Exxon Valdez Oil Spill
Restoration Project Final Report

Survey of Pigeon Guillemot Colonies in Prince William Sound, Alaska

Restoration Project 93034
Final Report

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STUDY HISTORY: Pigeon Guillemot colonies were first surveyed in the Sound in the 1970's and 1980's (Sowls *et. al loc. cit.*, U.S. Fish and Wildlife Service 1993) during general seabird colony surveys. The U.S. Fish and Wildlife Service began detailed studies of guillemots at Naked Island in the late 1970's (Oakley *loc. cit.*, Kuletz *loc. cit.*). After the spill, Natural Resource Damage Assessment Bird Study Number 9 (Oakley and Kuletz, 1994) was initiated to document damage from the oil spill on pigeon guillemot populations. Data on guillemots was also collected through 1992 by Natural Resource Damage Assessment Bird Study Number 2 (Klosiewski and Laing, 1994).

ABSTRACT: During a survey of 98% of Prince William Sound's (the Sound) shoreline in May and June 1993 we found 184 pigeon guillemot colonies, most of which were previously unknown. There were no guillemots at 14 former colony sites, but we found new colonies within a few km of eight of these sites. The southwestern Sound, with 41% of the shoreline surveyed, had 62% of the guillemots, the eastern Sound, with 24% of the shoreline surveyed, had 10% of the guillemots, and the Naked Island area, with only 2.5% of the shoreline, had 27% of all guillemots. We found concentrations on Jackpot, Fool, Pleiades, Seal, Evans and Bligh Islands, and in Passage Canal, Port Bainbridge, Harriman Fjord, and Blackstone Bay. In general, half of all guillemots were at 22 major clusters of colonies.

We counted a total of 3028 pigeon guillemots, including 1012 that were unassociated with colonies. Our count is within the range of a Sound-wide estimate of 3000 to 4900 guillemots from pelagic and shoreline surveys by another project in July 1993. These figures reflect a continuing depressed population compared with a 1970's high of about 15,000.

Guillemot counts at oiled Naked Island continue to decline, but numbers have also declined in nonoiled areas of the Sound. Reasons for this decline are unclear, but besides the oil spill killing birds outright, reduced food availability and increased predation are possible factors.

Studies of guillemot productivity, food availability and predation at several key locations would help clarify reasons for the guillemots' population decline. These studies, coupled with monitoring colonies every two to five years, would help evaluate possible restoration measures.

KEY WORDS: Pigeon Guillemot; Prince William Sound; colonies; populations; distribution; oil spill.

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EXECUTIVE SUMMARY

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INTRODUCTION

The pigeon guillemot (*Cepphus columba* Pallas) is a medium-sized, diving seabird that nests in rocky coastal habitat throughout the eastern subarctic North Pacific Ocean (Sowls *et. al* 1978; Ewins 1993). Pigeon guillemot ("guillemot") colonies are small and widely dispersed compared with other species (Sowls *et. al loc. cit.*), and some guillemots nest as isolated pairs (Kuletz pers. comm., this survey). Guillemots generally nest at elevations lower than 50 m in natural cavities in broken cliffs and among boulders and talus. They occasionally nest in earthen burrows abandoned by puffins or which they dig themselves (Sowls *et. al loc. cit.*, Oakley 1981, Kuletz pers. comm.), and in man-made structures such as wharves (Campbell 1977). In Prince William Sound, guillemots also nest in burrows among tree roots at cliff edges (Oakley *loc. cit.*; this survey). Guillemots feed on demersal or epibenthic prey mostly in near-shore waters shallower than 40 m (Kuletz 1983; Sanger 1983; DeGange and Sanger 1986).

Guillemot colonies were first surveyed in the Sound in the 1970's and 1980's (Figure 1) (Sowls *et. al loc. cit.*, U. S. Fish and Wildlife Service 1993) during general seabird colony surveys. The U. S. Fish and Wildlife Service (FWS) began detailed studies of guillemots at Naked Island, Prince William Sound ("the Sound"), in the late 1970's (Oakley *loc. cit.*, Kuletz *loc. cit.*). These and subsequent studies after the 1989 *Exxon Valdez* oil spill (Oakley and Kuletz ms, Klosiewski and Laing ms) provided baseline data for assessing the spill's affects on guillemots. However, the scanty nature of colony data from elsewhere in the Sound has hampered an assessment of the species' current status throughout the spill zone and the rest of the Sound.

Thus, in order to gain the necessary knowledge to make recommendations for restoration of the injured guillemot population, the FWS proposed an extensive survey of guillemot colonies in the Sound for three main reasons:

1. Evidence suggested that the guillemot population at Naked Island had been depressed and may be continuing a downward trend;

2. It was unknown whether studies at Naked Island had been representative of the Sound as a whole; and,

3. There had never been a colony survey for all of the Sound during the time-tide window that is critical for accurate counts of guillemots (see below).

Evidence collected through 1992 by Bird Study 2 (Klosiewski and Laing ms) suggests that the population of guillemots in the Sound had declined since the early 1970's. Guillemots are also one of nine seabird species whose population in the oiled area of the Sound declined compared with unoiled areas - the estimated number of guillemots in the oiled zone of the Sound during March 1990 was 33% lower than expected, a projection based on comparisons with unoiled areas (Klosiewski and Laing ms). Population counts at Naked Island also declined annually in the three years following the spill, and the decline along oiled shorelines was more pronounced than along unoiled shorelines (Oakley and Kuletz ms).

We suspected that existing data (FWS *loc. cit.*) did not represent the current status of colonies throughout the Sound. Most past seabird colony surveys focused on large, multi-species colonies; since guillemots represent only a small portion of all birds at these colonies, the guillemots had probably been underestimated or missed altogether. More significantly, earlier surveys missed the critical time-tide window (see below) when guillemots are most likely to be seen at their colonies. After the spill, colonies in the oiled shoreline zone were surveyed only at Naked Island in 1989 and 1990 (Oakley and Kuletz ms), and at Afognak Island in 1992 (Cody *et al* 1993). Klosiewski and Laing (ms) estimated the total guillemot population for PWS, but except

for Naked Island (Oakley and Kuletz ms), there was no current information on the status of guillemot colonies in all of the Sound's spill zone.

OBJECTIVES

Identify and map pigeon guillemot colonies within the trajectory of the spill within Prince William Sound.

METHODS

Study Area

The Sound's 5000-km shoreline is characterized by hundreds of islands, and myriad fjords, bays and secluded coves (Figure 1). The surrounding land is glacially-carved, steep and mountainous. Lower slopes are covered by muskegs interspersed with forests of Sitka spruce, and western and mountain hemlock, that constitute the northernmost extent of the North American temperate rain forest. The maritime climate is characterized by heavy winter snowfall and rain during other seasons. The Sound is a positive estuary. Oceanic water from the Gulf of Alaska enters the Sound through Hinchinbrook Entrance, combines with heavy freshwater runoff, circulates in a generally counter-clockwise pattern, and exits into the Gulf through Montague Strait and smaller passes to the west.

We surveyed all of the Sound's shoreline except for parts of the outer coast of Latouche Island, Stockdale Harbor on Montague Island, ice-clogged portions of Icy and Blackstone Bays and College Fiord, and very shallow waters of Orca Inlet (see below). We did not include the outer coasts of Hinchinbrook and Montague Islands in the study area.

Data Collection

We divided the Sound into eleven areas (Figure 2) according to their former degree of oiling from the *Exxon Valdez* oil spill, to allow subsequent geographic comparison of colony densities. Beginning on May 11 in Port Bainbridge, we surveyed these areas in the following order: Southwestern, Knight-Green-Montague, Southern Westcentral, Northern Westcentral, Northwestern, Northcentral (part), Naked Island Group, Port Fidalgo Vicinity, Port Gravina Vicinity, Southeastern, Northcentral (remainder), Northeastern. The survey ended on June 22.

We generally followed the protocol used for previous guillemot surveys at Naked Island and elsewhere (Nettleship 1976, Cairns 1979, and Oakley and Kuletz ms). We surveyed during the early stage of the breeding season between early May and mid-June before incubation of eggs began. Numbers of guillemots attending colonies and exhibiting distinctive breeding behavior are at a peak during this period, maximizing the opportunity to locate colonies (Ewins 1985, Vermeer *et al.* 1993, Kuletz unpublished data). This distinctive behavior is most prevalent in the early morning, especially during high tide, and again around high tide at other times of the day, although to a lesser extent.

We surveyed generally between 0500 and 1000 h on dates when these times coincided with high tide, and from one hour before to one hour after high tide on other dates. Using small boats, either 4 m inflatable skiffs or an 8 m open-top cruiser, we cruised the shoreline approximately 50 m from shore at a speed of about 4 - 8 knots.

When we sighted guillemots within 100 m of shore, we recorded their location, numbers, behavior, the shoreline type, and the date and time of day. We observed the guillemots for durations of less than a minute for isolated individuals and pairs, to as long as 30 minutes, depending on number of birds and the complexity of their behavior. Most observations lasted about 10 - 15 minutes. The latitude and longitude of colonies were determined with portable Global Positioning System units, and also marked on standard 1:63,360-series U. S. Geological Survey topographic maps. Where colonies were close to one another, we considered adjacent groups of guillemots to be separate colonies when the distance between them was ". . . sufficiently separated . . . that an observer can stand between them without disturbing either group . . . " (after Ewins 1985). This definition is somewhat arbitrary, but the boundaries of neighboring guillemot colonies are often vague.

We drew sketches of all colonies, indicating the suspected locations of nest sites, and we took photographs at several that spanned the observed or suspected extent of nesting (after Nettleship *loc. cit.*). We recorded the presence of isolated individuals and pairs, and other groups of guillemots seen within 100 m of shore that did not display breeding behavior.

Data Analysis

We evaluated the guillemots' behavior (summarized in Appendix 1) after the survey to assign a status of "colony, possible colony or non-colony" to each sighting. In general, we considered a group of four or more guillemots to be a colony when at least one pair exhibited any one the following behaviors:

- Copulation (they copulate only near their nests (Drent *loc. cit.*))
- Flying to or from a specific site on land (crevice in cliff or talus, burrow among tree roots, etc.) that we presumed to be a nest site.
- Sitting on land directly in front of the nest site.
- Delivering fish to a nest site.
- Sitting on rocks at or near water level in front of a site.
- Circling in the air between the water and land, or circling over the water within a limited area within 100 m of land.

We considered groups of guillemots merely sitting on the water within 100 m of land without displaying any of the behaviors above to be "possible colonies." These definitions are conservative, and most "possible colonies" were probably actual colonies.

We verified the locations of colonies and possible colonies for positioning on standard 1:63,360-series U. S. Geological Survey topographic maps. The location and number of guillemots were entered on standard FWS Colony Status Forms, and personnel from the Alaska Seabird Colony Catalog Project entered these data in a computerized database (FWS *loc. cit.*) to produce colony distribution maps (Figures 1 - 11).

We examined the distribution of all guillemots counted by comparing their total and relative numbers within the 11 areas mentioned above (Figure 2), and for subareas (described in Appendix 2) within each area. We calculated relative abundance of guillemots (number/km of shoreline) for all three components of guillemot numbers (colony, possible colony, non-colony) for each area and subarea using shoreline measurements derived by Bird Study 2.

Because the land management practices of colony land owners could influence guillemot population restoration, we determined the land ownership of each colony with the most current land ownership map of the Sound provided by the U. S. Forest Service.

RESULTS

Numbers of Colonies and Guillemots

We surveyed approximately 98% of the inner coastline of the entire Sound. We found 184 colonies and possible colonies during the survey (Table 1, Figures 3 - 11). However, we also found no guillemots at 14 locations where they formerly nested (Table 2), indicated by triangle symbols in Figures 4 - 11. At eight of the latter sites (e.g., on the narrow island north of Green Island, Figure 4) we found a new colony within 1-4 km. In all, we counted 1743 guillemots (58%) in 143 colonies, 273 (9%) in 41 possible colonies, and 1012 (33%) non-colony guillemots for a total 3028.

Distribution of Colonies and Total Numbers

Total and relative numbers of guillemots (Figures 12 and 13) were not distributed uniformly among the 11 analysis areas (Figure 2). With 828 guillemots in the Naked Island Group ("Naked Island")(Area D, Fig. 2) for an average density of 6.9 per km of shoreline (Figure 14), this small area clearly had the highest numbers and density in the Sound. Densities of guillemots at Naked Island were about seven times higher than the next highest densities in the Southwestern (Area B, Fig. 2) and Northern Westcentral (Area E, Fig. 2) Areas, and over an order of magnitude higher than all other areas (Figure 14).

About 62% of all guillemots counted were in the southwestern sector of the Sound (i.e., from Naked Island, south and southwest to Montague Island and Port Bainbridge) that included 41% of the shoreline surveyed (Figure 3, Table 3). Naked Island alone, with only 2.5% of the shoreline, had 27% of the guillemots. In contrast, the eastern Sound (i.e., Northeastern (Area H, Fig. 2), Port Fidalgo (Area I, Fig. 2), Port Gravina (Area J, Fig. 2), and Southeastern (Area K, Fig. 2) Areas) had 24% of the shoreline surveyed, but only about 10% of the guillemots counted (Table 3).

Major Concentrations of Colonies

Guillemot colonies also were not distributed uniformly within the 11 analysis areas (Figures 3 - 11, Table 3). About half (n = 1005) of all colony guillemots occurred in 22 major clusters that included 88 total colonies (Table 4). There were two general patterns of clumped colony distribution (Figures 3 - 11): 1. Smaller islands like Lone and Fool Islands (Figure 8) often had several colonies around their perimeter; 2. Colonies on larger islands and the mainland often occurred close together in clusters, with longer stretches of coastline in between. For example, on Storey Island (Figure 7) there were 10 colonies in three clusters - one of four colonies at the eastern end, and two others of three colonies each on the north and southwest shores.

We calculated an index of guillemots per km of shoreline for these colony clusters by first measuring relevant distances on topographic maps, as follows. For small islands, we measured their entire shoreline; on large islands, and on the mainland, we measured the distance along the shoreline between the colonies that were farthest apart within the cluster. For each of the 22 colony clusters we then divided these distances into numbers of colonies and total guillemots . The results (Table 4) allow a more definitive comparison of important colony locations in the Sound than possible from comparing the more inclusive data from broader areas of the Sound (Table 3).

Besides several locations at Naked Island, we found clusters of guillemot colonies at Jackpot, Fool, Pleiades, and Bligh Islands, and in Passage Canal. Jackpot Island in southern Dangerous Passage (Figure 6) had the greatest local concentration, with 78 guillemots in three colonies around the 0.6 km perimeter of the island, and Fool Island (Figure 8), with 65 guillemots in five colonies over 1.4 km of shoreline had the second highest local concentration (Table 3). We also found important concentrations of colonies on Evans Island, and in Port Bainbridge, Blackstone Bay, and Harriman Fjord (Figures 5, 8 and 9).

Number of Guillemots per Colony

Guillemot colony sizes are very small compared with other species of marine birds in the Sound (FWS *loc. cit.*). Of the 184 colonies or possible colonies we found, only 18 (10%) had 20 or more birds, while 58 (32%) had only four to six birds (Figure 15). Twenty-five percent of all birds seen were either pairs or lone birds (Figure 16), and 80% of all guillemots counted were in groups of 17 or fewer birds (Figure 17).

DISCUSSION

This survey greatly expanded our knowledge of the distribution of guillemots and their colonies in the Sound. The survey also showed that past studies at Naked Island (Oakley *loc. cit.*, Kuletz *loc. cit.*, Oakley and Kuletz *loc. cit.*) were conducted at the densest nesting area. However, while Naked Island studies applied to a moderate proportion (27%) of the Sound's guillemots, those studies should not be considered applicable to the entire Sound. Most (73%) of the Sound's guillemot population nests elsewhere than the Naked Island Group.

We also caution that data from individual colonies (Table 1) must be qualified. Because we were trying to survey as much of the Sound's shoreline as possible, we necessarily had to limit our time at any one colony, which may or may not have resulted in a maximum count of guillemots. Studies of guillemot colony attendance patterns have shown that numbers can fluctuate daily (Ewins *loc. cit.*, Nelson 1987, Kuletz, unpubl.). Thus, the results of this survey should be viewed as a minimum count of guillemot colonies and breeding population size for the Sound. However, given the vastness of the survey region, the short duration of the optimum sampling window, and the potential for hindrance from adverse weather, we believe that we have provided as accurate an assessment as possible of the status of guillemots in the Sound.

The overall population count for this survey (3028) is at the low end of the range of total Sound-wide population estimate of 3000 - 4900 guillemots derived from a July 1993 waterbird survey (B. Agler, pers. comm.). Considering that the latter survey estimated the total guillemot population, including nonbreeders, and our count did not include guillemots in offshore waters, the two population figures are remarkably similar. Regardless, the population of about 3000 to 4900 guillemots continues at a level far lower than the 15,000 estimated during the 1970's (Klosiewski and Laing ms).

Populations have declined at oiled Naked Island (Figure 20) and in unoiled areas as well. For example, 120 guillemots were estimated at colonies in Whale and Icy Bays in 1972 (Table 2), while our 1993 colony counts for these bays totaled 58. Similarly, the 1972 estimate for the Blackstone Glacier colony alone was 140 guillemots, while our 1993 count for all Blackstone Bay colonies was 99. The maximum numbers of guillemots at colonies are also way down. During the 1970's, seven colonies ranged in size from 80-300 guillemots (Table 2), while the maxima we found ranged from 43 to 48 birds at four colonies (Table 1).

Our discoveries of guillemots missing from the sites of 14 former colonies, and new colonies within 1 - 4 km of eight of these, warrants discussion. Individual guillemots are known to be tenacious to their nest sites for at least four years (Drent *loc. cit.*), but there seems to be little

information about the site tenacity of entire colonies. Data in Table 2 suggests that the locations of some Sound colonies have shifted over the 14-21 years between earlier surveys and our 1993 survey; i.e., guillemots at colonies we found a few km away from the sites of former colonies could be descendants of birds from the former colony.

We speculate that such a shift in colony location could happen as follows: Breeding guillemots are tenacious to their nest sites and aggressively exclude prospective new breeders (Drent *loc. cit.*). This limits new breeders to nest sites at a colony's periphery, in effect slightly changing the borders of the colony. As the older breeders die, their nest sites may not be re-occupied, which in effect would shift the center of the colony slightly. If this phenomenon were persistent over several years, the effect would be to slowly shift the colony's location.

The oil spill had an obvious impact on the guillemot population in 1989, killing part of the PWS population outright (Piatt *et al* 1990). However, it is difficult to say why the population had declined from its 1970's high up to the time of the spill, and why it remains depressed or continues to decline now. One may speculate that reduced food availability and increased predation have depressed guillemot numbers, but data on either possibility are limited to a few observations at Naked Island (Kuletz, pers. comm.). Studies of food availability, predation and productivity at several sites including Naked Island would help clarify the factors that influence population fluctuations. If predation proves to be seriously contributing to the guillemots' population decline, predator exclosures or other non-lethal means of predator control may be warranted. Recent studies in Puget Sound, Washington (Divoky, pers comm.) showed that pigeon guillemots readily nest in artificial nest boxes, and these could conceivably be made predator-resistant.

RECOMMENDATIONS FOR RESTORATION

Monitor Land Management Practices

Table 1 shows that Chugach National Forest is the major land manager for colonies and total numbers of breeding guillemots in the Sound. Numbers of breeding guillemots tally out to 92% on Chugach National Forest land, about 4% on Tatitlek Corporation land, and 2% each on Chugach Alaska Corporation land and "other." Two of the largest colonies, at The Pleiades (colony 02042, 48 birds) and on Bligh Island (colony 06002, 45 birds) are on land owned by Alaska Native corporations. Monitoring land management practices at major colonies would help assure that management practices that may be adverse to guillemot population restoration could be avoided.

