Invasive Plant Management in Glacier Bay National Park and Preserve
Gustavus, Alaska
Summer 2005 Field Season Report

Figure 1 – A coastal meadow in the Beardslee Islands with native Nootka lupine (*Lupinus nootkatensis*) and painbrush (*Castilleja* sp.) invaded by dandelions (*Taraxacum officinale* ssp. *officinale*).

Whitney Rapp
Invasive Plants Program Coordinator
NPS/GLBA
PO Box 140
Gustavus, AK 99826

September 2005

TABLE OF CONTENTS

ABSTRACT **5**

INTRODUCTION **5**

METHODS AND MATERIALS **6**

RESULTS **7**

DISCUSSION **9**

Achillea millefolium 9
Allium schoenoprasum 10
Alopecurus pratensis 10
Bromus inermis 10
Capsella bursa-pastoris 10
Cerastium fontanum 10
Dactylis glomerata 11
Hieracium aurantiacum 11
Hordeum jubatum 11
Hypochaeris radicata 11
Leucanthemum vulgare 12
Linaria vulgaris 13
Lolium perenne ssp. *perenne/multiflorum* 13
Lupinus polyphyllus 13
Lychnis chalcedonica 14
Matricaria discoidea 14
Myosotis palustris 14
Phalaris arundinacea 14
Phleum pratense 15
Plantago major 15
Poa palustris 15
Ranunculus acris 16
Ranunculus repens 16
Rubus idaeus 16
Rumex acetosella 16
Rumex crispus 16
Sonchus arvensis 17
Sorbus aucuparia 17
Symphytum officinale 18
Tanacetum vulgare 18
Taraxacum officinale ssp. *officinale* 18
Trifolium hybridum and *T. pratense* 19
Trifolium repens 20
Triticum aestivum 20
Unidentified Lamiaceae 21
Outreach/Education 21
Other Thoughts 22

RECOMMENDED PLANS FOR 2006 FIELD SEASON 23

ACKNOWLEDGEMENTS 25

LITERATURE CITED 26

APPENDICES 27

Appendix A – List of known invasive plants within or near GLBA 27

Appendix B – 2005 location maps of selected invasive plants in GLBA 2005 28
Cerastium fontanum distribution in Dry Bay in 2005 28
Cerastium fontanum distribution in Glacier Bay in 2005 29
Dactylis glomerata distribution in Dry Bay in 2005 30
Dactylis glomerata distribution in Glacier Bay in 2005 31
Leucanthemum vulgare distribution in Dry Bay in 2005 32
Leucanthemum vulgare distribution in Glacier Bay in 2005 33
Lupinus polyphyllus distribution in Dry Bay in 2005 34
Lupinus polyphyllus distribution in Glacier Bay in 2005 35
Matricaria discoidea distribution in Dry Bay in 2005 36
Matricaria discoidea distribution in Glacier Bay in 2005 37
Phalaris arundinacea distribution in Dry Bay in 2005 38
Phalaris arundinacea distribution in Glacier Bay in 2005 39
Phleum pratense distribution in Dry Bay in 2005 40
Phleum pratense distribution in Glacier Bay in 2005 41
Plantago major distribution in Dry Bay in 2005 42
Plantago major distribution in Glacier Bay in 2005 43
Ranunculus repens distribution in Dry Bay in 2005 44
Ranunculus repens distribution in Glacier Bay in 2005 45
Rubus idaeus distribution in Dry Bay in 2005 46
Rubus idaeus distribution in Glacier Bay in 2005 47
Rumex acetosella distribution in Dry Bay in 2005 48
Rumex acetosella distribution in Glacier Bay in 2005 49
Sonchus arvensis distribution in Dry Bay in 2005 50
Sonchus arvensis distribution in Glacier Bay in 2005 51
Symphytum officinale distribution in Dry Bay in 2005 52
Symphytum officinale distribution in Glacier Bay in 2005 53
Taraxacum officinale ssp. *officinale* distribution in Dry Bay in 2005 54
Taraxacum officinale ssp. *officinale* distribution in Glacier Bay in 2005 55
Trifolium hybridum/pratense distribution in Dry Bay in 2005 56
Trifolium hybridum/pratense distribution in Glacier Bay in 2005 57
Trifolium repens distribution in Dry Bay in 2005 58
Trifolium repens distribution in Glacier Bay in 2005 59
Areas without Non-Native Species in Dry Bay in 2005 60
Areas without Non-Native Species in Glacier Bay in 2005 61

Appendix C – Species biographies of select species prepared by the Alaska Natural Heritage Program 62

Abstract

For the second consecutive year, intensive inventory work was performed at Glacier Bay National Park and Preserve (GLBA) to document the distribution and abundance of non-native plant species. Within the 201 ha (497 acres) of the park and adjoining lands that were inventoried, twelve new species were documented bringing the total count of non-native plant species observed to 37. The most widespread species is common dandelion (*Taraxacum officinale* ssp. *officinale*), which has invaded coastal meadows and anthropogenically disturbed areas parkwide. Bartlett Cove has the greatest number of non-native species present. In the backcountry of Glacier Bay proper, mouse-ear chickweed (*Cerastium fontanum*), oxeye dasiy (*Leucanthemum vulgare*), American red raspberry (*Rubus idaeus*), perennial sowthistle (*Sonchus arvensis*), and common dandelion (*Taraxacum officinale* ssp. *officinale*) have been detected. Dry Bay's greatest threat is bigleaf lupine (*Lupinus polyphyllus*), which is successfully outcompeting other species in both open meadows and shaded understory areas. Throughout the season, control efforts removed approximately 1500 kg (3300 lb) of non-native plants. In subsequent years, inventory work should be repeated to determine the rate of spread of species already present and whether new species are colonizing. Control efforts should continue with work focusing on removing small, disjunct infestations and those in areas less disturbed by human activity, such as the backcountry.

Introduction

Since 2001, baseline surveys for non-native plant species have been carried out on National Park Service (NPS) lands in Alaska. These surveys serve as the first source of data to be used in formulating long-term monitoring and control plans for exotic plant species in Alaska's NPS units. Exotic plant species are a concern to resource managers because they threaten the genetic integrity of native flora through hybridization (D'Antonio et. al 2001), can outcompete resident plant species for limited resources, and can change the structure and function of ecosystems through alterations of geochemical and geophysical processes (Ruesnik et. al 1995, Gordon 1998). Already, 1.1 million ha (2.6 million acres) or over 3% of the 34 million ha (83 million acres) managed by the NPS nationwide are infested with nonnative plant and animal species (Drees 2004). Conservative estimates of the economic costs of biotic invasions are $137 billion in the United States annually (Pimental et al. 2004).

In Alaska, NPS lands have thus far avoided invasion by many pernicious exotic species found in the lower 48 states (Westbrooks 1998). Several factors have contributed to this immunity. The first is climate. Circumboreal flora are adapted to a wide range of climatic conditions that exotic plants cannot tolerate. In addition, many parklands in Alaska have remained relatively free of anthropogenic disturbances, such as livestock grazing, wildfire suppression, and altered hydrological regimes that encourage the introduction of exotic species. Consequently, the remote wilderness parks in Alaska still retain all of their major floral and faunal ecosystem components (Densmore et. al 2001). Despite these protective factors, the threat of exotic plant invasion is increasing due to factors including global warming, increases in construction-related disturbance, and tourism. Throughout Alaska, over 170 non-native plant species have been documented, accounting for approximately 10% of the flora (Carlson et al. 2005). Fortunately,

the NPS in Alaska has the opportunity to stay ahead of exotic plant introductions before they become a problem, but research and active management must begin now (Spencer 2001).

Glacier Bay National Park and Preserve (GLBA) is unique among Alaska NPS units with respect to exotic plants for several reasons. Two factors make it vulnerable to invasion: GLBA protects a large land area in the most temperate region of the state, and the terrestrial landscape is undergoing transformation across a mosaic of successional stages through the ongoing colonization of areas recently exposed by glacial retreat. On the other hand, there are very limited avenues for the introduction of exotic plants to the park. Only the immediate frontcountry of GLBA is accessible by vehicles (which must be barged in), and most visitors never step ashore in the rest of the park. So far, there are relatively few introduced species present in Gustavus or the park, but the threat of exotic plant introduction is aided by the influx of summer visitors, the escape of planted cultivars from Gustavus, and ongoing maintenance activities that disturb the soil and facilitate the establishment of exotic species. Fortunately, GLBA has fared well in its isolation and has a real opportunity to avoid the problems other parks are experiencing, but park managers must remain vigilant.

The purpose of surveys in GLBA during the 2005 field season was to provide information on the distribution, abundance, and species composition of exotic plants in three general areas: Bartlett Cove, Dry Bay, and backcountry Glacier Bay. In addition to making comparisons to survey work from 2004, new areas of the park were examined to broaden the knowledge of the invasive plant concerns within the park. Information on the status and number of exotic plant species in GLBA will be used to help prioritize areas in the park and state for long-term monitoring and control of these species on Alaska NPS lands.

Methods and Materials

Fieldwork at Glacier Bay National Park and Preserve occurred from May through September 2005 following the protocol written by the Alaska Regional Office. Areas inventoried included parts of Bartlett Cove; most of the established ORV trails in Dry Bay; and selected areas of the Glacier Bay backcountry, including parts of the Beardslee Islands, Berg Bay, Fingers Bay, mid-bay islands, the West Arm, and Dundas Bay. Effort focused on areas most likely affected by human activity or susceptible to colonization by non-native species based on land topography. While on site, digital photos were taken opportunistically. Where feasible and strategic, infestations were controlled through hand pulling.

For the second year, Trimble GeoXT GPS units were used for all data collection during inventory and control events. Equipped with a standardized data dictionary (Table 1) used by the Exotic Plant Management Team for all parks in the Alaska Region, the GeoXT can achieve submeter accuracy and ensure data integrity. Areas with and without non-native species were inventoried in sufficient detail to allow annual comparisons of plant distributions. The data dictionary provides sufficient detail for describing the size, diversity, and severity of exotic plant infestations and for population of two distinct databases: APCAM (nationwide NPS database for exotic plant data) and AKEPIC (a collaborative, multi-agency web-based database for tracking Alaskan exotic plants).

Table 1 - Fields used in GPS data dictionary and GIS shapefile for invasive plant surveys, summer 2005.

LocationID	Location ID (GLBA = bartlett_cove, beardslees, dry_bay, east_arm, gustavus, main bay. or west_arm; SITK = other)
Dstrbncs	Disturbance Type (coastal, stream, river, glacier, fill importation, trampling, wind throw, slide, animal, material extraction, ORV disturbance, mowing, wildfire, logging, mining, grazing, plowing, brush cutting, herbicide, wind, thermal, volcano, abandoned homesite, or other)
LctnDscrpt	Location Description
BufferM	Buffer distance (in meters) to convert points and lines to polygons
Taxon	Dominant exotic species
Phenology	Phenology of dominant exotic species (rosette, no_flower, full_flower, in_seed, stand_dead, or none)
CvrClssPer	Cover class percentage of dominant exotic species (0, 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100)
Action	Inventory, Monitor, Treatment, or Retreatment
Treatment	Treatment type (none, Pull/Dig-Manual, Cut, Basal Bark, Basal- thinline, other)
CntrlEffrt	Projected/actual control effort (low <1 hour, medium 1-8 hours, high >8 hours)
Undetermined	Stem count of dominant exotic species
Remarks	Remarks
StartDate	Date of site visit
StartTime	Time of site visit
AssocPark	Associated park (GLBA or SITK)
Recorder	Recorder (WSR = Whitney Rapp)
Taxon2, Taxon3…	Additional 4 fields for 4 other exotic taxa for each unique site including fields for Phenology, Cover Class Percentage, and Stem Count
Spatial Accuracy Fields	Range of attributes to describe spatial information and precision
Acres	GIS-calculated acreage of each infested or uninfested area

The data collected using the GPS was differentially corrected using the closest base station (Gustavus, AK) and edited in GPS Pathfinder Office (Trimble, version 3.00). The corrected files were exported as shapefiles for use in ArcGIS (ESRI, version 9) by EPMT personnel at the Alaska Regional Office.

Results

During the 2005 field season, approximately 201 ha (497 acres) were surveyed with the focus of the effort on areas frequented by people both currently and historically, the coastline, and areas previously not surveyed. Survey work during 2005 added significantly greater resolution to data on distribution and abundance of the known non-native species.

Inventory work in 2005 resulted in the documentation of 12 new non-native species within and near GLBA (Appendix A). An additional six species were located that had previously been documented in or near the park with herbarium specimens, but had not been found during previous non-native plant surveys. This brings the total count of non-native plant species to 37. The newly identified and located species include wild chive (*Allium schoenoprasm*), orchardgrass (*Dactylis glomerata*), orange hawkweed (*Hieracium aurantiacum*), hairy cat's ear (*Hypochaeris radicata*), tall buttercup (*Ranunculus acris*), creeping buttercup (*Ranunculus repens*), curly dock (*Rumex crispus*), perennial sowthistle (*Sonchus arvensis*), European mountain ash (*Sorbus aucuparis*), common comfrey (*Symphytum officinale*), alsike clover (*Trifolium hybridum*), and an unidentified mint family member (Lamiaceae). The species located this year that were previously collected for herbarium specimens include shepherd's purse (*Capsella bursa-pastoris*), foxtail barley (*Hordeum jubatum*), pineapple weed (*Matricaria discoidea*), marsh forget-me-knot (*Myosotis palustris*), American red raspberry (*Rubus ideaus*), sheep sorrel (*Rumex acetosella*), and chickweed (*Stellaria media*). Non-native species previously identified within GLBA that were not relocated in 2005 include *Achillea millefolium, Alopecurus pratensis, Linaria vulgaris, Lychnis chalcedonica,* and *Poa palustris*. Appendix B shows the locations of many of the non-native species observed during 2005. The shapefile generated from the field inventory may be used in GIS to access additional information, including the assessment of invasive plant densities and the estimated control effort needed for eradication.

Control efforts of non-native species were focused primarily in Bartlett Cove and in areas with small infestations of less common species. Treatment of common dandelions occurred early in the season during May and June primarily around the Visitor Information Station (VIS) and the Glacier Bay Lodge in Bartlett Cove. Oxeye daisies were removed in all located sites within Bartlett Cove, at Reid Inlet, and at some sites in Dry Bay. All known populations of reed canarygrass (*Phalaris arundinacea*) were controlled in Bartlett Cove with help from the SAGA (Southeast Alaska Guidance Association) crew in July. The SAGA crew also assisted in removing the only known population of tall buttercup. The single specimen of hairy cat's ear within the park was removed in July. During August and September, common timothy (*Phleum pratense*) was removed from roadside locations in much of Bartlett Cove. Other species that were controlled opportunistically in Bartlett Cove include creeping buttercup, common plantain, white clover, red clover, alsike clover, and mouse-ear chickweed. Perennial sowthistle flower heads were removed from Strawberry Island in August; however, the remainder of the plants were left intact. Another population of this species located in Gustavus was partially controlled in September. Throughout the field season, approximately 1500 kg (3300 lb) of non-native plants were removed.

Figure 2 – Survey work in Dundas Bay revealed no non-native plant species.

