

**Ground-nesting Marine Bird Distribution and Potential for Human Disturbance in
Glacier Bay National Park and Preserve, Alaska**



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Abstract

There is growing concern about the potential for human disturbance of birds that breed in coastal habitats of Glacier Bay National Park as visitor use increases in back-country areas. Except for a few large well-known colonies, and sites described anecdotally by Park staff, the distribution of ground-nesting marine birds in Glacier Bay is poorly known and largely undocumented. During the first year of a three-year study, we surveyed areas believed to be important to ground-nesting birds and areas with historically high human visitation rates. We used land-based beach surveys and kayak-based shoreline surveys to assess the distribution of nesting birds in areas with high visitor traffic. We found 395 nests belonging to seven bird species at 94 different sites. In 2003 we focused our effort on determining the distribution of four species: Black Oystercatcher (*Haematopus bachmani*), Arctic Tern (*Sterna paradisaea*), Mew Gull (*Larus canus*), and Glaucous-winged Gull (*Larus glaucescens*). We also recorded observations of less common ground-nesting bird species that we encountered such as Parasitic Jaeger (*Stercorarius parasiticus*), Semipalmated Plover (*Charadrius semipalmatus*) and Spotted Sandpiper (*Actitis macularia*). We will continue to survey beaches in Glacier Bay in 2004 and 2005 to provide a broad assessment of marine bird distribution and breeding sites in the park. This baseline information will be used to assess impacts of human disturbance and changes in bird populations over time.

Introduction

Glacier Bay National Park and Preserve (GLBNPP) contains a diverse assemblage of marine birds that use the bay for nesting, foraging, and molting. The species diversity in Glacier Bay is unmatched in the region, due in part to the unique geomorphic and successional characteristics that result in a wide array of habitat types. Seasonal bay-wide surveys in 1999 and 2000 revealed 64 bird species in Glacier Bay, and the majority (>80%) of birds were found in nearshore habitats (Robards et al. 2003).

Ground-nesting marine birds in the park are vulnerable to human impacts where backcountry visitors camp and walk near their nest sites or within nesting habitats. Visitor use between 1995 and 2000 varied from site to site and ranged between 1-416 reported overnight camping uses. At some level, human disturbance at nest sites may be

significant because intense parental care is required for egg and hatchling survival, and repeated disturbance may result in reduced productivity. Nest desertion by breeding birds in disturbed areas has been shown to increase predation on eggs and hatchlings by conspecifics or other predators (Bolduc and Guillemette 2003). Effects of human disturbance on ground-nesting birds may also include lower incubation time and decreased foraging rates which in turn can affect survival of offspring (Verhulst et al. 2001).

Despite management concern over susceptibility to disturbance from human activities, the distribution of ground-nesting marine birds in Glacier Bay is not well known. Large concentrations of birds in some nesting and roosting areas have resulted in closures to vessel and foot traffic. These include the unnamed islands east of Russell Island, Lone Island, Geikie Rock, Leland Island, South Marble Island, Boulder Island, Flapjack Island, Spider Island and Eider Island. However, many of these areas have not been surveyed in recent years and there is a need to have these islands re-evaluated as sites for closure.

Except for a few studies that focused on local populations, there has been little documentation of the status of ground-nesting birds in Glacier Bay. The breeding ecology of Black Oystercatchers in the Beardslee Island region of the lower bay was studied in 1989 (Lentfer and Maier 1995). Fifty-nine nests were found in the study area and the average clutch size was 2.66 eggs/clutch. Higher densities of breeding Black Oystercatchers were found on sparsely vegetated islands and reefs compared to forested islands. Glaucous-winged gull nesting activity at the Marble Islands was documented in 1999 and 2000 in order to assess the effects of traditional Native Alaskan egg harvesting on breeding success (Zador and Piatt 1999, 2002). In June of 1999, the minimum breeding population was 570 birds and 285 active nests were found on South Marble Island. Results from the study led researchers to recommend a conservative approach to egg harvest which limited the time period, number of collections and the proportion of nests for harvest.

This report summarizes results obtained during the first year of a three-year study to determine the distribution and abundance of ground-nesting marine birds in Glacier Bay, and to assess the potential for human disturbance of those nesting birds. The study

was identified as a natural resource priority in GLBNPP and funded under the project proposal PMIS 35598. A revised study plan entitled Human Disturbance of Coastal Marine Birds Nesting in Glacier Bay National Park, Alaska was prepared by USGS Alaska Science Center. When completed, this project will provide a broad assessment of ground-nesting marine bird breeding sites in Glacier Bay. This information will complement other projects conducted in the park such as the Marine Predator Survey, which covered at-sea distribution of marine birds and mammals (for details see Robards et al. 2003), and the Coastal Resources Inventory and Mapping Program, which mapped the physical and biological attributes of Glacier Bay's shoreline (Sharman et al. 2004).

Methods

Glacier Bay is a recently de-glaciated, Y-shaped fjord that contains 1897 km of coastline. The area is marked by several tidewater glaciers and coastal mountain peaks over 3000 m in elevation. The coastal nesting habitat includes sparsely vegetated sand and gravel beaches and cobble outwashes.

Survey areas were selected using pre-existing park-service data that detailed overnight visitor camp locations between 1995 and 2000 (Fig. 1). All beaches that had at least 30 cumulative overnight visitations reported by campers and all kayak drop-off locations were surveyed. In addition, we obtained permits to visit wilderness closures including the four unnamed islands east of Russell Island, Lone Island, Geikie Rock, Boulder Island and Flapjack Island.

In order to determine the distribution of ground-nesting seabirds, we carried out two types of surveys, land-based beach surveys, and kayak or boat-based shoreline surveys. We surveyed the bay for nesting birds between 4 June and 15 July, 2003. Surveys were ended in mid-July because most ground-nesting birds had completed incubation by that time. In 2003 we focused our effort on determining the distribution of four species: Black Oystercatcher (*Haematopus bachmani*), Arctic Tern (*Sterna paradisaea*), Mew Gull (*Larus canus*), and Glaucous-winged Gull (*Larus glaucescens*). We also recorded observations of other ground nesting bird nests we encountered, including Parasitic Jaeger (*Stercorarius parasiticus*), Semipalmated Plover (*Chardrius semipalmatus*) and Spotted Sandpiper (*Actitis macularia*).