Guard Against Inadvertent Human Disruption

Protecting colonies from inadvertent human disruption is a viable means of helping prevent further guillemot population decline. Most colonies found during this survey are located in remote areas, in rugged terrain that is not likely to be visited by humans. However, a notable exception is at Jackpot Island (Figure 6), location of the densest concentration of guillemots in the Sound. Jackpot Island is located on Chugach National Forest land, and it lies just offshore from Jackpot Bay, an increasingly popular destination for recreational boaters and sport fishermen. The island also has two beaches suitable for landing boats and for tent camping. These factors increase the chances for inadvertent human disruption to nesting guillemots. Therefore, we recommend that Chugach National Forest post Jackpot Island against unapproved human trespass during the May - August nesting season.

Analyze Existing Naked Island Data in More Detail

From 1989 through 1992, FWS personnel at Naked Island have accurately determined pigeon guillemot colony locations and counted total numbers of guillemots within successive, short segments of shoreline around the perimeters of each island in the Naked Island Group (Kuletz pers. comm.). The data we collected at Naked Island during the present survey adds to this data base. Together, these data comprise a detailed record of the fine-scale distribution of pigeon guillemots and their colonies for five consecutive years after the EVOS. To date, these data have not been analyzed, although they could provide valuable insight to the population dynamics of guillemot populations at Naked Island. We recommend that these data be analyzed for possible clues to why the population at Naked Island appears to be in a continued decline.

Future Surveys

The status of guillemot population restoration remains uncertain, so it is vitally important that the status of colonies and breeding population size throughout the Sound be monitored adequately in the future. We recommend that every five years the entire Sound be surveyed for pigeon guillemot colonies as done during this survey. This would give an accurate view of the sizes and locations of guillemot colonies, as well as provide ongoing data on the possible phenomenon of colonies shifting locations over the years.

Surveys in the Naked Island Group have been used in the past as an index of pigeon guillemot nesting population trends in the Sound (Oakley and Kuletz ms). However, the present survey showed that 73% of the Sound's breeding population nests elsewhere than the Naked Island Group, so population trends at Naked Island should not be assumed to reflect those of the entire Sound. We therefore recommend that every two years the 22 clusters of colonies delineated by this survey be monitored. We anticipate that the latter surveys could be done in two weeks by a field crew of two using a fast cruiser, at relatively low cost.

Finally, we note that pigeon guillemots were injured throughout the EVOS zone, and not just in Prince William Sound. Knowledge of the status of colonies outside of the Sound is as incomplete in these areas as it was in the Sound before the present survey. We therefore recommend that pigeon guillemot colony surveys be conducted outside PWS, especially in Kenai Fjords National Park, and on the Alaska Maritime National Wildlife Refuge lands.

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Table 1. Pigeon guillemot (PiGu) colonies found during surveys of Prince William Sound, May - June 1993.
*Colony Status: B = Colony, evidence of breeding; X = Possible colony, little evidence of breeding.
**Land owner: CNF = Chugach National Forest; CVC = Chenega Village Corporation;
CAC = Chugach Alaska Corporation; TC = Tatitlek Corporation; EC = Eyak Corporation;
DOD = Department of Defense; AK = State of Alaska

Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
01001	NE Gibbon Anchorage	60° 18.1'	147° 23.7'	12	B	CNF
01002	Green I, NW Pt #1	60° 15.6'	147° 30.0'	17	B	CNF
01003	South Green Island	60° 15.4'	147° 30.2'	16	B	CNF
01004	Channel Isle	60° 14.3'	147° 22.8'	21	B	CNF
01005	N of Gilmour Pt	60° 16.1'	147° 12.5'	4	B	CNF
01006	S of Stockdale Harbor	60° 17.4'	147° 13.8'	5	X	CNF
01008	Outer Marsha Bay	60° 20.0'	147° 39.1'	6	B	CAC
01009	N of Snug Harbor	60° 16.3'	147° 43.0'	4	X	CNF
01010	Discovery Pt	60° 14.7'	147° 41.9'	4	X	CNF
01011	S of Discovery Pt	60° 14.6'	147° 41.71'	16	B	CNF
01012	Drier Bay (Barnes Cove)	60° 19.2'	147° 46.2'	8	B	CAC
01013	Foul Pass	60° 29.89'	147° 37.58'	6	B	CNF
01014	NW of Drier Bay	60° 19.5'	147° 53.7'	6	X	CNF
01015	W of Mummy I	60° 17.1'	147° 56.1'	4	X	CNF
01016	Sphinx I	60° 29.6'	147° 34.9'	9	B	CNF
01017	*Void site no.*					
01018	W. Montague Islets	60° 10.6'	147° 20.9'	8	B	CNF
01019	Macleod Harbor N	59° 53.4'	147° 47.7'	13	B	CAC
01020	Macleod Harbor S	59° 52.3'	147° 49.1'	8	B	CNF
01021	Seal I #1	60° 25.8'	147° 24.8'	12	B	CNF
01022	Seal I #2	60° 25.74'	147° 24.86'	6	B	CNF
01023	Seal I #3	60° 25.8'	147° 23.65'	12	B	CNF
01024	Seal I #4 (Weather Station)	60° 25.5'	147° 24.1'	12	B	CNF
01025	Seal I #5 (SW Pt)	60° 25.55'	147° 24.7'	19	B	CNF
02001	Auk Bay, N Pt	60° 01.86'	148° 24.31'	4	B	CNF
02002	S of N Auk Bay	60° 02.53'	148° 23.8'	17	B	CNF
02003	N Auk Bay, N Pt	60° 03.62'	148° 23.1'	7	X	CNF

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Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
02004	N of N Auk Bay	60° 04.10'	148° 22.7'	9	X	CNF
02005	W Hogg Bay	60° 05.20'	148° 22.08'	26	B	CNF
02006	N of Hogg Pt	60° 06.17'	148° 17.38'	12	B	CNF
02007	Elrington I #1	59° 57.71'	148° 04.64'	22	B	CNF
02008	Elrington I #2	59° 57.44'	148° 05.10'	4	B	CNF
02009	Elrington I #3	59° 57.25'	148° 05.8'	14	X	CNF
02010	Elrington I #4	59° 57.00'	148° 06.2'	12	X	CNF
02011	S of Pt Waters	60° 06.96'	148° 17.91'	14	B	CNF
02012	N of Pt Waters	60° 07.60'	148° 17.9'	5	X	CNF
02013	NW of Pt Countess	60° 13.78'	148° 07.04'	6	B	CVC
02014	Gage Island	60° 11.30'	148° 00.4'	16	B	CVC
02015	Pt. Pyke	60° 01.88'	148° 18.86'	17	B	CNF
02016	Flemming Island	60° 11.10'	148° 01.2'	8	B	CVC
02017	Evans I #1	60° 08.10'	147° 57.6'	4	X	CNF
02018	Evans I #2	60° 02.40'	148° 07.20'	4	B	CNF
02019	Latouche I, E side	60° 00.56'	147° 51.47'	8	B	CAC
02020	North Twin Bay	59° 58.24'	148° 12.8'	16	B	CNF
02021	Squirrel Bay, SW Pt.	59° 59.7'	148° 09.0'	7	B	CNF
02022	Squirrel Bay, Middle	60° 00.50'	148° 07.91'	12	B	CNF
02023	Squirrel Bay, North	60° 00.69'	148° 08.04'	10	B	CNF
02024	SW of Aluklik Bay	60° 01.33'	148° 07.96'	4	B	CNF
02025	N of Aluklik Bay	60° 02.0'	148° 07.4'	4	B	CNF
02026	Brid Benchmark	60° 08.39'	148° 20.59'	9	B	CNF
02027	Bainbridge Glacier	60° 07.19'	148° 21.73'	5	B	CNF
02028	Auk Bay South	60° 00.70'	148° 23.69'	6	B	CNF
02029	Gray Bowl	59° 59.72'	148 24.23'	21	B	CNF
02030	South Gray Bowl	59° 59.58'	148° 24.30'	4	B	CNF

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Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
02031	Section 27	59° 58.61'	148° 23.97'	6	B	CNF
02032	Whale Bay, East Arm	60° 11.5'	148° 11.7'	4	X	CNF
02033	Section 27, South	59° 58.4'	148° 24.3'	7	B	CNF
02034	Whale Bay, West Arm	60° 13.10'	148° 15.55'	5	B	CNF
02035	Icy Bay #3	60° 12.96'	148° 19.43'	6	B	CNF
02036	Icy Bay #4	60° 12.1'	148° 21.9'	4	X	CNF
02037	Nassau Fjord	60° 15.90'	148° 20.19'	14	B	CNF
02038	Icy Bay #5	60° 12.3'	148° 23.3'	6	B	CNF
02039	Icy Bay #1	60° 14.9'	148° 16.5'	7	X	CNF
02040	Icy Bay #2	60° 14.05'	148° 17.62'	6	B	CNF
02041	West Bainbridge Passage	60° 06.93'	148° 16.18'	6	B	CNF
02042	Pleiades Islands	60° 13.7'	148° 00.85'	48	B	CVC
03001	Little Smith Island #1	60° 31.1'	147° 25.7'	7	B	CNF
03002	Naked I., Fleet	60° 39.3'	147° 26.8'	4	X	CNF
03003	Smith Island #1	60° 31.12'	147° 24.21'	16	B	CNF
03004	Smith Island #2	60° 31.70'	147° 19.03'	7	B	CNF
03005	Smith Island #3	60° 31.91'	147° 18.71'	5	B	CNF
03006	Little Smith Island #2	60° 31.29'	147° 25.40'	11	B	CNF
03007	Naked I., South Cabin Bay	60° 39.2'	147° 27.3'	9	B	CNF
03008	Naked I., West Point	60° 39.1'	147° 30.0'	8	B	CNF
03009	Naked I., Crest Benchmark	60° 39.0'	147° 29.9'	4	B	CNF
03010	Naked I., North Outside Bay	60° 38.85'	147° 29.65'	14	B	CNF
03011	Naked I., Hook Island	60° 38.75'	147° 28.53'	18	B	CNF
03012	Naked I., Hook Island II	60° 38.83'	147° 27.7'	4	X	CNF
03013	Naked I., Pt. East of Daisy	60° 37.73'	147° 25.23'	4	X	CNF
03014	Naked I., Bass Harbor SW	60° 37.9'	147° 25.15'	8	X	CNF
03015	Peak Island #1	60° 42.04'	147° 25.0'	18	B	CNF

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Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
03016	Peak Island #2	60° 41.55'	147° 21.82'	12	B	CNF
03017	Peak Island #3	60° 42.00'	147° 21.11'	13	B	CNF
03018	Peak Island #4	60° 42.90'	147° 21.54'	11	B	CNF
03019	Peak Island #5	60° 42.87'	147° 21.67'	15	B	CNF
03020	Peak Island #6	60° 42.6'	147° 22.7'	8	X	CNF
03021	Naked Island, Bass Harbor E	60° 37.6'	147° 23.2'	8	X	CNF
03022	Storey Island, Cocos	60° 44.09'	147° 25.29'	29	B	CNF
03023	Storey Island, Dixie	60° 43.9'	147° 26.7'	9	B	CNF
03024	Storey Island, Folly	60° 43.69'	147° 27.23'	9	B	CNF
03025	Storey Island, NW of Major	60° 43.47'	147° 28.70'	33	B	CNF
03026	Storey Island, Quest	60° 43.75'	147° 23.4'	18	B	CNF
03027	Naked Island, North of Tuft	60° 37.28'	147° 28.89'	21	B	CNF
03028	Naked Island, Bass Harbor W	60° 38.70'	147° 24.41'	8	B	CNF
03029	Naked Island, Bass Harbor NW	60° 38.96'	147° 23.82'	5	B	CNF
03030	Bass Island, Ball Benchmark	60° 37.03'	147° 23.1'	10	B	CNF
03031	Agnes Triangle	60° 36.85'	147° 23.4'	8	B	CNF
03032	Naked Island, North Cabin Bay	60° 40.63'	147° 28.0'	12	B	CNF
03033	Naked Island, Row Annex	60° 41.1'	147° 29.1'	9	B	CNF
03034	Naked Island, Row	60° 41.2'	147° 29.1'	17	B	CNF
03035	Naked Island, Thumb	60° 41.5'	147° 28.7'	2	X	CNF
03036	Naked Island, Igloo Annex	60° 40.43'	147° 23.8'	11	X	CNF
03037	Naked Island, Glory	60° 40.25'	147° 23.4'	4	X	CNF
03038	Naked Island, Glory Annex	60° 39.63'	147° 23.24'	12	B	CNF
03039	Naked Island, Edgar	60° 39.93'	147° 21.24'	9	B	CNF
03040	Naked Island, Abner	60° 40.65'	147° 19.65'	6	B	CNF
03041	Naked Island, S of Abner	60° 40.2'	147° 19.2'	8	X	CNF
03042	Storey Island, Near Major	60° 43.4'	147° 28.03'	6	B	CNF

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Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
03043	Storey Island, E of Major	60° 43.2'	147° 27.2'	4	B	CNF
03044	Storey Island, N of Quest	60° 44.00'	147° 22.90'	16	B	CNF
03045	Storey Island, S of Lily	60° 44.26'	147° 22.70'	12	B	CNF
03046	Storey Island, E of Storey	60° 44.53'	147° 23.35'	13	B	CNF
03047	Naked Island, Igloo	60° 41.1'	147° 24.0'	43	B	CNF
03048	Naked Island, Nomad	60° 41.67'	147° 28.25'	5	B	CNF
04001	Chenega Island, N of Lint	60° 20.15'	148° 00.3'	15	B	CVC
04002	Chenega Island, Chop	60° 20.7'	148° 59.7'	4	X	CVC
04003	Port Nellie Juan, Graystone Bay	60° 31.2'	148° 24.6'	5	X	CNF
04004	Jackpot Island, East	60° 19.15'	148° 11.45'	26	B	CNF
04005	Jackpot Island, Northwest	60° 19.20'	148° 11.50'	26	B	CNF
04006	Jackpot Island, Southwest	60° 19.10'	148° 11.55'	26	B	CNF
05001	Passage Canal, Twin Falls	60° 48.23'	148° 39.31'	47	B	CNF
05002	Passage Canal, DeLong Dock	60° 46.7'	148° 39.93'	7	X	DOD
05003	Blackstone Bay, S of Zircon	60° 45.8'	148° 31.4'	8	B	CNF
05004	Blackstone Bay, Pt S of Zircon	60° 45.3'	148° 31.7'	4	X	CNF
05005	Cochrane Bay, 3-finger Bay	60° 39.52'	148° 20.93'	5	X	CNF
05006	Cochrane Bay, S of Jello	60° 38.0'	148° 24.6'	4	B	CNF
05007	Blackstone B, Northland Glacier	60° 40.65'	148° 40.89'	12	B	CNF
05008	Passage Canal	60° 48.0'	148° 40.0'	20	B	CNF
05009	Cochrane Bay, S of Jello #2	60° 38.24'	148° 24.28'	15	B	CNF
05010	Blackstone Bay, Willard Island	60° 42.4'	148° 39.0'	14	B	CNF
05011	Blackstone Bay, Beloit Glacier	60° 39.6'	148° 39.9'	29	B	CNF
05012	Blackstone Bay, Section 22	60° 46.3'	148° 33.9'	7	B	CNF
05013	Blackstone Bay, W of Xeno	60° 47.0'	148° 31.33'	27	B	CNF
05014	Perry Island, N of Daycare Cove	60° 43.1'	147° 52.6'	6	B	CNF
05015	Perry Island, Billings Pt.	60° 41.46'	147° 50.6'	11	B	CNF

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Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
05016	Perry Island, South Bay	60° 39.9'	147° 55.7'	7	X	CNF
05017	Lone Island #1	60° 41.9'	147° 45.1'	3	X	CNF
05018	Lone Island #2	60° 41.46'	147° 44.99'	13	B	CNF
05019	Lone Island #3	60° 41.09'	147° 45.09'	11	B	CNF
05020	Lone Island #4	60° 40.31'	147° 45.95'	8	B	CNF
05021	Lone Island #5	60° 40.69'	147° 44.96'	11	B	CNF
05022	Lone Island #6	60° 41.2'	147° 44.6'	16	X	CNF
06001	Bligh Island #1	60° 48.34'	146° 47.59'	4	B	TC
06002	Bligh Island #2	60° 48.42'	146° 47.66'	45	B	TC
06003	Bligh Island #3	60° 49.00'	146° 48.80'	4	B	TC
06004	Reef Island	60° 50.80'	146° 50.47'	4	B	TC
07001	Goose Island	60° 43.1'	146° 44.0'	7	X	TC
07002	Red Head	60° 40.16'	146° 29.76'	9	B	TC
07003	North of Orca Inlet	60° 37.75'	145° 45.1'	6	X	EC
08001	West of Pt Doran #2	61° 03.8'	148° 11.9'	9	X	CNF
08002	West of Pt Doran #3	61° 03.66'	148° 12.82'	10	B	CNF
08003	Toboggan Glacier	61° 03.07'	148° 15.97'	4	B	CNF
08004	Cascade Glacier	61° 07.04'	148° 10.26'	24	B	CNF
08005	North Barry Arm	61° 06.39'	148° 10.63'	6	B	CNF
08006	North Surprise Inlet	61° 03.60'	148° 23.32'	5	B	CNF
08007	South Surprise Inlet	61° 02.60'	148° 22.24'	7	B	CNF
08008	East of Pt Doran	61° 04.59'	148° 07.93'	11	B	CNF
08009	Yale Arm Island #1	61° 12.43'	148° 42.52'	4	B	CNF
08010	Yale Arm Island #2	61° 12.23'	148° 42.79'	19	B	CNF
08011	West of Pt Doran #1	61° 03.9'	148° 11.3'	7	B	CNF
09001	Dutch Group #1	60° 45.65'	147° 48.4'	7	B	CNF
09002	Dutch Group #2	60° 45.6'	147° 48.7'	17	B	CNF

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Site No.	Site Name	Lat North	Long West	Total PiGu	*Colony Status	**Land Owner
09003	West Axel Lind	60° 47.27'	147° 43.71'	5	B	CNF
09004	East Axel Lind	60° 47.70'	147° 42.60'	5	B	CNF
09005	North of Granite Point	60° 53.3'	147° 20.7'	8	X	CNF
09006	Northeast of Bull Head	60° 51.99'	147° 06.10'	8	B	CNF
09007	S. Glacier Island	60° 51.75'	147° 11.24'	7	B	AK
09008	East of Iceberg Point	60° 52.5'	147° 18.9'	7	X	AK
09009	Fool Island #1	60° 45.8'	147° 54.5'	10	B	CNF
09010	Fool Island #2	60° 45.84'	147° 54.62'	14	B	CNF
09011	Fool Island #3	60° 45.9'	147° 54.8'	11	B	CNF
09012	Fool Island #4	60° 45.9'	147° 55.0'	8	B	CNF
09013	Fool Island #5	60° 45.78'	147° 54.73'	9	B	CNF
09014	Fool Island #6	60° 45.8'	147° 55.0'	10	B	CNF
10001	Valdez Arm	60° 58.19'	147° 51.85'	15	B	CNF
10002	Western Port Valdez	61° 06.74'	146° 38.22'	6	B	AK
11001	Boswell Rocks	60° 24.7'	146° 06.3'	6	B	AK/EC
11002	Hawkins Cutoff	60° 28.1'	146° 21.0'	7	X	CNF
11003	North of Bear Cape	60° 20.98'	146° 43.45'	14	B	CNF
11004	2nd Point S. of Deer Cove	60° 22.40'	146° 43.52'	24	B	CNF
11005	1st Point S. of Deer Cove	60° 22.9'	146° 43.9'	9	X	CNF
11006	1st Point S. of Johnstone Pt.	60° 28.7'	146° 37.3'	12	B	CNF
11007	South of Port Etches	60° 16.1'	146° 41.8'	9	X	CNF
11008	N.W. of Cape Hinchinbrook	60° 15.3'	146° 41.2'	5	X	CNF

Table 2. Comparison of pigeon guillemot (PiGu) numbers at Prince William Sound colonies before and after the 1993 survey.