Discussion

With the identification of 12 new non-native species within and near GLBA this year, the urgency of continued monitoring and control to protect the native plant community became more compelling. In terms of distribution, *Taraxacum officinale* ssp. *officinale* has the most widespread distribution throughout the park. In Dry Bay, the species of greatest concern is *Lupinus polyphyllus* based on its current extent and ability to displace native species. Following many recent construction-related disturbance events, a number of invasive species have become well established in Bartlett Cove and will challenge management in the future. There are several other specimens, primarily grasses, that have been sent to Alaska Natural Heritage Program for positive identification and could increase the number of non-native species detected in 2005.

Achillea millefolium

Specimens of both common yarrow (*Achillea millefolium*) and boreal yarrow (*A. borealis*) have been identified in the GLBA herbarium. *A. borealis* is generally considered native to Alaska and *A. millefolium* may be either native or introduced. In correspondance with Debra Trock, the author of the *Achillea* section of the *Flora of North America*, *A. borealis* is no longer recognized as a species or as a variety of *A. millefolium*. In addition, there are no definitive morphological characteristics for determining nativity. Genetically, it is difficult to determine nativity as well. Work by Ron Tyrl of Oklahoma State University determined that *A. millefolium* is a cosmopolitan polyploid complex of both native and introduced plants that have hybridized, producing tetraploid, hexaploid, octaploid and pentaploid populations (Trock pers comm. 2005). Based on these factors, all yarrow found in the park with the typical white to pale pink flowers will be treated as native unless additional information suggests otherwise.

Allium schoenoprasum

An *Allium* species that keys out to be wild chives (*A. schoenoprasum*) was found growing in several places in Dry Bay; however, the plants were beyond flowering so positive identification is uncertain. This species is listed as non-native by some sources (ITIS.usda.gov, Plants.usda.gov) and native by other sources (Klinkenberg 2004, Hultén 1968). Further work is needed to verify the taxonomy and nativity of this species to determine whether it should be a species of management concern.

Alopecurus pratensis

Meadow foxtail was collected from Bartlett Cove in 1961 and archived in the GLBA herbarium. Subsequent identification has not occurred, but this may be a result of insufficient grass identification skills. Future work should seek to relocate this species to determine if it is still present.

Bromus inermis

Smooth brome is growing along roadsides in Gustavus, as well as on the GLBA park property in Gustavus near the school. This species has not yet been located within Bartlett Cove or elsewhere in the park. This species should be searched for in future inventories since suitable habitat is available in Bartlett Cove and elsewhere, and it is known as an invader of wetland habitats in the lower 48 states.

Capsella bursa-pastoris

Common in disturbed areas of Gustavus including near the airport, shepherd's purse has been found growing only in the depot area of Bartlett Cove. The largest plants were found growing on a pile of soil near the shooting range, which may indicate the source of the introduction. Smaller plants were found growing near an excavated hole and near the chain link fence that secures the depot. All plants were removed in September; however, some plants had already dropped seeds.

Figure 3 – *Cerastium fontanum* growing thickly near the Visitor Information Station (VIS) in Bartlett Cove.

Cerastium fontanum

Mouse-ear chickweed is common in Bartlett Cove and Gustavus growing along roadsides and in disturbed areas. The species is present in scattered locations in Dry Bay. A population of *C. fontanum* was also found on Young Island in the Beardslee Islands. The population in the Beardslees should be controlled since this is the only

known location in the backcountry. Other populations of the species should be controlled as time permits.

Dactylis glomerata

Orchardgrass has been found growing scattered along the roads in Bartlett Cove and in Gustavus. At this point, it is growing in a low enough density that it could be targeted for complete removal in 2006.

Hieracium aurantiacum

Orange hawkweed has not yet been located within GLBA; however, it was included in multiple arrangements by Gustavus residents at the 4th of July contest, which suggests it is growing several places within Gustavus. Effort in 2006 should be made to locate and eliminate this species since it can become very aggressive.

Figure 4 – Jenni Burr and Erica Madison volunteered to help remove *Cerastium fontanum* from near the VIS.

Hordeum jubatum

Although considered native by most (Pojar and MacKinnon 1994, ITIS.usda.gov), foxtail barley can become very weedy in some areas. Although it has been detected in several areas within the park, including Dry Bay, Strawberry Island, and South Sandy Cove, it does not appear to be an invasive threat. Continued monitoring of the species is warranted.

Hypochaeris radicata

A single specimen of hairy cat's ear was removed from the Bartlett River trailhead. No other individuals of this species have been observed in the park or in Gustavus.

Figure 5 – *Leucanthemum vulgare* growing in a field in Dry Bay.

Leucanthemum vulgare

Ox-eye daisies have proven very successful at growing in the vicinity of GLBA. As a result, this species was targeted for removal in 2005. All known populations of *L. vulgare* were removed in Bartlett Cove. A single population of daisies growing in a Dryas (*Dryas drummondii*) mat at a popular camping area in Reid Inlet was controlled. Some of the populations of daisies in Dry Bay were controlled; however, additional effort before mid-July is needed in subsequent years, particularly around the Hazen's house. In general, areas surrounding flowering daisy populations have abundant seedlings, which are often cryptic due to their low-growing rosette of leaves. Due to these seedlings, all areas where daisies were controlled in 2005 will need to be revisited in 2006 and subsequent years to remove any persistent plants. Ox-eye daisies are very prevalent in Gustavus, and landowners are very fond of the flowers. Outreach efforts will need to continue to educate Gustavus residents that the species poses a risk to the native flora. Shasta daisies, which are also non-native but less invasive, may provide a suitable alternative. Additionally, the native arctic daisy (*Dendranthema arcticum*) was transplanted to two gardens in Gustavus in 2005 to see how it performs in cultivation.

Figure 6 – Monica Rectenwald triumphant that a population of daisies in Dry Bay have been removed.

Linaria vulgaris

Butter and eggs is common in some areas of Gustavus; however, it has not yet been detected in GLBA. Annual monitoring for this species should continue and outreach efforts should emphasize that this plant is very difficult to eradicate once established.

Lolium perenne ssp. *perenne/multiflorum*

Both *Lolium perenne* ssp. *perenne* and *L perenne* ssp..*multiflorum* (perennial ryegrass) have been identified growing along the recently paved roadsides in Bartlett Cove. Both subspecies were seeded as part of the revegetation process after the road construction. Although these plants were intended to be short-lived, there recurrence after more than three years suggests that they may be reseeding. Continued monitoring of these species is necessary.

Lupinus polyphyllus

Figure 7 – In addition to invading open meadows, *Lupinus polyphyllus* appears to spread vegetatively in the shaded understory of Dry Bay's forests.

Large-leaved lupine is native to the Pacific Northwest; however, most sources consider the species introduced to Alaska (Hultén 1968). In Gustavus, a pink-flowered cultivar is commonly planted; however, it has not yet been observed in Bartlett Cove. In Dry Bay, the more common purple-flowered form is very widespread, particularly near the Alsek River. The species is occupying both open meadow and shaded understory habitats in very dense colonies that are excluding native species. It appears that most of the plants are spreading vegetatively by rhizomes since only a fraction of the population was flowering. Most of the areas already occupied by *L. polyphyllus* are relatively free from human disturbance and are responding to natural disturbance resulting from successional processes, which further makes this species a threat to the native ecosystem. It is difficult to know when the species was introduced to Dry Bay. It is absent from the GLBA herbarium; however, Greg Dudgeon, a former ranger in Dry Bay, can remember the species as being prevalent as early as 1990. Since *L. polyphyllus* is growing in the same habitats with the native *L. nootkatensis*, it is possible that the two are hybridizing. Plants with intermediate morphological characteristics were observed in 2005.

Lychnis chalcedonica

Maltesecross is an escaped ornamental species that was observed in Gustavus during the 2004 inventory. It was not relocated in 2005 during surveys; however, it was included in several of the 4th of July flower arrangements from Gustavus residents. Future inventories should continue to look for this species.

Matricaria discoidea

Pineappleweed is found in continuously disturbed areas, including near the depot and in parking areas in Bartlett Cove, on ORV trails in Dry Bay, and in Gustavus. The species has not been observed spreading into nearby less disturbed habitats or displacing native species. Therefore, although it is non-native, it is not of high management concern.

Myosotis palustris

No species of forget-me-nots are native to Southeast Alaska; however, since they are the state flower, they have been planted widely, including this year in planter boxes at the Glacier Bay Lodge. They have escaped cultivation around the Glacier Bay Lodge and in Gustavus and are thriving in moist areas, including drainage ditches. It is possible that multiple *Myosotis* species are present. Efforts should be made to remove the plants in June of 2006 before seed is set. In addition, Glacier Bay Lodge should be encouraged to plant native species or annual species with minimal threat of reseeding and not to sell Alaska wildflower mixes, which often include invasive species.

Figure 8 – A variegated cultivar of *Phalaris arundinacea* grows along the foundation of Andy Varni's home in Dry Bay, which also has a high concentration of other exotic species.

Phalaris arundinacea

Reed canarygrass is definitely native to Europe, although some people believe the species may have a circumboreal distribution. The species has a long agricultural record, including cultivation for forage as early as 1749 in Sweden. In the US, the first agronomic trials probably began in the 1830s when New England farmers began experimenting with crosses to increase palatability to livestock. With subsequent

breeding for vigorous growth and drought tolerance, super-strains of canarygrass were developed that have become problematic as they have escaped. In addition to agricultural uses, reed canarygrass has often been used for erosion control due to its tolerance of wet areas and its ability to spread rapidly. With the potential of the grass being native, removal does become questionable. Populations growing south of the Alaska Range are generally associated with anthropogenic disturbance and are most likely introduced or introgressed genotypes (Lapina and Carlson). Since reed canarygrass has never been seen in GLBA outside of Gustavus/Bartlett Cove, it is most likely a result of human introduction.

The Alaska Natural Heritage Program has ranked many non-native species (scale of 1-100 with a higher number indicating a greater threat) based on the species' observed ability to invade native communities and their subsequent difficulty in removal. Reed canarygrass is the highest ranked species (83, Appendix A) according to its threat to the native ecosystem currently present in GLBA. This grass forms dense monospecific stands that displace all other species, provides poor habitat for wildlife, and affects soil hydrology. All known stands of this grass within Bartlett Cove were dug out with the aid of the SAGA crew, yielding approximately 725 kg (1600 lbs). Regrowth is likely over subsequent years, so these areas need to be retreated annually. A stand of a variegated cultivar is growing beside Andy Varni's home in Dry Bay (Fig. 8). This stand is bounded by the home and a walkway and does not appear to be spreading as vigorously as the non-variegated forms.

Phleum pratense

Common timothy is abundant throughout Gustavus and common in Bartlett Cove. It was likely brought in as hay or grown for grazing animals. In Bartlett Cove, it is prevalent along the recently disturbed roadsides. During the late summer, all the located plants on the south side of the main road and some of the plants on the north side of the road were removed. Time did not permit the removal of additional plants. In the backcountry, there are reports of the species being seen; however, all specimens observed in 2005 appeared to be the native *Phleum alpinium*. Plants with intermediate morphological characteristics were observed in both Bartlett Cove and the backcountry. Although no information on hybridization was found, it may be possible for these species to hybridize.

Plantago major

Common plantain is growing in recently disturbed locations in Bartlett Cove and Dry Bay, such as along roads, in parking areas, and along trails. Although prevalent, it does not appear to be spreading outward into less disturbed areas or displacing native species. As a result, this species' presence should continue to be inventoried and plants should be controlled as time permits; however, it should not be made a top management priority.

Poa palustris

A single herbarium specimen of fowl bluegrass was collected from Drake Island; however, the herbarium sheet was lost at some point in time. Additional training in grass identification and

more survey effort are needed to relocate this species. It is likely that other non-native *Poa* species are also present within the park.

Ranunculus acris

Tall buttercup was found growing in a dense stand between the Bartlett Cove fuel and pulic use docks near the former location of the kayak racks. The plants were dug out; however, they were already dropping seed. In addition, it is difficult to distinguish the seedlings of *R. acris* from the native *R. uncinatus*. For these reasons, this site will need to be resurveyed and treated before early July 2006.

Ranunculus repens

Cooper (1939) collected creeping buttercup in a beach meadow near Bartlett Cove in 1935. Today, this species is abundant in a few locations within Bartlett Cove, including the Bauer/Young (GBQ 03) and Seraphin (GBQ 09A) residences and near the depot. Like *R. acris*, it is difficult to distinguish seedlings of *R. repens* from the native buttercup. Control of this species is challenging due to the rooting at each node and its ability to integrate into mowed lawns. The species is most easily identified in mid-summer when the flowers are blooming. Since this species has proven very invasive in other areas of Southeast Alaska, such as Sitka National Historical Park, investing the resources in trying to control the relatively small populations of this species early is warranted.

Rubus idaeus

Although red raspberries are native to Alaska, the range map in Hultén (1968) does not show the species to be present in the coastal areas of Southeast Alaska. In addition, there are no collected specimens from this area in either the GLBA or the University of Alaska herbaria. All of the *R. ideaus* populations found to date within GLBA can be associated with current or historic human use, so it is probable that the plants were introduced for cultivation. Due to the uncertainty of nativity, this species will be treated as native until management decides otherwise.

Rumex acetosella

Sheep sorrel is known to be growing in three locations in GLBA: behind the depot building, near the Seraphin residence (GBQ 03), and between the fuel and public use docks. Due to the limited size of these populations, efforts should be made to control these populations in 2006.

Rumex crispus

Curly dock, not to be confused with the native western dock (*R. occidentalis*), has not yet been observed in GLBA; however, it is present in Gustavus, such as in the Sharman's vegetable garden. Monitoring for this species in the future is needed.

Sonchus arvensis

Perennial sowthistle is well established near the former fox farm on Strawberry Island. It is likely that the species was introduced while the fox farm was in operation, which was before the late 1930s. Two populations separated by a wet meadow were found in the herbaceous areas between the forest and the shoreline. The larger population appears bound by physical conditions of hydric soils, the intertidal, and the shaded forest margin that prevent continued vegetative expansion. The smaller, more eastern population appears to have room for continued expansion. In addition, this species could spread by seed to start new populations elsewhere. In 2005, all the flower heads were removed from the plants; however, time and personnel were not available to fully control the plants. A population of *S. arvensis* has also established along the roadside across from the Gustavus Inn in Gustavus. All the flowering plants and about half of the non-flowering plants were removed in September 2005. Due to the restricted extent of this species and its ability to form dense colonies, it is recommended that this species be targeted for removal in 2006.

Sorbus aucuparia

European mountain ash trees have been planted by landowners around Gustavus. The proliferous production of red berries, which are consumed by birds and then redistributed, have resulted in mountain ash trees germinating in new locations within Gustavus. Although it is possible that *S. aucuparia* may hybridize with the native *S. sitchensis*, the mountain ashes observed in Gustavus display the characteristics of the non-native species (Table 2).

Table 2 – Comparison of traits of native and non-native mountain ash species (Klinkenberg 2004, Hultén 1968).

