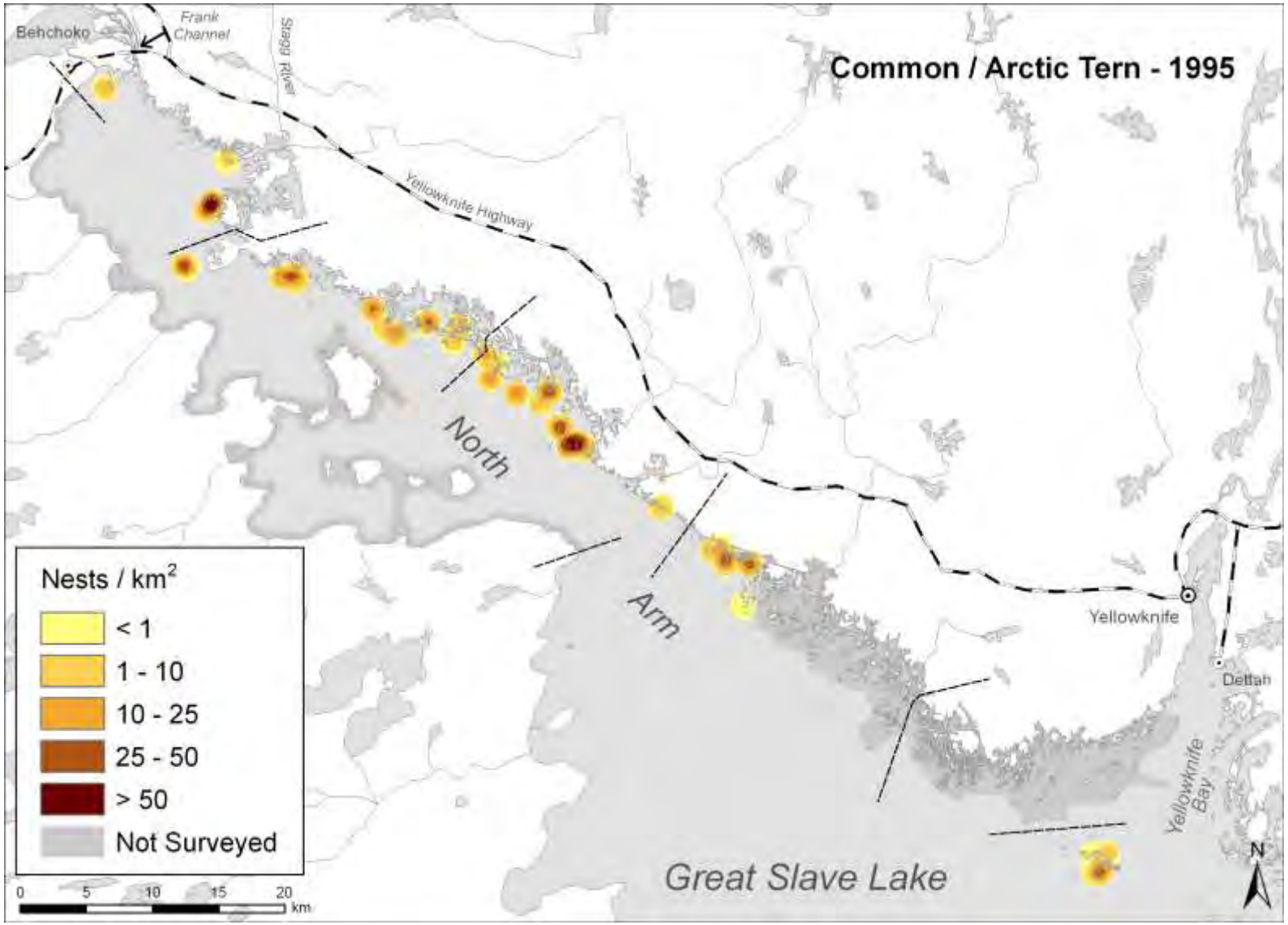

Figure 80. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 1995

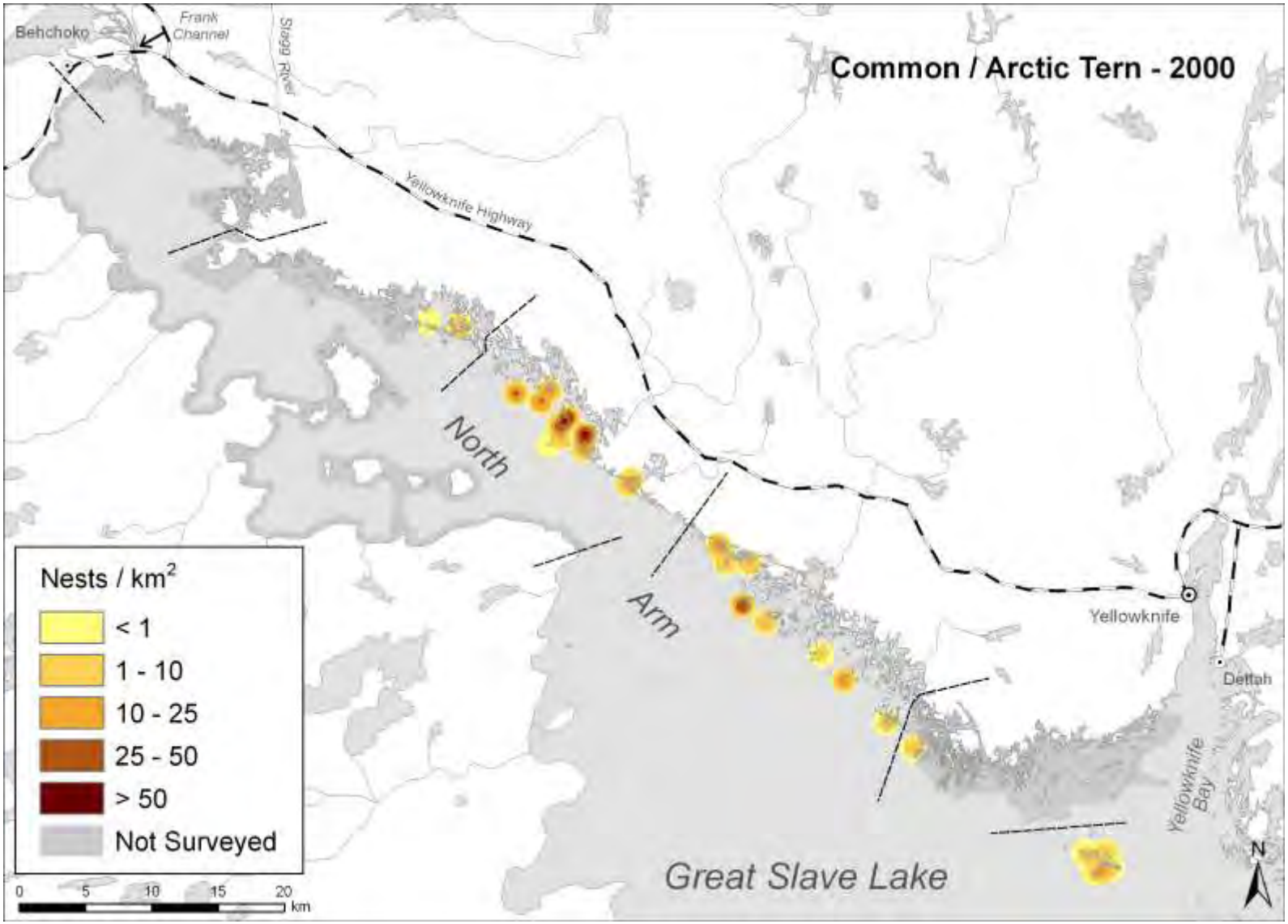

Figure 81. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 2000

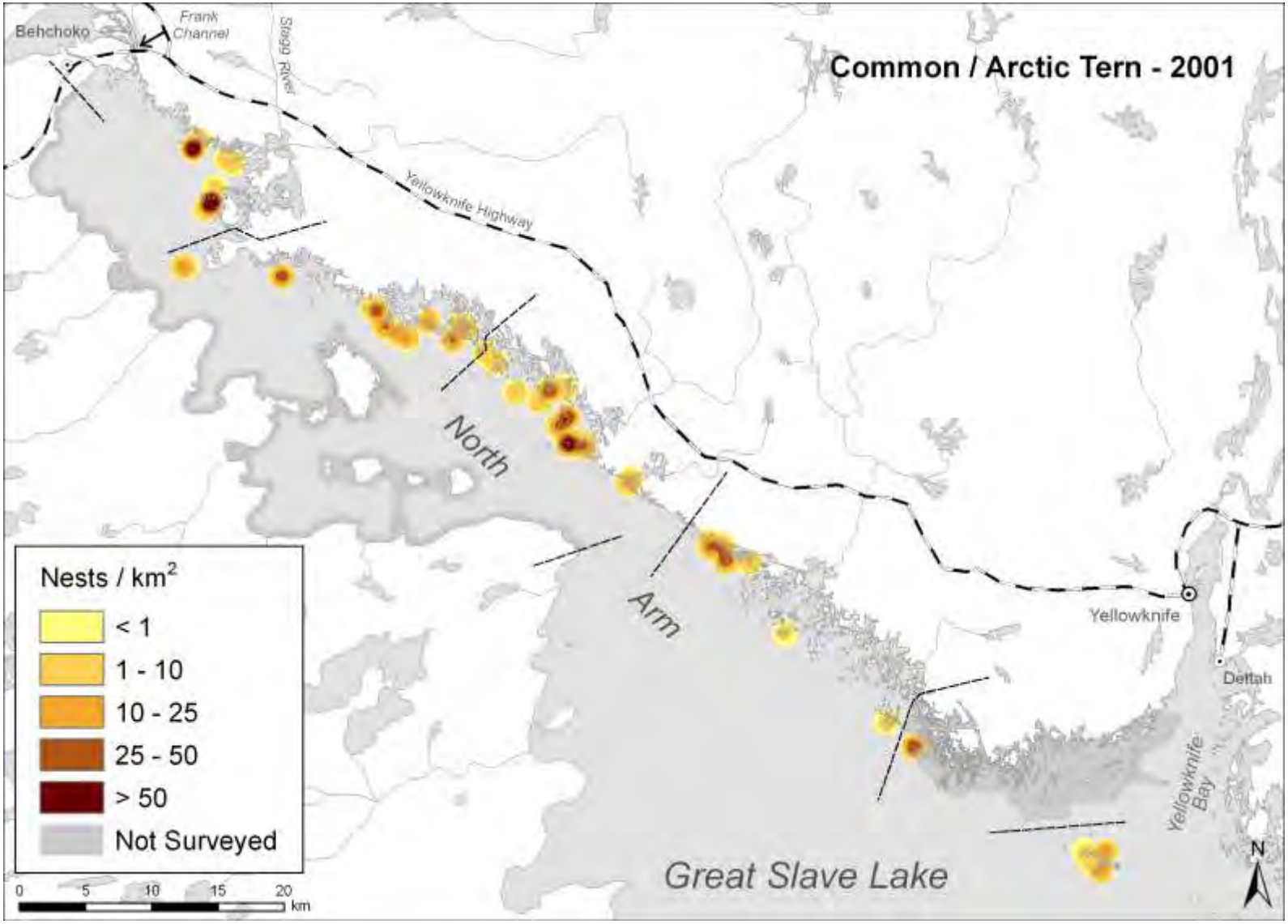

Figure 82. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 2001

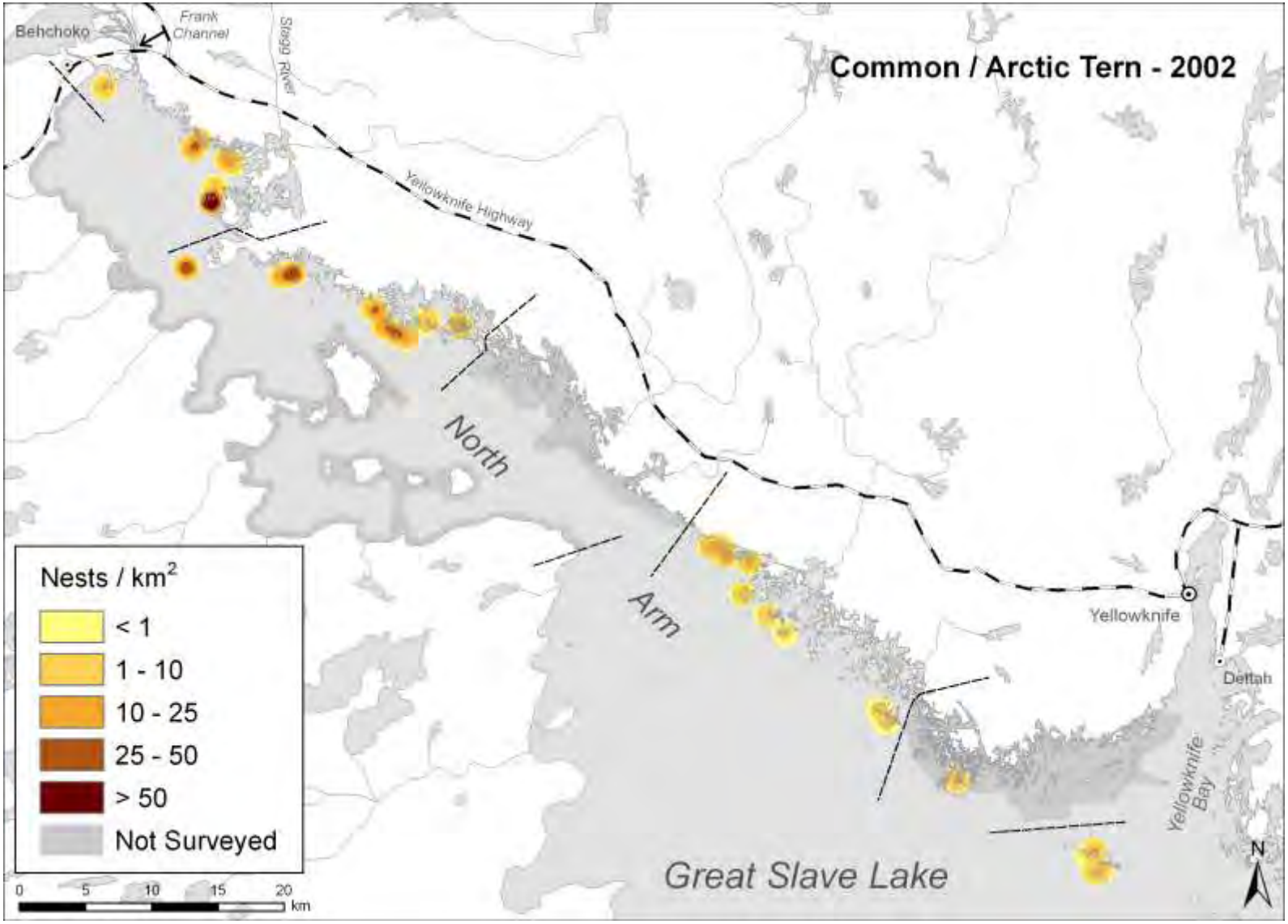

Figure 83. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 2002

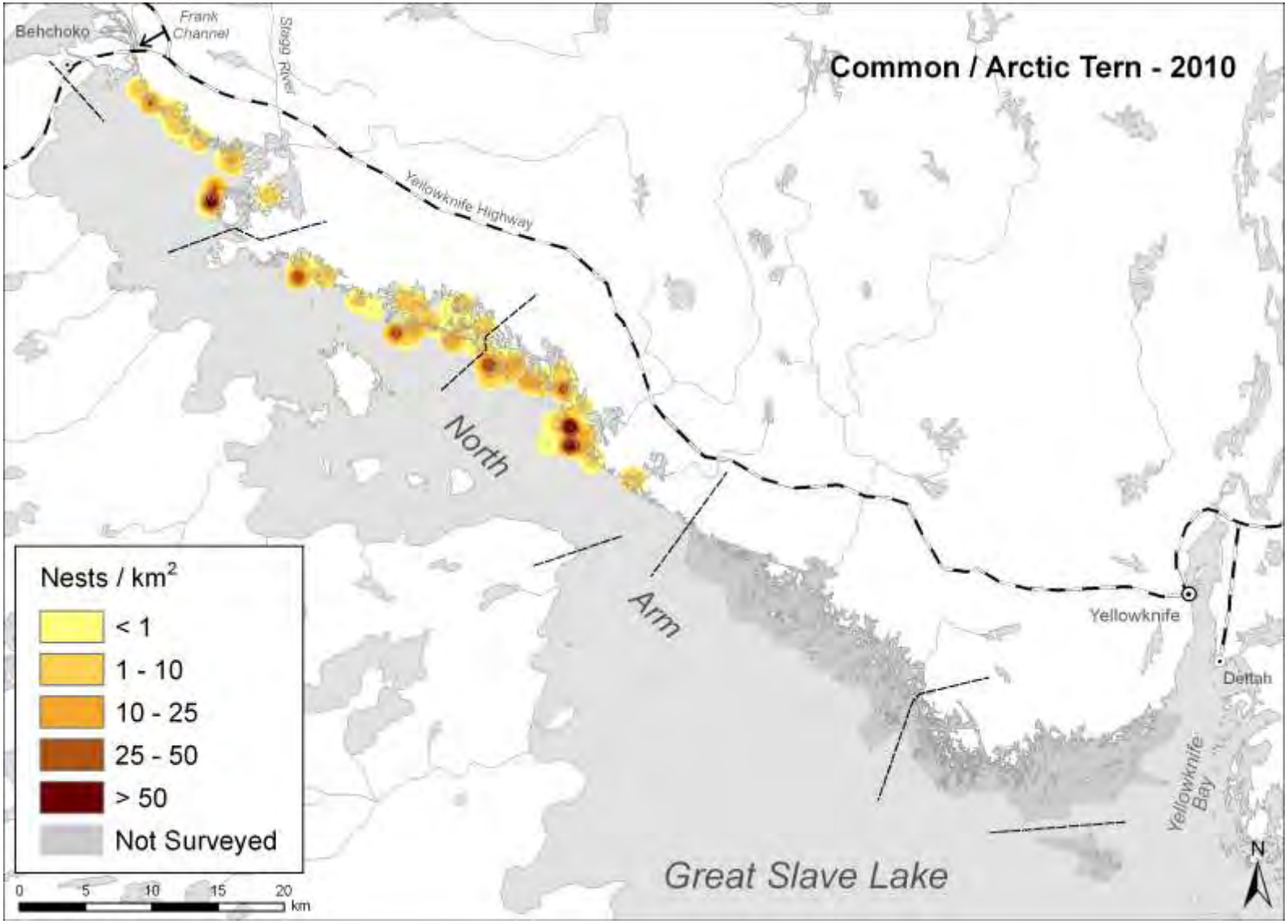

Figure 84. Distribution and density of Common and Arctic terns nesting on the North Arm of Great Slave Lake, 2010