	Most Recent Pre-1993 Data				1993 Survey Data				
Area of PWS	Site Name	Fig. 1 Site No.	Date	# PiGu	# PiGu	Increase (Decrease)	Site No.	Report Fig. #	Notes
Knight-Montague	W. Montague Islets	63-6	07-72	10	8	(2)	01018	4	
Knight-Montague	Channel Isle	63-9	07-72	30	21	(9)	01004	4	
Knight-Montague	S. Green Island	63-12	07-72	40	16	(24)	01003	4	Also near 93 site 01002 (17 PiGu)
Knight-Montague	N. Green Island	63-14	07-72	10	0	(10)		4	Near 93 site 01001 (12 PiGu)
Knight-Montague	Seal Island	63-17	08-84	90	61*	(29)	*	4	* 5 sites in '93: 01021-01025
Knight-Montague	Clove Triangle	63-20	07-78	4	0	(4)		7	
Naked Island	Little Smith Island	63-18	06-79	58	18*	(40)	*	7	* 2 sites in '93: 03001 and 03006
Naked Island	Smith Island	63-19	06-79	300	28*	(272)	*	7	* 3 sites in '93: 03003-03005
Naked Island	Agnes Triangle	63-21	07-78	20	8	(12)	03031	7	Also near 93 site 03030 (10 PiGu)
Naked Island	E. Pt. Naked I.	63-23	07-78	240	0	(240)		7	
Naked Island	West Storey Island	63-26	07-77	20	0	(20)		7	Near 93 sites 03025, 03042 (39 PiGu tot)
Naked Island	East Storey Island	63-25	07-77	10	0	(10)		7	Near 93 site 03024 (9 PiGu)
Naked Island	Peak Island	63-43	07-78	100	12	(88)	03016	7	Also near 93 site 03017 (13 PiGu)
Naked Island	Bass Harbor	63-52	06-84	112	0	(112)		7	
Northcentral	Dutch Group	63-18	07-72	50	0	(50)		8	Near 93 sites 09001, 09002 (24 PiGu tot)
Northcentral	Fool Island	63-28	07-72	40	62	22	*	8	* 5 sites in '93: 09009 - 09014
Northcentral	S. Glacier Island	63-58	05-85	24	7	(17)	09007	10	

Table 2. Comparison of pigeon guillemot (PiGu) numbers at Prince William Sound colonies before and after the 1993 survey.

	Most Recent Pre-1993 Data				1993 Survey Data				
Area of PWS	Site Name	Fig. 1 Site No.	Date	# PiGu	# PiGu	Increase (Decrease)	Site No.	Report Fig. #	Notes
Northeastern	W. Side Valdez Arm	64-32	07-85	44	0	(44)		10	93 site 10001 (15 PiGu) 4-5 km away
Northwestern	Coxe Glacier	69-08	06-84	50	0	(50)			93 site 08004 (24 PiGu) 3 km away
Southeastern	Boswell Rocks	64-12	07-72	10	6	(4)	11001	11	
Southeastern	Constantine Harbor	64-21	07-76	12	0	(12)			Closest 93 site (14 PiGu) 4-5 km away
Southwestern	Port Bainbridge	63-4	07-72	40	0	(40)		5	Near 93 site 02026 (9 PiGu)
Southwestern	Whale Bay	63-8	07-72	80	0	(80)		6	Near 93 site 02034 (5 PiGu)
Southwestern	Chenega Glacier	63-10	07-72	40	0	(40)		6	Near 93 site 02037 (14 PiGu)
Westcentral	Blackstone Glacier	63-22	07-72	140	0	(140)		8	Near 93 site 05007 (12 PiGu)
Westcentral	Passage Canal	63-31	07-72	40	20	(20)	05008	8	

Table 3. Geographic comparison of colonies and other concentrations of pigeon guillemots (PiGu) in Prince William Sound, May - June 1993. See Figure 2 for area boundaries. See Appendix 2 for full descriptions of subareas.

Area and Subarea	km of Shore Sr'vyd	Nesting colonies: Number of: Col'ny	Nesting colonies: Number of: Pigu	Nesting colonies: Mean/km Col'ny	Nesting colonies: Mean/km Pigu	"Possible" colonies: Number of: Sites	"Possible" colonies: Number of: Pigu	"Possible" colonies: Mean/km Sites	"Possible" colonies: Mean/km Pigu	"Non-Colony" Guillemots: Total	"Non-Colony" Guillemots: #/km	GRAND TOTAL: All Pigu's	GRAND TOTAL: Mean #/km
Knight - Green- West Montague (Area A, Fig. 2)													
Eleanor Island	40.0									4	0.10	4	0.10
Ingot and Disk Islands and vicinity	37.4	2	15	0.05	0.40					4	0.11	19	0.51
Knight I.: Passage Pt. to Herring Pt.	53.2												
Knight I.: Herring Pt. to Drier Bay	82.5					1	6	0.01	0.07	2	0.02	8	0.10
Knight I.: Drier Bay to Long Channel	64.0	1	8	0.02	0.13					5	0.08	13	0.20
Knight I.: Squirrel to Squire Islands	48.2					1	4					4	0.08
Knight I.: Long Channel to Pt. Helen	46.5												
Knight I.: Pt. Helen to Bay of Isles	61.1	2	22	0.03	0.36	2	15	0.03	0.25	7	0.11	44	0.72
Knight I.: Bay of Isles to Passage Pt	61.9									11	0.18	11	0.18
Seal Island	2.5	5	61	2.00	24.38					2	0.80	63	25.18
Green Island and vicinity	53.6	4	66	0.07	1.23					8	0.15	74	1.38
Montague Island: West side	182.7	4	33	0.02	0.18	1	5	0.01	0.03	26	0.14	64	0.35
Area Total	**733.6**	**18**	**205**	**0.02**	**0.28**	**5**	**30**	**0.01**	**0.04**	**69**	**0.09**	**304**	**0.41**
	15.3 % total area											**9.8 % all PIGu's**	
Southwestern (Area B, Fig. 2)													
Icy/Whale Bays	116.5	6	43	0.05	0.37	3	15	0.03	0.13	67	0.57	125	1.07
Plaeides Islands	2.5	1	48	0.40	19.41							48	19.41
Bainbridge Passage	61.6	1	6	0.02	0.10					8	0.13	14	0.23
Port Bainbridge	101.7	13	148	0.13	1.46	3	21	0.03	0.21	36	0.35	205	2.02
Bainbridge Island, east shore	55.1	2	24	0.04	0.44					13	0.24	37	0.67
Evans Island	123.3	6	41	0.05	0.33	1	4	0.01	0.03	13	0.11	58	0.47
Elrington Island	59.6	3	42	0.05	0.70	2	26	0.03	0.44	18	0.30	86	1.44
Latouche Island	50.7	1	8	0.02	0.16					7	0.14	15	0.30
Area Total	**571.0**	**33**	**360**	**0.06**	**0.63**	**9**	**66**	**0.02**	**0.12**	**162**	**0.28**	**588**	**1.03**
	11.9 % total area											**19.5 % all PIGu's**	

Table 3. Geographic comparison of colonies and other concentrations of pigeon guillemots (PiGu) in Prince William Sound, May - June 1993. See Figure 2 for area boundaries. See Appendix 2 for full descriptions of subareas.

	km of	Nesting colonies				"Possible" colonies				"Non-Colony"		GRAND TOTAL	
	Shore	Number of:		Mean/km		Number of:		Mean/km		Guillemots		All	Mean
Area and Subarea	**Sr'vyd**	**Col'ny**	**Pigu**	**Col'ny**	**Pigu**	**Sites**	**Pigu**	**Sites**	**Pigu**	**Total**	**#/km**	**Pigu's**	**#/km**
Naked Island Group (Area D, Fig. 2)													
Naked Island: East half	24.3	4	33	0.16	1.36	2	16	0.08	0.66	11	0.45	60	2.46
Naked Island: West half	47.7	14	185	0.29	3.88	7	37	0.15	0.78	103	2.16	325	6.82
Storey Island	18.8	10	149	0.53	7.93					93	4.95	242	12.87
Peak Island	14.0	5	69	0.36	4.92	1	8	0.07	0.57	17	1.21	94	6.71
Smith and Little Smith Islands	14.9	5	46	0.34	3.08					61	4.09	107	7.17
Area Total	**119.8**	**38**	**482**	**0.32**	**4.02**	**10**	**61**	**0.08**	**0.51**	**285**	**2.38**	**828**	**6.91**
% Total	**2.5**											**27.4 % all PiGu's**	
Southern Westcentral (Area C, Fig. 2)													
Chenega Island: E and S shores	36.0	1	15	0.42	0.42	1	4	0.03	0.11	10	0.28	29	0.81
Chenega Island: West shore	49.6									6	0.12	6	0.12
Jackpot Island	0.6	3	78	5.00	130.00							78	130.00
Dangerous Passage: West shore	123.8									12	0.10	12	0.10
Main Bay - Eshamy vicinity	100.4									4	0.04	4	0.04
Port Nellie Juan	167.6					1	5	0.01	0.03	12	0.07	17	0.10
Kings Bay	72.9									25	0.34	25	0.34
Area Total	**550.9**	**4**	**93**	**0.01**	**0.17**	**2**	**9**	**0.00**	**0.02**	**69**	**0.13**	**171**	**0.31**
	11.5 % total area											**5.7 % all PiGu's**	
Northern Westcentral (Area E, Fig. 2)													
Lone Island	11.1	4	43	0.36	3.88	2	19	0.18	1.71	33	2.98	95	8.57
Perry Island	81.0	2	17	0.02	0.21	1	7	0.01	0.09	30	0.37	54	0.67
Culross and Applegate Islands	99.1									3	0.03	3	0.03
Culross Passage: West shore	47.9									12	0.25	12	0.25
Cochrane Bay	87.9	2	19	0.02	0.22	1	5	0.01	0.06	4	0.05	28	0.32
Blackstone Bay	82.6	6	97	0.07	1.17	1	2	0.01	0.02	32	0.39	131	1.59
Passage Canal	63.5	2	67	0.03	1.05	1	7	0.02	0.11	3	0.05	77	1.21
Area Total	**473.2**	**16**	**243**	**0.03**	**0.51**	**6**	**40**	**0.01**	**0.08**	**117**	**0.25**	**400**	**0.85**
	9.9 % total area											**13.2 % all PiGu's**	

Table 3. Geographic comparison of colonies and other concentrations of pigeon guillemots (PiGu) in Prince William Sound, May - June 1993. See Figure 2 for area boundaries. See Appendix 2 for full descriptions of subareas.

Area and Subarea	km of Shore	Nesting colonies				"Possible" colonies				"Non-Colony"		GRAND TOTAL	
		Number of:		Mean/km		Number of:		Mean/km		Guillemots		All	Mean
	Sr'vyd	Col'ny	Pigu	Col'ny	Pigu	Sites	Pigu	Sites	Pigu	Total	#/km	Pigu's	#/km
Northwestern (Area F, Fig. 2)													
Port Wells	126.9									4	0.03	4	0.03
Barry Arm	45.7	3	41	0.07	0.90					23	0.50	64	1.40
Harriman Fjord	61.7	6	42	0.10	0.68	1	9	0.02	0.15	27	0.44	78	1.26
College Fjord	122.2	2	23							34	0.28	57	0.47
Area Total	**356.4**	**11**	**106**	**0.03**	**0.30**	**1**	**9**	**0.00**	**0.03**	**88**	**0.25**	**203**	**0.57**
	7.4 % total area											**6.7 % all PIGu's**	
Northcentral (Area G, Fig. 2)													
Esther Passage	59.9												
Esther Island: South shore	45.4									15	0.33	15	0.33
Eastern Wells Passage	43.2	8	86	0.19	1.99					17	0.39	103	2.38
Eaglek Bay	149.9	2	10	0.01	0.07					19	0.13	29	0.19
Unakwik Inlet	164.5									1	0.01	1	0.01
Wells Bay/Fairmont vicinity	126.7									2	0.02	2	0.02
Long Bay	82.3					1	8	0.01	0.10	14	0.17	22	0.27
Glacier Island: South shore	28.4	2	15	0.07	0.53	1	7	0.04	0.25	40	1.41	62	2.18
Glacier Island: North shore	62.2									7	0.11	7	0.11
Columbia Bay	75.6												
Area Total	**838.2**	**12**	**111**	**0.01**	**0.13**	**2**	**15**	**0.00**	**0.02**	**115**	**0.14**	**241**	**0.29**
	17.5 % total area											**8.0 % all PIGu's**	
Northeastern (Area H, Fig. 2)													
Valdez Arm and Valdez Narrows	134.7	1	15	0.01	0.11					7	0.05	22	0.16
Port Valdez	79.1	1	6	0.01	0.08					4	0.05	10	0.13
Area Total	**213.8**	**2**	**21**	**0.01**	**0.10**					**11**	**0.05**	**32**	**0.15**
	4.5 % total area											**1.1 % all PIGu's**	

Table 3. Geographic comparison of colonies and other concentrations of pigeon guillemots (PiGu) in Prince William Sound, May - June 1993. See Figure 2 for area boundaries. See Appendix 2 for full descriptions of subareas.

Area and Subarea	km of Shore Sr'vyd	Nesting colonies: Number of: Col'ny	Nesting colonies: Number of: Pigu	Nesting colonies: Mean/km Col'ny	Nesting colonies: Mean/km Pigu	"Possible" colonies: Number of: Sites	"Possible" colonies: Number of: Pigu	"Possible" colonies: Mean/km Sites	"Possible" colonies: Mean/km Pigu	"Non-Colony" Guillemots Total	"Non-Colony" Guillemots #/km	GRAND TOTAL All Pigu's	GRAND TOTAL Mean #/km
Port Fidalgo Vicinity (Area I, Fig. 2)													
Bligh Island	65.3	4	57	0.06	0.87					14		71	1.09
Tatitlek Narrows: East shore	40.6												
Port Fidalgo	171.1												
Area Total	**277.0**	**4**	**57**	**0.01**	**0.21**					**14**		**71**	**0.26**
	15.8 % total area											**2.4 % all PIGu's**	
Port Gravina Vicinity (Area J, Fig. 2)													
Knowles Head vicinity	32.3					1	7	0.03	0.22	6	0.19	13	0.40
Port Gravina	130.2	1	9	0.01	0.07					8	0.06	17	0.13
Sheep and Simpson Bays	124.1					1	6	0.01	0.05	10	0.08	16	0.13
Area Total	**286.6**	**1**	**9**	**0.00**	**0.03**	**2**	**13**	**0.01**	**0.05**	**24**	**0.08**	**46**	**0.16**
	6 % total area											**1.5 % all PIGu's**	
Southeastern (Area K, Fig. 2)													
Cordova vicinity	56.3									4	0.07	4	0.07
Hawkins Island, north shore	93.9									3	0.03	3	0.03
Hawkins Island, south shore	66.3									7	0.11	7	0.11
Hinchinbrook Island, north shore#	58.8	1	6	0.02	0.10	1	7	0.02	0.12	6	0.10	19	0.32
Hinchinbrook Island, NW shore	23.5	3	50	0.13	2.13	1	9	0.04	0.38	9	0.38	68	2.90
Hinchinbrook Island, SW shore	67.3					2	14	0.03	0.21	29	0.43	43	0.64
Total	**366.1**	**4**	**56**	**0.01**	**0.15**	**4**	**30**	**0.01**	**0.08**	**58**	**0.16**	**144**	**0.39**
	7.6 % total area											**4.8 % all PIGu's**	
TOTAL FOR ALL AREAS:	**4,786**	**143**	**1,743**	**0.03**	**0.36**	**41**	**273**	**0.01**	**0.06**	**1,012**	**0.21**	**3,028**	**0.63**

#Boswell Rock colony included in this subarea, although Hinchinbrook Island shoreline between there and Hawkins Cutoff was not surveyed.

Table 4. Major concentrations of pigeon guillemot (Pigu) colonies in Prince William Sound, May - June, 1993.
A colony is defined as ≥4 guillemots nesting at same location; see text for further information.
Land ownership: CNF = Chugach National Forest; CVC = Chenega Village Corp.; TC = Tatitlek Corp.

Colony/colony group	Location in PWS	Land owner	Number of Colonies	Number of Pigu	km. of shore	Mean # per km. Colonies	Mean # per km. Pigu
Jackpot Island	W-central, South	CNF	3	78	0.6	5.0	130.0
Fool Island	Northcentral	CNF	5	65	1.4	3.6	46.4
Storey Island, east end	Naked I. Group	CNF	4	59	1.9	2.1	31.1
Pleiades Isls.	Southwestern	CVC	1	48	1.6	0.6	30.0
Bligh I, SW corner	Northeastern	TC	3	53	1.9	1.6	27.9
Storey Island, SW shore	Naked I. Group	CNF	3	43	1.6	1.9	26.9
Passage Canal, N shore	W-central, North	CNF	2	63	2.4	0.8	26.3
Naked I., McPherson Psg.	Naked I. Group	CNF	4	70	3.2	1.3	21.9
Naked Island, S Cabin Bay	Naked I. Group	CNF	2	13	0.6	3.3	21.7
Storey Island, North	Naked I. Group	CNF	3	47	2.4	1.3	19.6
Seal Island	Naked I. Group	CNF	5	51	2.7	1.9	18.9
Naked Island, Northwest	Naked I. Group	CNF	5	45	3.4	1.5	13.2
W Hinchinbrook Island	Southeastern	CNF	3	47	3.8	0.8	12.4
Port Bainbridge, SW	Southwestern	CNF	5	45	4.8	1.0	9.4
Naked Island, Bass Hbr. &	Naked I. Group	CNF	7	51	6.4	1.1	8.0
Little Smith Island	Naked I. Group	CNF	2	18	2.7	0.7	6.7
Peak Island	Naked I. Group	CNF	6	77	12.0	0.5	6.4
Lone Island	W-central, North	CNF	6	62	9.6	0.6	6.5
Port Bainbridge, NW	Southwestern	CNF	7	77	14.0	0.5	5.5
Naked Island, Northeast	Naked I. Group	CNF	3	23	5.0	0.6	4.6
Naked Island, Outside Bay	Naked I. Group	CNF	6	69	15.0	0.4	4.6
Smith Island	Naked I. Group	CNF	3	29	12.0	0.3	2.4
		Total	88	1,055	**Mean**	0.8	9.7

Figure 1. Prince William Sound, Alaska, showing locations of pigeon guillemot colonies known prior to 1993.