Land-based beach surveys were conducted in areas that were open to motorized vessels. Prior to landing a 4.8 m skiff at the site, we conducted a preliminary survey from the boat to assess areas where nesting may be concentrated and to get an accurate count of birds. After landing, a search was conducted by walking the length of the beach within the area between the high tide line and the upland, terrestrial vegetation. If the area was too large to walk, we limited our search to areas where we observed birds flying, loafing or exhibiting nesting behavior. Nesting behavior was indicated by single birds or pairs of birds that did not flush easily and that exhibited aggressive or defensive behavior such as diving and broken-wing display.

Shoreline surveys were conducted from kayaks at sites within non-motorized areas of the park including Beardslee Islands, Hugh Miller Complex, Rendu Inlet, Adams Inlet and Muir Inlet west of Riggs Glacier. We also conducted shoreline surveys from a skiff at beaches within motorized waters of the park that were not appropriate for landing a vessel or were not accessible by foot. Surveyors observed the shore from distances between 3 and 10 m, and they landed onshore when birds were thought to be nesting. Concentrations of birds, defensive behavior by one or more birds, or the presence of paired birds were reasons for searching onshore. Once ashore, methods for finding and documenting nests were the same as for land-based surveys.

Data recorded during each beach and shoreline survey included: survey locations determined by a handheld Garmin E-Trex Venture GPS unit, species and number of adult birds present, adult behavior, nests present, habitat features, and signs of human use or disturbance. Additional data recorded for each nest we located included: GPS coordinates, status of nest (inactive, active with eggs, chicks or adults present), adult behavior and general characteristics of habitat surrounding the nest.

Because Black Oystercatchers make multiple “nest bowls” and lay eggs in only one (Andres and Falxa 1995), we took one GPS location when many empty nest bowls were found next to each other. In these cases, the number of empty nest bowls near the primary nest was noted. We also recorded evidence of recent nesting activity, such as the presence of egg shells or territorial adults.

Results and Discussion

During a 6-week period we surveyed a total of 94 coastal areas within Glacier Bay for nesting marine birds (Fig. 1). We discovered 279 nests in 52 areas using the beach survey method, and 116 nests in 42 areas using the shoreline survey method.

Black Oystercatchers

Between 4 June and 12 July we found 89 active Black Oystercatcher nests, 39 territorial pairs defending empty nests and three predated nests widely distributed throughout the bay (Fig. 2). Sixty-two nests contained eggs and 27 nests contained chicks. The average clutch size was 2.00 ($n = 62$). The nests were often made of shell pieces and gravel (Appendix 1) and were generally found near the high tide line of gravel and cobble beaches. Eggs were cream colored with brownish spots and like eggs of other ground-nesting species, they were cryptic and difficult to locate except at close range (Appendix 1). Newly hatched chicks were brownish-grey and mottled to blend in with their surroundings (Appendix 1). Older chicks were observed hiding in the intertidal zone under rocks near one or two parents.

The first chicks were found in three separate nests on 12 June at Sturgess Island. One of the nests with chicks at this site contained one pipping egg and two chicks that had already hatched (Table 1). We found 1 four-egg clutch on 12 July at Boulder Island. The nest was located on the latest date that we observed eggs, and it was an unusually large clutch. Black oystercatchers rarely lay more than 1-3 eggs (Andres and Falxa 1995).

Previous work on Black Oystercatchers in Glacier Bay was confined to the Beardslee Islands, where Lentfer and Maier (1995) tracked the fate of 59 nests throughout a breeding season. Our effort comprised a one-time search for nests in this area during the breeding season, and we found only 9 active nests and 19 territorial pairs defending empty nests. This suggests a decline in the number of oystercatchers nesting in the Beardslees. We also observed a lower average clutch size (1.90 eggs/clutch) compared to the previous study by Lentfer and Maier (2.66 eggs/clutch). However, owing to logistical constraints we were unable to survey several islands visited by Lentfer and Maier, and we may have missed some earlier breeding effort. Further study is

needed to determine whether the apparent decline is real, or a result of different survey efforts.

Arctic Terns

We found 36 Arctic Tern nests in the east and west arms of Glacier Bay (Fig. 3). An additional three nests were found in the lower bay on the small treeless islet east-north east of Strawberry Island. Of the 39 Arctic Tern nests found between 13 June and 1 July, 2003, one nest was empty, 25 contained eggs, 9 contained chicks, and two contained eggs and chicks. We also found a single nest with one egg and one predated egg, and one nest containing a dead chick. Average clutch size was 1.76 eggs/nest ($n = 25$). Nests had very little or no nesting material and eggs were laid in slight depressions in the substrate or on bare rock in areas with little vegetation. Eggs were small, speckled and cream to buff colored (Appendix 1). Chicks were light colored with black spots.

There were three sites at which Arctic Terns were observed nesting in concentrated colonies, but individual nest locations and contents were not recorded. Two of these colony sites, the large outwash on the mainland north of Russell Island and the north shore from Riggs Glacier to Muir Glacier (Fig. 3), were too vast to adequately sample for all nests using our survey methods (and they were generally well inland of the coastal beach sites where we were focusing our surveys). We observed Arctic Terns flying over the large outwash north of Russell Island and suspect that nesting occurred throughout the area. We counted approximately 100 adult Arctic Terns near the head of Muir Inlet and chicks were observed in the intertidal zone with parents on 23 June. We were unable to land the kayaks to further investigate this site. The third colony site was the largest of the closed islands east of Russell Island. During the survey there were 80 Glaucous-winged Gulls in the area, and we did not count individual nests in order to minimize predation while adult terns were off the nests. These three colony sites are important breeding sites for Arctic Terns in Glacier Bay, and further study in these areas is needed to quantify the distribution and abundance of this species.