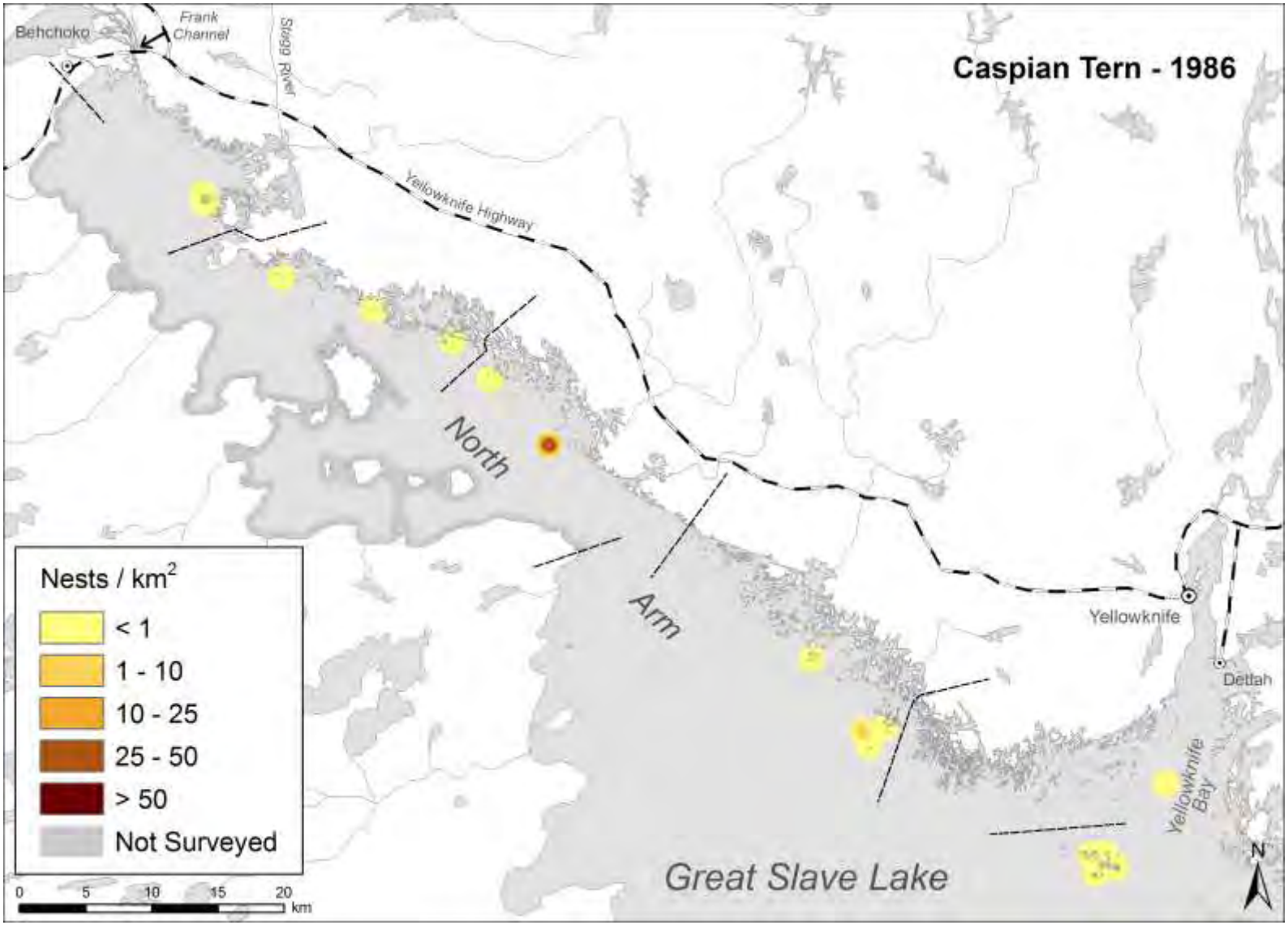

Figure 85. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1986

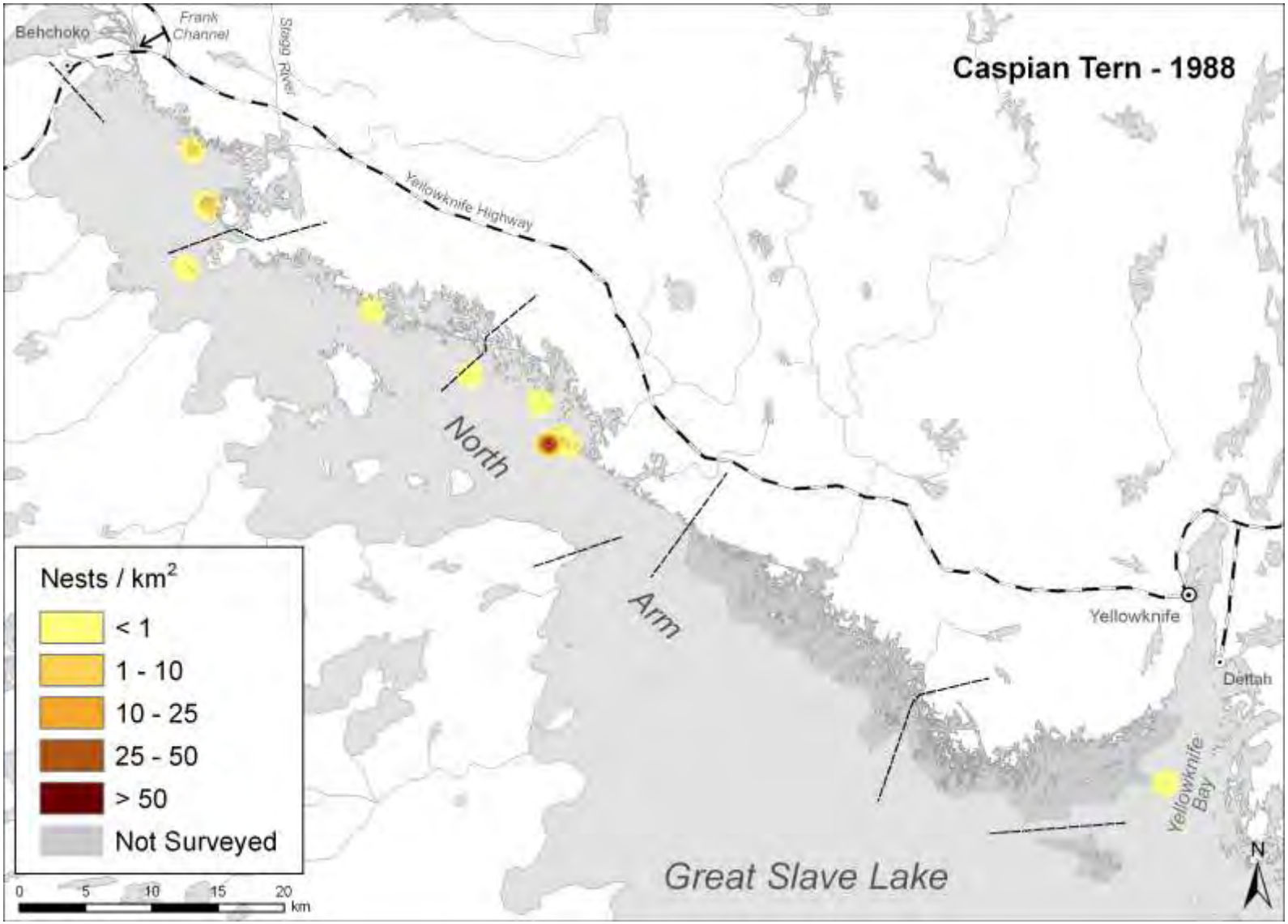

Figure 86. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1988

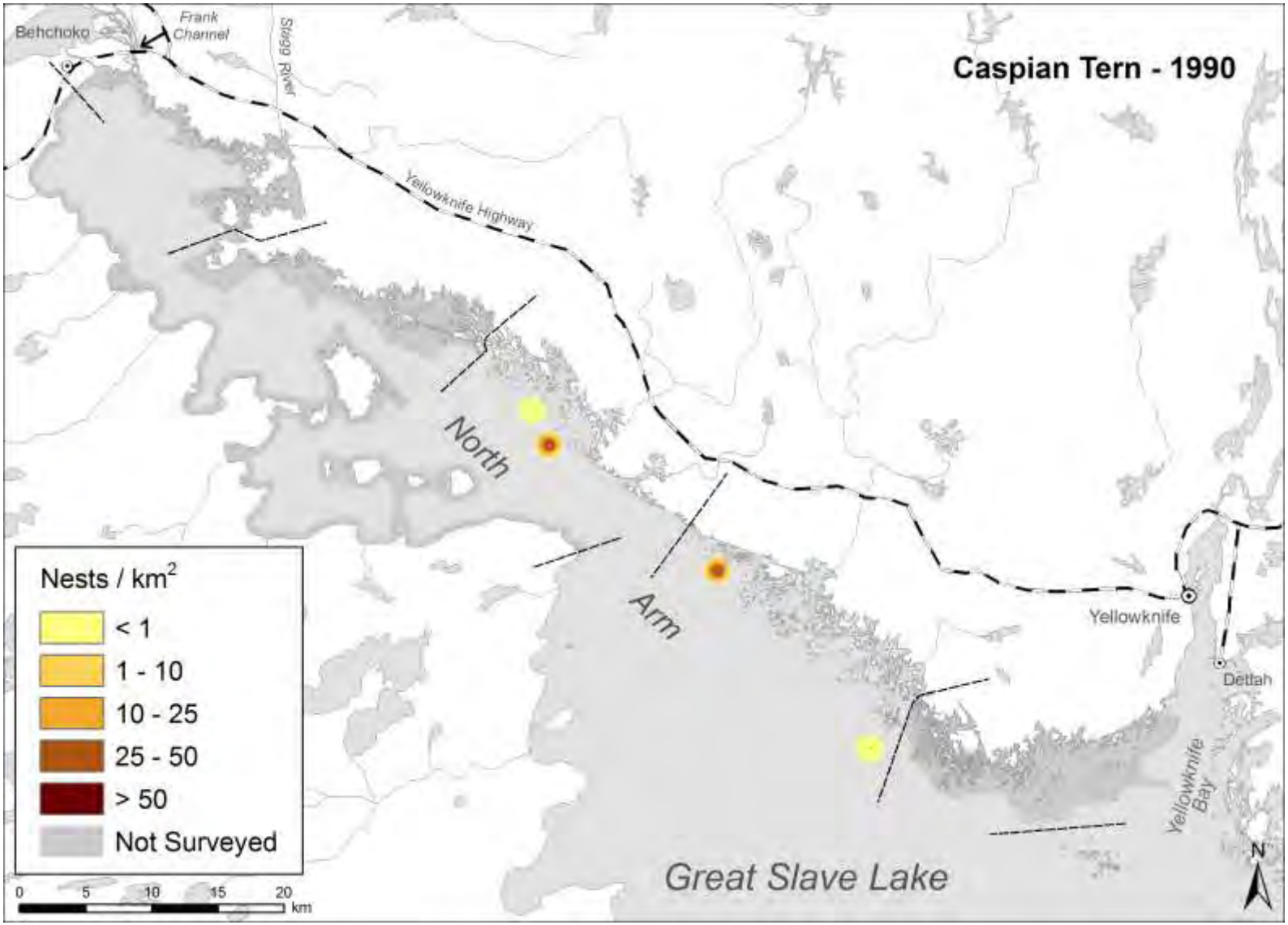

Figure 87. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1990

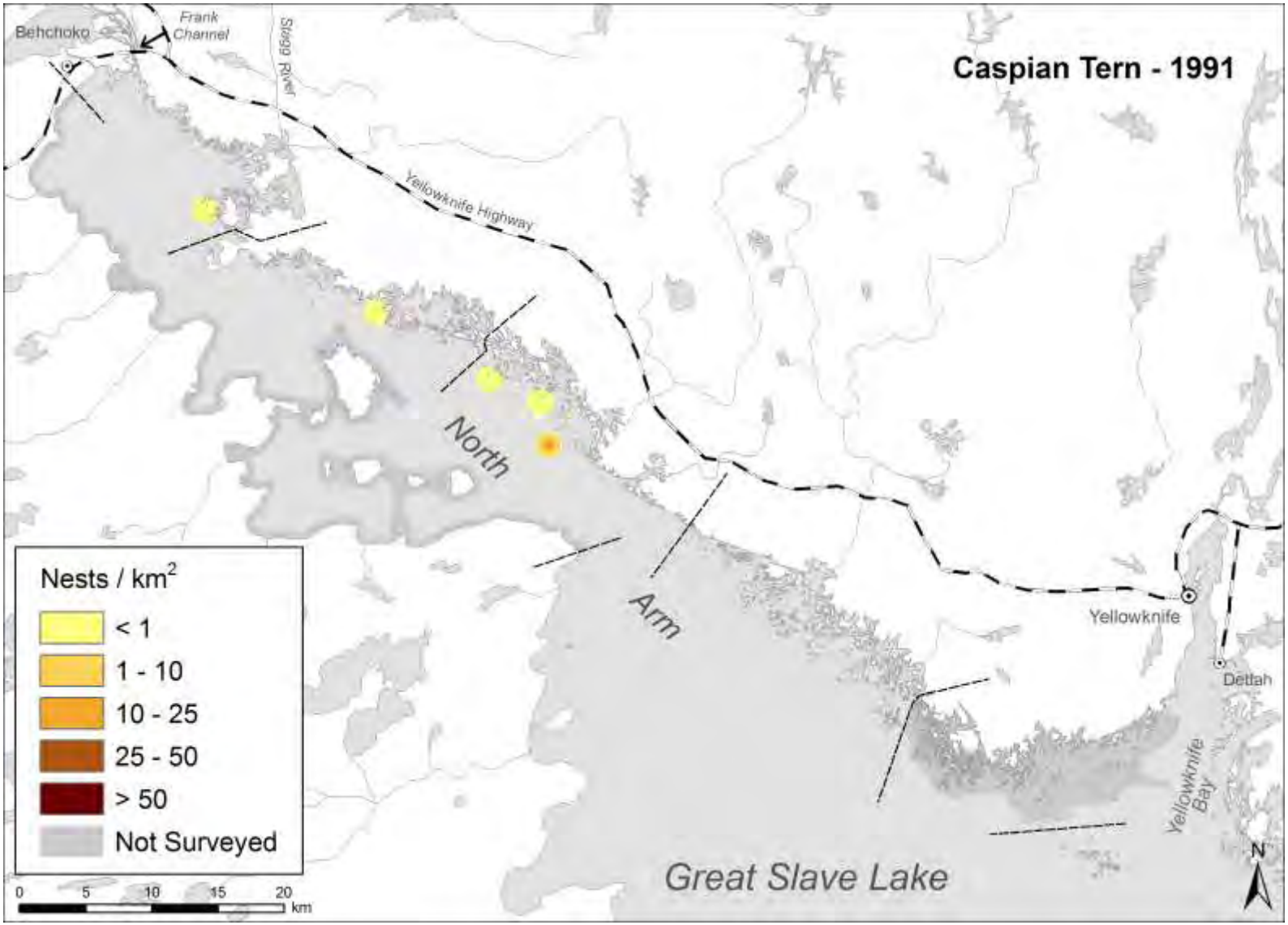

Figure 88. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1991