Seabird Colony Catalog
U.S. Fish and Wildlife Service

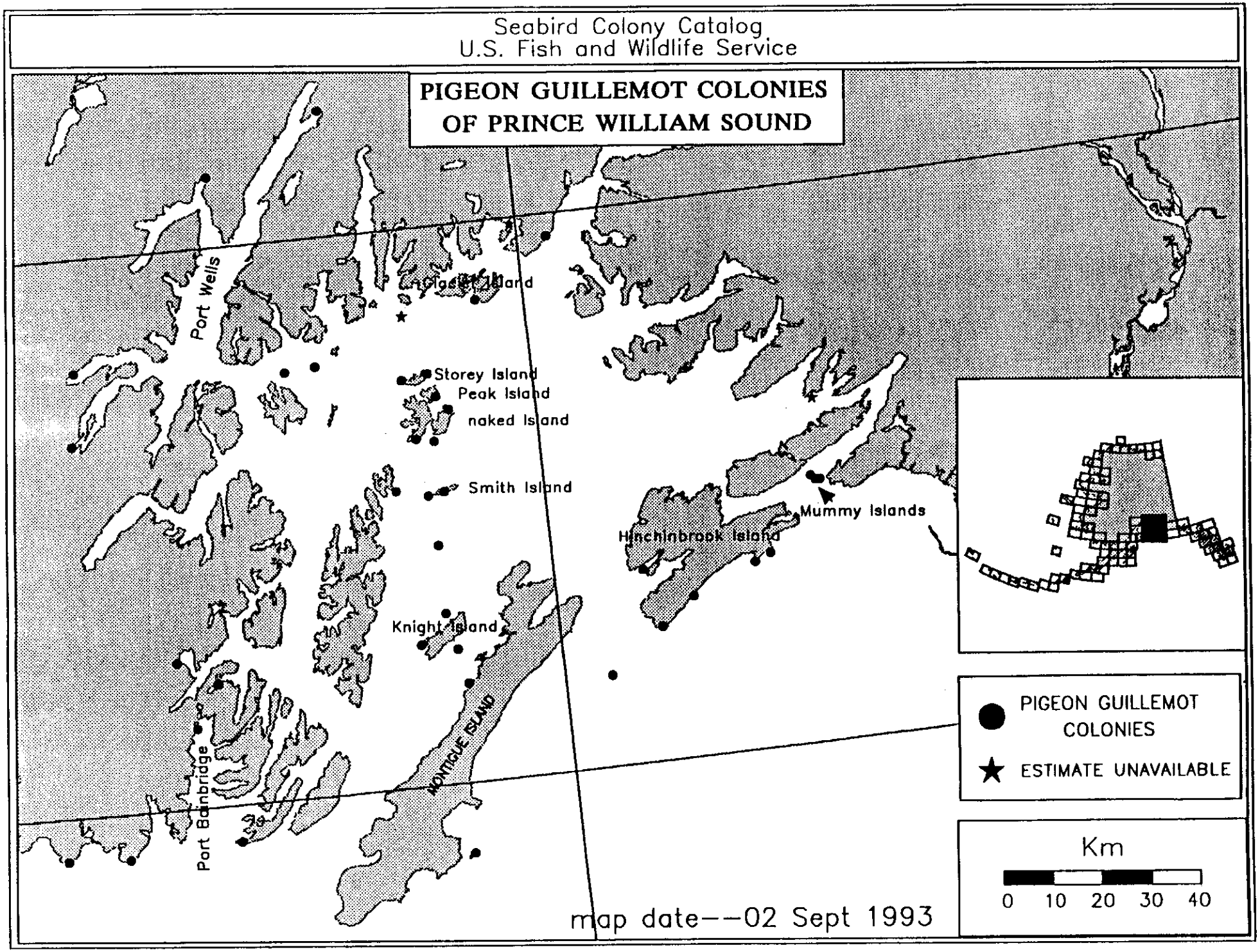


Figure 2. Prince William Sound, Alaska, showing boundaries of 11 areas used to compare distribution of pigeon guillemots, May - June 1993.

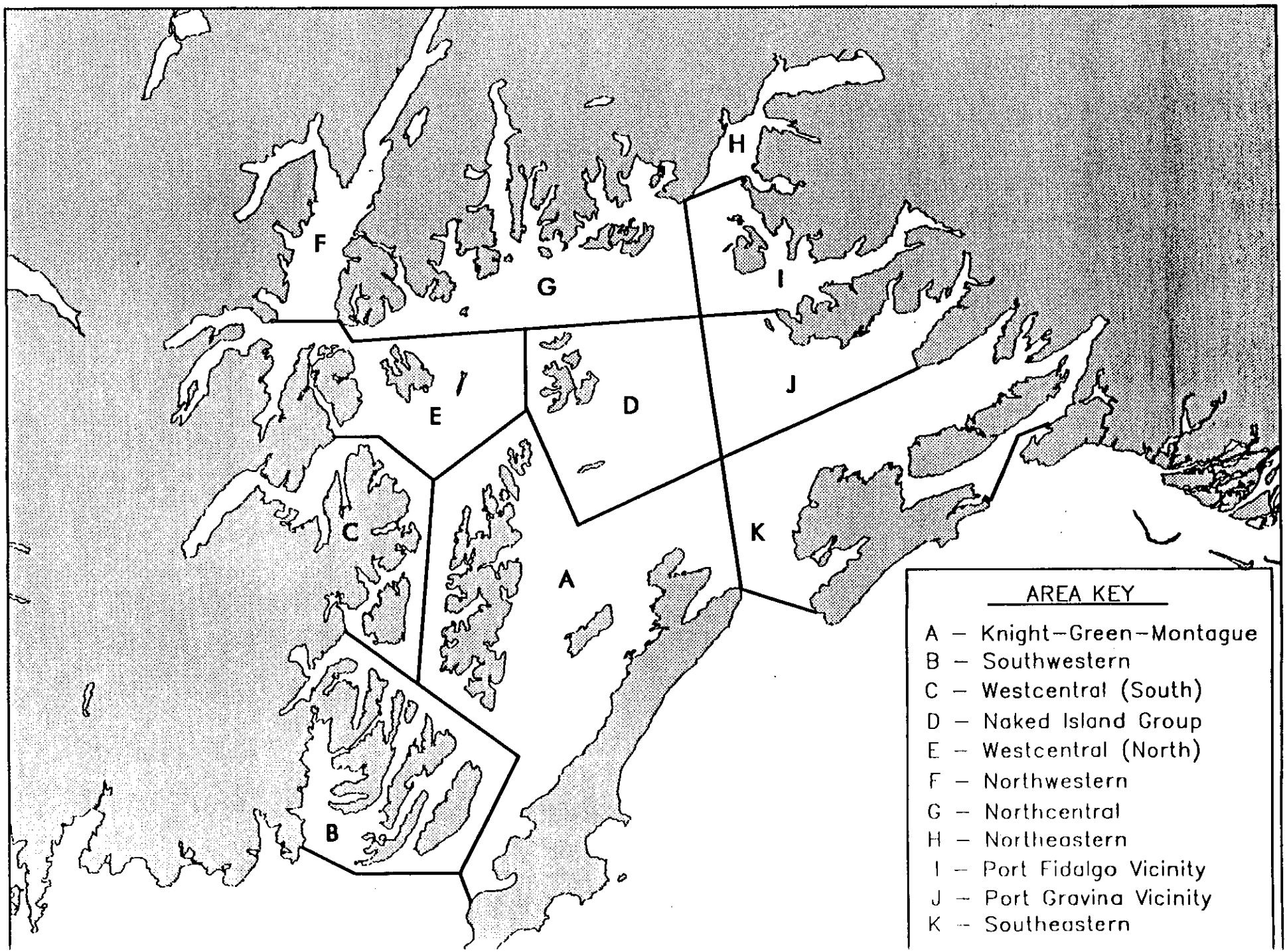

F
G
H
I
J
E
D
C
A
K
B
AREA KEY
A – Knight–Green–Montague
B – Southwestern
C – Westcentral (South)
D – Naked Island Group
E – Westcentral (North)
F – Northwestern
G – Northcentral
H – Northeastern
I – Port Fidalgo Vicinity
J – Port Gravina Vicinity
K – Southeastern

Figure 3. Pigeon guillemot colonies found during survey of Prince William Sound, Alaska, May - June 1993.

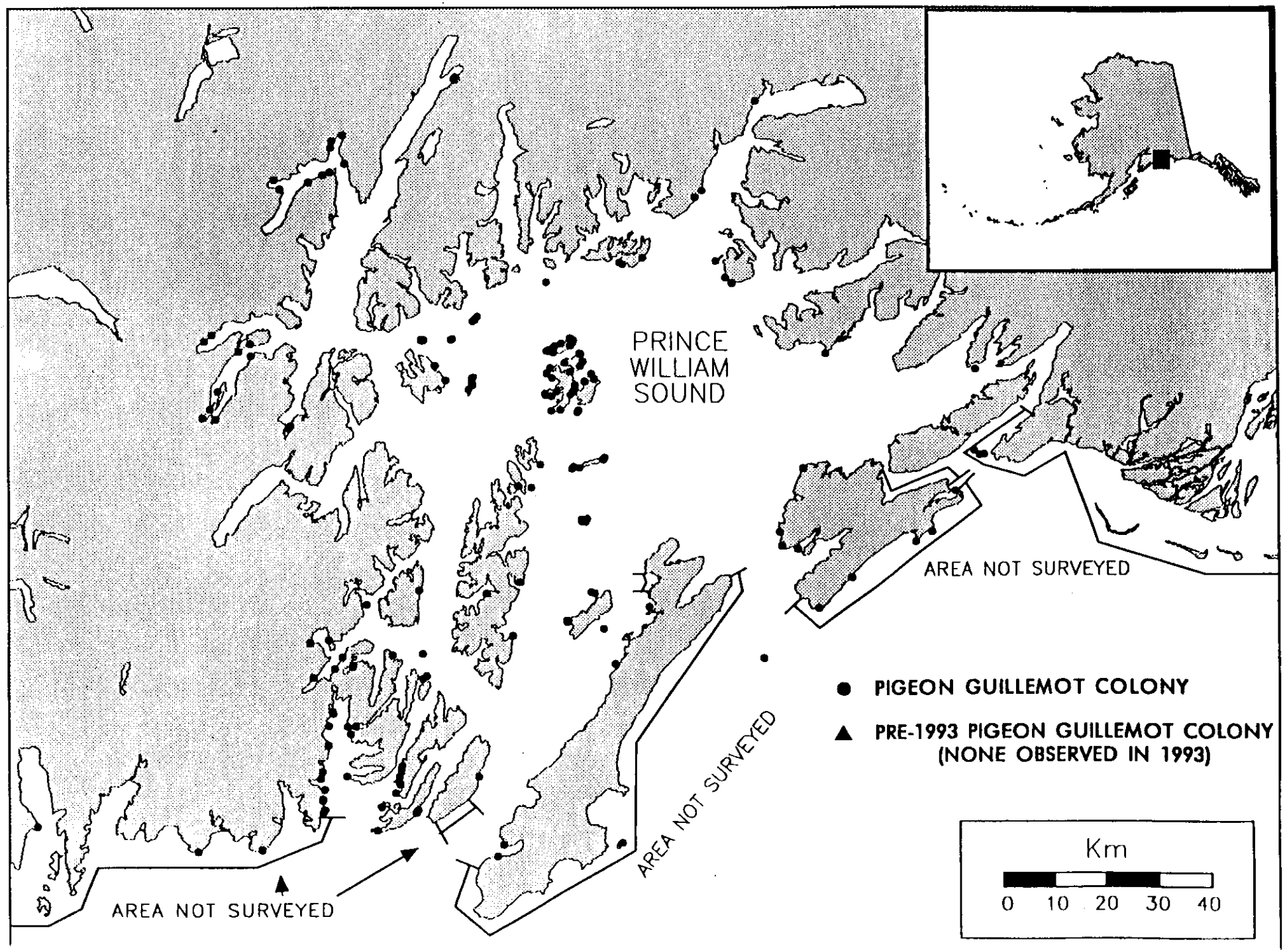

PRINCE
WILLIAM
SOUND
AREA NOT SURVEYED
AREA NOT SURVEYED
AREA NOT SURVEYED
PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
Km
0 10 20 30 40

Figure 4. Pigeon guillemot colonies found in the Green Island - Western Montague Island vicinity of Prince William Sound, Alaska, May - June 1993.

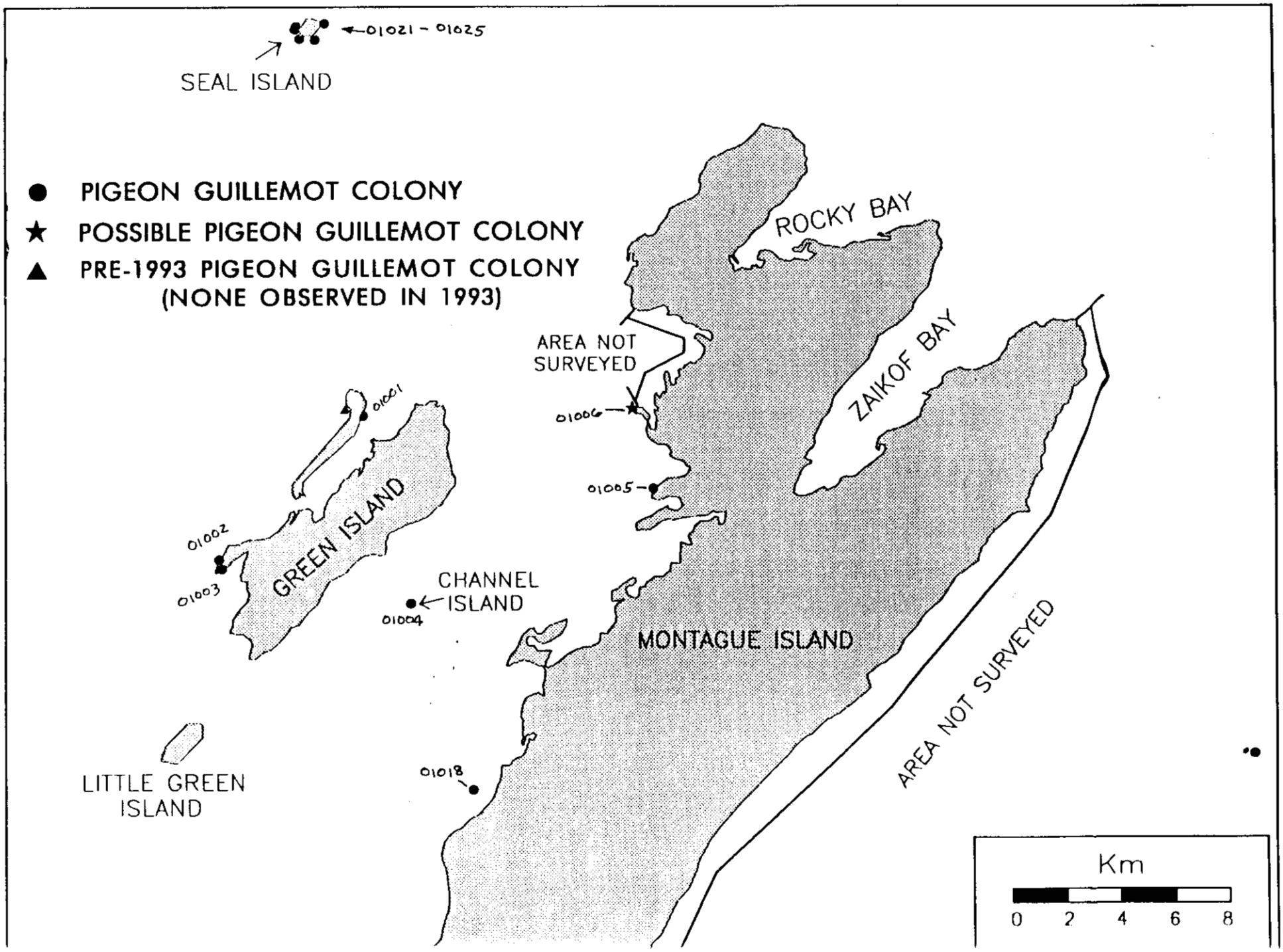

SEAL ISLAND
01021 - 01025
PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
ROCKY BAY
AREA NOT
SURVEYED
ZAIKOF BAY
01001
01006
01005
01002
01003
GREEN ISLAND
CHANNEL
ISLAND
01004
MONTAGUE ISLAND
AREA NOT SURVEYED
LITTLE GREEN
ISLAND
01018
Km
0 2 4 6 8

Figure 5. Pigeon guillemot colonies found in the Southwestern Area of Prince William Sound, Alaska, May - June 1993.

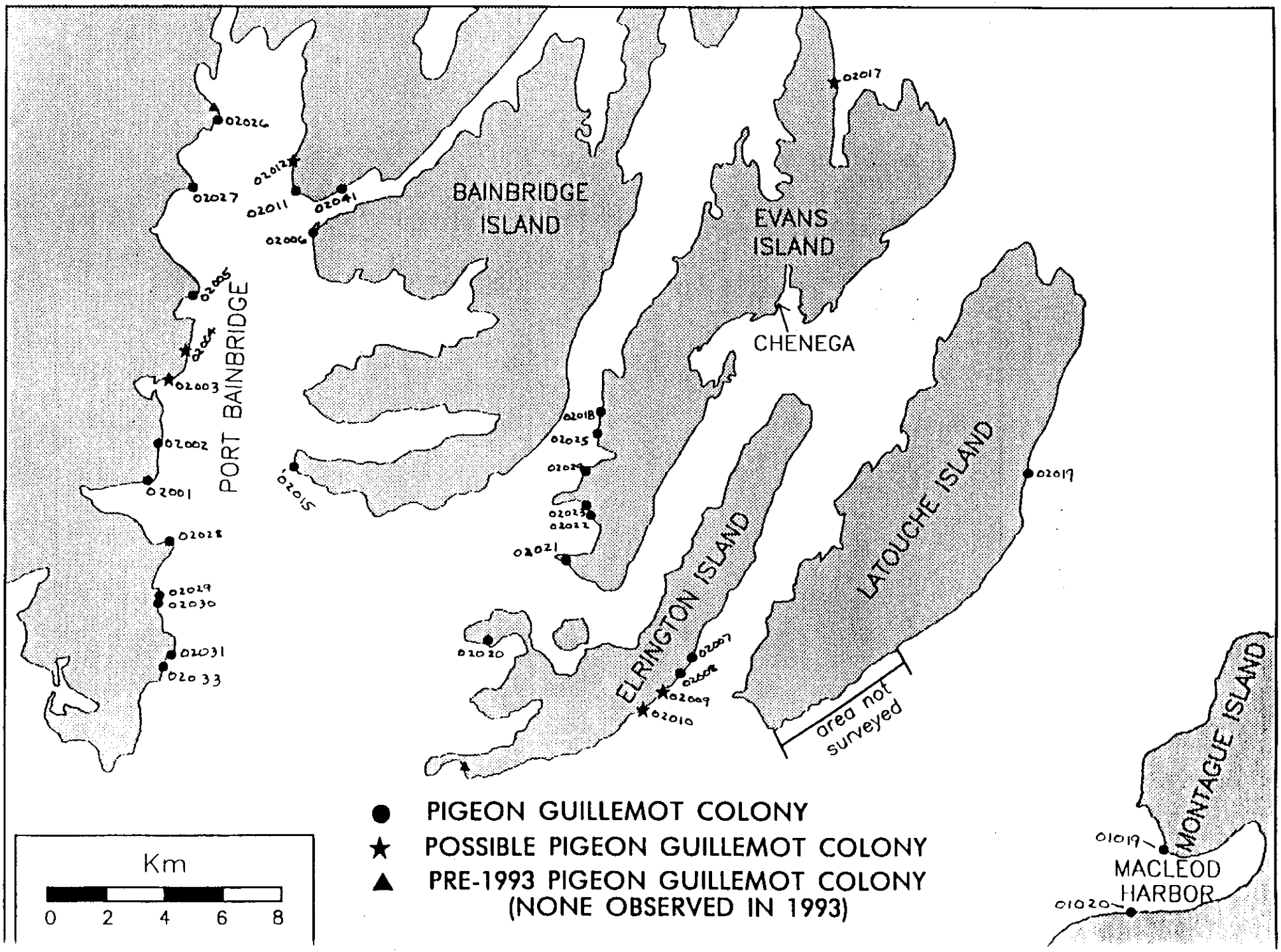

BAINBRIDGE ISLAND
EVANS ISLAND
CHENEGA
PORT BAINBRIDGE
ELRINGTON ISLAND
LATOUCHE ISLAND
MONTAGUE ISLAND
MACLEOD HARBOR
area not surveyed
02026
02027
02012
02011
02041
02006
02005
02004
02003
02002
02001
02028
02029
02030
02031
02033
02015
02018
02025
02024
02023
02022
02021
02017
02020
02007
02008
02009
02010
01019
01020
Km
0 2 4 6 8
PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)

Figure 6. Pigeon guillemot colonies found in the Icy Bay to southern Knight Island vicinity of Prince William Sound, Alaska, May - June 1993.