We observed Arctic Terns feeding on small schooling fishes. Arctic Terns were observed catching juvenile pink salmon (*Oncorhynchus gorbuscha*) near Russell Island, and two fresh discarded pink salmon (102 and 110 mm total length) were found at the

colony site east of Russell Island. Arctic Terns also fed capelin (*Mallotus villosus*) to their chicks at Sealer's Island on 15 June and on the north shore of Tarr Inlet on 29 June. We observed an adult flying with a capelin near a nesting site at the head of Queen Inlet on 1 July. Also, an Arctic Tern caught a forage size capelin (about 90 mm in length) nearshore at the north spit of McBride Glacier. Both Queen and McBride may be important feeding areas for terns and other bird species because of the presence of spawning capelin during the breeding season (Arimitsu and Piatt, *in prep.*).

Although there was no tern nesting activity at McBride in 2003, anecdotal reports suggest that terns nested at McBride as early as 1975 (G. Streveler, pers. comm.) and as recently as 1998 (T. Lewis, pers. comm.). Arctic Terns are known to relocate breeding sites in response to food availability or predators (Hatch 2002). The potential for human disturbance at McBride is high. McBride is one of the most heavily used areas by visitors (Fig. 1), and the historical tern nesting area on the north spit is in the walking path to the best views of the glacier. On the other hand, the arrival of a wolf den with pups around the same time the terns disappeared from the area (J. Brakel, pers. comm.) suggests another factor in the demise of the colony.

Mew Gulls

We found 37 Mew Gull nests in the east and west arms of Glacier Bay, and at the head of Geikie Inlet (Fig. 4). Between 6 June and 7 July we located 15 nests containing eggs and four nests containing chicks. Average clutch size was 2.07 eggs/nest ($n = 15$). No direct signs of predation were noted. Eighteen of the Mew Gull nests we found were empty. Some of these nests, especially the nests surveyed on 30 June and 1 July in Rendu and Queen Inlets, were actively defended by adults and it is possible that chicks had already left the nest at the time of our search. Active nests were generally well formed and made of small sticks, and we often found them near streams or in cobble outwash areas. Eggs were speckled and medium in size (Appendix 1). Chicks were often found away from the nest near the shore, and they entered the water accompanied by one or more flying adults when observers approached. For this reason, we tried to minimize the amount of time spent at Mew Gull nesting sites when chicks were present. We found the first chick on 20 June, and we observed two pipping eggs in a three egg clutch on 28 June (Table 1).

We found two colony sites where individual nests were not mapped (Fig. 4). The first was on the north shore between Riggs Glacier and Muir Glacier, where we were unable to land the kayaks because of weather and unsuitable shoreline. We saw approximately 75 Mew Gulls at this site. They were exhibiting nesting behavior but the number of nests is unknown. The second site was the largest of the unnamed islands east of Russell Island (see wildlife closure discussion).

Glaucous-winged gulls

We found 175 Glaucous-winged Gull nests (Fig.5). There were large Glaucous-winged Gull colonies at Boulder Island and Flapjack Island (see wildlife closure discussion section). We also located a total of 30 nests on the north shore between Riggs and Muir Glaciers, Sealer's Island, Sturgess Island, the Islet off Tlingit Point and within the Hugh Miller Complex. Ten of these nests were empty, two had signs of predation, 14 contained eggs and four contained chicks. Average clutch size was 2.32 eggs/nest ($n = 114$). Nests were large, well formed and usually made of sticks, mud and moss. Nesting habitat was variable and included areas with little or no vegetation as well as areas with thick coastal vegetation. Eggs were large compared to other species' eggs, and chicks were light colored with black spots (Appendix 1).

Other Species

In addition to the species described above, we located nests of three other ground-nesting species that were sparsely distributed throughout the bay (Fig. 6).

One Parasitic Jaeger nest, containing a single egg, was found on 23 June near the head of Muir Inlet. The shallow nest-bowl was found near low growing coastal vegetation (Appendix 1). Also, pairs of Parasitic Jaegers were observed in 2003 by other researchers on the east side of Reid glacier face and north of Forest creek in Muir Inlet (T. Lewis, pers. comm.). The presence of pairs onshore may indicate nesting and further investigation at these sites is necessary.

We found 13 Semipalmated Plover nests in the bay. Because these nests are very inconspicuous and time-consuming to locate, the number of nests we found probably represents a minimum number of Semipalmated Plover nests in the surveyed

areas. Between 7 June and 23 June we found ten nests containing eggs, two nests containing chicks and one nest with chicks and eggs. Average clutch size was 3.6 eggs/nest (n = 10). The first eggs were observed on 7 June at the head of Geikie Inlet, and a recently hatched chick was observed on 13 June at the McBride Glacier's north spit (Table 1). Nests were shallow nest bowls lined with local, low lying vegetation, and were found on gravel and sand near vegetative cover. Eggs were small, speckled, and usually bluish to grey in color (Appendix 1). Chicks were mottled brown and black.

We found two Spotted Sandpiper nests during our survey in 2003. These were the most difficult nests to locate because Spotted Sandpipers nested within vegetation in most areas. Often, single adults or pairs of adults were flushed from the shrubs but the nests were not located even after a thorough search. One nest with two chicks was discovered on 29 June near Margerie Glacier. One nest, containing four eggs, was located near a fire scar at Hunter Cove on 12 June. In addition, one nest containing four eggs was reported by a park ranger in Blue Mouse Cove (W. Bredow, pers. comm.).

Wildlife Closures

Areas that have been historically closed to foot traffic because of concerns about disturbance to wildlife were surveyed to assess the current status of nesting birds. We surveyed many of the smaller closed islands by boat because we did not want to cause unnecessary disturbance to nesting birds or marine mammals that were hauled out on beaches. In these cases we counted all birds visible from the water and noted signs of nesting. Results and preliminary recommendations are described under the subheading for each area.

Unnamed islands east of Russell Island

We refer to the four unnamed islands east of Russell Island as Islands 1-4 for the purposes of describing nesting activity (Fig. 7). All of these islands were surveyed on 2 July, 2003.