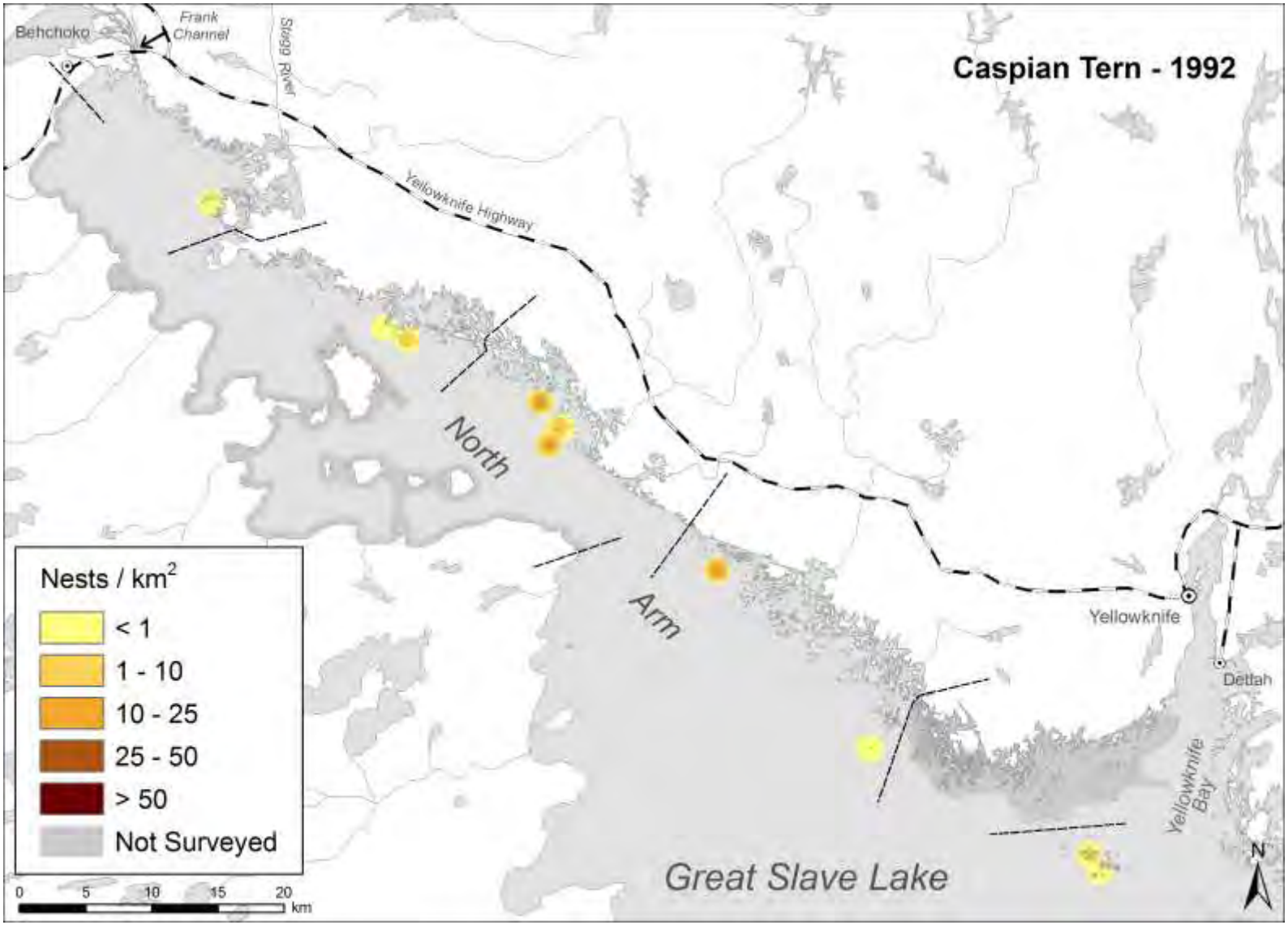

Figure 89. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1992

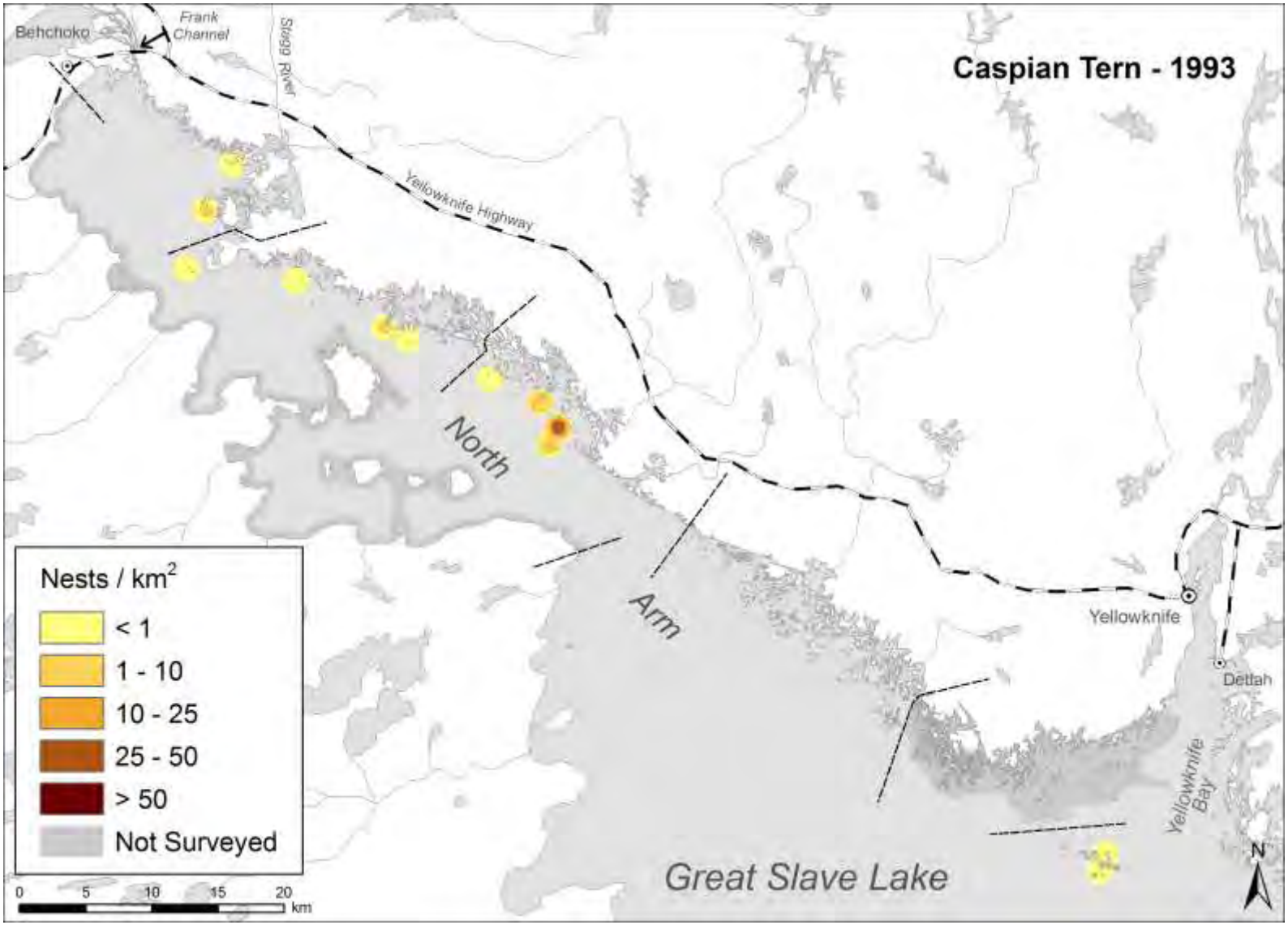

Figure 90. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1993

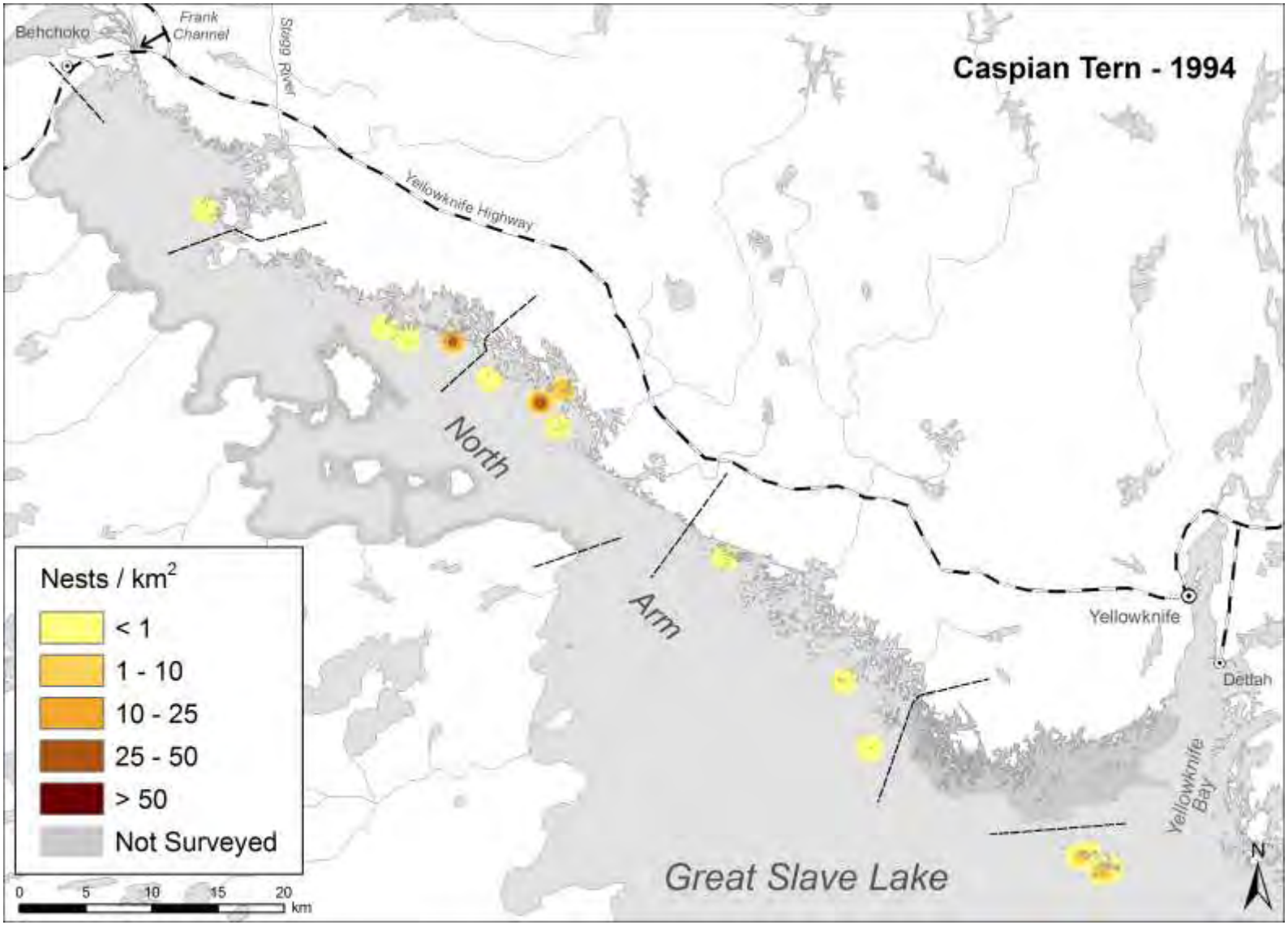

Figure 91. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1994

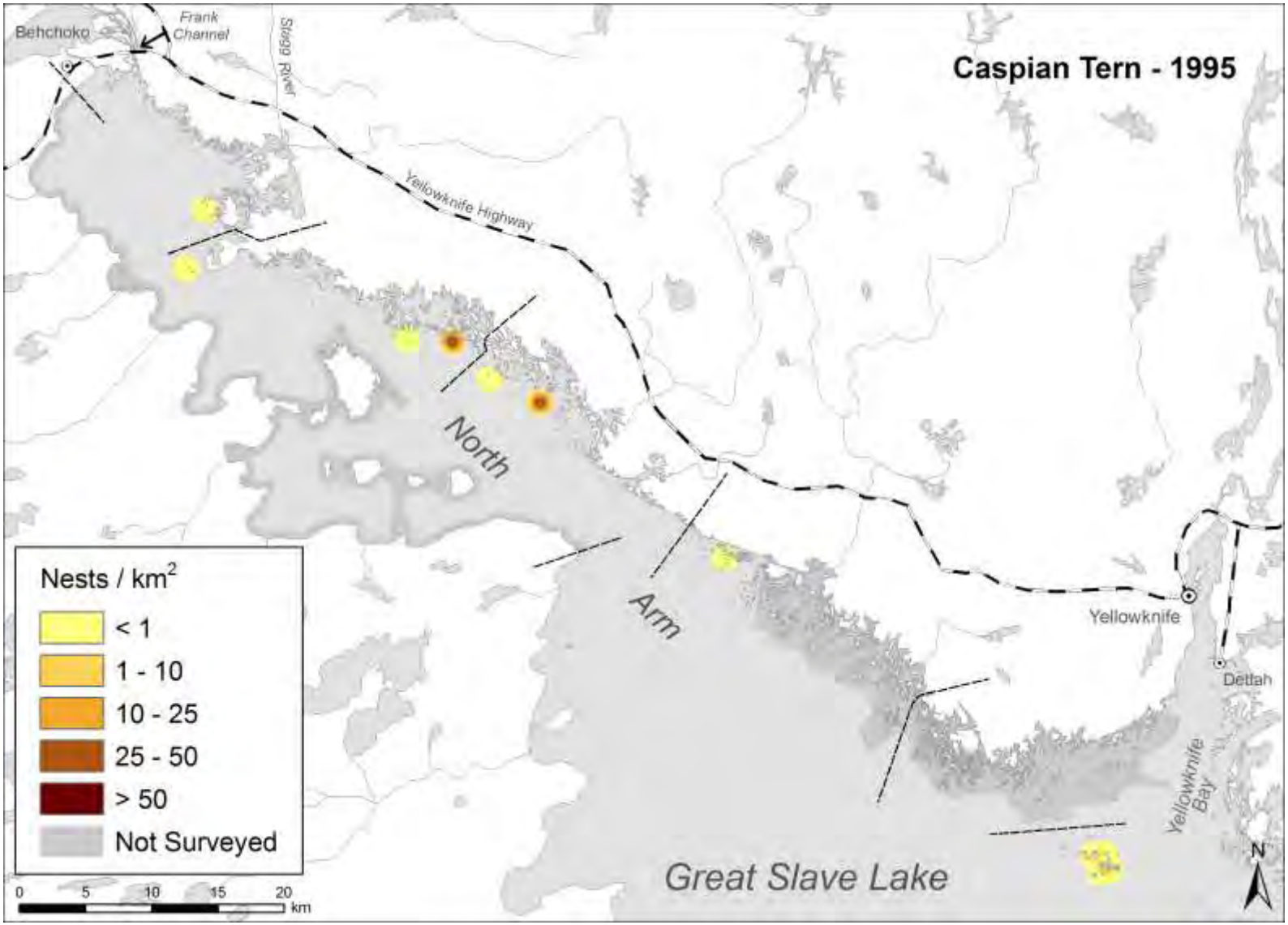

Figure 92. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 1995