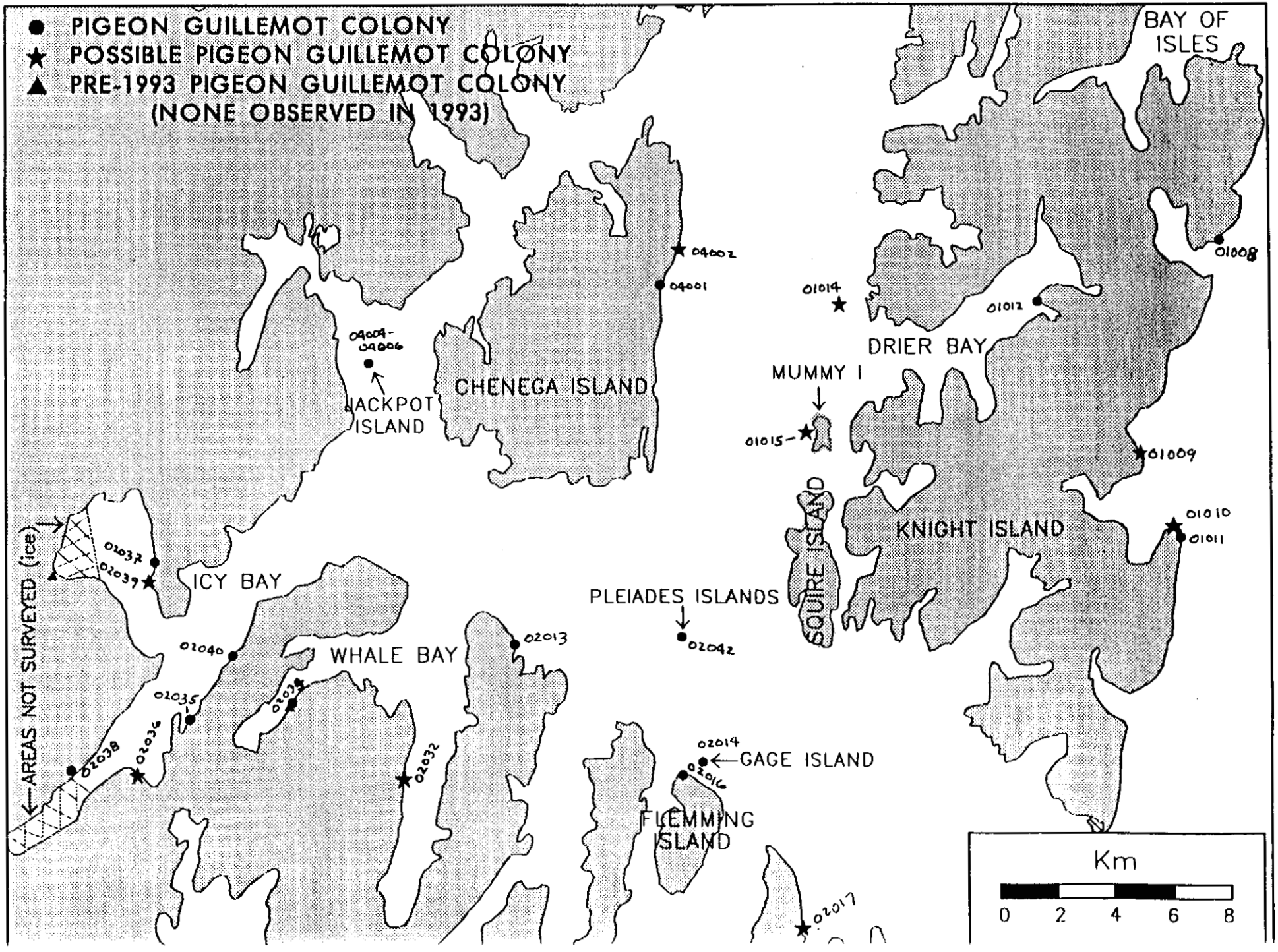

PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
BAY OF ISLES
01008
04002
04001
01014
01012
04004-04006
JACKPOT ISLAND
CHENEGA ISLAND
DRIER BAY
MUMMY I
01015
01009
SQUIRE ISLAND
KNIGHT ISLAND
01010
01011
AREAS NOT SURVEYED (ice)
02037
02039
ICY BAY
PLEIADES ISLANDS
02042
01040
WHALE BAY
02013
02035
02034
02038
02036
02032
02014
GAGE ISLAND
02016
FLEMMING ISLAND
02017
Km
0 2 4 6 8

Figure 7. Pigeon guillemot colonies found in the Naked Island Group of Prince William Sound, Alaska, May - June 1993.

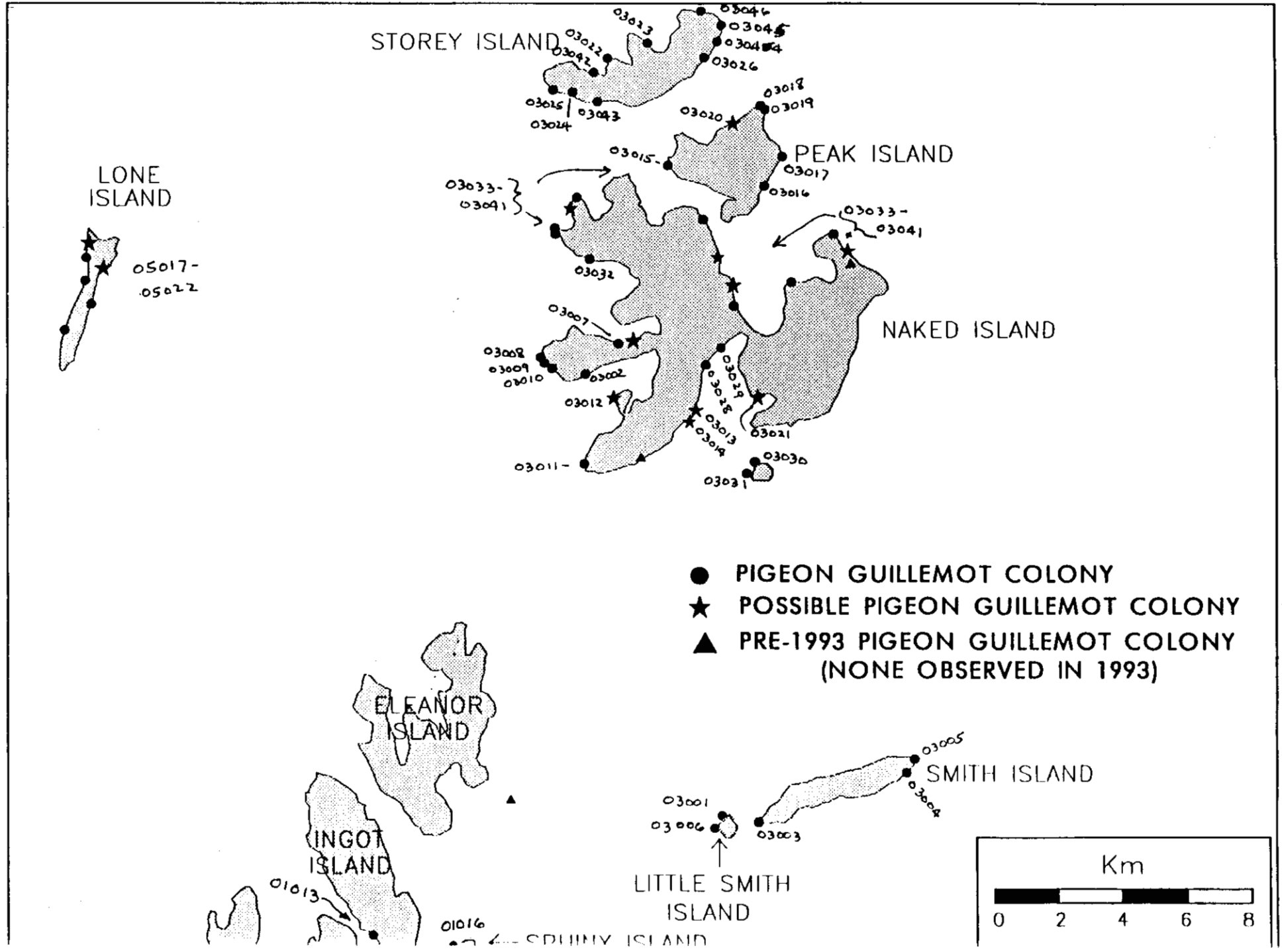

STOREY ISLAND
03046
03033
03045
03022
03044
03042
03026
03025
03043
03024
03018
03019
03020
PEAK ISLAND
03015
03017
03016
LONE ISLAND
05017-
05022
03033-
03041
03033-
03041
03032
03007
NAKED ISLAND
03008
03009
03010
03002
03012
03029
03028
03013
03014
03021
03011
03030
03031
PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
ELEANOR ISLAND
03005
SMITH ISLAND
03001
03004
03006
03003
INGOT ISLAND
01013
LITTLE SMITH ISLAND
01016
SPUNY ISLAND
Km
0 2 4 6 8

Figure 8. Pigeon guillemot colonies found in the Northern Westcentral area of Prince William Sound, Alaska, May - June 1993.

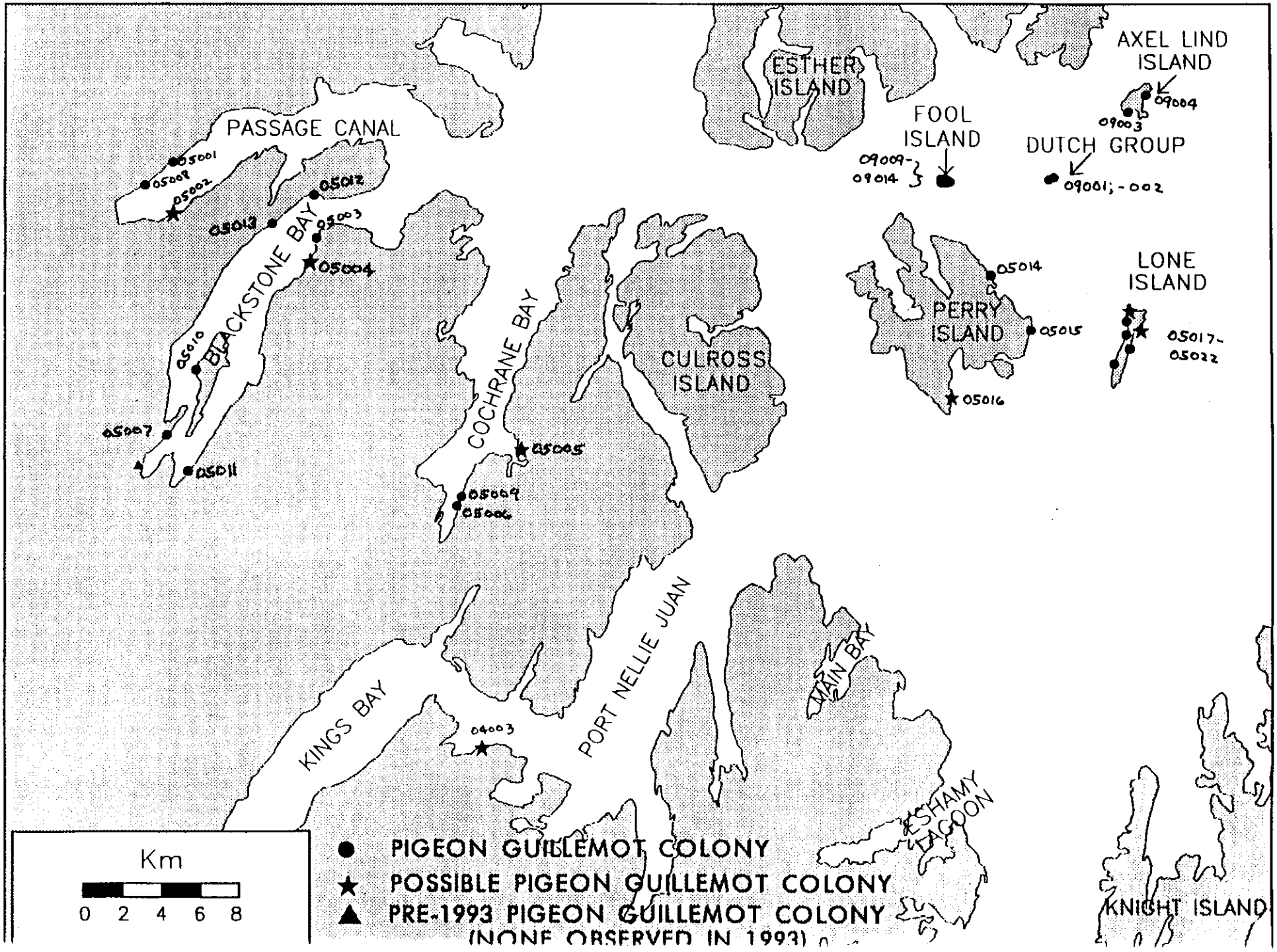

PASSAGE CANAL
05001
05008
05002
05012
05013
BLACKSTONE BAY
05003
05004
05010
05007
05011
COCHRANE BAY
05005
05009
05006
CULROSS ISLAND
ESTHER ISLAND
FOOL ISLAND
09009-09014
AXEL LIND ISLAND
09004
09003
DUTCH GROUP
09001; -002
05014
PERRY ISLAND
05015
05016
LONE ISLAND
05017-05022
KINGS BAY
04003
PORT NELLIE JUAN
MAIN BAY
ESHAMY LAGOON
KNIGHT ISLAND
Km
0 2 4 6 8
PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)

Figure 9. Pigeon guillemot colonies found in the Northwestern area of Prince William Sound, Alaska, May - June 1993.

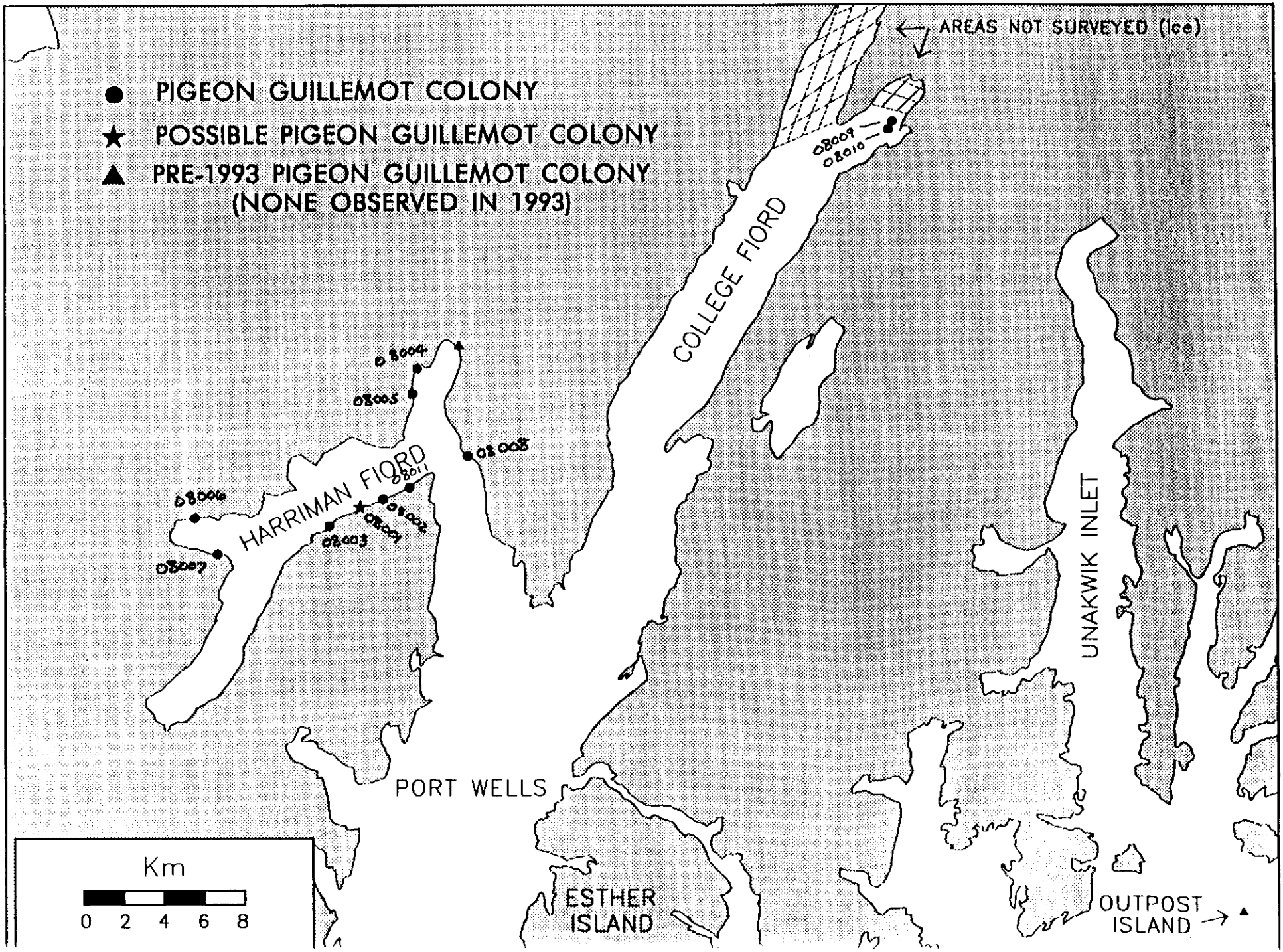

PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
AREAS NOT SURVEYED (Ice)
COLLEGE FIORD
HARRIMAN FIORD
UNAKWIK INLET
PORT WELLS
ESTHER ISLAND
OUTPOST ISLAND
Km
0 2 4 6 8

Figure 10. Pigeon guillemot colonies found in the Northeastern area of Prince William Sound, Alaska, May - June 1993.