	Sorbus aucuparia **(non-native)**	***Sorbus sitchensis*** **(native)**
Height	Small tree, 5-15 m	Medium to tall shrub, 1-4 m
Trunk/Stem	Primarily single stem, grayish, branched	Multi-stem, grayish-red, sparingly branched
Winter buds/ young growth	Grayish soft-hairy	Somewhat rusty-hairy
Leaves	11 to 15 (17) leaflets, sharp pointed at the tip, mostly smooth, saw-toothed almost to the base	7 to 11 leaflets, rounded to blunt at the tip, sometimes rusty-hairy below, coarsely saw-toothed for not more than ¾ their length
Flowers	Flat-topped; branches white-hairy; calyces hairy	Half-rounded; branches rusty-hairy; calyces mostly smooth
Fruits	Globe-shaped; not glaucous	Globe-shaped to ellipsoid; glaucous
Habitat	Cultivated, and escaped	Woods, up into subalpine region

To date, the non-native mountain ash has been observed only in Gustavus, including on the GLBA property near the school. Since this species has become problematic in other Southeast Alaskan communities, such as Sitka, continued monitoring is recommended.

Symphytum officinale

Common comfrey has been planted for its ornamental and herbal properties in Dry Bay, at the Bartlett Cove depot, and on the GLBA property in Gustavus. The Dry Bay population is still within the bounds where it was planted; however, both of the other populations have spread by seed to form new populations. Since this species is successfully reproducing and spreading, it should be removed at least in Bartlett Cove and Gustavus where the original plantings have been abandoned.

Figure 9 – Due to glacial rebound, Glacier Bay has extensive coastal meadows that are being created as the land rises from the bay. These meadows are widely invaded by *Taraxacum officinale* ssp. *officinale*.

Tanacetum vulgare

Tansy is another species often planted for its easy-care, ornamental nature; however, it has the ability to reproduce and invade natural areas. To date, it has only been observed in Gustavus, including along Mountain View Highway this summer. Future inventory work should determine whether the species is spreading into the park.

Taraxacum officinale ssp. *officinale*

In 1935, William S. Cooper collected *Taraxacum officinale* from the Bartlett Cove area (Cooper 1939). Today, it is common to see dandelions in open, non-wetland areas in the herbaceous area above the intertidal within most parts of Glacier Bay proper. Their distribution is still patchy near the glaciers; however, they have the ability to succeed in very young soils previously colonized only by native, early successional species. In Dry Bay, dandelions are present, but their densities are much lower than in Glacier Bay proper. Survey work in Dundas Bay resulted in finding no invasive species, including dandelions. Observations made by Sean and Janet Neilson in Lituya Bay in May 2005

indicate that dandelions are scattered throughout the bay. In areas of lower dandelion densities, it would be most valuable to survey during May and early June when the plants are in full bloom and more easily observed. Arresting the spread of this species will be extremely labor and time intensive based on the widespread distribution of the species and its ability to disperse seeds long distances by wind and animals. For example, South Marble Island in the middle of Glacier Bay proper was glowing yellow from dandelion flowers in early spring, and this island is not visited by humans and is 2.6 km (1.6 miles) from the next closest island.

Figures 10 & 11 – Before and after images of the flagpole area near the VIS showing how the removal of dandelions affects the view.

Native *Taraxacum* species have been identified within the park, so future monitoring should be careful to distinguish the variations. The native species are smaller, often grow in undisturbed areas and alpine meadows, and have differences in the involucral bracts. The invasive species has long, smooth, bright green involucral bracts that curl downward away from the flower. In contrast, the native species will have involucral bracts that may be dark colored, widely triangular, clasping the flower, or have bumps on them. The native and exotic species have hybridized in other areas. Influences of *T. officinale* ssp. *officinale* on postglacial plant successional processes in Glacier Bay could be substantial and may warrant establishing long term monitoring plots to assist in understading the effects.

Trifolium hybridum and *T. pratense*

Both alsike and red clover have patchy distributions throughout Bartlett Cove and Gustavus. The plants are easily removed, so all known plants in Bartlett Cove in 2005 were controlled. In Dry Bay, a single red clover specimen was found in the garden of Brad Swanson. Due to sentimental reasons, Brad wanted to keep his plant, which he has had for multiple years. He promises to remove any new plants if they appear and is aware that he will receive all the blame for the invasion of this species in Dry Bay if his plant spreads. In 2006, all plants in Bartlett Cove should be removed, and Brad Swanson should be contacted again.

Figure 12 – The only known clover in Dry Bay is growing in Brad Swanson's garden.

Trifolium repens

Since the recent paving (2001-2002), revegetation (through 2004), and erosion control (through 2005) work on the road to Bartlett Cove, white clover has become well established along the length of the disturbed area. White clover is particularly difficult to remove since it roots at each node. As a result, the entire mat needs to be pulled up with a hoe or cultivator, creating significant soil disturbance and disruption of all neighboring plants. Although it is difficult to remove, its distribution is still at a point that control efforts are warranted, so this should be a priority species in 2006.

Triticum aestivum

Figure 13 – White clover with interspersed dandelions forms a dense mat that becomes very difficult to remove since it forms roots at the branch nodes.

Wheat hybrids are growing along most of the roadways in Bartlett Cove from seed used during the revegetation process after the road was paved. Both Regreen (a sterile wheat x wheatgrass hybrid) and Pioneer/Quickguard Sterile Triticale (a sterile wheat x rye hybrid) were hydroseeded multiple times over several years. At least some of the seeds have proven fertile since viable seed has been produced in 2004 and 2005. Many of these seeds have germinated while still in the seed head in September to October in both years and may be

perpetuating the species. A control area (~ 50 m long) along the north side of the road between two large boulders near the permanent housing driveway was cleared of all flower heads to determine whether this would affect the density of the wheat in 2006. Both wheat hybrids are supposed to be annuals to short-lived perennials and should be dying naturally since at least two seasons have passed. Depending on the density of the wheat in 2006, the plants should be cut low to the ground before early July 2006. A second cutting may be needed in late August since the plants have shown that they can send up a second group of flower heads.

Unidentified Lamiaceae

An unidentified species in the mint family was removed from near the Glacier Bay Lodge. A specimen will be identified by the Alaska Natural Heritage Program. Based on the plant's variegated foliage and its close proximity to the lodge, it is likely that this was an escaped ornamental species. The species should be surveyed for again in 2006 since the plant was in seed when removed. The Glacier Bay Lodge should be encouraged to plant native species and annual species with minimal risk of reproducing in Alaska.

Outreach/Education

In 2005, several outreach/education programs were conducted in the park and the community. In May, the Resource Management division presented programs to the kayak guide companies and other interested residents. At this program, I introduced the park's new Invasive Plants Program and the list of non-native species, provided handouts, and informed the guides how they could help inventory and prevent the spread of species by keeping their gear and boots clean. Before the school year ended, program volunteer Susan Tran led a program with the elementary school about the threat of non-native plants. On July 4th, an invasive, exotic flower arranging contest was sponsored at Gustavus' celebration that brought in over 25 entries. In addition to the arrangements, people could pick up invasive species literature or talk to me about the issues Gustavus and

Figure 14 – Whitney Rapp showing a few of the arrangements brought for judging at the Gustavus 4th of July Invasive, Exotic Flower Arranging Contest.

GLBA face. On July 13, Susan Tran led a native species celebration potluck with Gustavus children following Story Hour at the Gustavus Library, which included crafts, face painting, and conversations – all centered on the theme of native plant values and threats by invasive exotics. A community weed pulling event was sponsored on July 16 near the VIS. I led plant walks and discussions with the SAGA crew in July and Hoonah City Schools in August. All GLBA employees received informative emails periodically throughout the summer updating them on the program's progress and species of concern.

In 2006, a priority should be to provide training for the interpretive rangers who interact with the visitors and for maintenance employees that will be working in the field. A follow-up contest at the 4th of July will be an excellent opportunity to reach many Gustavus residents. Work with Gustavus school children, including control events, should be prioritized when school is in session. Finding ways to attract more volunteers to help control species, collect native plant seeds, or otherwise assist the program is also important.

Other Thoughts

Although GLBA and Gustavus are geographically isolated, they are not immune to invasion by non-native species. To date, 37 non-native species have been identified within GLBA and Gustavus; however, many more species in nearby communities have not yet been observed. Resources, both time and people, to continue to inventory and control invasive species must be made available consistently for the long term to maintain the unique assemblage of native species and preserve the vast wilderness that we are entrusted to preserve in its natural condition.

GLBA needs to ensure that all future anthropogenic disturbances be mitigated in the most ecological manner, including pre-construction removal and storage of native vegetation for replanting, collection of local native seeds, and follow through with subsequent control of non-native species. A nursery area and seed bank should be created to facilitate revegetating areas.

In addition to the species documented in this report, there are several additional cultivated vegetable and flower species, including rhubarb, chives, asparagus, irises, shasta daisies, and lettuce, growing near the homes in Dry Bay and on the Gustavus property owned by GLBA. None of these species currently display invasive tendencies; however, a long term plan should be in place to remove these plants if the residencies become abandoned.

Recommended Plans for 2006 Field Season

Prevention and proactive removal will save time and money in the future with regards to invasive plant management. Maintaining trained personnel to lead the program is essential. For control events, recruiting volunteers will ensure rapid removal.

Priority Species for Treatment in 2006:

Capsella bursa-pastoris
Cerastium fontanum on Young Island
Dactylis glomerata
Hypochaeris radicata
Leucanthemum vulgaris
Myosotis spp.
Phalaris arundinacea
Phleum pratense
Ranunculus acris
Ranunculus repens
Rumex acetosella
Sonchus arvensis
Symphytum officinale
Trifolium hybridum
Trifolium pratense
Trifolium repens

April

- Provide educational program to interpretive rangers during their training.
- Plan for the 2006 field season, including ensuring adequate field assistants will be available.

May

- Provide educational program to maintenance employees working outside and interested community members.
- Survey for *Taraxacum officinale* ssp. *officinale* when they are in peak bloom. Recruit volunteer crews to remove plants from most frequented areas near Lodge and Visitor Information Station.
- Encourage Glacier Bay Lodge to plant native species or minimal threat annual species around lodge.
- Plan and deliver a program for the Gustavus School before the school year ends.
- Ongoing data processing.

June

- Continue inventorying and controlling all non-native species.
- Continue inventorying park to determine distribution of non-native species.
- Remove *Myosotis* plants near lodge.
- Ongoing data processing.

July

- Continue inventorying and controlling all non-native species.
- Sponsor 4th of July contest at Gustavus celebration.

- Retreat *Ranunculus acris* near outer dock before middle of the month.
- Retreat *Phalaris arundinacea* throughout Bartlett Cove.
- Control *Ranunculus repens* throughout Bartlett Cove.
- Retreat and locate new populations of *Leucanthemum vulgare.*
- Go to Dry Bay before the middle of the month for inventory and control work.
- Ongoing data processing.

August

- Control *Phleum pratense* and *Dactylis glomerata*, particularly along the road.
- Continue inventorying and controlling all non-native species.
- Ongoing data processing.

September

- Continue inventorying and controlling all species.
- Ongoing data processing.

October - November

- Complete data processing and write reports.
- Plan for 2007.

Acknowledgements

Susan Boudreau and Lewis Sharman are always available to assist and guide me. At the regional level, Jeff Heys and Penny Bauder have answered questions, processed data, and assisted in multiple other ways. For funding my position, I would like to thank the Alaska Region Exotic Plant Management Team, the Southeast Alaskan Coastal Cluster, and Glacier Bay National Park and Preserve. The GLBA maintenance division has lent me tools, allowed the SAGA crew to work with me, and in particular, Dean Waguespack has incinerated over 1.5 tons of invasive plants, which are not particularly combustible. My deepest appreciation goes to all the volunteers who assisted inventorying, controlling plants, driving a vessel, pointing me to plants I need to check out, and otherwise, including the entire SAGA crew, Susan Boudreau, Wendy Bredow, Jenni Burr, Miriam Fisher, Chris Gabriele, Bonnie Harris, Sarah Keefer, Lynda Lancaster, Linda Lieberman, Bob and Ellie McCreery, Erica Madison, Monica Rectenwald, Rose Salazar, Lewis Sharman, Justin Smith, Susan Tran, and Kaina Young. Without these volunteers, I would have accomplished very little this summer.

Literature Cited

Carlson, Matt, Irina Lapina, Helen Cortes-Burns, and Michael Shephard. *Non-Native Plants of Alaska: Taxonomy and Monitoring Protocols*. Presentation from the Invasive Plant Identification Training June 14, 2005. Anchorage, Alaska. http://akweeds.uaa.alaska.edu/pdfs/workshops/Non-native_plant_wrkshp_Introduction.pdf

Cooper, William S. 1939. *Additions to the flora of the Glacier Bay National Monument, Alaska, 1935-1936*. Bulletin of the Torrey Botanical Club. 66: 453-456.

D'Antonio, C., L.A. Meyerson, and J. Denslow. 2001. *Exotic species and conservation: research needs*. Pages 59-80 in M.E. Soule and G.H. Orians editors. Conservation Biology: Research priorities for the next decade. Island Press, London.

Densmore, R.V., P.C. McKee and C. Roland. 2001. *Exotic plants in Alaskan National Park Units*. Final Report for IA 14431A991000027. USGS, BRD. Digital report and Database.

Drees, L. 2004. *A retrospective on NPS invasive species policy and management*. Park Science. 22(2): 21-26.

Gordon, D.R. 1998. *Effects of invasive, non-indigenous plant species on ecosystem processes: Lessons from Florida*. Ecological Applications 8(4): 975-989.

Hultén, Eric. 1968. *Flora of Alaska and neighboring territories: a manual of the vascular plants.* Stanford University Press, Stanford, California, 1008 pp.

Klinkenberg, Brian. 2004. *E-Flora BC: Atlas of the Plants of British Columbia* [www.eflora.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver.

Lapina, Irina and Matthew Carlson. *Weed risk assessment form for Phalaris arundinacea*. http://akweeds.uaa.alaska.edu/pdfs/weed_risk_assess_pdfs/Weed_Risk_asses_PHAR.pdf

Pimental, D., L. Lach, R. Zuniga, and D. Morrison. 2000. *Environmental and economic costs of nonindigenous species in the United States*. BioScience. 50(1): 53-65.

Ruesnik, J.L., I.M. Parker, M.J. Groom, and P.M. Kareiva. 1995. *Reducing the risk of nonindigenous species introductions*. Bioscience 45(7): 465-477.

Spencer, P. 2001. *Exotic plants in Alaska NPS Units, Implementation Plan*, FY02.

Westbrooks, R.G. 1998. *Invasive plants: changing the landscape of America: fact book.* Federal Interagency Committee for the Management of Noxious Weeds, Washington D.C. 109pp.