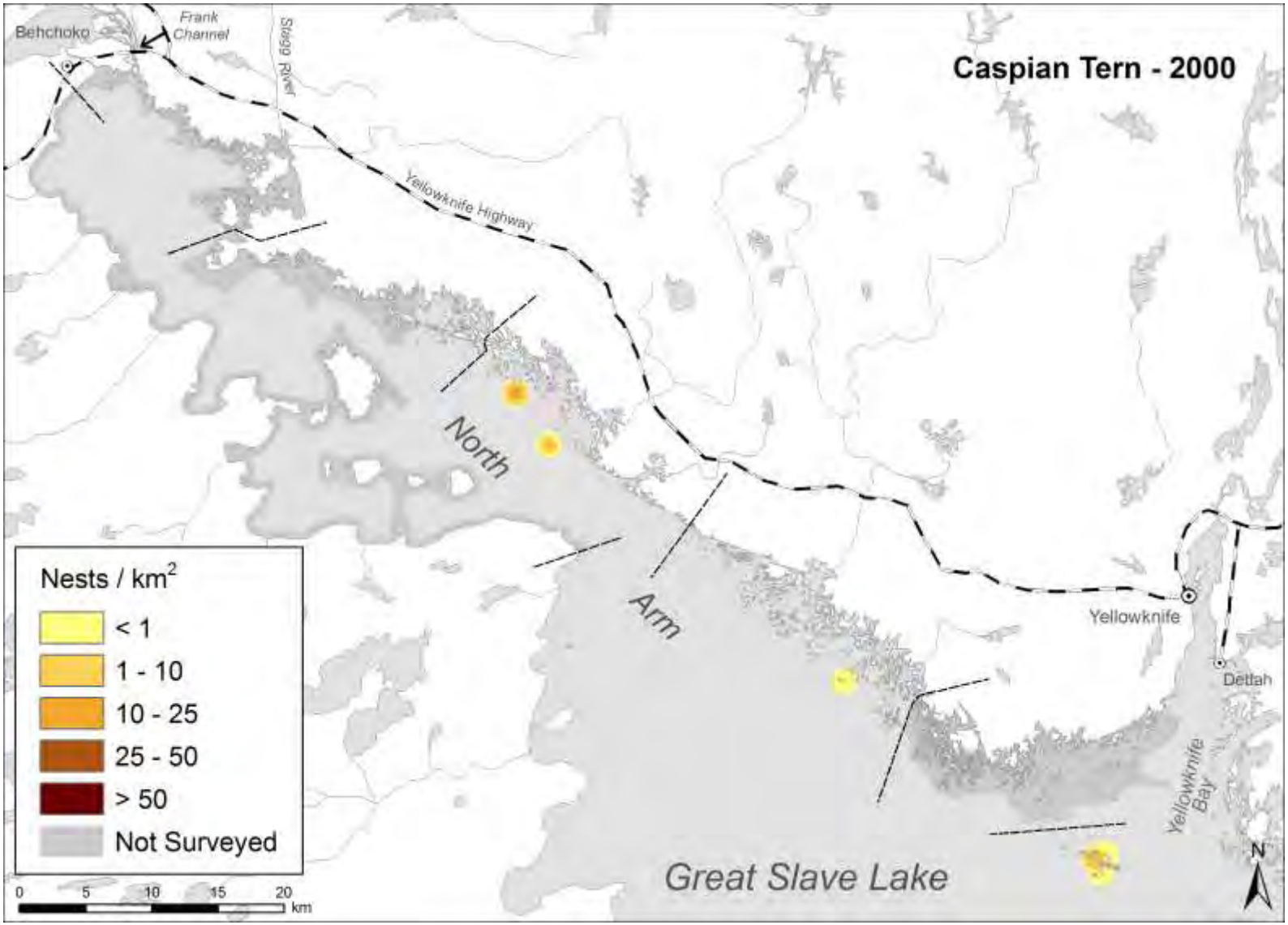

Figure 93. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 2000

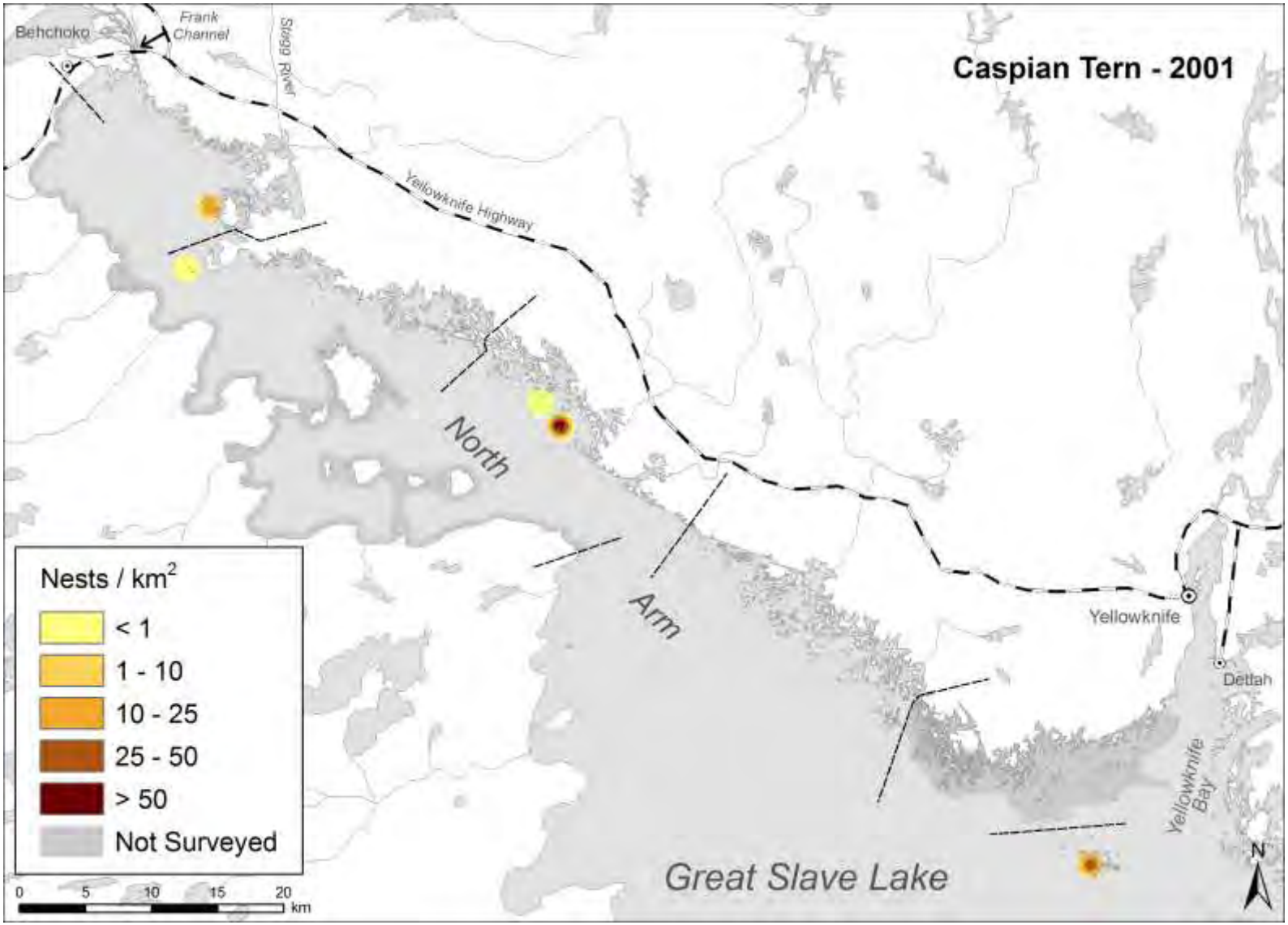

Figure 94. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 2001

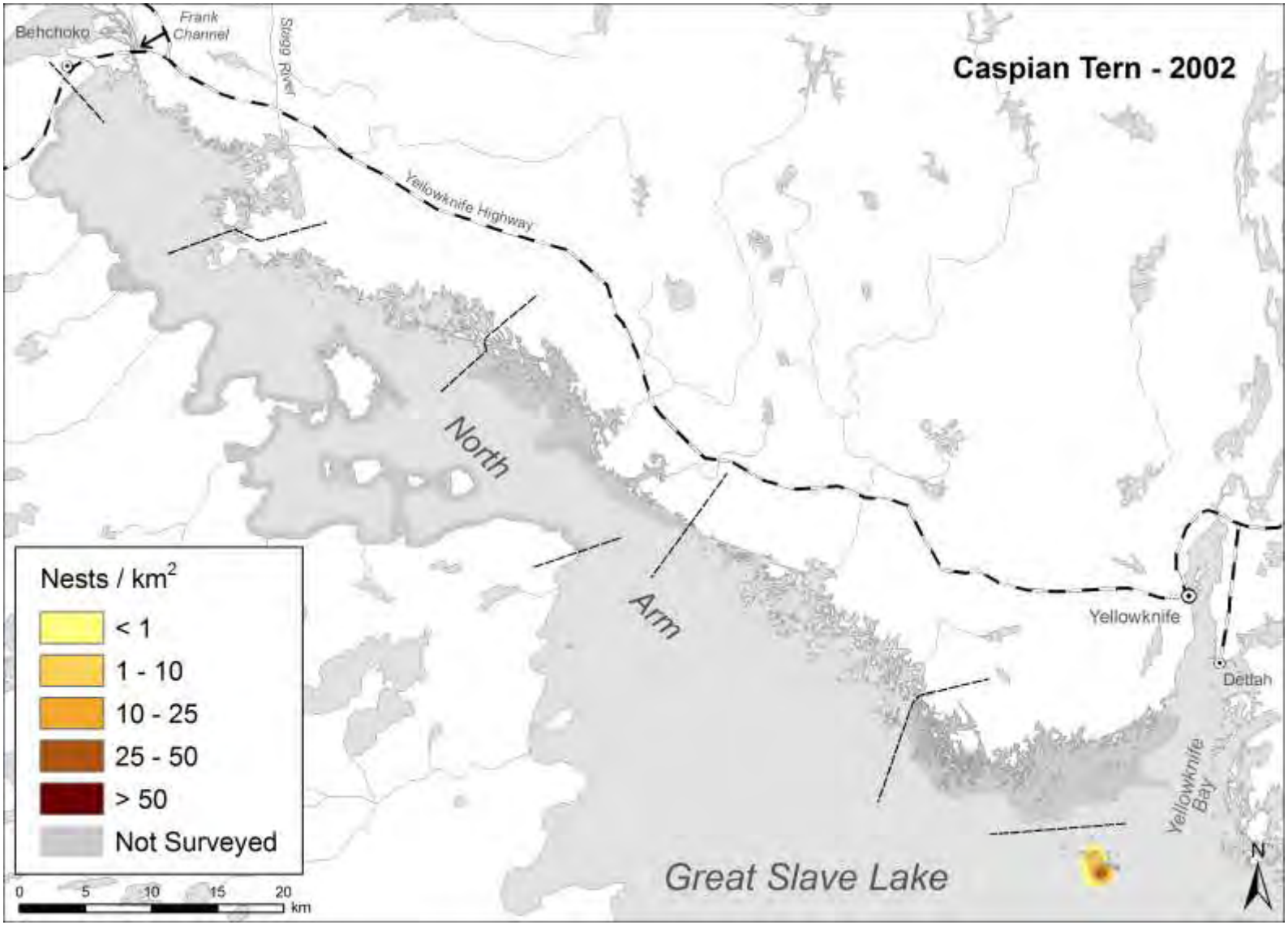

Figure 95. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 2002

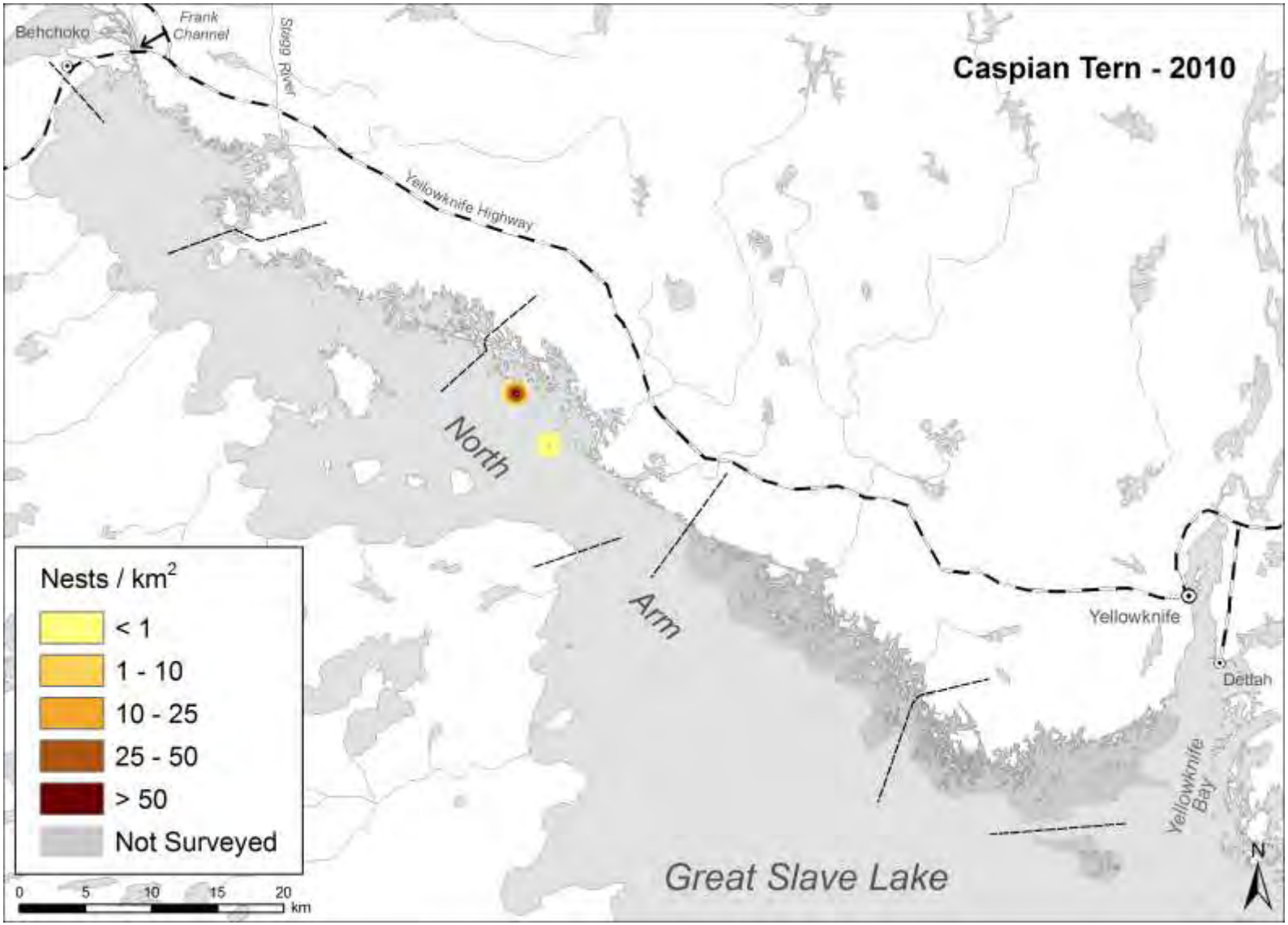

Figure 96. Distribution and density of Caspian Terns nesting on the North Arm of Great Slave Lake, 2010