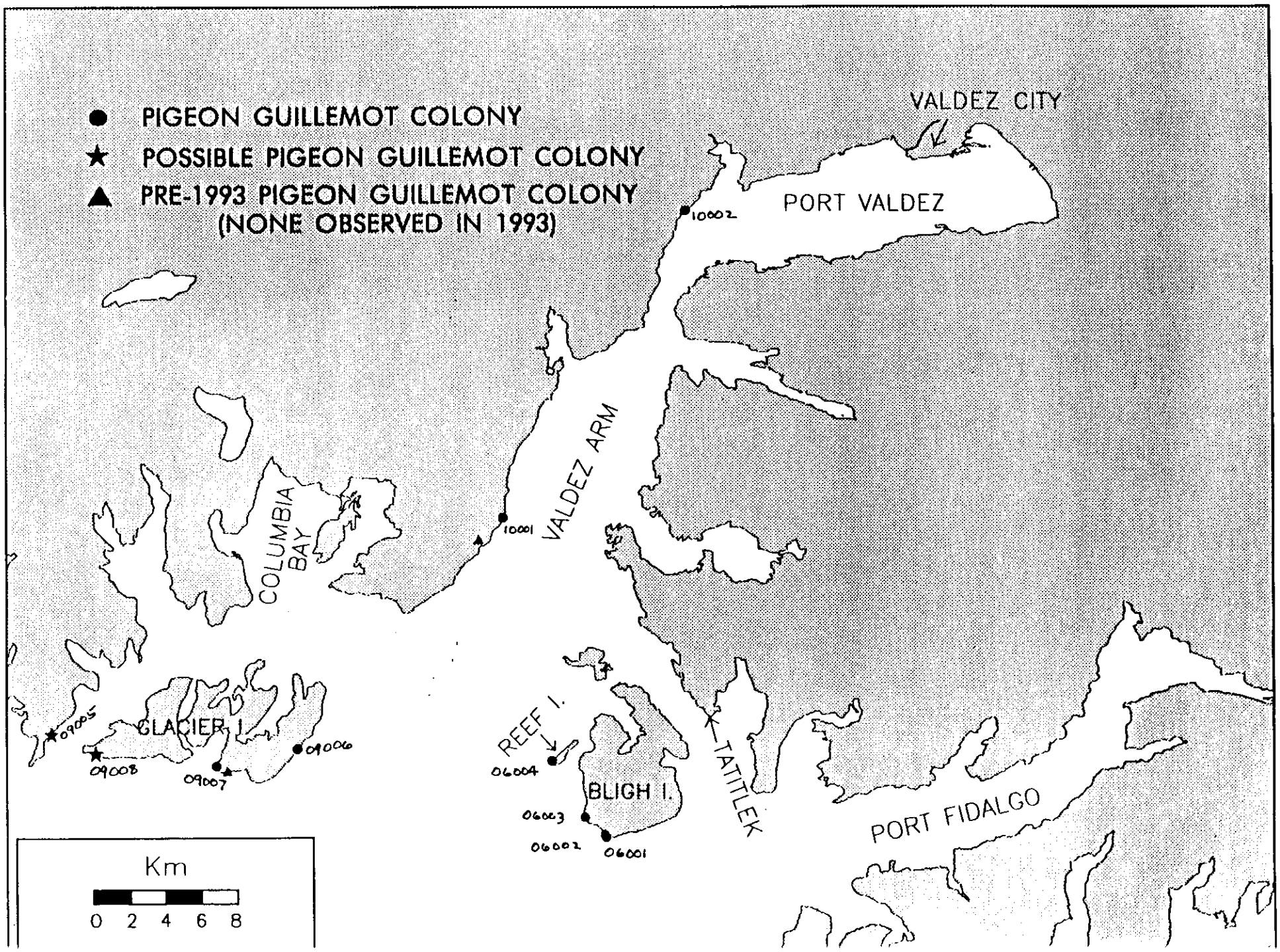

PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
VALDEZ CITY
PORT VALDEZ
10002
VALDEZ ARM
10001
COLUMBIA BAY
GLACIER I.
09005
09008
09007
09006
REEF I.
06004
BLIGH I.
06003
06002
06001
TATITLEK
PORT FIDALGO
Km
0 2 4 6 8

Figure 11. Pigeon guillemot colonies found in the Southeastern area of Prince William Sound, Alaska, May - June 1993.

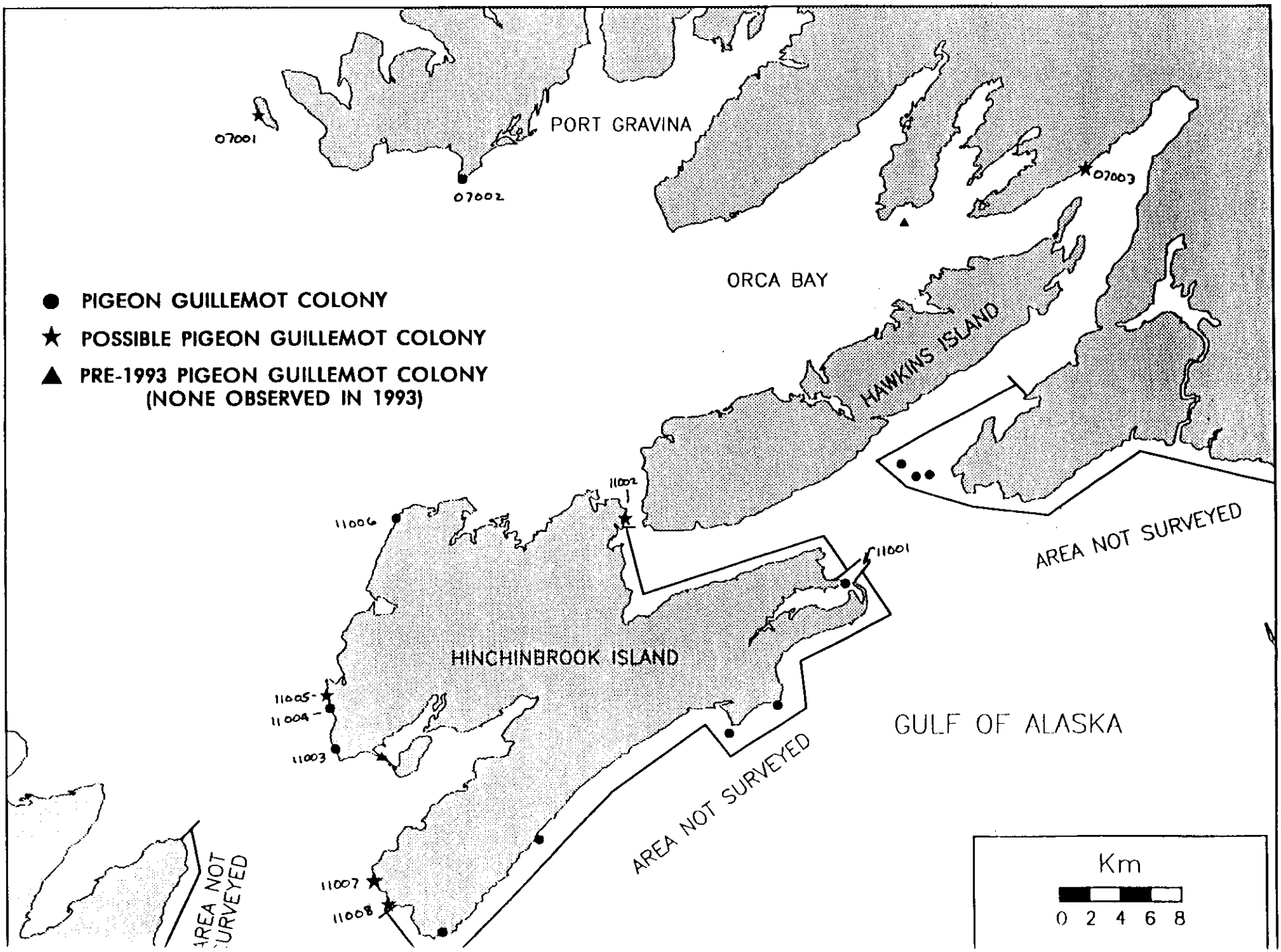

PIGEON GUILLEMOT COLONY
POSSIBLE PIGEON GUILLEMOT COLONY
PRE-1993 PIGEON GUILLEMOT COLONY
(NONE OBSERVED IN 1993)
PORT GRAVINA
07001
07002
07003
ORCA BAY
HAWKINS ISLAND
AREA NOT SURVEYED
11002
11006
11001
HINCHINBROOK ISLAND
11005
11004
11003
GULF OF ALASKA
AREA NOT SURVEYED
11007
11008
AREA NOT SURVEYED
Km
0 2 4 6 8

Figure 12. Comparison of total numbers of pigeon guillemots counted in 11 areas of Prince William Sound, Alaska, May - June 1993.

Figure 12

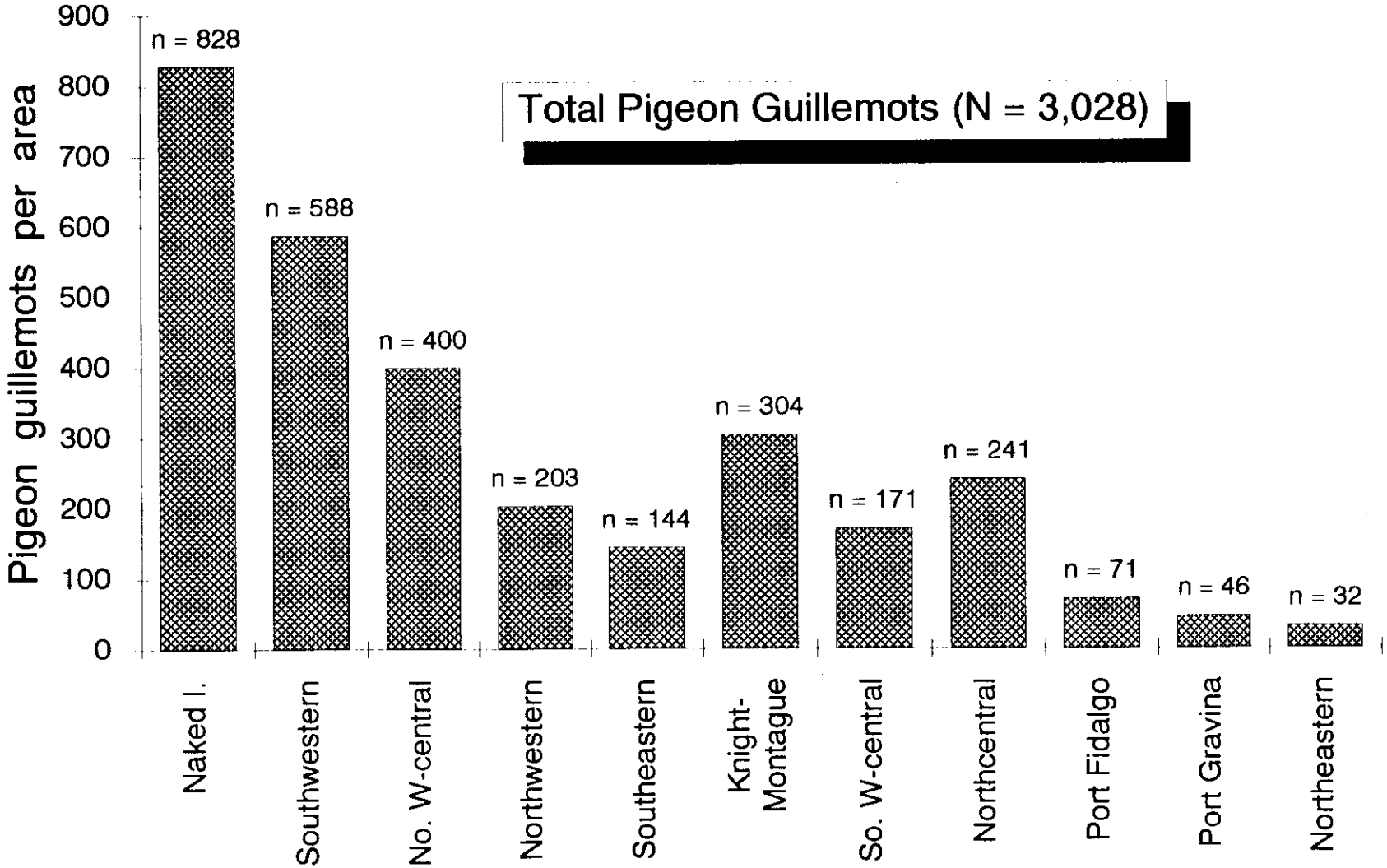

Total Pigeon Guillemots (N = 3,028)
Pigeon guillemots per area
900
800
700
600
500
400
300
200
100
0
n = 828
n = 588
n = 400
n = 203
n = 144
n = 304
n = 171
n = 241
n = 71
n = 46
n = 32
Naked I.
Southwestern
No. W-central
Northwestern
Southeastern
Knight-Montague
So. W-central
Northcentral
Port Fidalgo
Port Gravina
Northeastern

Figure 13. Percentages of all pigeon guillemots counted in 11 geographic areas of Prince William Sound, Alaska, during colony surveys, May - June 1993.

Figure 13

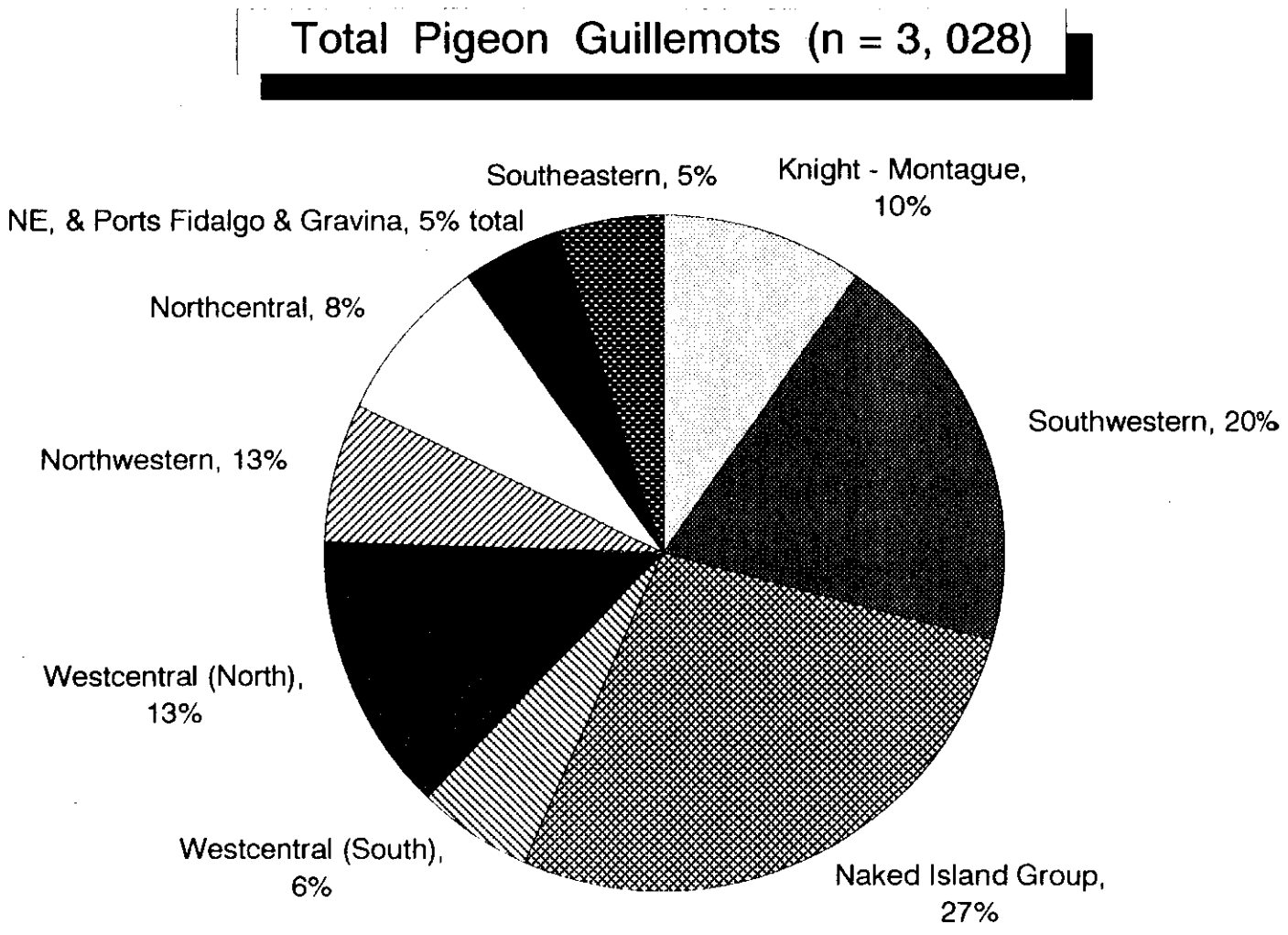

Total Pigeon Guillemots (n = 3, 028)
Southeastern, 5%
Knight - Montague, 10%
NE, & Ports Fidalgo & Gravina, 5% total
Northcentral, 8%
Southwestern, 20%
Northwestern, 13%
Westcentral (North), 13%
Westcentral (South), 6%
Naked Island Group, 27%

Figure 14. Pigeon guillemots per km of shoreline among 11 geographic areas of Prince William Sound, Alaska, May - June 1993.

Figure 14

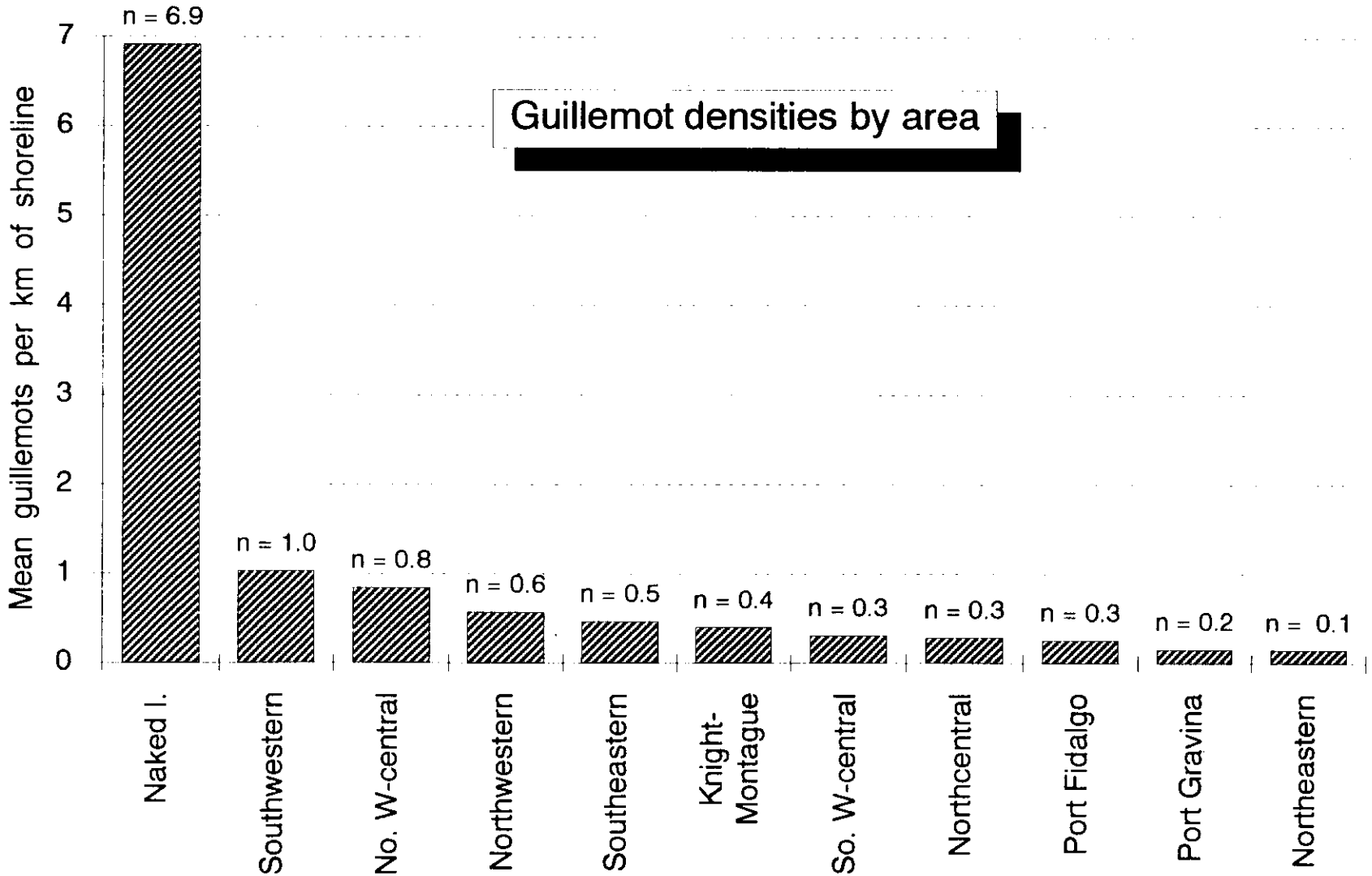

Guillemot densities by area
Mean guillemots per km of shoreline
0
1
2
3
4
5
6
7
n = 6.9
n = 1.0
n = 0.8
n = 0.6
n = 0.5
n = 0.4
n = 0.3
n = 0.3
n = 0.3
n = 0.2
n = 0.1
Naked I.
Southwestern
No. W-central
Northwestern
Southeastern
Knight-Montague
So. W-central
Northcentral
Port Fidalgo
Port Gravina
Northeastern

Figure 15. Pigeon guillemots counted at colonies and possible colonies in Prince William Sound, Alaska, May-June 1993.