Appendices

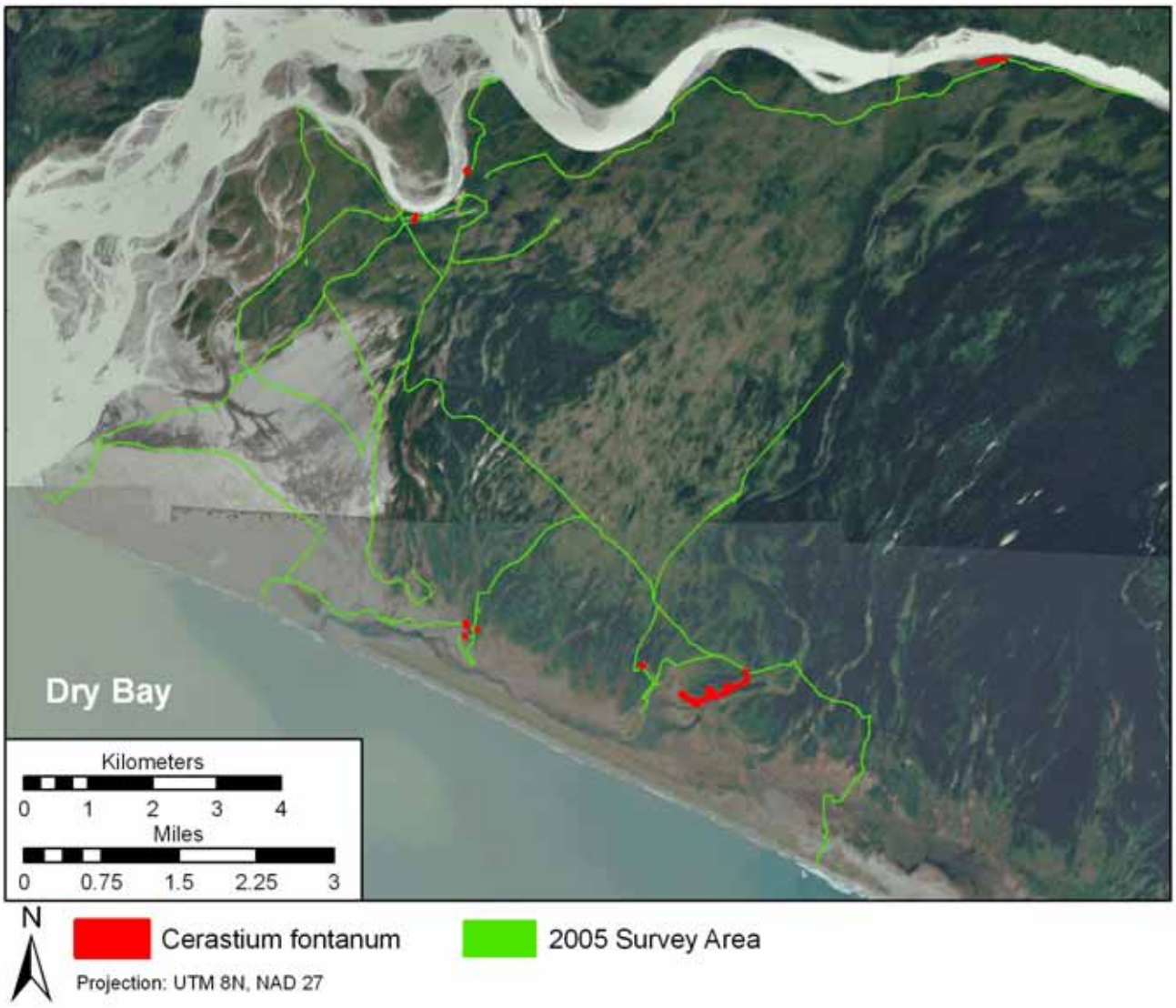
Appendix A – List of known invasive plants within or near GLBA

Common Name	Scientific Name	When Observed[a]	AK Weeds Ranking[b]
yarrow	*Achillea millefolium* **	1	48
wild chives	*Allium schoenoprasum* *, **	3	not ranked
meadow foxtail	*Alopecurus pratensis*	1	not ranked
smooth brome	*Bromus inermis*	1, 2, 3	62
shepherd's purse	*Capsella bursa-pastoris*	1, 3	not ranked
mouse-ear chickweed	*Cerastium fontanum*	1, 2, 3	not ranked
orchardgrass	*Dactylis glomerata*	3	not ranked
orange hawkweed	*Hieracium aurantiacum*	3	71
foxtail barley	*Hordeum jubatum* **	1, 3	63
hairy cat's ear	*Hypochaeris radicata*	3	not ranked
oxeye daisy	*Leucanthemum vulgare*	2, 3	61
butter and eggs	*Linaria vulgaris*	1	63
perennial ryegrass	*Lolium perenne* ssp. *perenne/multiflorum*	1, 2, 3	41
bigleaf lupine	*Lupinus polyphyllus* **	2, 3	53
maltesecross	*Lychnis chalcedonica*	2	not ranked
pineappleweed	*Matricaria discoidea*	1, 3	34
marsh forget-me-not	*Myosotis palustris*	1, 3	not ranked
reed canarygrass	*Phalaris arundinacea*	1, 2, 3	83
common timothy	*Phleum pratense*	1, 2, 3	56
common plantain	*Plantago major*	2, 3	44
fowl bluegrass	*Poa palustris*	1	not ranked
tall buttercup	*Ranunculus acris*	3	54
creeping buttercup	*Ranunculus repens*	3	54
American red raspberry	*Rubus idaeus* **	1, 3	not ranked
sheep sorrel	*Rumex acetosella*	1, 3	not ranked
curly dock	*Rumex crispus*	3	not ranked
perennial sowthistle	*Sonchus arvensis*	3	59
European mountain ash	*Sorbus aucuparia*	3	53
chickweed	*Stellaria media*	1, 3	not ranked
common comfrey	*Symphytum officinale*	3	not ranked
common tansy	*Tanacetum vulgare*	2, 3	57
common dandelion	*Taraxacum officinale* ssp. *officinale*	1, 2, 3	62
alsike clover	*Trifolium hybridum*	3	57
red clover	*Trifolium pratense*	1, 2, 3	not ranked
white clover	*Trifolium repens*	1, 2, 3	59
common wheat	*Triticum aestivum*	2, 3	not ranked
	Unidentified Lamiaceae *	3	not ranked

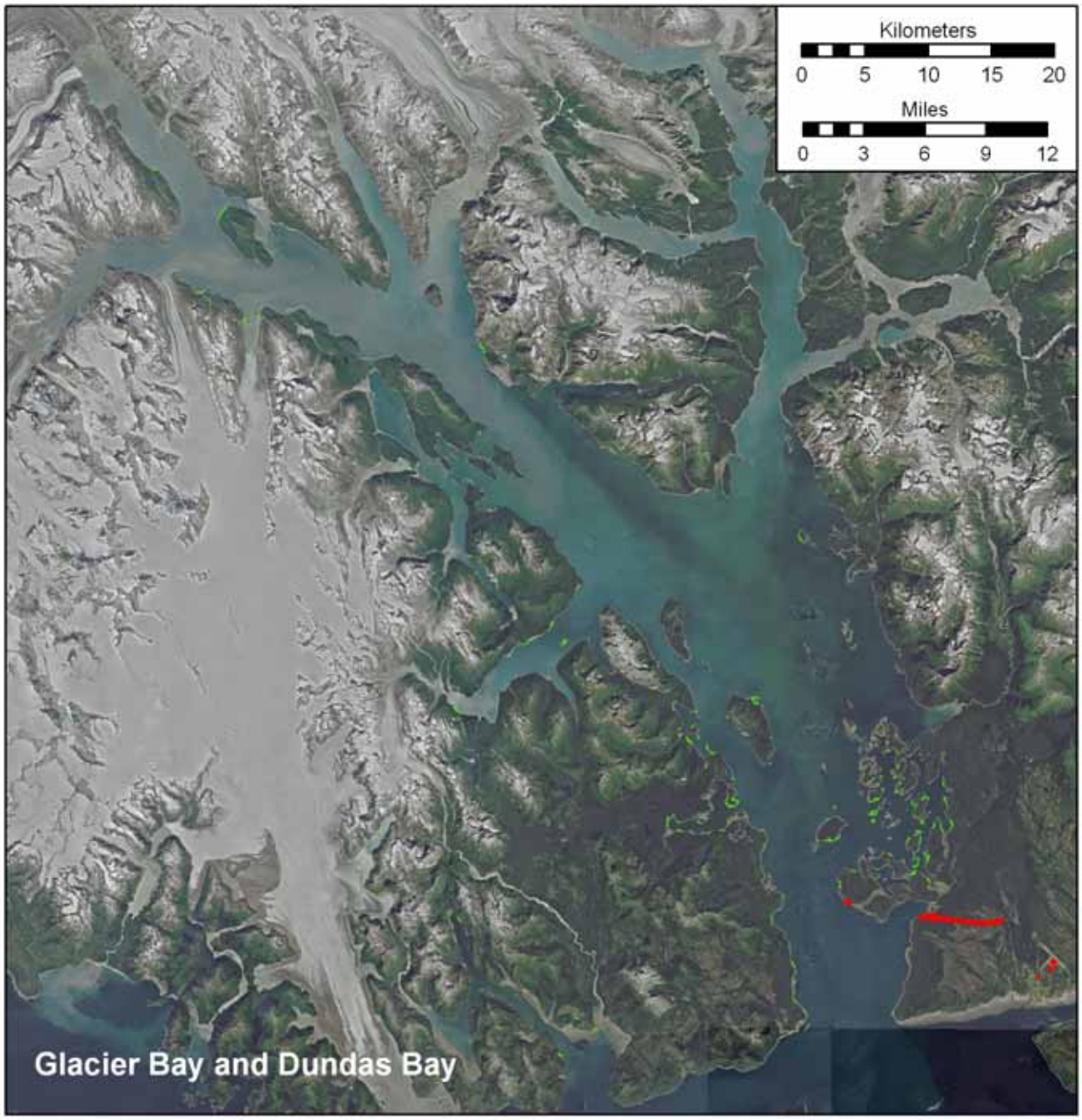
[a] - 1 = Herbarium specimen; 2 = 2004 Exotic Plant Inventory; 3 = 2005 Exotic Plant Inventory
[b] - Ranking according to threat to native ecosystems in Alaska from low (0) to high (100) (http://akweeds.uaa.alaska.edu/akweeds_ranking_geo.htm).
* Species identification requires verification
** Species nativity in question for this location

Appendix B – 2005 location maps of selected invasive plants in GLBA 2005

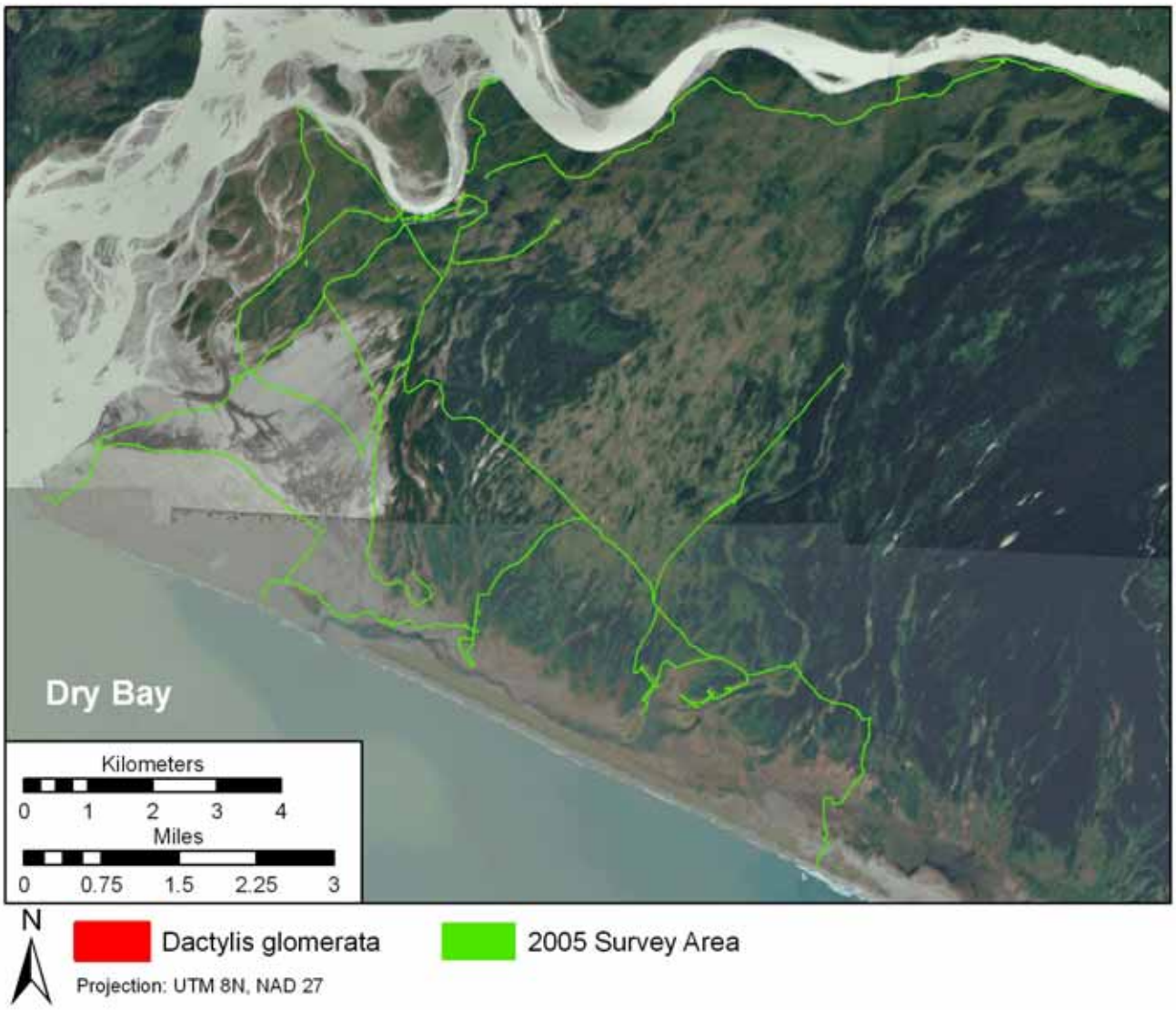
Cerastium fontanum distribution in Dry Bay in 2005