We observed nine Black Oystercatchers and two Pigeon Guillemots (*Cephus columba*) on Island 1. We found two Black Oystercatcher nests with chicks and one

territorial pair defending an area with empty nests. This island may also be used by nesting Pigeon Guillemots.

We observed six Black Oystercatchers on Island 2. Two Black Oystercatcher nests containing eggs and one predated Black Oystercatcher egg were found at this island. There were 20-30 adult Pigeon Guillemots resting on land and in the water near the islet. They were seen flying in and out of crevices on the islet, which suggests that Pigeon Guillemots nest at this location.

There were five Mew Gulls, eight Black Oystercatchers, 25 Arctic Terns, and 81 Harlequin Ducks on Island 3, a small treeless outcrop. We observed two Mew Gull nest bowls; one was empty and one contained a single egg. We found empty Black Oystercatcher nests defended by territorial adults in two locations, and one predated Black Oystercatcher egg. We also found three active Arctic Tern nests, all of which contained two eggs.

Island 4 is an important nesting area for Arctic Terns, Black Oystercatchers, and Mew Gulls. We surveyed the west point of this island on foot. The rest of the island could not be walked and was surveyed from a skiff. Most of the nesting activity was limited to the west point of the island. We observed six Pigeon Guillemots, 12 Black Oystercatchers, 20 Mew Gulls, 75 Arctic Terns and 80 Glaucous-winged Gulls on the island. There was one territorial pair of Black Oystercatchers defending two empty nest bowls. We also saw one Black Oystercatcher chick and 13 Mew Gull chicks at the water's edge. We recorded four Arctic Tern nests containing eggs and one nest contained one chick and a pipping egg (Table 1). We also found one Arctic Tern egg submerged in water at the high tide line. There are likely more Arctic Tern nests on this island, but we were reluctant to count them accurately given the high potential for disturbance.

All of the four unnamed islands east of Russell Island are small and have evidence of concentrated nesting activity. In addition, camping potential is relatively low on these islands. We recommend these islands remain closed to foot traffic.

Lone Island

On 15 July, 2003 there were nine harbor seals (*Phoca vitulina*) and three Steller sea lions (*Eumetopias jubatus*) hauled out on Lone Island and we made our observations from the

boat to minimize disturbance. We observed 266 Glaucous-winged Gulls, 13 Black Oystercatchers, one Bonaparte's Gull (*Larus philadelphia*), 187 Black-legged Kittiwakes (*Rissa tridactyla*), 19 Pigeon Guillemots, one Bald Eagle (*Haliaeetus leucocephalus*), seven Northwestern Crows (*Corvus caurinus*), one Tufted Puffin (*Fratercula cirrhata*), three Black Turnstones (*Arenaria melanocephala*) and 10 Harlequin Ducks (*Histrionicus histrionicus*). The Glaucous-winged Gulls appeared to be nesting on the hillside facing south. There were 44 empty Black-legged Kittiwake nests. Adults were stomping on nesting material or standing in pairs on nests, but we did not observe any chicks or eggs in the nests. Three Pigeon Guillemots were sitting on the water with fish, and we saw one adult fly into a nest. The fish were identified as one crescent gunnel (*Pholis laeta*), one sturgeon poacher (*Agonus acipenserinus*), and one fish was an unidentified sculpin. The Northwestern Crows were concentrated in alder where they may have been nesting. We also saw one Tufted Puffin fly from a burrow on the northeast side of the island. This is obviously an important area for marine mammals and birds. We recommend that it remain closed to foot traffic.

Geikie Rock

We surveyed Geikie rock from a skiff on 15 July, 2003. There were 15 harbor seals hauled out, 147 Glaucous-winged Gulls, 30 Pigeon Guillemots, four Arctic Terns, 21 Black Oystercatchers, 130 Harlequin Ducks, 17 Pelagic Cormorants (*Phalacrocorax pelagicus*), 22 Black Turnstones and one Ruddy Turnstone (*Arenaria interpres*) roosting on the island. Of the 250 Black-legged Kittiwakes on the rock, about 90% were immature. Five Glaucous-winged Gull chicks were at the shoreline, and we observed an Arctic Tern with an unidentified fish and a Pigeon Guillemot with a gunnel (*Pholis* sp.). Geikie Rock continues to be an important area for marine birds and mammals; we recommend that it remain closed to foot traffic.

Leland Island

We surveyed Leland Island and the smaller islet to the north of the main island by foot on 7 July, 2003. We found a total of eight Black Oystercatcher nests and all of them contained eggs. However, nesting was not concentrated on this relatively large island.

We recommend repeated surveys at this island in 2004 and 2005 to determine the extent of nesting activity.

Boulder Island

Boulder Island was surveyed by foot on 12 July, 2003. There were 15 Black Oystercatchers, one pair of Arctic Terns and over 600 Glaucous-winged Gulls at this site. There were two Black Oystercatcher nests containing eggs on the island. The Arctic Terns appeared to be defending a nest, although we were unable to locate it. We found 88 Glaucous-winged Gull nests on Boulder Island, average clutch size was 2.53 egg/nest ($n = 40$). Almost half of the Glaucous-winged Gull nests ($n=43$) were empty, four had predated eggs and 40 had eggs. We observed one nest with one chick and one hatching chick (Table 1). This was the largest Glaucous-winged Gull colony we encountered during our survey and is one of the more important nesting areas in the bay. We recommend that this island remain closed to foot traffic.

Flapjack Island

Flapjack Island was surveyed by foot on 26 June. There were 43 Black Oystercatchers, 14 Common Mergansers, 20 Harlequin Ducks, and seven Black Scoters on the island. In addition, there were approximately 225 adult and over 900 sub-adult Black-legged Kittiwakes, 200 mostly sub-adult Glaucous-winged Gulls and over 300 Red-breasted Mergansers on the beach.