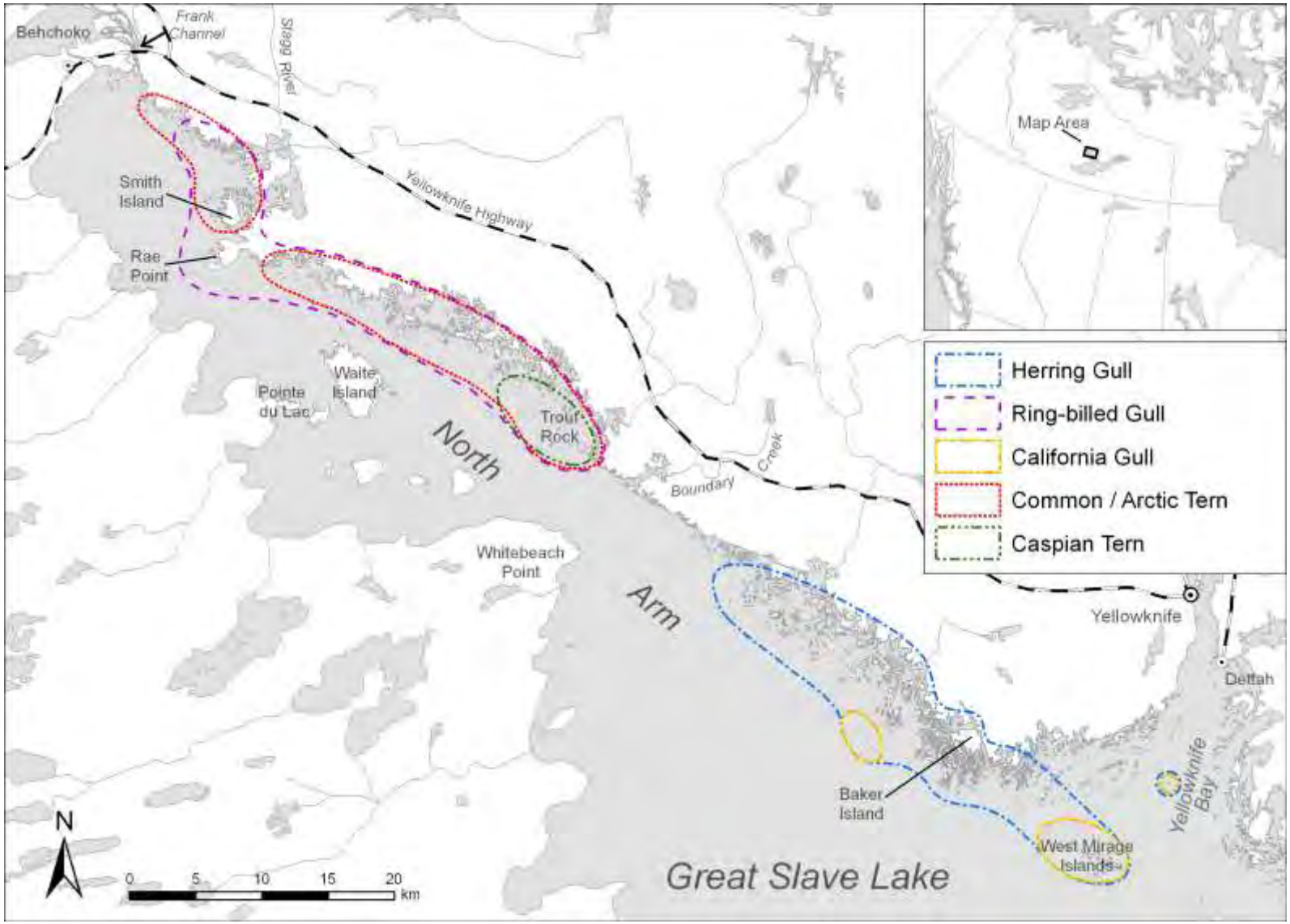

Figure 97. General high use areas for nesting larids on the North Arm of Great Slave Lake, Northwest Territories[1,2]

[1]Areas depicted indicate sections that are of relatively high importance for each species. They are not meant to indicate the extent of distribution for any species.

[2]Mew Gull is found in low densities across the northeastern shoreline with