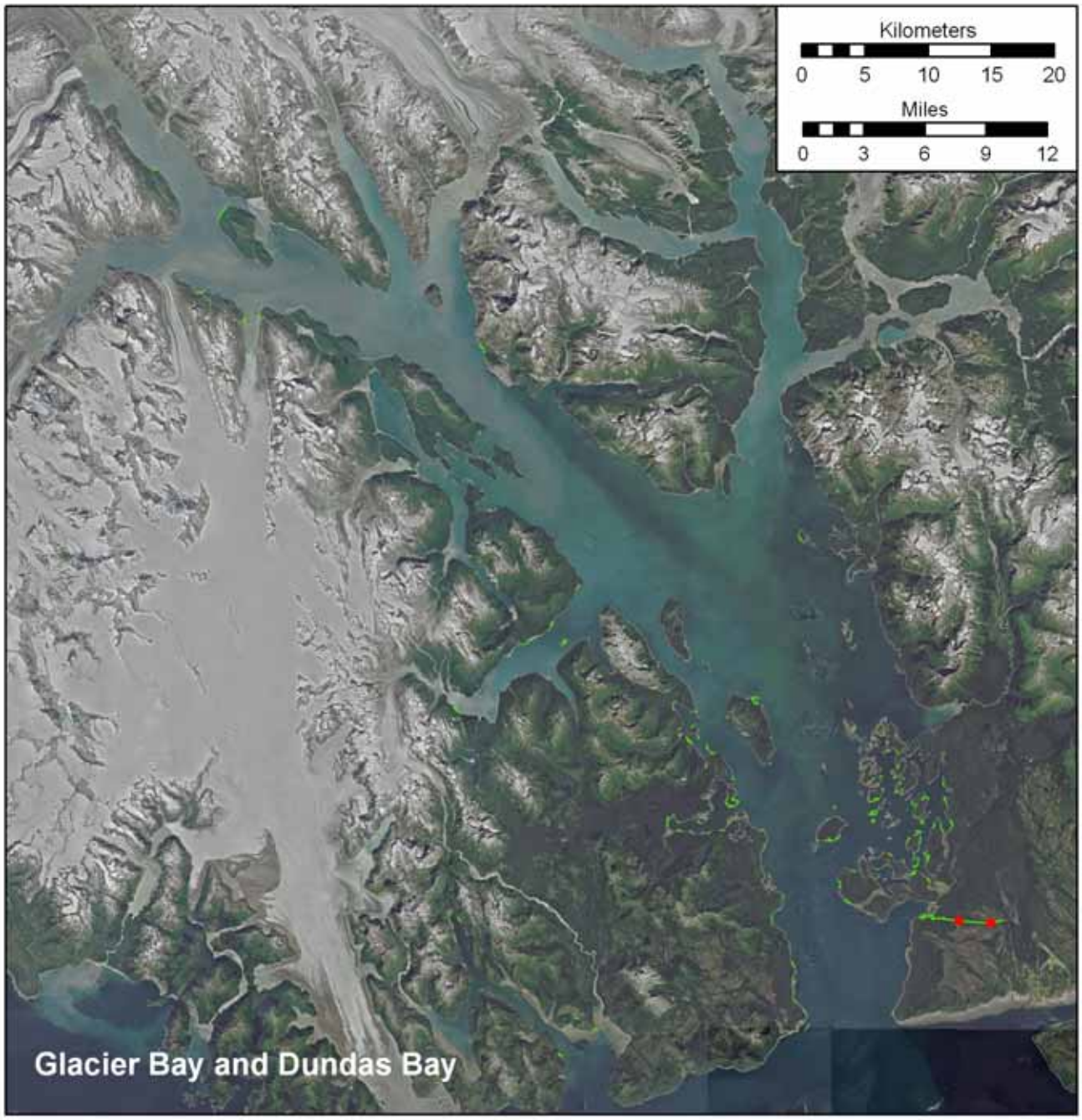
Cerastium fontanum distribution in Glacier Bay in 2005



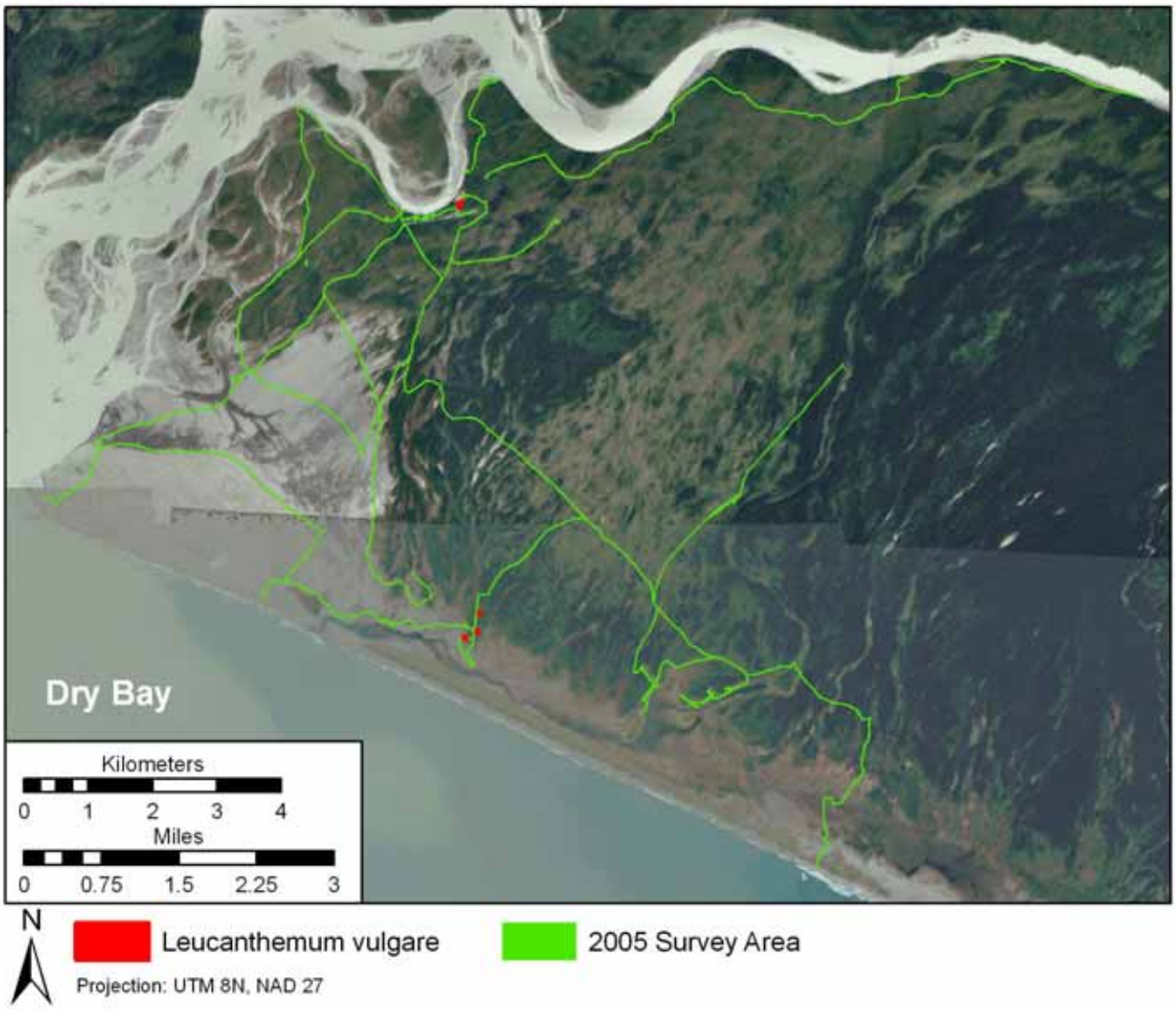
Dactylis glomerata distribution in Dry Bay in 2005



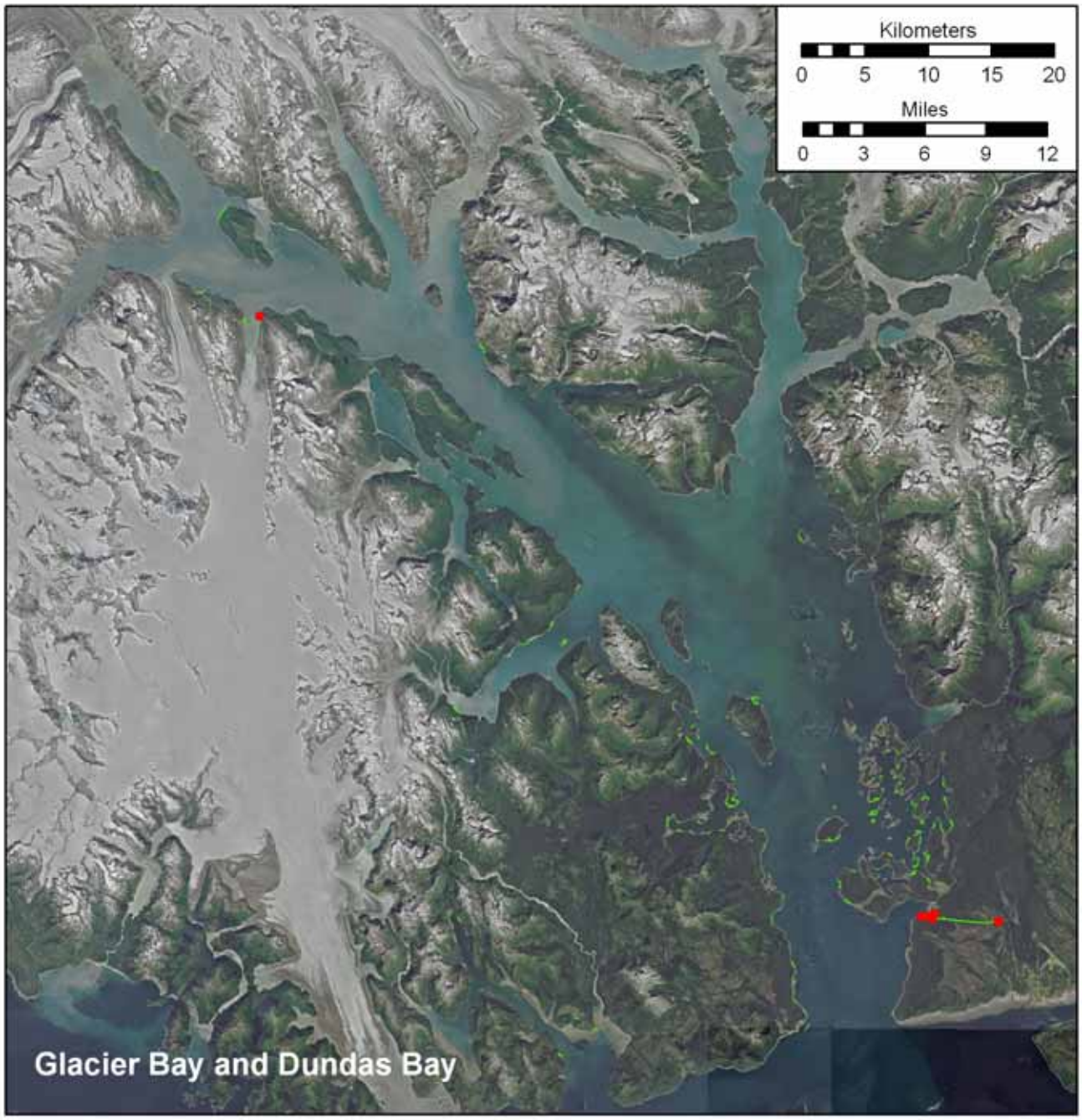
Dactylis glomerata distribution in Glacier Bay in 2005



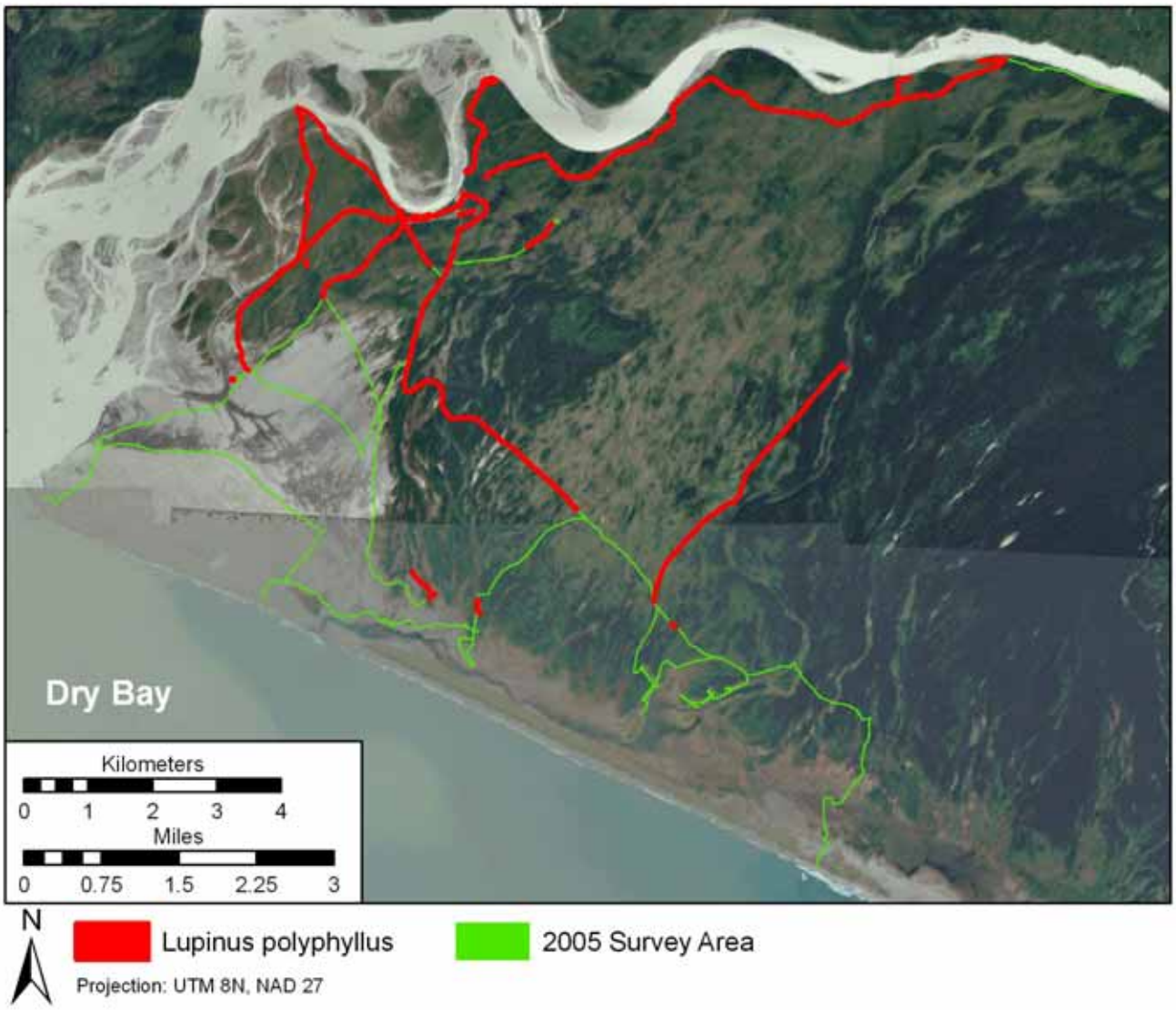
Leucanthemum vulgare distribution in Dry Bay in 2005