Figure 15

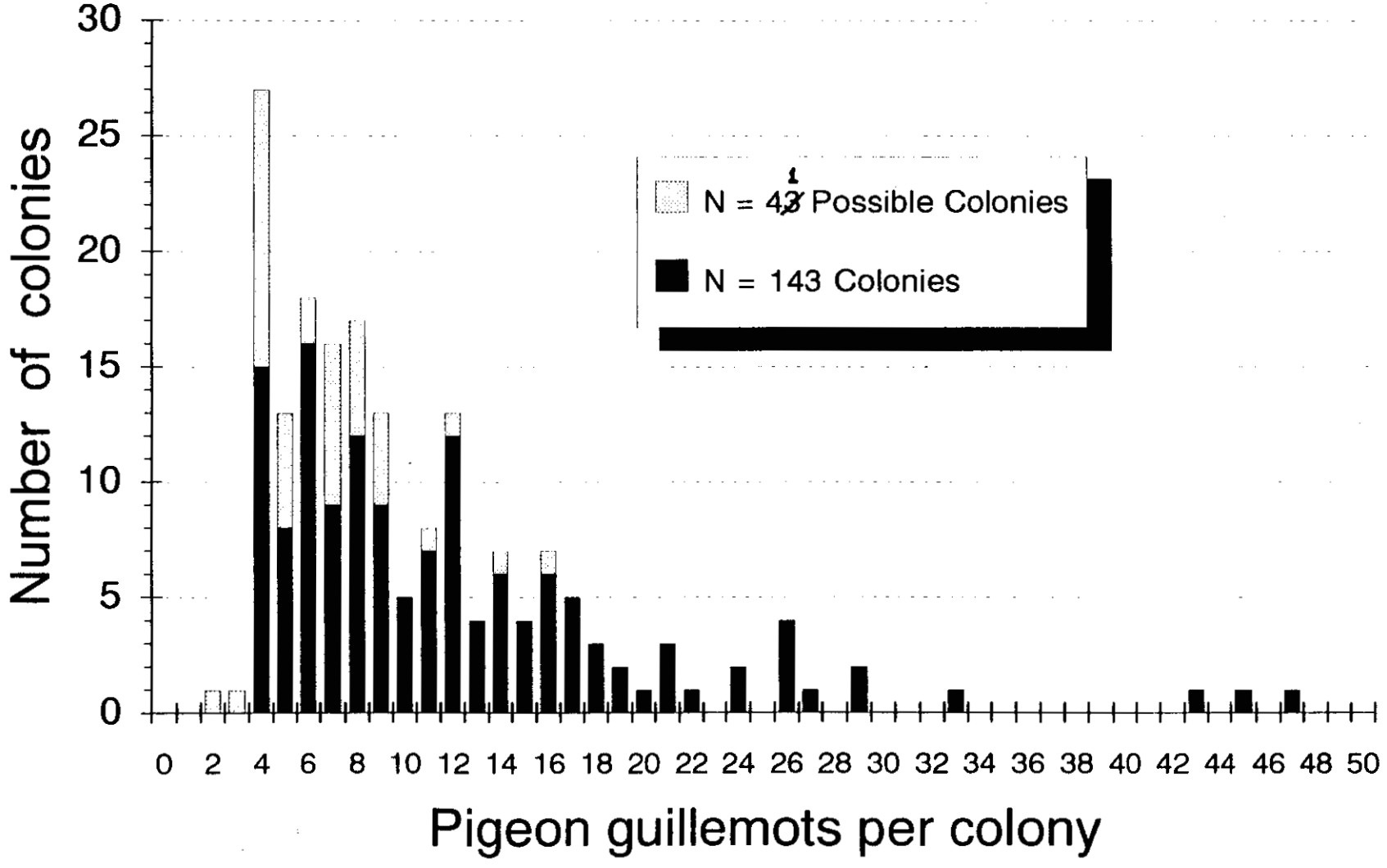

Number of colonies
30
25
20
15
10
5
0
N = 43 Possible Colonies
N = 143 Colonies
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Pigeon guillemots per colony

Figure 16. Pigeon guillemots counted during "non-colony" sightings in Prince William Sound, Alaska, May - June 1993.

Figure 16

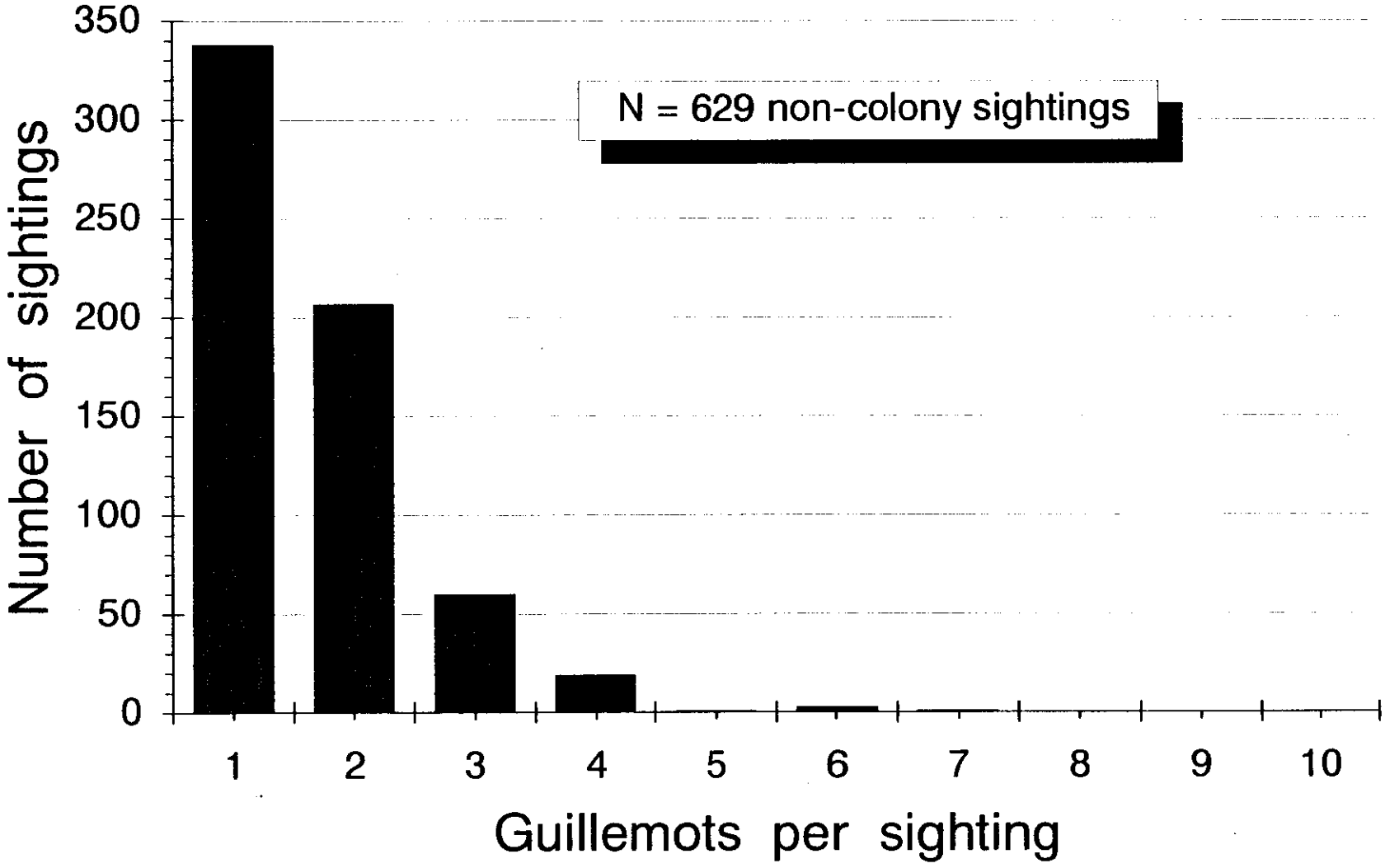

N = 629 non-colony sightings
Number of sightings
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
Guillemots per sighting

Figure 17. Cumulative percent of all pigeon guillemots counted during colony surveys of Prince William Sound, Alaska, May - June 1993, as a function of guillemots per sighting.

Figure 17

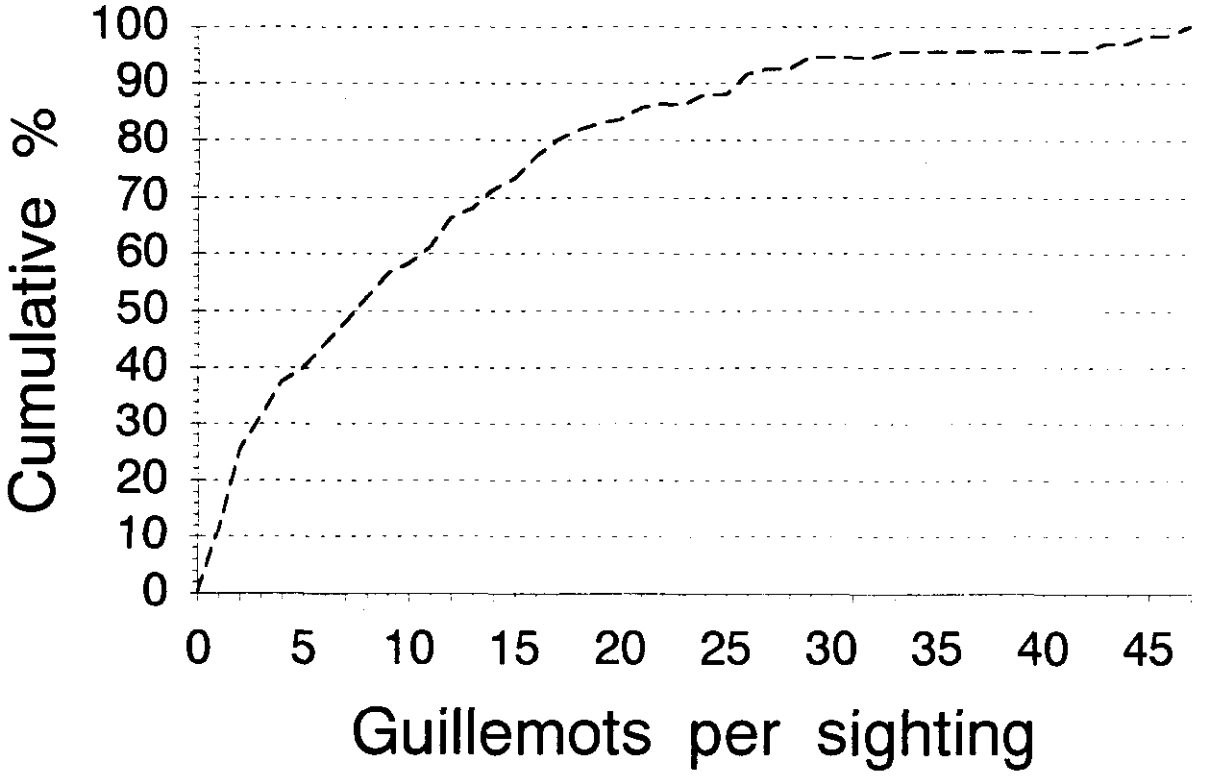
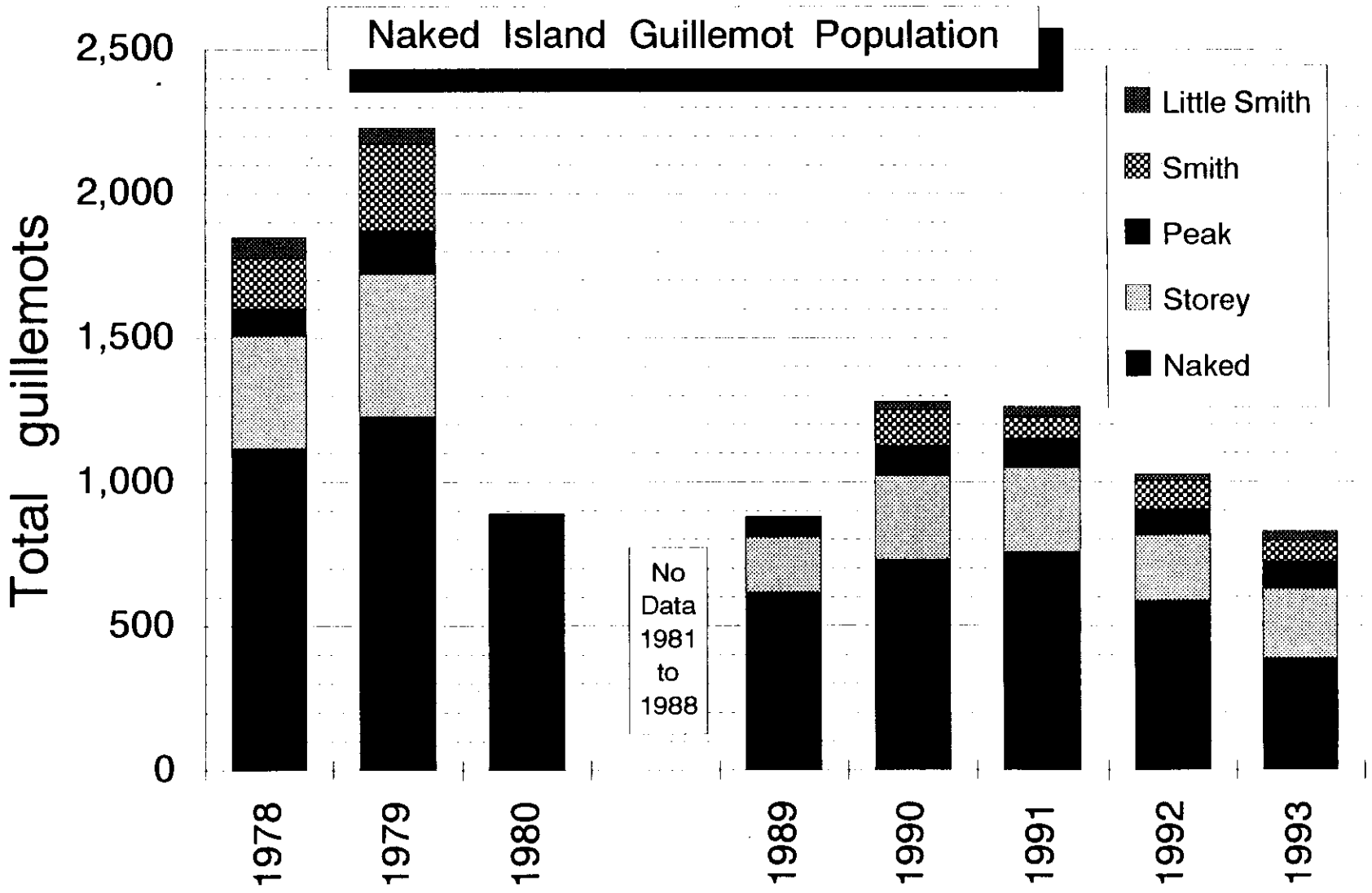

Cumulative %
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
Guillemots per sighting

Figure 18. Pigeon guillemot population trend at the Naked Island Group, Prince William Sound, Alaska 1978 - 1993; adapted from Oakley and Kuletz ms.

Figure 18


Naked Island Guillemot Population
Total guillemots
2,500
2,000
1,500
1,000
500
0
Little Smith
Smith
Peak
Storey
Naked
No Data 1981 to 1988
1978
1979
1980
1989
1990
1991
1992
1993

Appendix 1. Behavior* of pigeon guillemots (PiGu) observed during colony surveys in Prince William Sound, May-June 1993. *Defined on last page of table.

Site	# PiGu			Sit on		Duet	Bill	Whis-	Cir-	Flock	Fly	Sit	Fly	Fly	Copu	Fish			Preening	
No.	TOT	Land	water	water	Land	flight	dip	tle	cle	water	nest	nest	in	away	late	hold	deliver	Dive	Preen	Allo.
1001	12	0	12	X				X	X									X		
1002	17	0	17	X		X		X	X									X		
1003	16	2	14	X				X	X											
1004	21	6	15	X	X			X	X	X								X	X	
1005	4	0	4	X					X											
1006	5	0	5	X				X										X		X
1008	6	0	6	X				X	X											
1009	4	0	4	X				X										X		X
1010	4	0	4	X				X												X
1011	16	3	13	X	X			X										X		
1012	8	0	8	X				X	X									X	X	
1013	6	2	4	X	X	X		X	X		X	X								
1014	6	0	6	X			X	X	X									X	X	X
1015	4	0	4	X				X					X							X
1016	9	0	9	X			X	X					X					X	X	X
1017	VOID COLONY NUMBER																			
1018	8	0	8	X	X	X		X	X											
1019	13	6	7	X	X	X	X	X	X	X		X								
1020	8	0	8	X		X		X	X											
1021	12	4	8		X	X					X									
1022	6	3	3	X	X															
1023	12	5	7	X	X								X							
1024	12	4	8		X			X	X											
1025	20	4	15	X	X		X	X	X	X	X									
2001	4	0	4	X		X		X	X											
2002	17	13	4	X	X		X	X												
2003	7	0	7	X																X
2004	9	0	9	X			X			X										X
2005	26	0	26	X				X		X										
2006	12	2	10	X	X	X	X	X		X	X									
2007	22	4	18	X	X		X	X	X		X	X	X							
2008	4	4	0		X			X		X										
2009	14	0	14	X									X							X
2010	12	0	12	X				X					X							X

Appendix 1. Behavior* of pigeon guillemots (PiGu) observed during colony surveys in Prince William Sound, May-June 1993. *Defined on last page of table.