We found 57 Glaucous-winged Gull nests concentrated on the north end of the island. Average clutch size was 1.68 eggs/nest ($n = 25$). Thirty one nests were empty, 25 nests contained eggs and one nest had a single chick. We also found one Black Oystercatcher nest with eggs and one territorial Black Oystercatcher pair defending an empty nest.

Flapjack Island is an important Glaucous-winged Gull colony and roosting area for Black-legged Kittiwakes, Black Oystercatchers and Red-breasted Mergansers. We recommend that this area remain closed to foot traffic.

Work in 2004

In order to determine the areas that are most susceptible to human disturbance, we will continue to search for nests in areas with high visitor use. New information regarding visitor use (number of camps between 1995 and 2002) in Glacier Bay will be considered when 2004 survey locations are decided; all areas where 39 or more camps have been reported will be surveyed. We will also continue our census of areas with existing wildlife closures and we will visit areas that are used by birds but may not have high levels of visitor use at this time. This information may be useful in the future as visitation to these areas increases.

Baseline data on the distribution of ground-nesting birds in the park will be used for monitoring changes in breeding bird abundance and distribution over time. Ultimately, we will provide recommendations for implementing a management program that will minimize human disturbance to breeding birds in Glacier Bay.

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Table 1. Dates, location and contents for Black Oystercatcher, Semipalmated Plover, Mew Gull, Arctic Tern and Glaucous-winged Gull nests where hatching (or pipping) was directly observed.

| Species | Date | Location | Nest Contents |
|----------------------|----------------|------------------------|---|
| Black Oystercatcher | 6/12/2003 | Sturgess Island | 2 chicks, 1 pipping egg |
| Semipalmated Plover | 6/13/2003 | McBride | 2 chicks (one just hatched), 2 eggs |
| Black Oystercatcher | 6/13-6/14/2003 | McBride | 6/13 -3 eggs (1 pipping); 6/14 -2 chicks, 1 egg |
| Mew Gull | 6/28/2003 | Johns Hopkins | 1egg, 2 pipping eggs |
| Arctic Tern | 7/2/2003 | East of Russell Island | 1 chick, 1 pipping egg |
| Glaucous-winged Gull | 7/12/2003 | Boulder Island | 1 chick, 1 pipping egg |

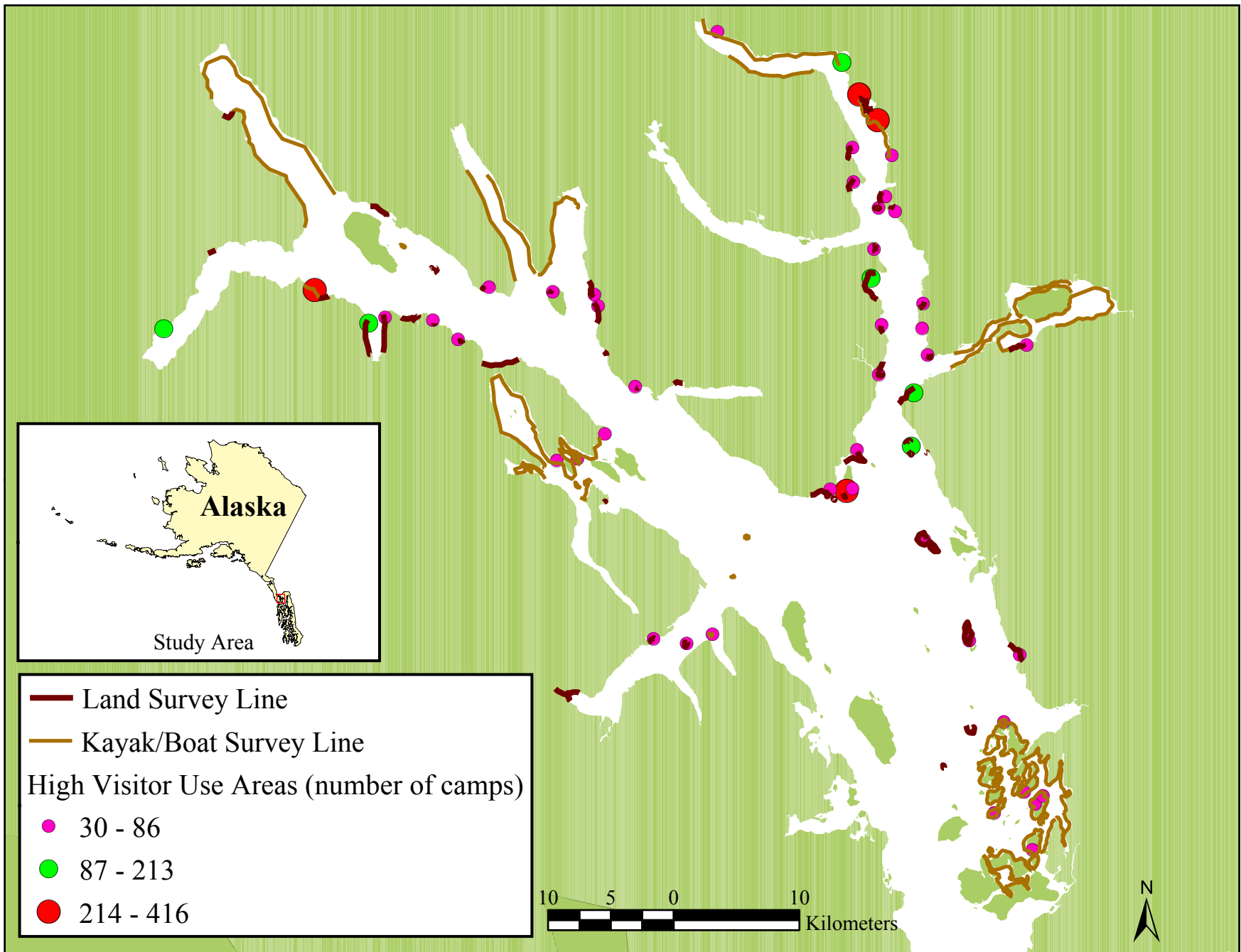


Figure 1. Map of study area with 2003 survey lines and high visitor use areas between 1995-2000.