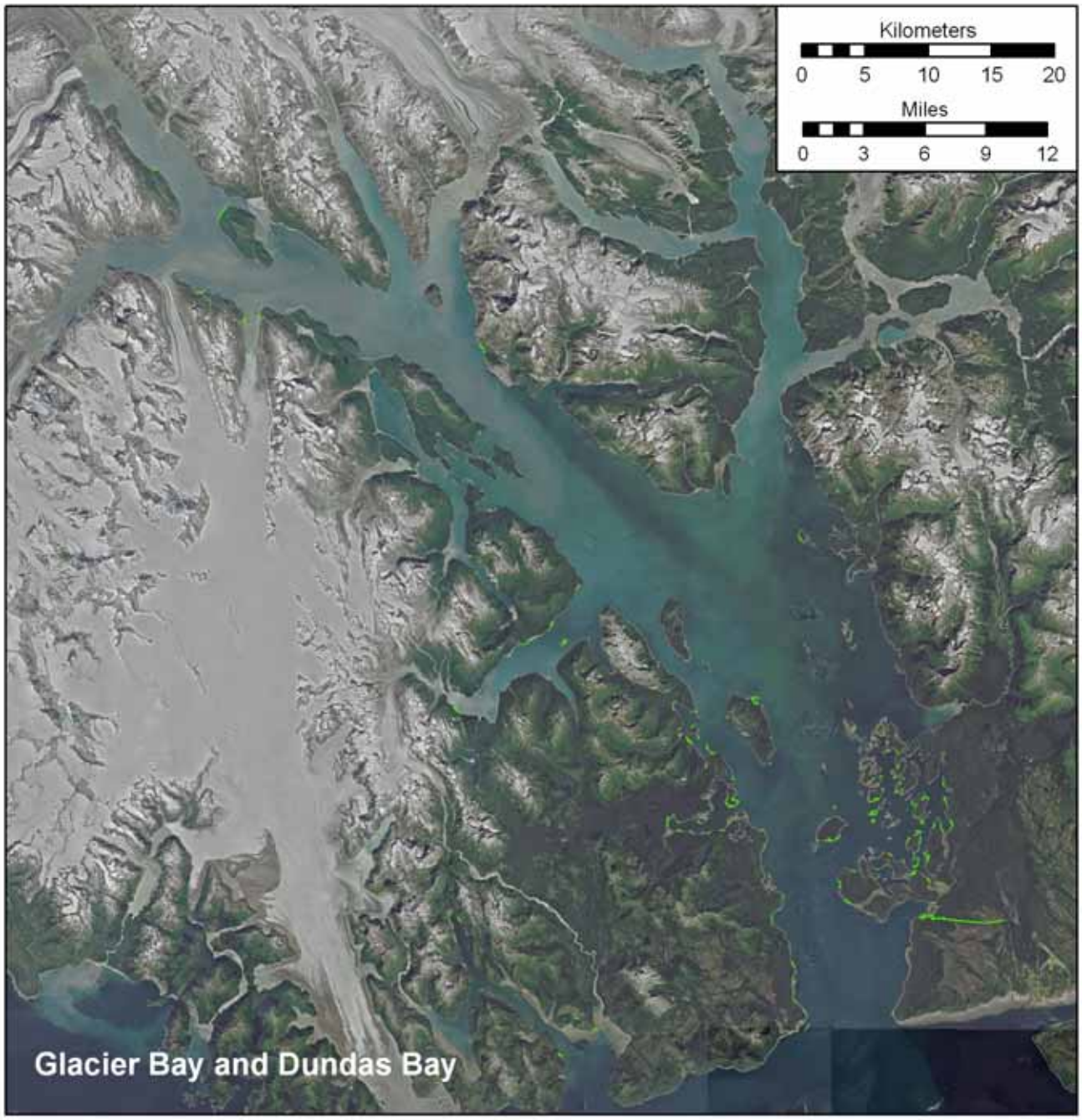
Leucanthemum vulgare distribution in Glacier Bay in 2005



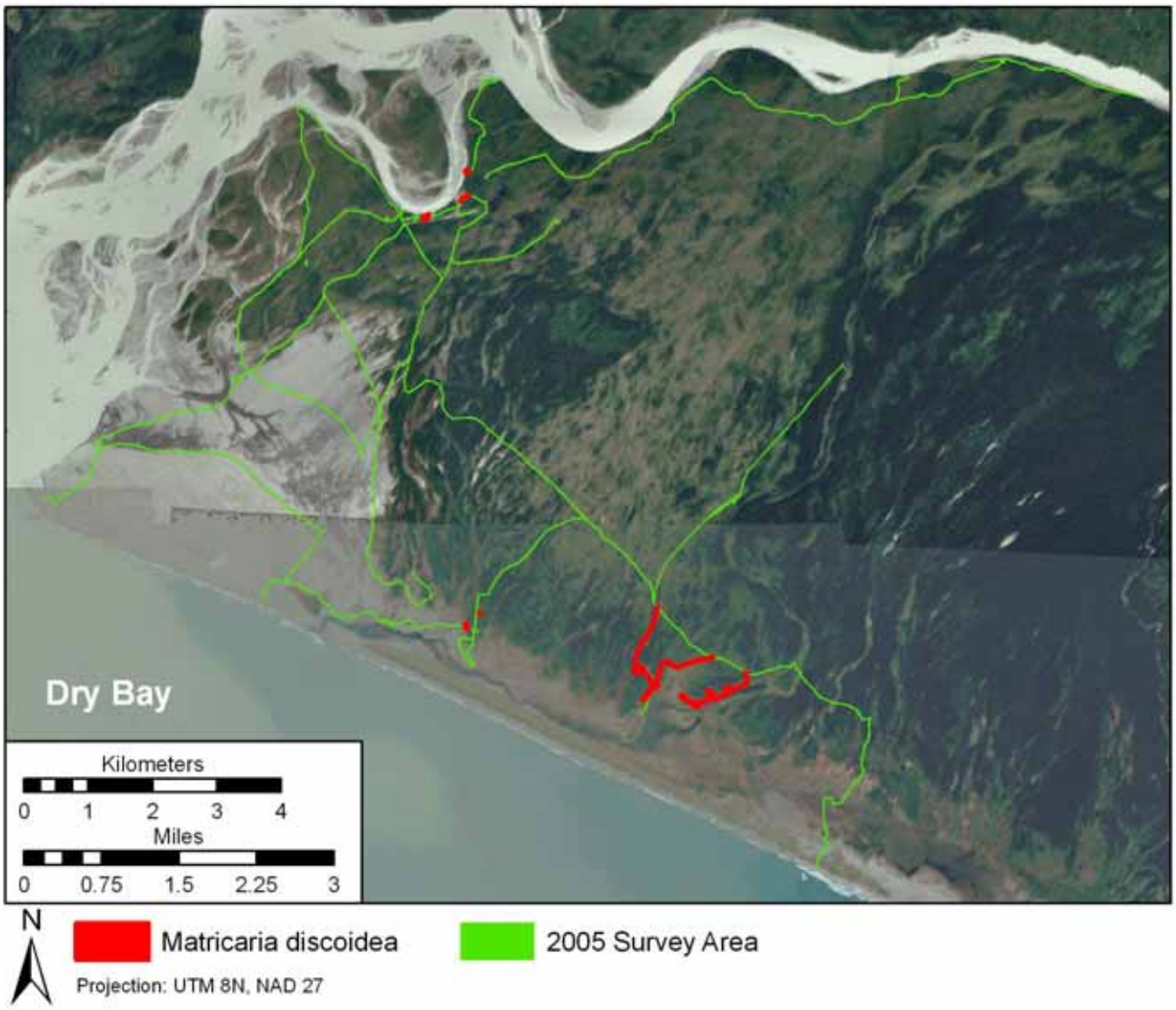
Lupinus polyphyllus distribution in Dry Bay in 2005



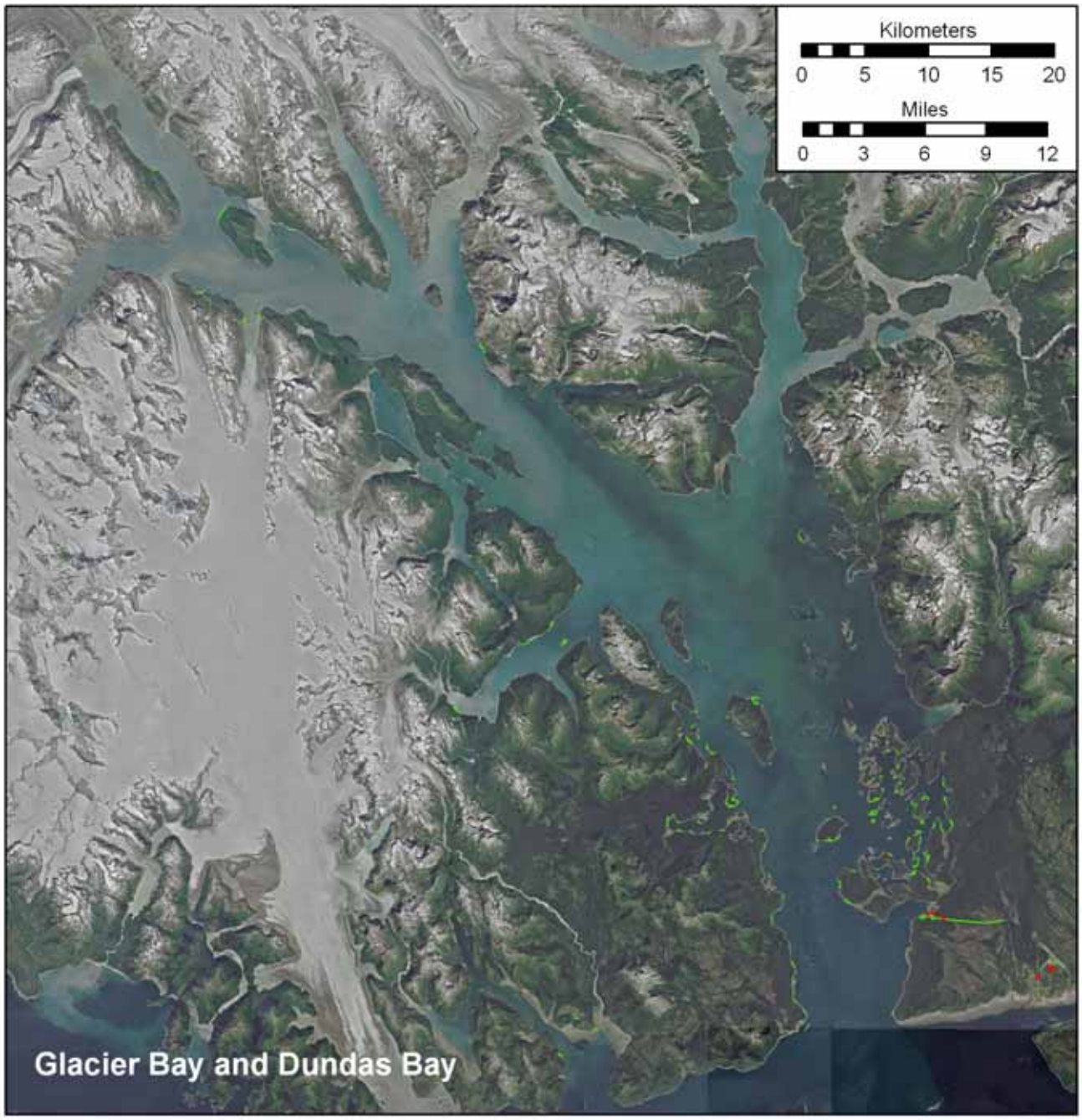
Lupinus polyphyllus distribution in Glacier Bay in 2005



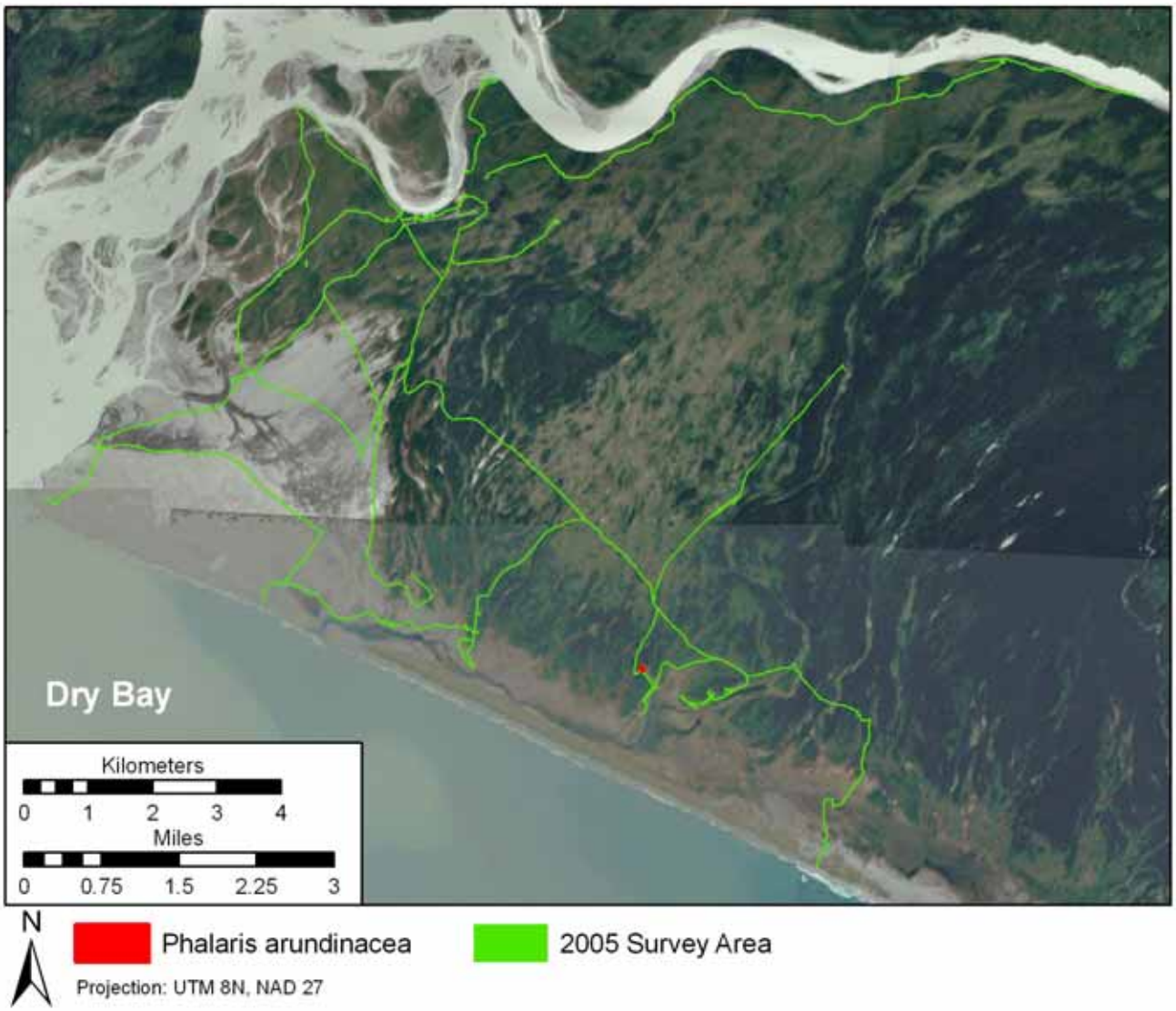
Matricaria discoidea distribution in Dry Bay in 2005