Site	# PIGu			Sit on		Duet	Bill	Whis-	Cir-	Flock	Fly	Sit	Fly	Fly	Copu	Fish			Preening	
No.	TOT	Land	water	water	Land	flight	dip	tle	cle	water	nest	nest	in	away	late	hold	deliver	Dive	Preen	Allo.
2011	14	1	13	X			X	X	X											
2012	5	0	5	X			X	X												X
2013	6	1	5	X	X	X	X	X	X	X	X	X								
2014	16	0	16	X		X		X		X										
2015	17	9	8	X	X				X		X									
2016	8	0	8	X		X	X	X	X											
2017	4	0	4	X			X	X	X											X
2018	4	2	2	X	X			X	X		X	X	X	X						
2019	8	2	6	X		X		X						X	X					
2020	16	0	16	X		X		X	X											
2021	7	0	7	X		X	X	X												
2022	12	4	8	X	X		X	X		X										
2023	10	2	8	X	X		X	X		X								X	X	
2024	4	2	2	X	X			X												
2025	4	0	4	X	X		X	X												
2026	9	0	9	X				X	X		X									
2027	5	0	5	X	X			X												
2028	6	6	0		X	X		X	X		X	X								
2029	21	7	14	X	X			X												
2030	4	2	2	X	X			X												
2031	6	3	3	X	X			X												
2032	4	0	4	X			X	X												X
2033	7	2	5	X	X	X	X	X	X											
2034	5	2	3	X	X		X	X							X					
2035	6	3	3	X	X		X	X			X									
2036	4	2	2	X	X	X	X	X	X											
2037	14	0	14	X		X	X	X	X	X										
2038	6	1	5	X	X	X	X	X		X										
2039	7	0	7	X	X			X						X						
2040	6	2	4	X				X												
3001	7	4	3	X	X			X	X		X									
3002	4	0	4	X				X					X							
3003	16	0	16	X				X		X										X
3004	7	4	3	X	X			X	X	X										

Appendix 1. Behavior* of pigeon guillemots (PiGu) observed during colony surveys in Prince William Sound, May-June 1993. *Defined on last page of table.

Site	# PiGu			Sit on		Duet	Bill	Whis-	Cir-	Flock	Fly	Sit	Fly	Fly	Copu	Fish		Preening		
No.	TOT	Land	water	water	Land	flight	dip	tle	cle	water	nest	nest	in	away	late	hold	deliver	Dive	Preen	Allo.
3005	5	5	0	X	X															
3006	11	4	7	X	X			X		X			X	X						
3007	9	0	9	X	X	X	X	X										X		
3008	8	0	8	X	X		X	X		X								X		
3009	4	2	2	X	X	X		X	X											
3010	14	14	0		X	X	X	X	X											
3011	18	4	14	X	X		X	X											X	
3012	4	0	4	X			X	X										X		X
3013	4	0	4	X			X	X		X								X		X
3014	8	0	8	X		X	X	X		X								X		X
3015	18	15	3	X	X		X	X	X	X	X	X		X					X	
3016	12	10	2	X	X			X	X		X									
3017	13	1	12	X	X		X	X		X	X									
3018	11	7	4	X	X			X												
3019	15	0	15	X	X		X	X		X								X	X	
3020	8	0	8	X			X			X			X							X
3021	8	0	8	X		X	X	X												X
3022	29	9	20	X	X		X	X	X	X	X	X								
3023	9	5	4	X	X	X	X	X		X										
3024	9	1	8	X	X			X	X	X	X									
3025	33	24	9	X	X			X		X										
3026	18	9	9	X	X	X		X	X											
3027	21	15	6	X	X	X	X	X	X					X						
3028	8	5	3	X	X			X	X	X										
3029	5	0	5	X	X		X	X		X										
3030	10	4	6	X	X		X	X										X		
3031	8	2	6	X	X			X					X							
3032	12	11	1	X	X			X	X		X				X					
3033	9	0	9	X				X	X					X						X
3034	17	0	17	X		X	X	X						X						
3035	2	0	2	X																X
3036	11	0	11	X				X		X										X
3037	4	0	4	X				X												X
3038	12	0	12	X				X												

Appendix 1. Behavior* of pigeon guillemots (PiGu) observed during colony surveys in Prince William Sound, May-June 1993. *Defined on last page of table.

Site	# PiGu			Sit on		Duet	Bill	Whis-	Clr-	Flock	Fly	Sit	Fly	Fly	Copu	Fish			Preening	
No.	TOT	Land	water	water	Land	flight	dip	tle	cle	water	nest	nest	in	away	late	hold	deliver	Dive	Preen	Allo.
3039	9	5	4	X	X			X			X				X					
3040	6	1	5	X	X		X	X						X						
3041	8	0	8	X			X	X	X	X										X
3042	6	1	5	X	X					X										
3043	4	0	4	X	X			X	X											
3044	16	2	14	X	X		X	X		X									X	
3045	12	6	6	X	X		X	X		X										
3046	13	4	9	X	X			X		X										
3047	43	9	34	X	X	X	X	X	X	X	X								X	
3048	5	1	4	X	X			X			X									
4001	48	4	44	X	X	X	X	X	X	X	X	X								
4002	15	2	13	X			X	X		X	X									
4003	4	0	4	X		X							X							X
4004	5	0	5	X			X	X										X		X
4005	26	1	25	X	X	X	X	X	X	X	X	X							X	
4006	26	1	25	X	X	X	X	X	X	X	X	X							X	
4007	26	1	25	X	X	X	X	X	X	X	X	X							X	
5001	47	5	42	X	X	X	X	X						X						
5002	7	4	3	X	X	X	X	X				X								X
5003	8	0	8	X	X	X		X	X			X			X					
5004	4	0	4	X				X												X
5005	5	0	5	X		X		X					X							X
5006	4	2	2	X		X						X	X							
5007	12	4	8	X	X	X	X	X	X	X										
5008	20	0	20	X		X	X	X						X						
5009	15	5	10	X	X	X	X	X	X	X	X	X		X	X			X		
5010	14	0	14	X		X	X	X		X				X				X		
5011	29	16	13	X	X	X	X	X	X	X				X	X					
5012	7	4	3	X	X			X		X	X									
5013	27	4	23	X	X			X	X					X						
5014	6	3	3	X	X	X	X		X											
5015	11	5	6	X	X	X	X	X	X	X										
5016	7	0	7	X				X					X							X
5017	3	2	1	X	X			X			X				X					X

Appendix 1. Behavior* of pigeon guillemots (PiGu) observed during colony surveys in Prince William Sound, May-June 1993. *Defined on last page of table.

Site	# PIGu			Sit on		Duet	Bill	Whis-	Cir-	Flock	Fly	Sit	Fly	Fly	Copu	Fish			Preening	
No.	TOT	Land	water	water	Land	flight	dip	tle	cle	water	nest	nest	in	away	late	hold	deliver	Dive	Preen	Allo.
5018	13	8	5	X	X	X	X	X	X	X					X					
5019	11	0	11	X			X	X	X				X	X						
5020	8	0	8	X			X	X	X	X										
5021	11	6	5	X	X		X	X	X	X					X					
5022	16	0	16	X			X	X		X								X		X
6001	4	0	4	X				X	X											
6002	45	2	43	X	X	X	X	X	X	X	X	X		X	X					
6003	4	1	3	X	X		X	X												
6004	4	0	4	X	X			X	X		X	X								
7001	7	0	7	X			X	X		X			X					X	X	X
7002	9	4	5	X	X			X		X	X	X	X							
7003	6	0	6	X			X	X	X										X	X
8001	9	0	9	X	X			X		X										X
8002	10	4	6	X	X			X		X	X	X								
8003	4	2	2	X	X			X												
8004	24	13	11	X	X		X	X		X		X	X							
8005	6	2	4	X	X								X							
8006	5	0	5	X	X		X	X		X			X							
8007	7	5	2	X	X	X	X	X	X	X					X					
8008	11	8	3	X	X	X		X	X		X	X				X				
8009	4	3	1	X	X	X	X	X	X		X	X								
8010	19	3	16	X			X	X	X	X										
8011	7	1	6	X				X	X	X		X	X							
9001	7	0	7	X	X	X	X	X	X					X						
9002	17	8	9	X	X		X	X			X								X	
9003	5	4	1	X	X			X	X				X		X					
9004	5	0	5	X		X	X	X	X	X									X	
9005	8	0	8	X		X		X		X										X
9006	8	6	2	X	X				X	X										
9007	7	4	3	X	X			X												
9008	7	0	7	X			X	X		X										X
9009	10	2	8	X	X	X	X	X		X					X					
9010	14	6	8	X	X		X	X		X										
9011	11	0	11	X				X		X										X

Appendix 1. Behavior* of pigeon guillemots (PiGu) observed during colony surveys in Prince William Sound, May-June 1993. *Defined on last page of table.

Site	# PIGu			Sit on		Duet	Bill	Whis-	Cir-	Flock	Fly	Sit	Fly	Fly	Copu	Fish			Preening	
No.	TOT	Land	water	water	Land	flight	dip	tle	cle	water	nest	nest	in	away	late	hold	deliver	Dive	Preen	Allo.
9012	8	0	8	X			X	X		X										X
9013	9	0	9	X		X	X	X		X										X
9014	10	8	2	X	X	X	X	X		X										
10001	15	10	5	X	X		X	X	X	X	X							X		
10002	4	4	0		X													X		
11001	6	0	6	X					X											
11002	7	0	7	X						X				X						X
11003	14	3	11	X	X			X	X											
11004	24	7	17	X	X		X	X	X	X										
11005	9	0	9	X			X	X		X										X
11006	12	6	6	X	X		X	X	X	X				X					X	
11007	9	0	9	X			X	X												X
11008	5	0	5	X			X	X												X

*Definitions of behavior (** indicates behaviour described by Drent (loc. cit))

Sit on Water/Land = Sit on water or land without exibiting other behavior; Duet flight** = one bird flying very closely behind another; Bill dip** = bird thrusts bill into water, often to eye-level, and rapidly shakes head back and forth; Whistle = any vocalization; Circle = fly in circle in front of a confined location ashore, presumed to be nest site, within 100 m of shore; Flock water = assemble on water in discrete group that does not disperse; Fly nest = fly either to or from the water from or to location on land presumed to be nest site; Fly in = fly to vicinity of colony from farther than 100 m offshore; Fly away = fly from vicinity of colony to location farther than 100 m offshore; Copulate = definition necessary?!; Fish hold = PiGu holds fish in bill while sitting on water or land; Fish deliver = PiGu flies to nest site with fish in bill; Dive = enough said?; Preen = bird cleans or smooths feathers with bill; Allopreen = mutual or alternate preening between two birds.

Appendix 2. Descriptions of subareas used to compare pigeon guillemot distribution in Prince William Sound May - June 1993. See Figure 2 for key to areas.

Area and Subarea	Descriptions
A: Knight - Green - East Montague Islands	
Eleanor Island	• Eleanor, Block and Entrance Islands, and adjacent islets.
Ingot and Disk Islands and vicinity	• Ingot, Disk and Sphinx Islands
Knight I: Passage Pt. to Herring Pt.	• Passage Pt. to Herring Pt., including all coves and inlets that comprise Herring Bay
Knight I: Herring Pt. to Drier Bay	• West side of Knight Island, from Herring Pt. to the point forming the northwest corner of Drier Bay, plus Aguliak and other adjacent islets
Knight I: Drier Bay to S Long Channel	• West side of Knight Island, from the point forming the northwest corner of Drier Bay, south to the south end of Long Channel.
Knight I: Squirrel to Squire Islands	• Squirrel, Mummy and Squire Islands, plus all adjacent islets
Knight I: S end Long Channel to Pt. Helen	• South side of Knight Island, from Long Channel to Pt. Helen.
Knight I: Pt. Helen to Bay of Isles	• East side of Knight Island, from Pt. Helen north to the point forming the southeast corner of Bay of Isles.
Knight I: Bay of Isles to Passage Pt.	• East side of Knight Island, from the point forming the southeast corner of Bay of Isles, north to Passage Pt. and including all adjacent islets
Seal Island	• Shoreline of Seal Island, located E-N-E of Bay of Isles.
Green Island and vicinity	• Green, Little Green, and Channel Islands, plus adjacent islets
Montague Island (West side)	• North and west sides of Montague Island, from Zaikof Pt. west and south along the Sound side of the island to the first point south of Macleod Harbor, but excluding Stockdale Harbor (i.e., Graveyard Pt. south to the 2nd point north of Gilmour Pt.).

Appendix 2. Descriptions of subareas used to compare pigeon guillemot distribution in Prince William Sound May - June 1993. See Figure 2 for key to areas.

Area and Subarea	Descriptions
B: Southwestern	
Port Bainbridge	• Port Bainbridge, from first point north of Cape Puget, thence clockwise around the Port to Point Pyke
Bainbridge Passage	• Bainbridge Passage, from points Countess and Bainbridge in the north, SW to Port Bainbridge
Bainbridge Island, east side	• East shore of Bainbridge Island, from Point Pyke north to Bainbridge Point, plus Flemming Island
Evans Island	• Evans Island, plus all adjacent small islands and islets
Elrington Island	• Elringtoin Island, excluding islets in Elrington Passage, which are considerted part of the Evans Island subarea.
Latouche Island	• Latouche Island, and Chicken and Izmaylou Islands, but excluding Danger Island and a portion of the southeastern shore of Latouche Island.
Plaeides Islands	• All islets of the Plaeides Island group
Icy and Whale Bays	• Icy and Whale Bays, including all shoreline between Pt. Countess at the northwest corner of Bainbridge Passage, and Icy Pt., at the northest corner of Icy Bay, but excluding upper portions of both bays that were choked with glacial ice.
D: Naked Island Group	
Naked Island - East	• That part of Naked Island east of the Bass Harbor - McPherson Passage isthmus, plus Bass Island.
Naked Island - West	• That part of Naked Island west of the Bass Harbor - McPherson Passage isthmus.
Peak Island	• Shoreline of Peak Island
Storey Island	• Shoreline of Storey Island and adjacent islet
Smith and Little Smith Islands	• Shorelines of Smith and Little Smith Islands

Appendix 2. Descriptions of subareas used to compare pigeon guillemot distribution in Prince William Sound May - June 1993. See Figure 2 for key to areas.

Area and Subarea	Descriptions
C: Southern Westcentral	
Chenega Island, east and south sides	• East and south shores of Chenega Island, including adjacent islets
Chenega Island, west side	• West side of Chenega islands, plus adjacent islets in Dangerous Passage, including Junction Island at the north end of the Passage
Jackpot Island	• Shoreline of Jackpot Island
Dangerous Passage, west side	• W side of Dangerous Passage, from Icy Pt. N to Pt. Nowell
Eshamy - Main Bay vicinity	• Mainland coast and adjacent islets, from Pt. Nowell north to Lighthouse Reserve Pt.
Port Nellie Juan	• Mainland coast and adjacent islets, from Lighthouse Reserve Pt. and the point forming the southwest corner of Culross Passage, westward to the mouth of Kings Bay, as marked by Coxcomb Pt. and the point forming the southeast corner of West Finger Inlet.
Kings Bay	• Mainland coast and adjacent islets, upstream from Coxcomb Pt. and the point forming the SE corner of West Finger Inlet, and including West Finger Inlet
E: Northern Westcentral	
Lone Island	• Shoreline of Lone Island
Perry Island	• Shorelines of Perry Island and adjacent islets
Culross and Applegate Islands	• Shorelines of Culross and Applegate Islands, and adjacent islets
Culross Passage, west side	• West shoreline of Culross Passage and adjacent islets, from southwest corner of Passage north to Split Pt., and including Long Bay and Lagoon
Cochrane Bay	• Shorelines of Cochrane Bay and adjacent islets, from Split Pt. at north entrance to Culross Passage, west to Blackstone Pt.

Appendix 2. Descriptions of subareas used to compare pigeon guillemot distribution in Prince William Sound May - June 1993. See Figure 2 for key to areas.

Area and Subarea	Descriptions
E: Northern Westcentral (continued)	
Blackstone Bay	• Shorelines of Blackstone Bay and adjacent islets, upstream from Blackstone Pt. and Strong Pt.
Passage Canal	• Shorelines of Passage Canal, upstream from Pigot Pt. and Strong Pt.
F: Northwestern	
Port Wells	• Mainland shorelines and adjacent islets between Pt. Pigot and north Harrison Lagoon spit on the west side, and Points Golden and Esther on the east side, but excluding Pakenham Pt.
Barry Arm	• Mainland shorelines and adjacent islets north of north Harrison Lagoon Spit and Pakenham Pt., to Pt. Doran and the point north of Pt. Doran (Hinge Benchmark).
Harriman Fjord	• Mainland shorelines and adjacent islets upstream (west) of Pt Doran and the point north of Point Doran, excluding upper Surprise Inlet which was chocked with glacial ice.
College Fjord	• Mainland shorelines and adjacent islets upstream of Points Pakenham and Golden, excluding Harvard Arm and upper Yale Arm, where ice prevented surveys.
G: Northcentral	
Esther Passage	• Both sides of the Passage, and adjacent islets, from the north entrance south to Pt. Squid Benchmark and the point forming the western corner of the mouth of Squaw Bay.
Esther Island, south side	• South shore of Esther Island and adjacent islets, between Pt. Esther and Pt. Squid Benchmark in southern mouth of Esther Passage
Eastern Wells Passage	• Mainland shoreline and adjacent islets between the west corner of the mouth of Squaw Bay and east to Ragged Pt., plus the Dutch Group, Bald Head Chris and Fool Islands.

Appendix 2. Descriptions of subareas used to compare pigeon guillemot distribution in Prince William Sound May - June 1993. See Figure 2 for key to areas.

Area and Subarea	Descriptions
G: Northcentral (continued)	
Eaglek Bay	• Mainland shoreline and adjacent islets between Ragged Pt. and Kiniklik Pt, plus Axel Lind Island and adjacent islets.
Unakwik Inlet	• Mainland shoreline and adjacent islets between Kiniklik and Unakwik Points, including Unakwik Inlet and its side bays.
Wells Bay/Fairmont vicinity	• Mainland shoreline and adjacent islets between Unakwik and Granite Points, including Wells and Cedar Bays, and Olsen and Fairmont Islands.
Glacier Island, south side	• South shore of Glacier Island, between Iceberg and Finski Pts
Glacier Island, north side	• North shore of Glacier Island, between Iceberg and Finski Pts.
Long Bay area	• Mainland shore and adjacent islets between Granite and Flen
Columbia Bay	• Mainland shore and adjacent islets between Flent Pt. and Pt. Freemantle
H: Northeastern	
Port Valdez	• Port Valdez upstream of The Narrows
Valdez Arm and Valdez Narrows	• Valdez Narrows and Valdez Arm and its side bays, north of Pt. Freemantle and Rocky Pt.
I: Port Fidalgo Vicinity	
Bligh Island and vicinity	• Bligh, Busby and Reef Islands and adjacent islets
Tatitlek Narrows, east side	• Mainland shoreline and adjacent islets between Rocky and Bidarka Points.
Port Fidalgo	• Mainland shoreline and adjacent islets between Bidarka Pt. and Porcupine Pt.

Appendix 2. Descriptions of subareas used to compare pigeon guillemot distribution in Prince William Sound May - June 1993. See Figure 2 for key to areas.

Area and Subarea	Descriptions
J: Port Gravina Vicinity	
Knowles Head vicinity	• Mainland shoreline and adjacent islets between Porcupine Pt. and Red Head.
Port Gravina	• Mainland shoreline and adjacent islets between Red Head and Gravina Point.
Sheep-Simpson Bays	• Mainland shoreline and adjacent islets between Gravina and Bomb Points.
K: Southeastern	
Cordova Vicinity	• Mainland shoreline and adjacent islets between Bomb Pt. and the City of Cordova, including Channel I. and other nearby islands.
Hawkins Island, north side	• North side of Hawkins Island, between Salmo Pt. and the narrows at Hawkins Cutoff
Hawkins Island, south side	• South side of Hawkins Island, between Salmo Pt. and the narrows at Hawkins Cutoff
Hinchinbrook Island, north side	• Johnstone Pt. to Hawkins Cutoff Narrows, plus adjacent islets
Hinchinbrook Island, northwestern side	• Johnstone Pt. to Bear Cape, plus adjacent islets.
Hinchinbrook Island, southwestern	• Bear Cape to Ruff Benchmark Pt., plus adjacent islets.