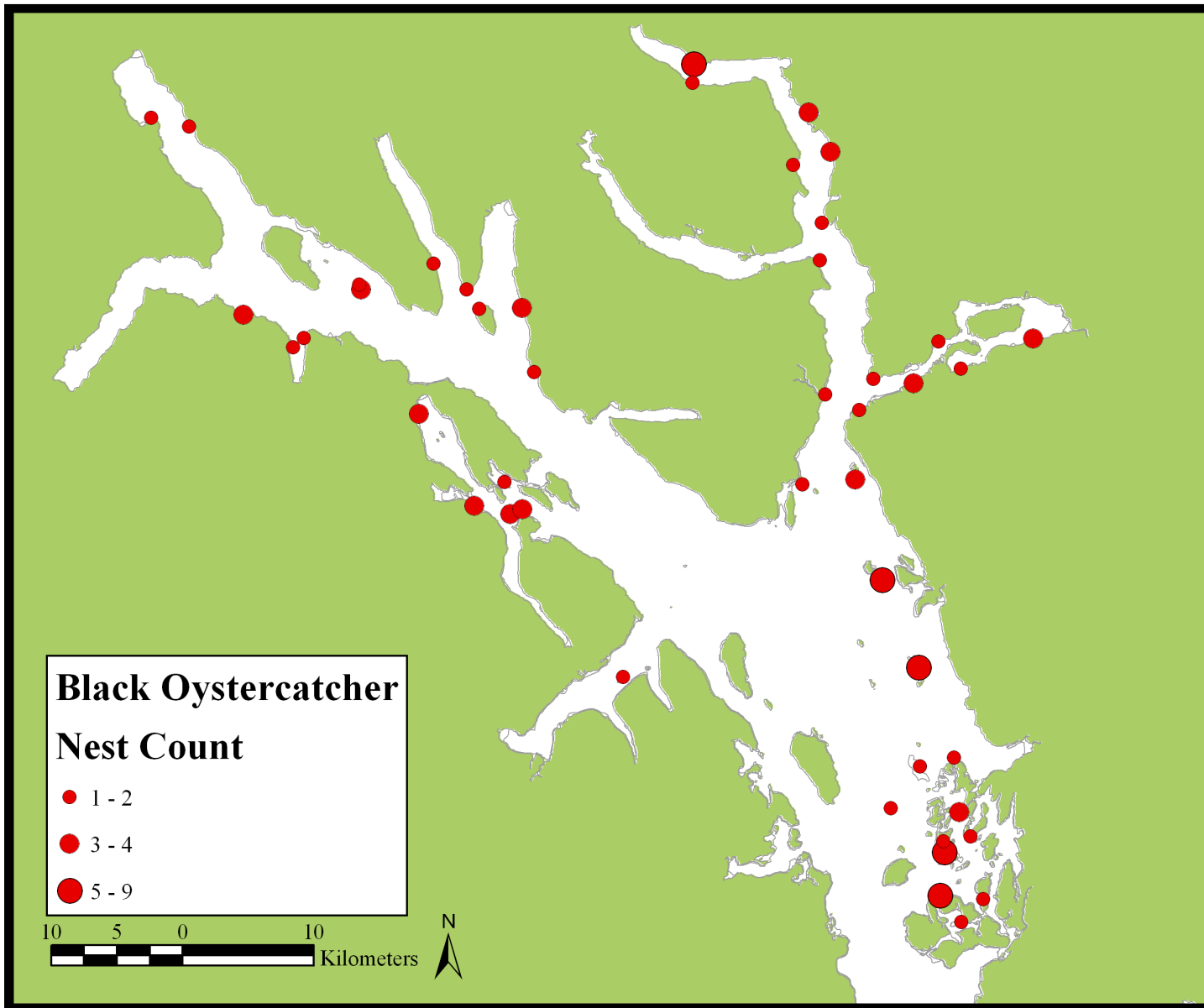


Figure 2. Black Oystercatcher nest locations during the 2003 survey in Glacier Bay.