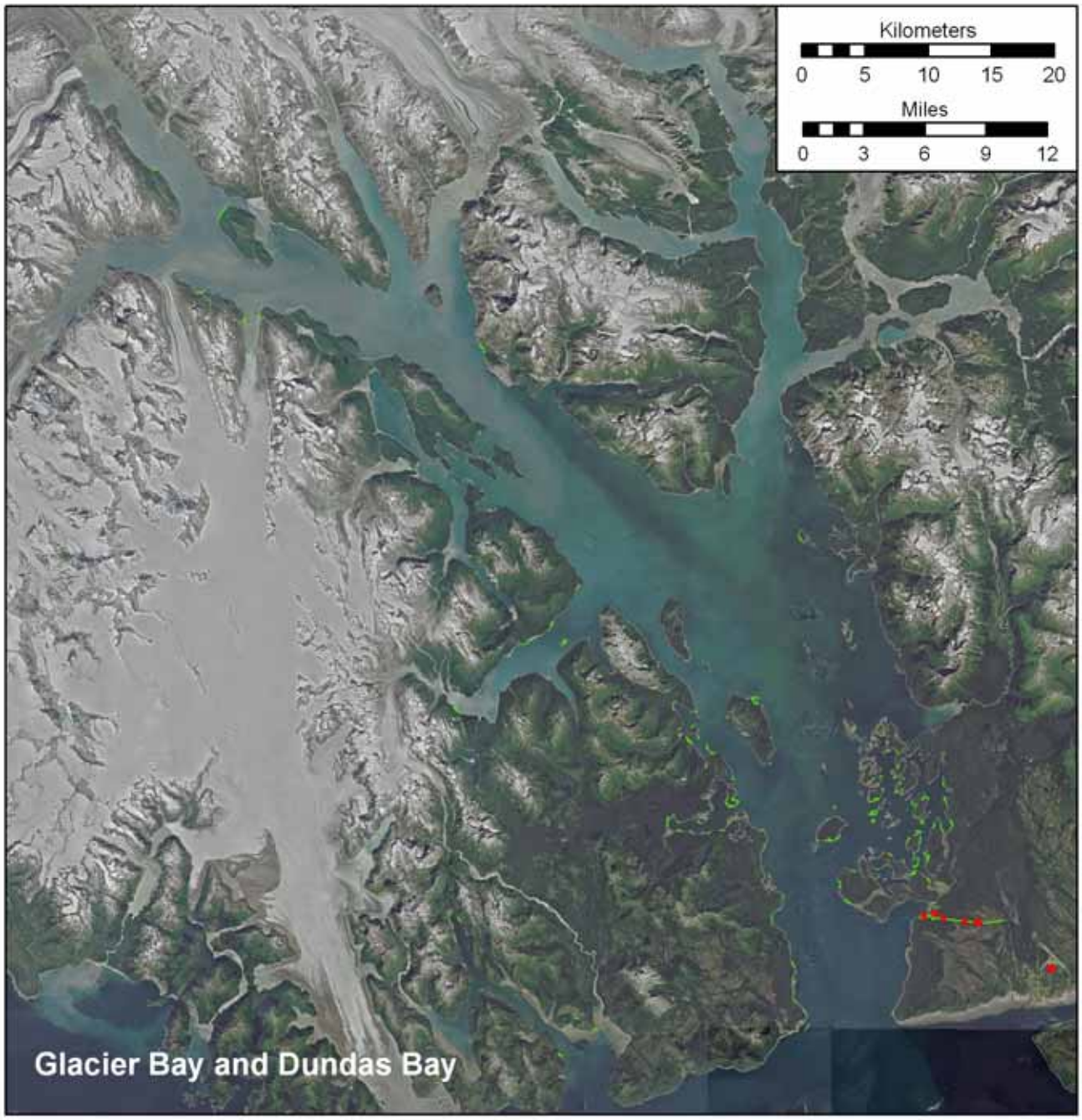
Matricaria discoidea distribution in Glacier Bay in 2005



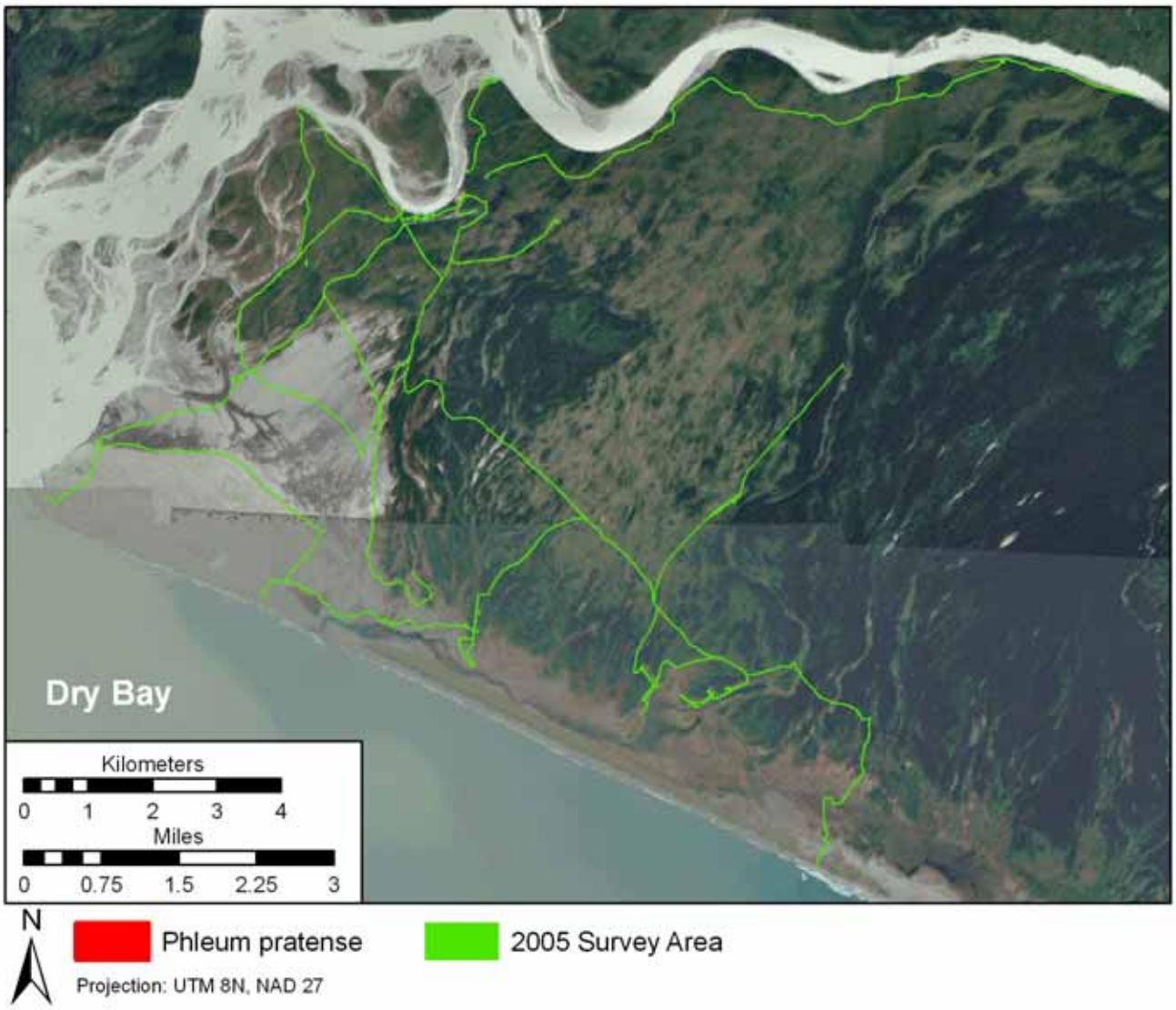
Phalaris arundinacea distribution in Dry Bay in 2005



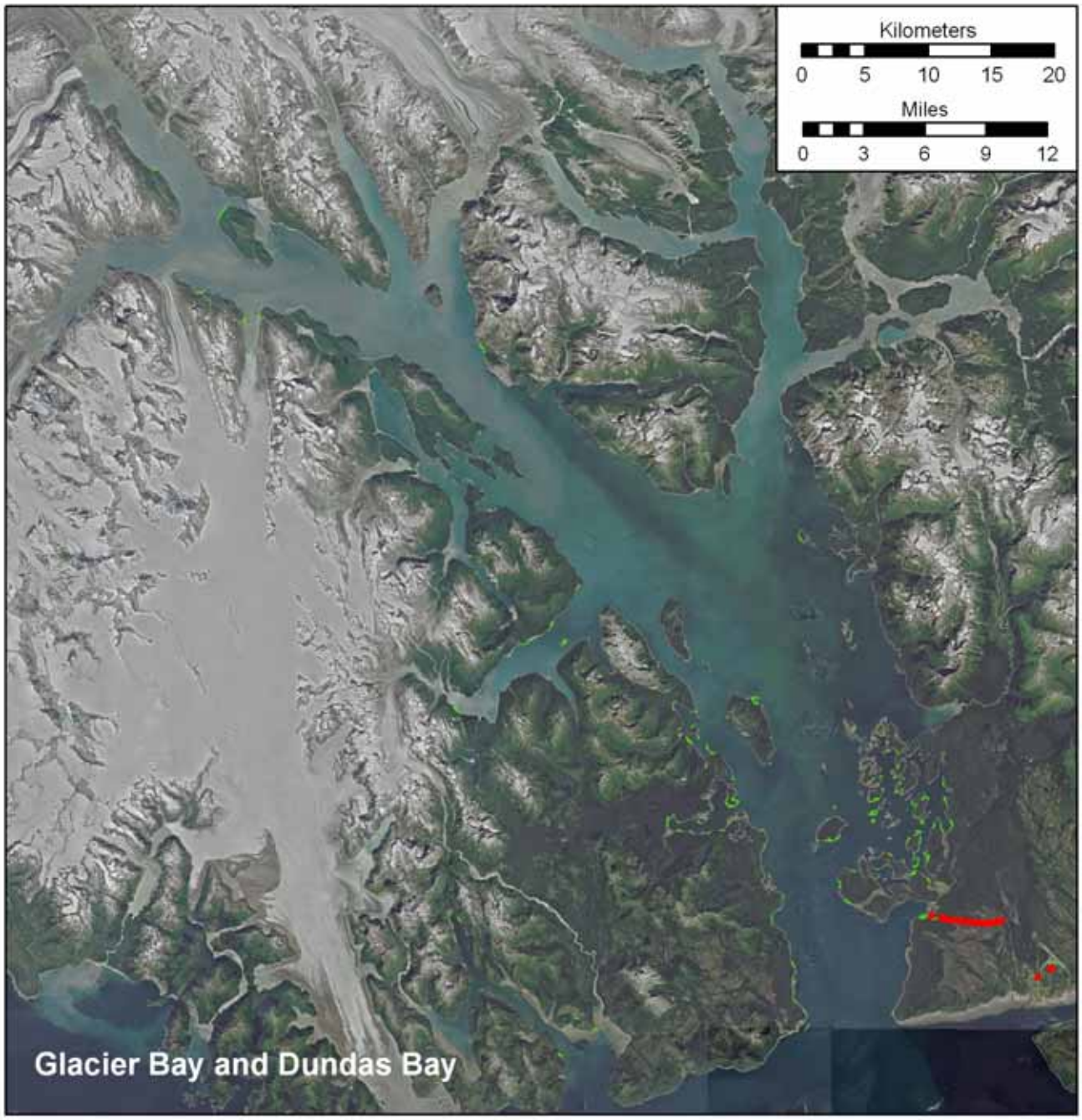
Phalaris arundinacea distribution in Glacier Bay in 2005



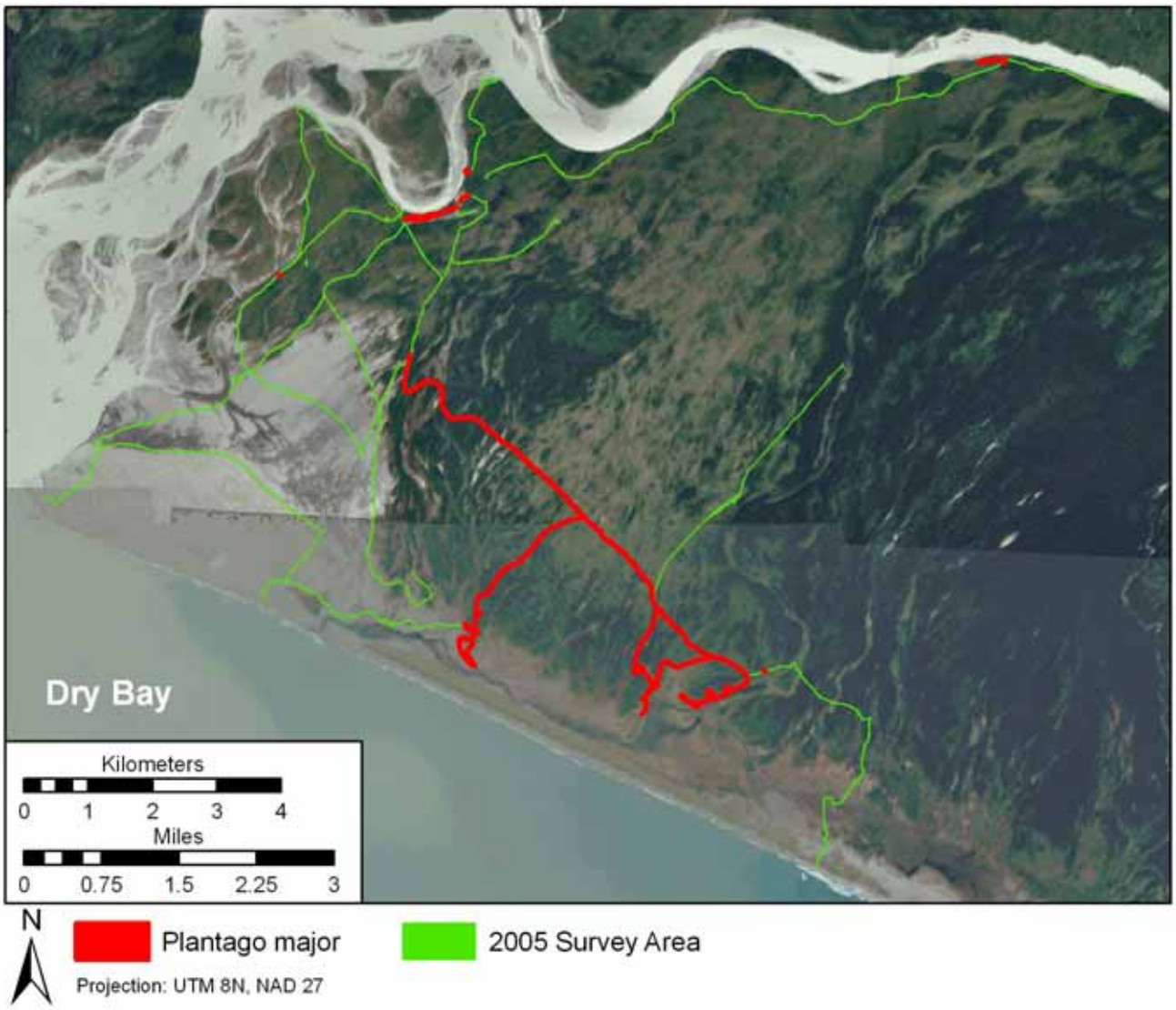
Phleum pratense distribution in Dry Bay in 2005