no obvious areas of particular importance, and have thus been excluded from map.

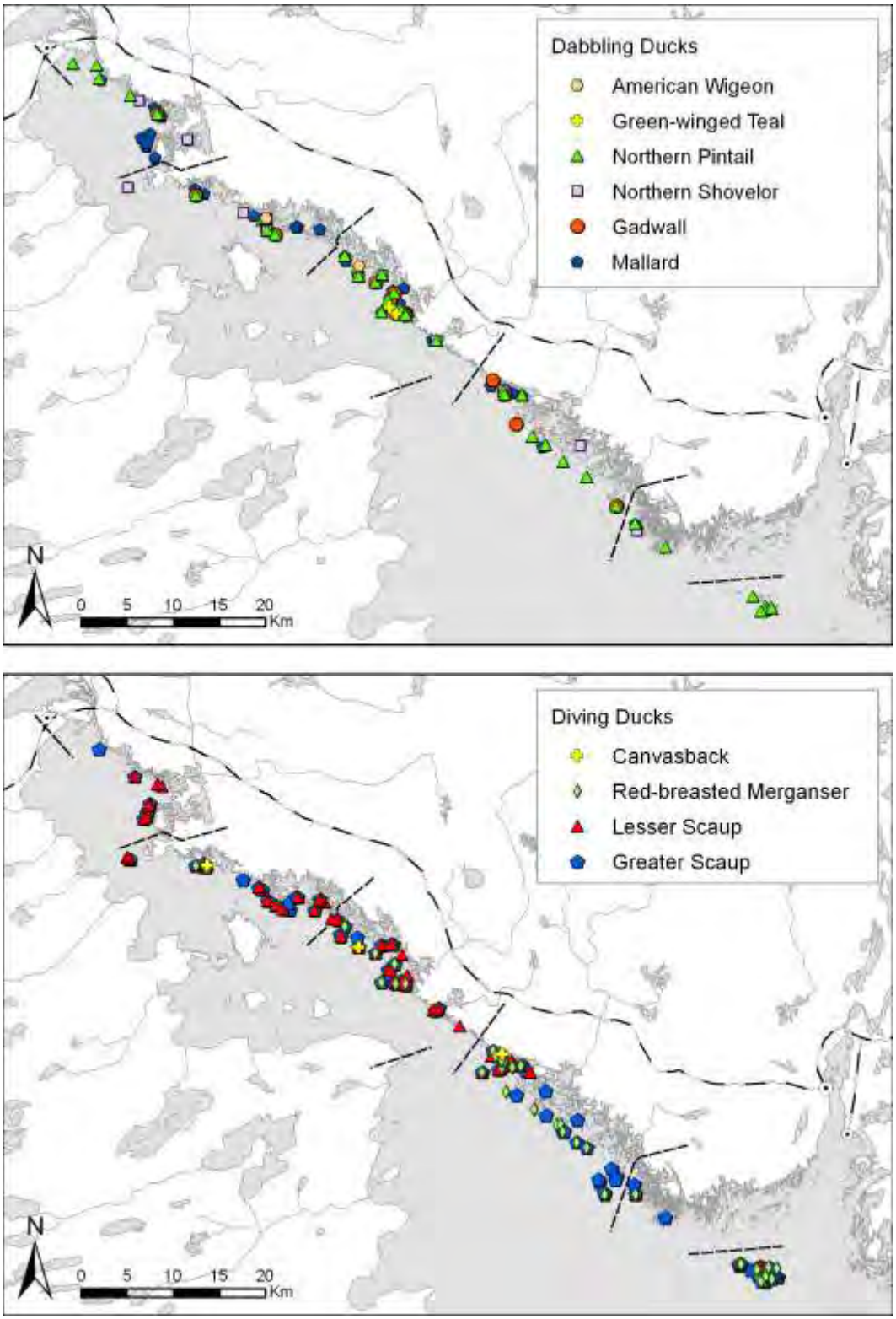

Figure 98. Location of duck nests observed during surveys of larids and waterfowl on the North Arm of Great Slave Lake, 1990-2010

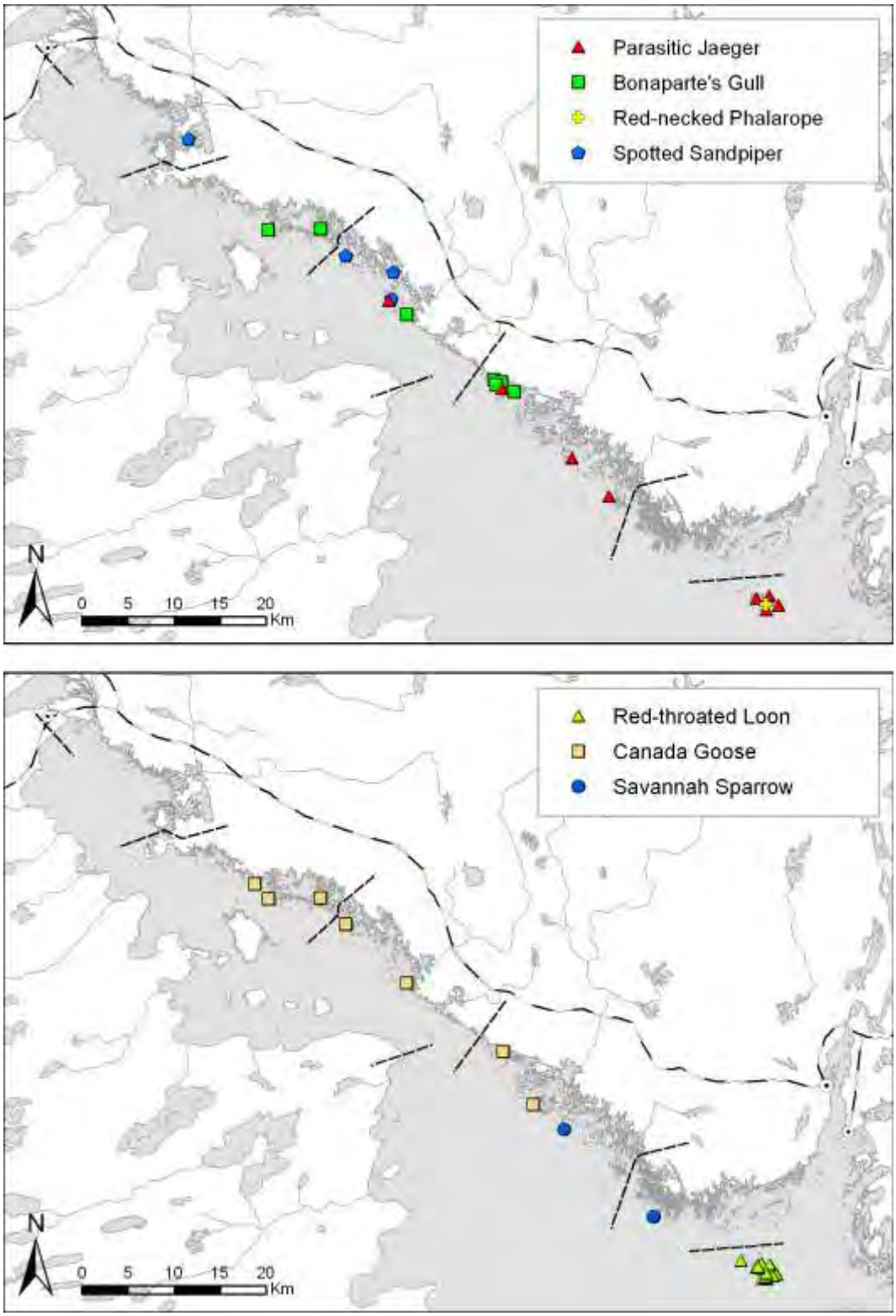

Figure 99. Location of nests of non-target birds observed during surveys of larids and waterfowl on the North Arm of Great Slave Lake, 1990-2010