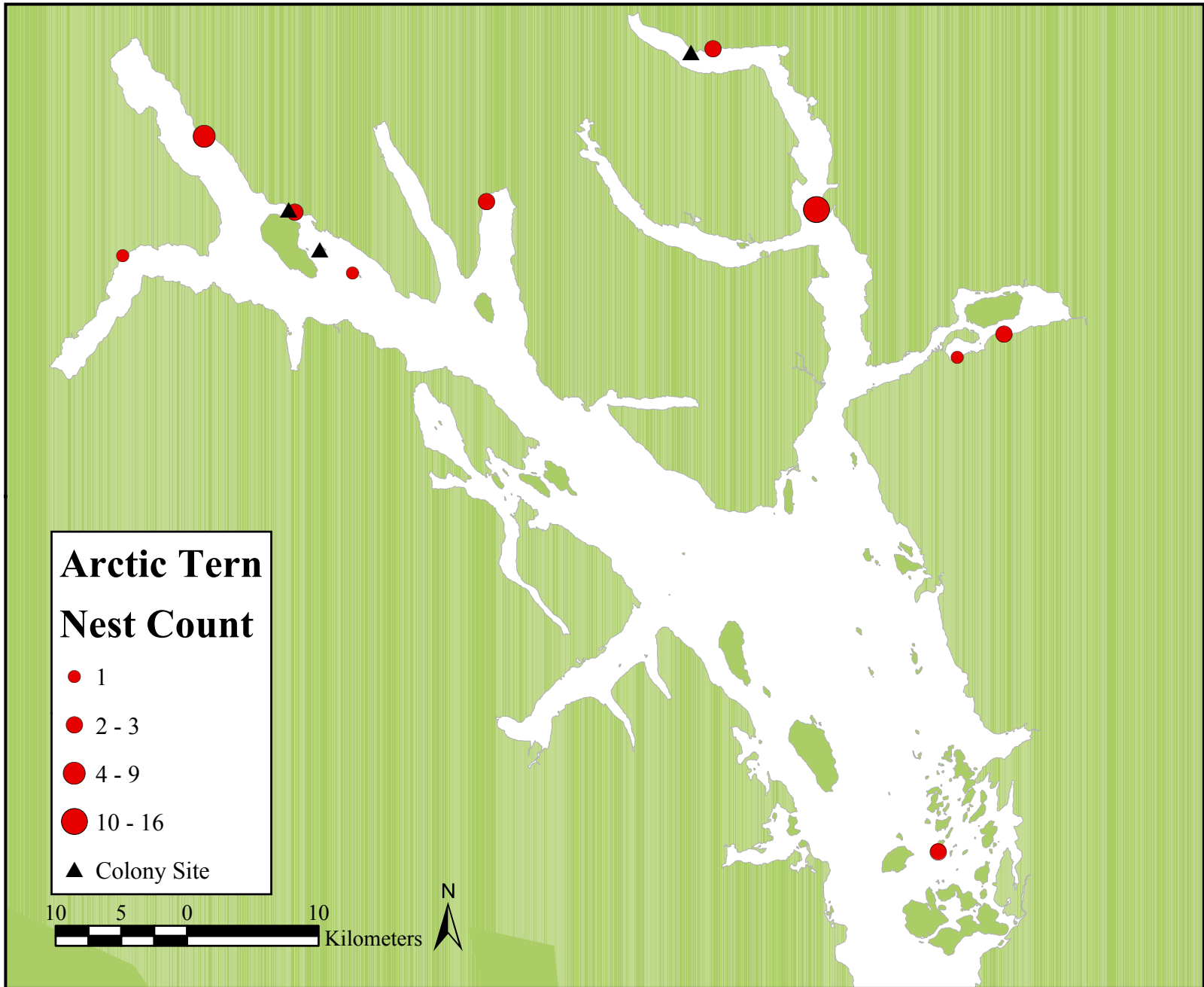


Figure 3. Arctic Tern nest locations during the 2003 survey in Glacier Bay.

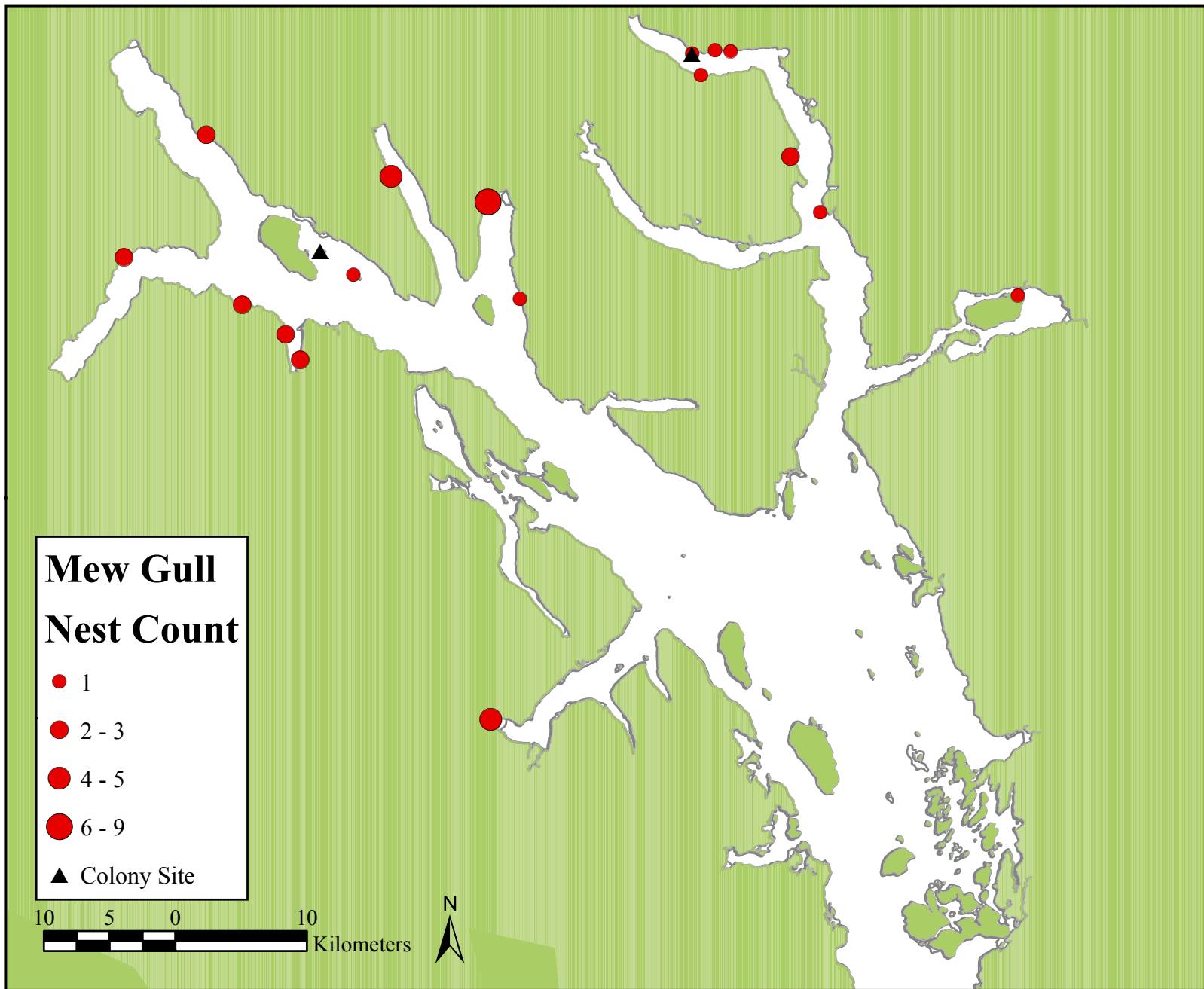


Figure 4. Mew Gull nest locations during the 2003 survey in Glacier Bay.