Appendix 1. Scientific and common names of bird species referenced in this report[1]

Family	Scientific Name	Common Name
Anatidae	*Branta canadensis*	Canada Goose
	Anas strepera	Gadwall
	Anas americana	American Wigeon
	Anas platyrhynchos	Mallard
	Anas clypeata	Northern Shoveler
	Anas acuta	Northern Pintail
	Anas crecca	American Green-winged Teal
	Aythya valisinaria	Canvasback
	Aythya marila	Greater Scaup
	Aythya affinis	Lesser Scaup
	Mergus serrator	Red-breasted Merganser
Gaviidae	*Gavia stellata*	Red-throated Loon
Laridae	*Larus canus*	Mew Gull
	Larus delawarensis	Ring-billed Gull
	Larus californicus	California Gull
	Larus argentatus	Herring Gull
	Chroicocephalus philadelphia	Bonaparte's Gull
	Hydroprogne caspia	Caspian Tern
	Chlidonias niger	Black Tern
	Sterna hirundo	Common Tern
	Sterna paradisea	Arctic Tern
Scolopacidae	*Actitis macularius*	Spotted Sandpiper
	Phalaropus lobatus	Red-necked Phalarope
Stercororiidae	*Stercorarius parasiticus*	Parasitic Jaeger
Corvidae	*Corvus corax*	Common Raven
Emberizidae	*Passerculus sandwichensis*	Savannah Sparrow

[1]American Ornithologists Union, 2012

Appendix 2. Herring Gull nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	6	4	0	0	20	5	125	12	147	12	82	8	-	-
1988	8	6	1	1	28	5	-	-	37[1]	1[1]	-	-	0	0
1990	-	-	-	-	23	4	131	30	43[1]	10[1]	58	8	-	-
1991	10	7	0	0	9	3	93	20	-	-	1	1	-	-
1992	4	4	4	4	12	7	81	15	-	-	72	9	-	-
1993	5	3	6	5	13	7	34	13	-	-	45	14	-	-
1994	10	8	3	3	15	7	67	18	-	-	74	11	-	-
1995	3	3	6	6	8	7	20[1]	3[1]	-	-	38	12	-	-
2000	-	-	-	-	3	1	4	2	1[1]	1[1]	32	6	-	-
2001	7	4	2	2	10	5	15	4	2[1]	1[1]	73	10	-	-
2002	4	3	1	1	-	-	1	1	7[1]	2[1]	4	2	-	-
2010	58	28	18	18	31	12	-	-	-	-	-	-	0	0
Total	115	70	42	40	172	63	571	118	479	81	237	27	0	0

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means that the zone was not surveyed.

Appendix 3. Mew Gull nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	2	2	0	0	13	7	5	5	25	2	1	1	-	-
1988	1	1	3	1	15	8	-	-	24[1]	1[1]	-	-	0	0
1990	-	-	-	-	9	2	10	8	-	-	0	0	-	-
1991	10	4	4	4	10	6	4	4	-	-	1	1	-	-
1992	9	5	2	2	4	2	6	6	-	-	-	-	-	-
1993	11	5	7	5	14	6	8	7	-	-	7	6	-	-
1994	13	5	5	4	12	3	12	8	-	-	3	3	-	-
1995	5	1	9	5	32	13	5[1]	5[1]	-	-	4	4	-	-
2000	-	-	1[1]	1[1]	6	3	4	3	1[1]	1[1]	5	4	-	-
2001	5	3	6	6	17	12	7	6	-	-	2	2	-	-
2002	4	3	2	2	-	-	8	6	2[1]	1[1]	0	0	-	-
2010	20	18	38	26	25	20	-	-	-	-	-	-	0	0
Total	80	47	77	56	157	82	69	58	52	5	23	21	0	0

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means that zone was not surveyed.

Appendix 4. Ring-billed Gull nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	0	0	188	3	53	7	0	0	0	0	0	0	-	-
1988	72	2	99	4	138	5	-	-	-	-	-	-	0	0
1990	-	-	-	-	43	1	0	0	-	-	0	0	-	-
1991	237	3	123	5	29	3	0	0	-	-	0	0	-	-
1992	0	0	74	3	149	4	0	0	-	-	0	0	-	-
1993	0	0	245	3	9	1	29	1	-	-	0	0	-	-
1994	0	0	213	5	40	4	15	2	-	-	0	0	-	-
1995	0	0	207	4	7	1	28[1]	1[1]	-	-	0	0	-	-
2000	-	-	-	-	20	1	38	1	-	-	0	0	-	-
2001	14	2	285	3	34	3	45	2	-	-	0	0	-	-
2002	22	1	32	1	-	-	31	2	-	-	0	0	-	-
2010	0	0	2	1	29	2	-	-	-	-	-	-	0	0
Total	345	8	1468	32	551	32	186	9	0	0	0	0	0	0

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means zone was not surveyed.

Appendix 5. California Gull nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	0	0	0	0	0	0	31	2	44	1	17	2	-	-
1988	0	0	0	0	0	0	-	-	29[1]	1[1]	-	-	0	0
1990	-	-	-	-	0	0	75	4	-	-	0	0	-	-
1991	0	0	0	0	0	0	10	1	-	-	0	0	-	-
1992	0	0	0	0	0	0	48	2	-	-	41	1	-	-
1993	0	0	0	0	0	0	8	2	-	-	35	1	-	-
1994	0	0	0	0	0	0	37	1	-	-	31	2	-	-
1995	0	0	0	0	0	0	-	-	-	-	87	4	-	-
2000	-	-	-	-	0	0	0	0	-	-	1	1	-	-
2001	0	0	0	0	0	0	21	1	-	-	16	1	-	-
2002	0	0	0	0	-	-	0	0	-	-	0	0	-	-
2010	0	0	0	0	0	0	-	-	-	-	-	-	0	0
Total	0	0	0	0	0	0	230	13	73	2	228	12	0	0

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means zone was not surveyed.

Appendix 6. Common Tern nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	56	5	75	6	164	11	36	3	55	3	0	0	-	-
1988	108	6	181	11	162	9	-	-	24[1]	1[1]	-	-	22	2
1990	-	-	-	-	85	8	61	10	-	-	8	1	-	-
1991	152	10	127	10	223	11	99	6	-	-	18	2	-	-
1992	105	9	125	15	167	14	85	9	11[1]	1[1]	24	3	-	-
1993	159	8	197	11	305	18	85	7	17[1]	1[1]	34	5	-	-
1994	180	9	176	12	289	15	99	11	2[1]	1[1]	23	4	-	-
1995	104	5	195	13	270	18	77	8	-	-	36	4	-	-
2000	-	-	6[1]	2[1]	218	16	115	10	6[1]	1[1]	22	7	-	-
2001	221	8	220	14	244	22	94	12	46[1]	1[1]	43	5	-	-
2002	182	8	248	13	-	-	70	10	13[1]	1[1]	24	4	-	-
2010	133	12	118	12	245	27	-	-	-	-	-	-	0	0
Total	1400	80	1668	119	2372	169	821	86	174	10	232	35	22	2

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means zone was not surveyed.

Appendix 7. Arctic Tern nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	53	5	1	1	56	7	35	4	1	1	22	2	-	-
1988	3	2	0	0	49	7	-	-	-	-	-	-	0	0
1990	-	-	-	-	24	5	72	8	-	-	5	1	-	-
1991	7	4	8	3	8	3	1	1	-	-	2	1	-	-
1992	11	7	16	8	9	6	9	4	-	-	7	1	-	-
1993	6	2	9	7	26	10	8	4	-	-	3	2	-	-
1994	10	6	24	8	17	11	9	7	3[1]	1[1]	9	4	-	-
1995	10	1	10	2	28	12	15[1]	5[1]	-	-	7	6	-	-
2000	-	-	6[1]	2[1]	60	10	12	4	-	-	10	6	-	-
2001	29	4	27	11	70	21	31	8	-	-	12	4	-	-
2002	23	6	11	6	-	-	2	2	-	-	2	2	-	-
2010	45	10	75	25	153	28	-	-	-	-	-	-	0	0
Total	197	47	187	73	500	120	194	47	4	2	79	29	0	0

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means zone was not surveyed.

Appendix 8. Common and Arctic Tern nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	109	8	76	7	220	13	71	5	56	3	22	2	-	-
1988	111	7	181	11	211	13	-	-	24[1]	1[1]	-	-	22	2
1990	-	-	-	-	109	8	133	12	-	-	13	1	-	-
1991	159	12	135	10	231	11	100	6	-	-	20	2	-	-
1992	116	12	141	15	176	14	94	10	11[1]	1[1]	31	3	-	-
1993	165	8	206	14	331	18	93	7	17[1]	1[1]	37	5	-	-
1994	190	12	200	12	306	16	108	12	5[1]	1[1]	32	5	-	-
1995	114	5	205	13	298	19	92	9	-	-	43	6	-	-
2000	-	-	12[1]	3[1]	278	16	127	10	6[1]	1[1]	32	9	-	-
2001	250	8	247	15	314	24	125	12	46[1]	1[1]	55	6	-	-
2002	205	8	259	13	-	-	75	12	13[1]	1[1]	27	5	-	-
2010	178	20	193	30	398	38	-	-	-	-	-	-	0	0
Total	1597	100	1855	143	2872	190	1018	95	178	10	312	44	22	2

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means zone was not surveyed.

Appendix 9. Caspian Tern nest summary by zone

	Stagg River		Old Fort Rae		Trout Rock		Enodah		Yellowknife Bay		West Mirage Islands		Southwest Shoreline	
Year	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**	**Nests**	**Sites**
1986	2	2	3	3	50	2	5	4	1	1	4	4	-	-
1988	5	3	2	2	60	5	-	-	1[1]	1[1]	-	-	0	0
1990	-	-	-	-	43	2	44	2	-	-	0	0	-	-
1991	1	1	1	1	16	3	0	0	-	-	0	0	-	-
1992	1	1	4	2	45	4	26	2	-	-	3	2	-	-
1993	3	2	5	4	63	5	0	0	-	-	2	2	-	-
1994	1	1	35	3	55	4	3	3	-	-	7	5	-	-
1995	1	1	43	3	41	2	1[1]	1[1]	-	-	4	4	-	-
2000	-	-	-	-	23	2	1	1	-	-	9	3	-	-
2001	22	1	1	1	76	3	0	0	-	-	39	1	-	-
2002	0	0	0	0	-	-	0	0	-	-	43	3	-	-
2010	0	0	0	0	65	2	-	-	-	-	-	-	0	0
Total	36	12	94	19	537	34	80	13	2	2	111	24	0	0

[1] Entire zone not surveyed. Value reflects partial survey or incidental observations only.
Dash (-) means zone was not surveyed.