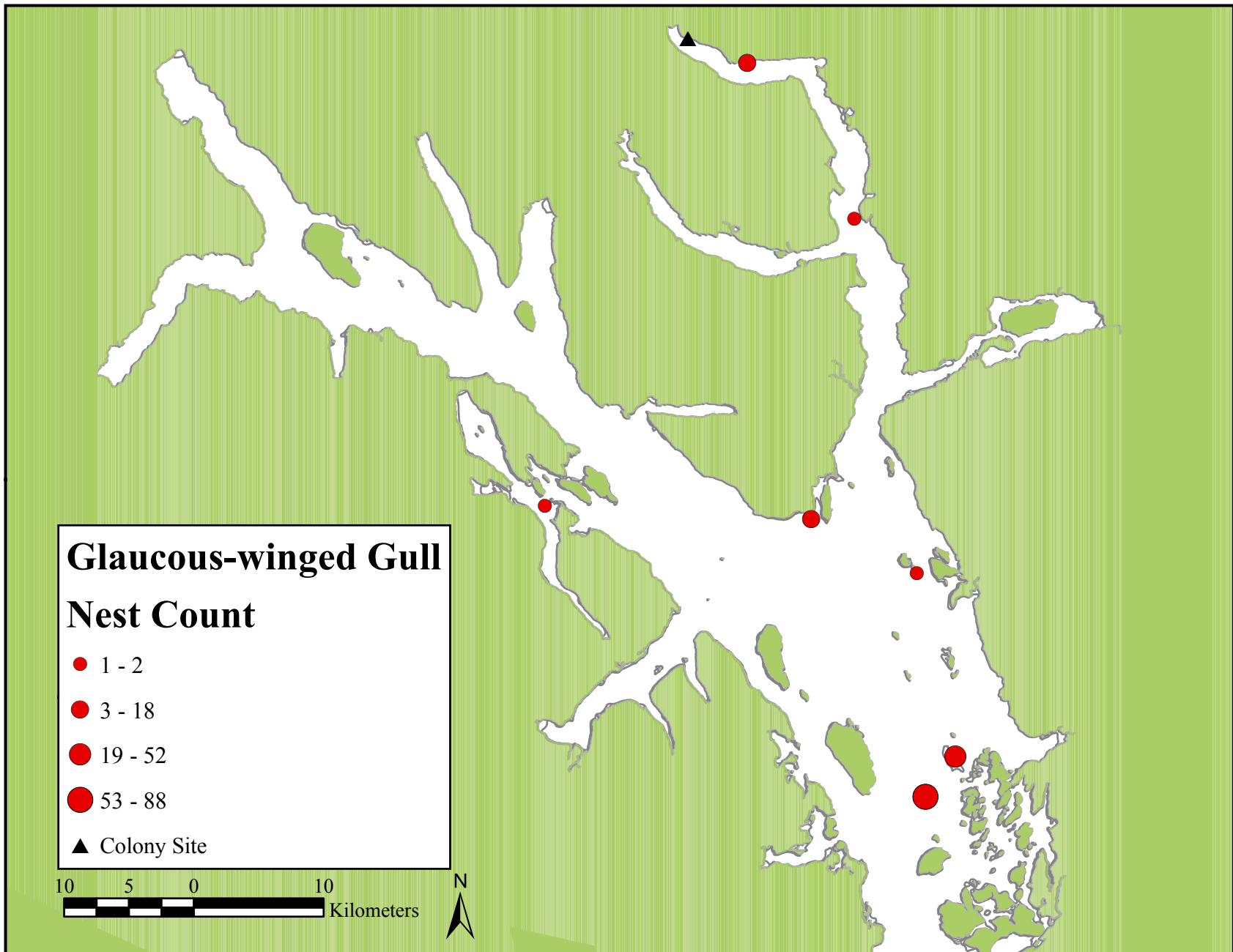


Figure 5. Glaucous-winged Gull nests during the 2003 survey in Glacier Bay.



Figure 6. Parasitic Jaeger, Semipalmated Plover and Spotted Sandpiper nest locations during the 2003 survey in Glacier Bay.

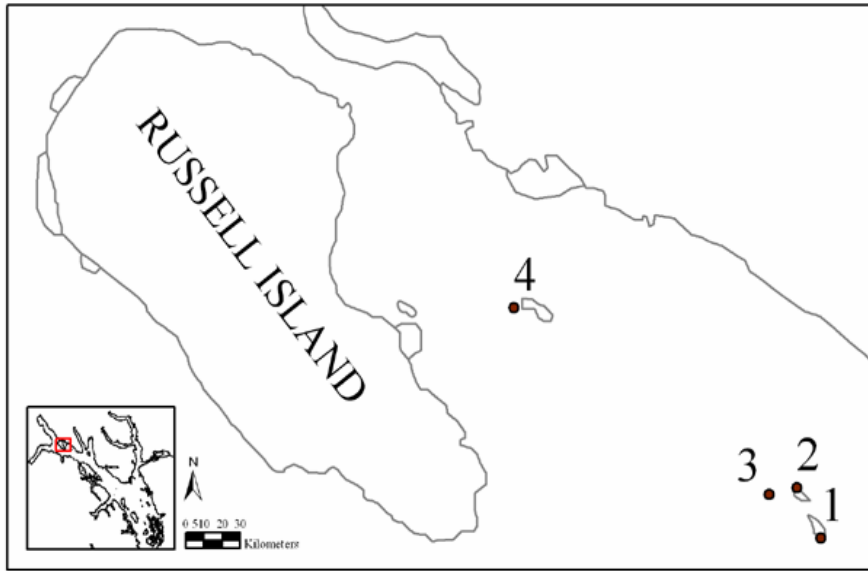


Figure 7. Locations of Islands 1-4 in reference to the islands east of Russell Island in the west arm of Glacier Bay.

Appendix 1. Photos of nests in Glacier Bay.



Black Oystercatcher nest



Black Oystercatcher chick



Arctic Tern nest



Mew Gull nest



Glaucous-winged Gull nest



Glaucous-winged Gull chicks



Parasitic Jaeger nest



Semipalmated Plover nest