Appendix 10. Proportion of larid nests containing at least one chick on the North Arm by date, 1990-2010

		Herring Gull		Mew Gull		Ring-billed Gull		California Gull		Common Tern		Arctic Tern		Caspian Tern	
Year	Date	%	Nests[1]	%	Nests[1]	%	Nests[1]	%	Nests[1]	%	Nests[1]	%	Nests[1]	%	Nests[1]
1990	19 June	9.9	81	-	0	-	0	1.3	75	-	0	-	0	0.0	1
	20 June	4.6	87	0.0	10	-	0	-	0	0.0	6	0.0	38	0.0	43
	21 June	10.0	20	0.0	2	0.0	43	-	0	0.0	64	-	0	0.0	41
	22 June	10.3	58	0.0	5	-	0	-	0	0.0	14	0.0	1	-	0
1991	20 June	20.0	5	0.0	6	-	0	-	0	0.0	112	0.0	2	-	0
	21 June	20.0	5	0.0	4	0.0	152	-	0	0.0	105	0.0	9	-	0
	22 June	-	0	16.7	6	0.0	49	-	0	0.0	148	0.0	4	0.0	2
	23 June	0.0	18	0.0	9	0.0	27	-	0	0.0	214	0.0	9	0.0	15
	26 June	15.9	63	0.0	3	-	0	0.0	10	0.0	23	-	0	-	0
	27 June	0.0	1	0.0	1	-	0	-	0	0.0	18	0.0	2	-	0
1992	20 June	0.0	2	0.0	2	-	0	-	0	0.0	39	0.0	1	-	0
	21 June	0.0	3	0.0	8	0.0	3	-	0	0.0	161	0.0	18	0.0	1
	22 June	0.0	3	0.0	1	0.0	85	-	0	0.0	91	0.0	9	0.0	4
	23 June	0.0	10	-	0	0.0	150	-	0	0.0	106	0.0	4	0.0	46
	24 June	0.0	16	0.0	6	-	0	-	0	0.0	95	0.0	12	0.0	25
	25 June	0.0	29	0.0	4	-	0	-	0	0.0	37	0.0	1	-	0
	27 June	21.9	32	-	0	-	0	0.0	4	0.0	11	-	0	0.0	1
	30 June	0.0	18	-	0	-	0	-	0	0.0	8	0.0	7	0.0	3
1993	18 June	33.3	3	0.0	11	-	0	-	0	0.0	159	0.0	6	0.0	3
	20 June	60.0	5	0.0	5	0.0	128	-	0	0.0	149	0.0	6	0.0	5
	21 June	-	0	0.0	2	0.0	36	-	0	0.0	55	0.0	5	-	0
	22 June	30.8	13	0.0	14	0.0	9	-	0	0.0	287	0.0	24	0.0	63
	23 June	68.8	16	0.0	6	3.4	29	-	0	0.0	85	0.0	8	-	0
	24 June	100.0	5	-	0	-	0	0.0	8	0.0	17	-	0	-	0

	29 June	9.1	11	0.0	2	-	0	-	0	6.7	30	0.0	3	0.0	2
	30 June	62.5	8	0.0	3	-	0	-	0	-	0	0.0	2	-	0
1994	18 June	33.3	6	-	0	-	0	-	0	0.0	60	0.0	2	-	0
	19 June	33.3	6	0.0	7	29.9	187	-	0	0.0	216	0.0	29	0.0	1
	20 June	100.0	1	0.0	4	0.0	25	-	0	0.0	107	0.0	10	0.0	35
	21 June	53.3	15	0.0	12	0.0	40	-	0	0.0	272	0.0	15	0.0	44
	22 June	27.3	11	0.0	6	0.0	15	-	0	3.6	56	0.0	8	100.0	1
	24 June	10.5	19	0.0	6	-	0	-	0	6.8	44	0.0	4	0.0	1
	28 June	52.1	48	0.0	2	-	0	33.3	36	27.3	11	100.0	8	40.0	5
	29 June	65.6	64	0.0	1	-	0	41.9	31	-	0	-	0	0.0.	3
1995	16 June	0.0	2	-	0	-	0	-	0	0.0	8	-	0	-	0
	17 June	0.0	6	0.0	5	0.0	122	-	0	0.0	246	0.0	19	0.0	2
	18 June	0.0	4	0.0	11	0.0	84	-	0	0.0	99	0.0	9	0.0	43
	19 June	-	0	0.0	5	-	0	-	0	0.0	46	0.0	4	0.0	40
	21 June	0.0	23	20.7	29	0.0	35	-	0	0.0	218	0.0	25	0.0	1
	22 June	0.0	2	100.0	1	-	0	-	0	0.0	29	0.0	6	-	0
	26 June	-	0	-	0	-	0	45.2	42	-	0	-	0	-	0
	28 June	41.7	24	33.3	3	-	0	0.0	21	11.1	36	20.0	5	0.0	3
	30 June	50.0	14	0.0	1	-	0	8.3	24	-	0	100.0	2	0.0	1
2000	22 June	0.0	27	0.0	2	-	0	-	0	0.0	8	0.0	4	0.0	1
	23 June	25.0	4	0.0	3	-	0	0.0	1	0.0	14	0.0	6	0.0	8
	26 June	100.0	1	0.0	1	-	0	-	0	0.0	6	-	0	-	0
	27 June	50.0	4	25.0	4	-	0	-	0	0.0	66	0.0	12	0.0	1
	28 June	-	0	0.0	5	-	0	-	0	0.0	93	0.0	36	33.3	3
	29 June	-	0	33.3	3	-	0	-	0	1.2	86	3.7	27	-	0
2001	20 June	0.0	5	0.0	3	0.0	8	-	0	0.0	96	0.0	4	-	0
	21 June	25.0	4	0.0	5	0.0	315	-	0	4.2	284	5.6	36	0.0	23
	23 June	0.0	2	0.0	7	0.0	16	-	0	0.0	83	0.0	25	0.0	1

	24 June	0.0	8	0.0	11	0.0	18	-	0	0.0	215	0.0	48	0.0	75
	25 June	0.0	2	0.0	8	0.0	45	-	0	1.0	98	0.0	44	-	0
	26 June	28.6	14	0.0	1	-	0	13.6	22	2.1	48	0.0	1	-	0
	28 June	0.0	23	0.0	2	-	0	-	0	0.0	36	0.0	5	-	0
	29 June	0.0	9	-	0	-	0	-	0	0.0	6	0.0	7	0.0	39
2002	25 June	0.0	4	0.0	4	0.0	22	-	0	0.0	170	0.0	23	-	0
	26 June	0.0	1	0.0	1	0.0	32	-	0	0.0	215	0.0	9	-	0
	27 June	-	0	100.^	1	-	0	-	0	0.0	45	0.0	2	-	0
	08 July	100.0	7	-	0	0.0	1	-	0	-	0	-	0	-	0
	09 July	-	0	-	0	-	0	-	0	100.^	1	100.^	1	-	0
	10 July	100.0	1	83.3	6	-	0	-	0	20.0	15	-	0	-	0
	11 July	50.0	4	-	0	-	0	-	0	12.5	8	0.0	2	2.4	42
	12 July	0	0	-	0	-	0	-	0	0.0	12	-	0	-	0
2010	22 June	42.9	7	-	0	-	0	-	0	-	0	-	0	-	0
	23 June	82.4	17	14.3	7	-	0	-	0	22.2	36	-	0	-	0
	24 June	50.0	6	50.0	2	-	0	-	0	12.5	8	0.0	3	-	0
	25 June	66.7	3	60.0	5	-	0	-	0	21.6	37	33.3	12	-	0
	26 June	55.6	18	12.5	8	-	0	-	0	-	0	0.0	8	0.0	1
	27 June	81.3	16	12.5	8	60.0	25	-	0	8.3	60	7.1	14	16.9	59
	28 June	0.0	1	46.7	15	-	0	-	0	-	0	41.4	29	-	0
	29 June	50.0	2	53.3	15	0.0	1	-	0	46.1	76	42.9	21	-	0
Total		**-**	**947**	**-**	**330**	**-**	**1702**	**-**	**274**	**-**	**5304**	**-**	**696**	**-**	**688**

[1] Values reflect the total number of nests observed, including those without young.

Appendix 11. Average size of islands (ha) containing larid colonies on the North Arm of Great Slave Lake

Zone		Herring Gull	Mew Gull	Ring-billed Gull	California Gull	Common Tern	Arctic Tern	Tern spp.[1]	Caspian Tern
Stagg River	Mean ± SE	0.12 ± 0.02	0.36 ± 0.06	0.17 ± 0.04	-	0.20 ± 0.03	0.27 ± 0.05	0.22 ± 0.03	0.12 ± 0.03
	n	70	47	8	0	80	47	100	12
Old Fort Rae	Mean ± SE	0.12 ± 0.03	0.23 ± 0.13	0.12 ± 0.03	-	0.11 ± 0.01	0.20 ± 0.10	0.16 ± 0.05	0.08 ± 0.02
	n	40	55	32	0	118	73	142	19
Trout Rock	Mean ± SE	0.21 ± 0.02	0.23 ± 0.02	0.24 ± 0.03	-	0.21 ± 0.02	0.20 ± 0.02	0.20 ± 0.01	0.25 ± 0.18
	n	63	82	32	0	169	120	190	34
Enodah	Mean ± SE	0.27 ± 0.02	0.36 ± 0.04	0.35 ± 0.06	0.23 ± 0.04	0.39 ± 0.03	0.42 ± 0.05	0.38 ± 0.03	0.39 ± 0.07
	n	118	58	9	13	86	47	95	13
Yellowknife Bay	Mean ± SE	0.24 ± 0.05	0.17 ± 0.03	-	0.50 ± 0.00	0.19 ± 0.02	0.19 ± 0.02	0.19 ± 0.02	0.50 ± 0.00
	n	27	5	0	2	8	2	8	2
West Mirage Islands	Mean ± SE	0.74 ± 0.09	1.25 ± 0.46	-	1.27 ± 0.26	1.31 ± 0.36	1.32 ± 0.43	1.39 ± 0.35	0.57 ± 0.14
	n	81	21	0	12	35	29	44	24
Southwest Shoreline	Mean ± SE	-	-	-	-	0.01 ± 0.00	-	0.01 ± 0.00	-
	n	0	0	0	0	2	0	2	0
Total	Mean ± SE	0.31 ± 0.02	0.36 ± 0.05	0.20 ± 0.02	0.71 ± 0.15	0.29 ± 0.03	0.34 ± 0.05	0.31 ± 0.03	0.30 ± 0.04
	n	399	268	81	27	498	318	581	104

[1] Common Tern and/or Arctic Tern.

Appendix 12. Average distance to the mainland (m) of larid colonies on the North Arm of Great Slave Lake

Zone		Herring Gull	Mew Gull	Ring-billed Gull	California Gull	Common Tern	Arctic Tern	Tern spp.[1]	Caspian Tern
Stagg River	Mean ± SE	1793 ± 163	1356 ± 171	1946 ± 326	-	1488 ± 120	1568 ± 172	1486 ± 111	2399 ± 221
	n	70	47	8	0	80	47	100	12
Old Fort Rae	Mean ± SE	1550 ± 128	1298 ± 100	1586 ± 96	-	1503 ± 65	1333 ± 91	1423 ± 61	1951 ± 189
	n	40	55	32	0	118	73	142	19
Trout Rock	Mean ± SE	2288 ± 103	1435 ± 89	2228 ± 144	-	1587 ± 63	1529 ± 74	1570 ± 60	2606 ± 104
	n	63	82	32	0	169	120	190	34
Enodah	Mean ± SE	3681 ± 117	1770 ± 173	2432 ± 471	5079 ± 29	1609 ± 138	1423 ± 172	1589 ± 132	3603 ± 435
	n	118	58	9	13	86	47	95	13
Yellowknife Bay	Mean ± SE	3318 ± 185	2052 ± 358	-	5161 ± 0	2359 ± 241	2323 ± 327	2359 ± 241	5161 ± 0
	n	27	5	0	2	8	2	8	2
West Mirage Islands	Mean ± SE	8590 ± 92	8824 ± 138	-	8039 ± 281	9106 ± 109	9157 ± 115	9058 ± 97	8999 ± 131
	n	81	21	0	12	35	29	44	24
Southwest Shoreline	Mean ± SE	-	-	-	-	4153 ± 1497	-	4153 ± 1497	-
	n	0	0	0	0	2	0	2	0
Total	Mean ± SE	3888 ± 136	2056 ± 135	1969 ± 97	6400 ± 312	2106 ± 96	2175 ± 134	2109 ± 92	4111 ± 282
	n	399	268	81	27	498	318	581	104

[1] Common Tern and/or Arctic Tern.

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Additional information can be obtained at:

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