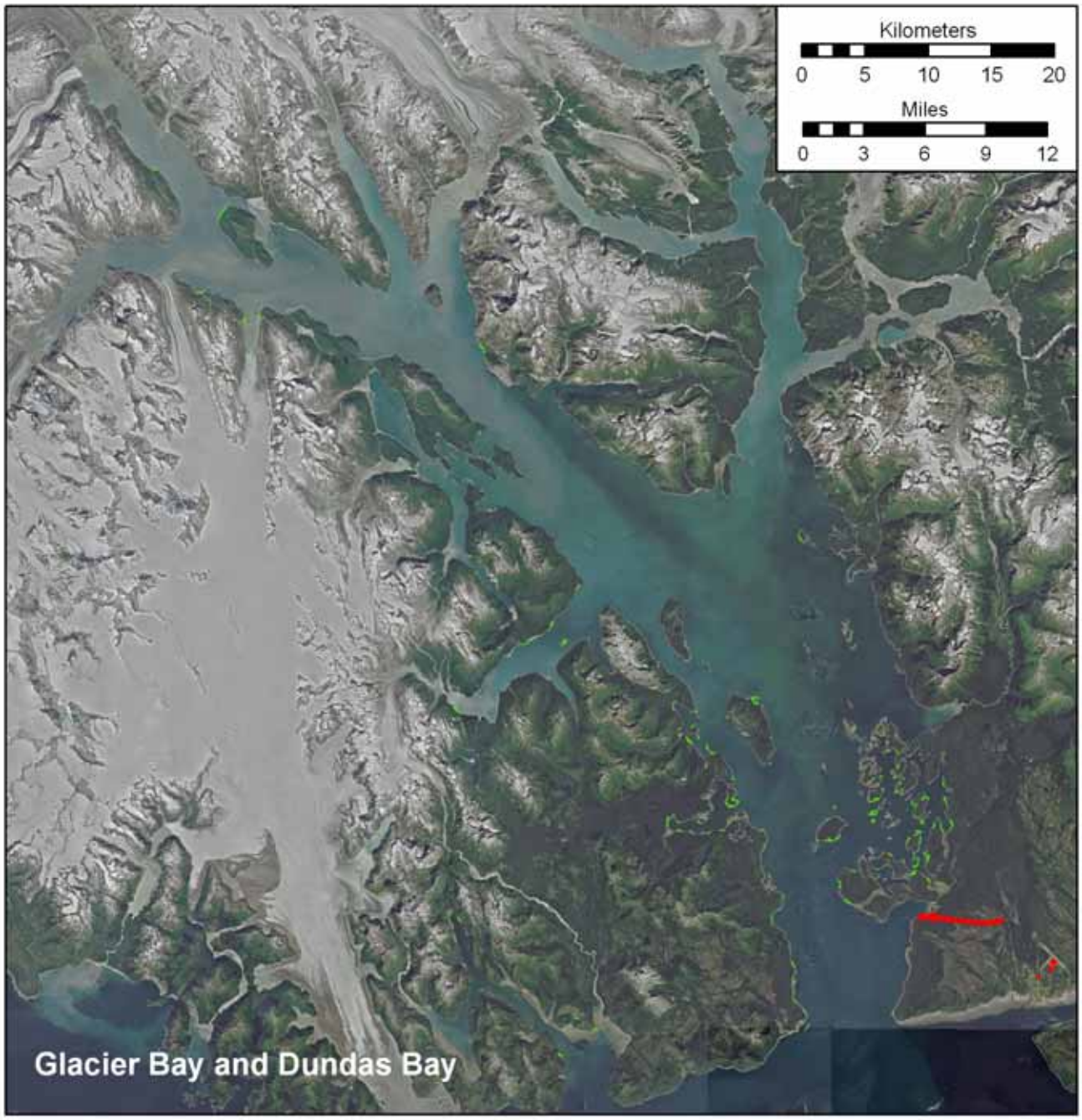
Phleum pratense distribution in Glacier Bay in 2005



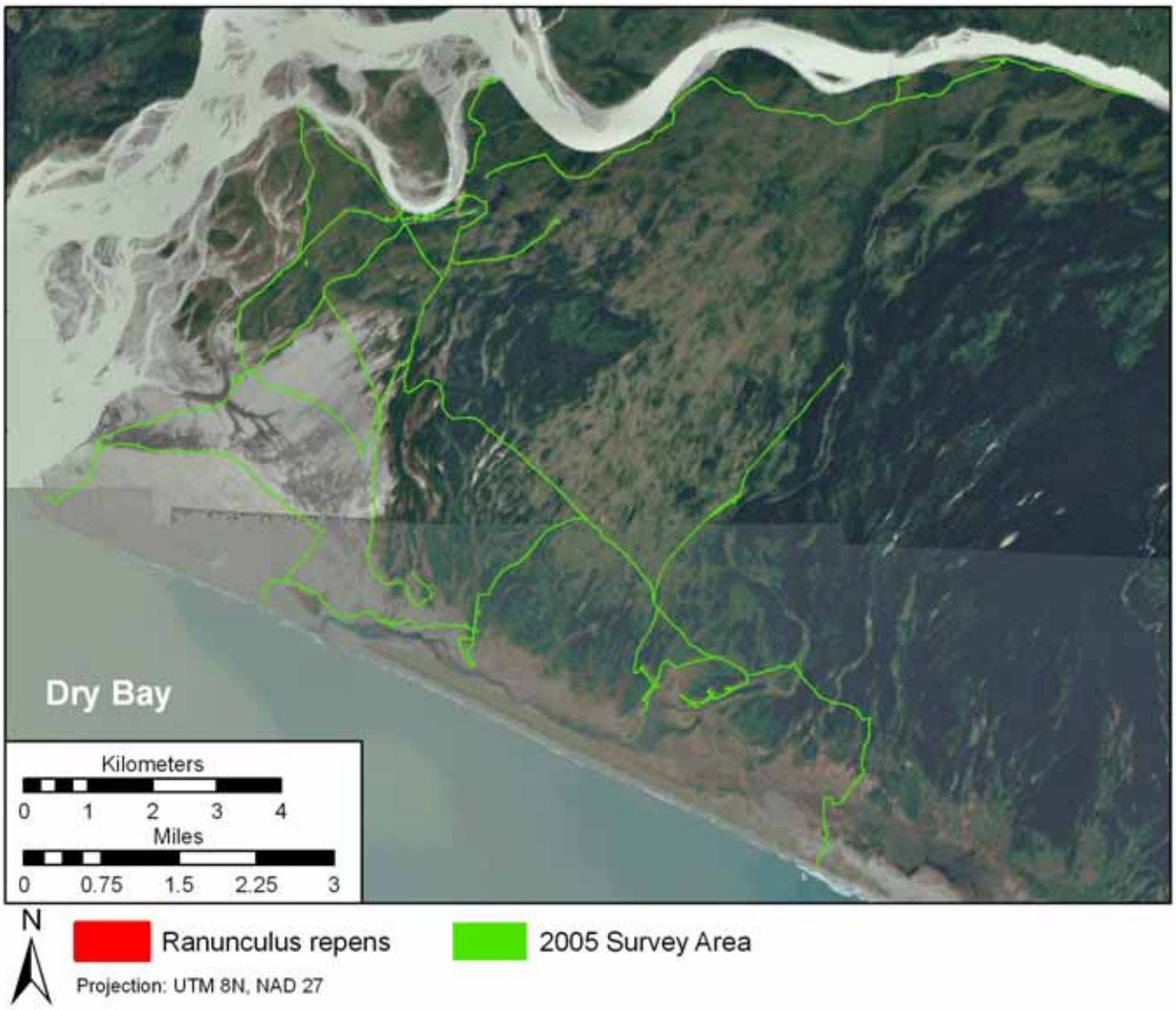
Plantago major distribution in Dry Bay in 2005



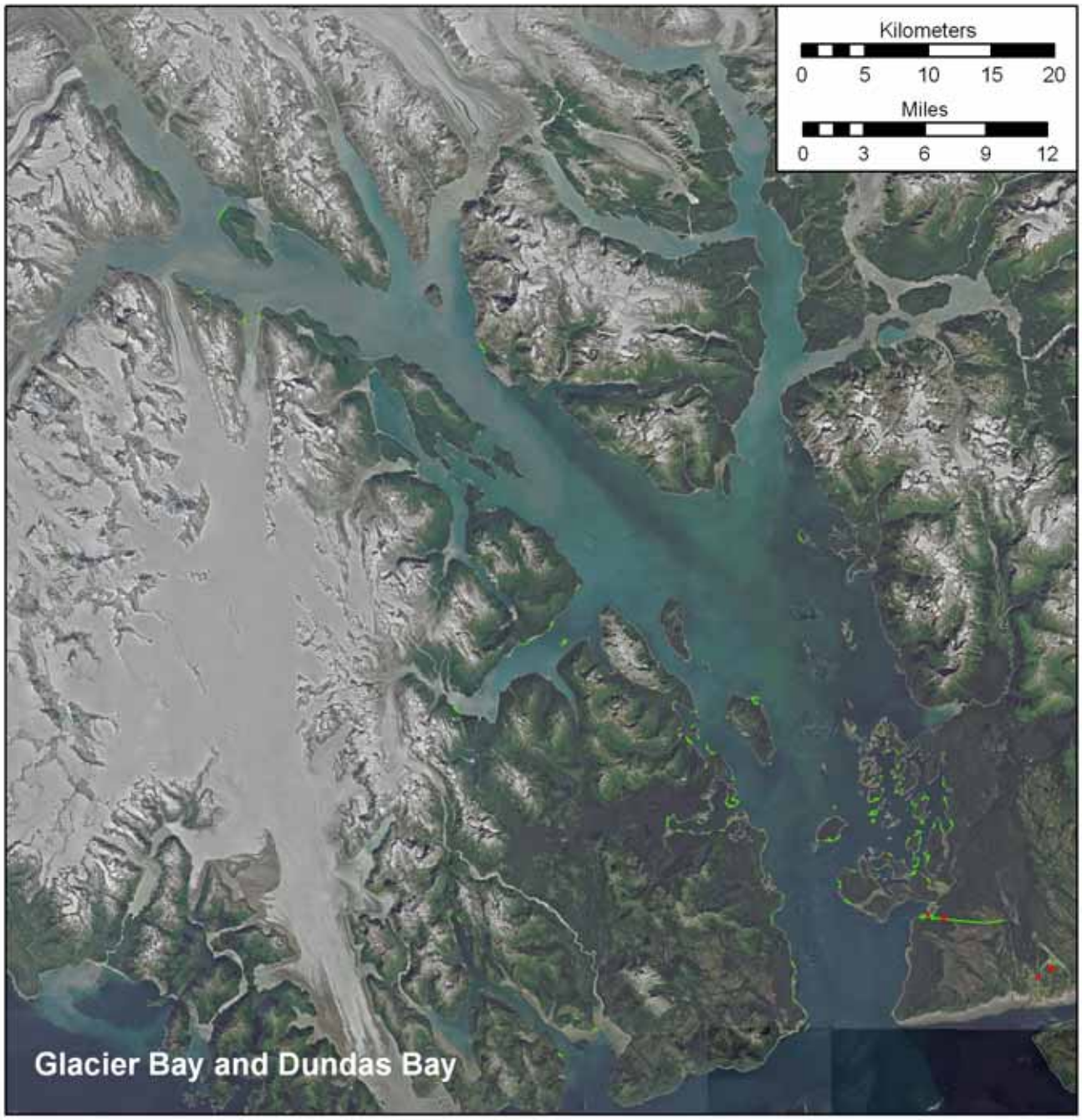
Plantago major distribution in Glacier Bay in 2005



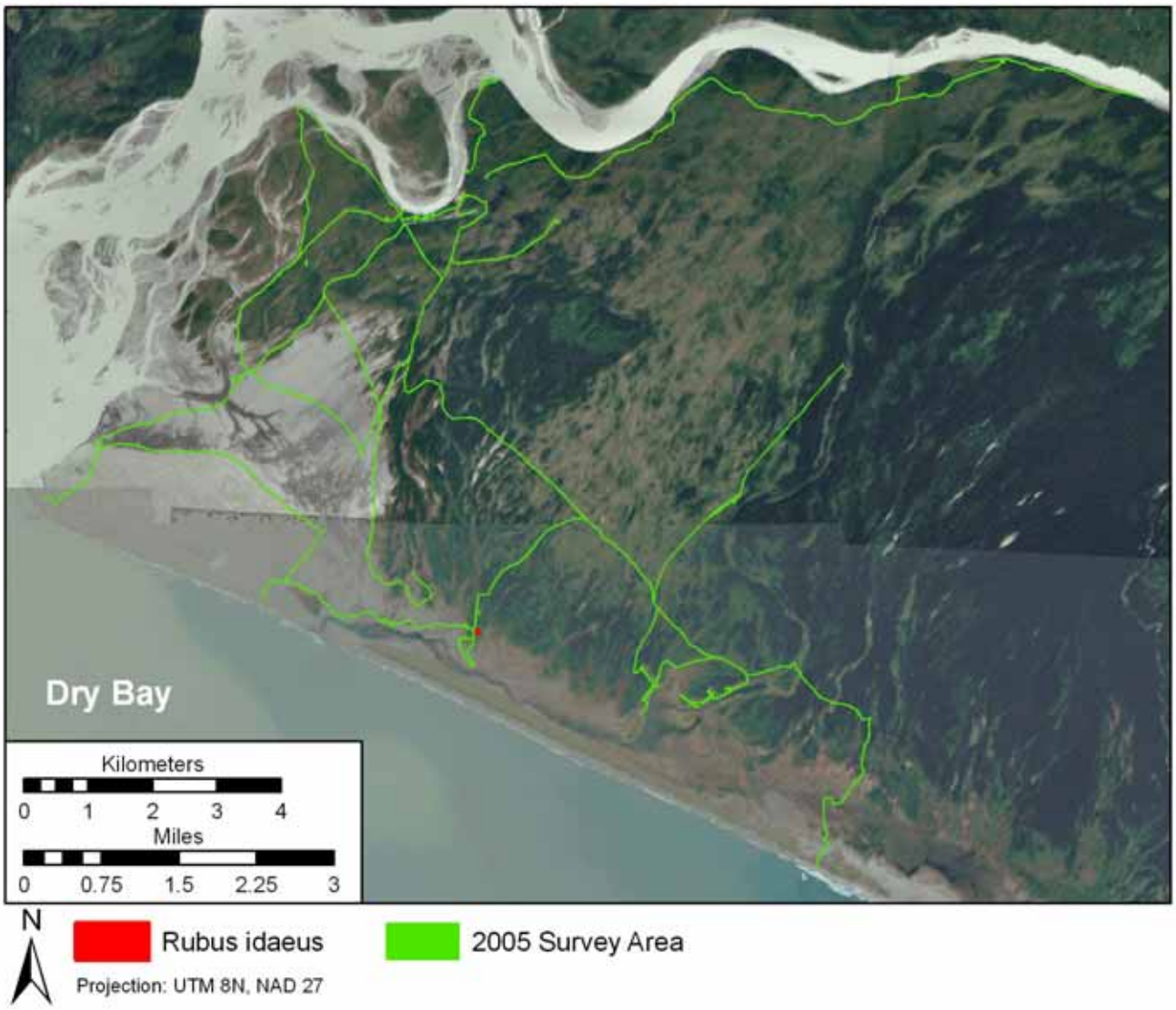
Ranunculus repens distribution in Dry Bay in 2005



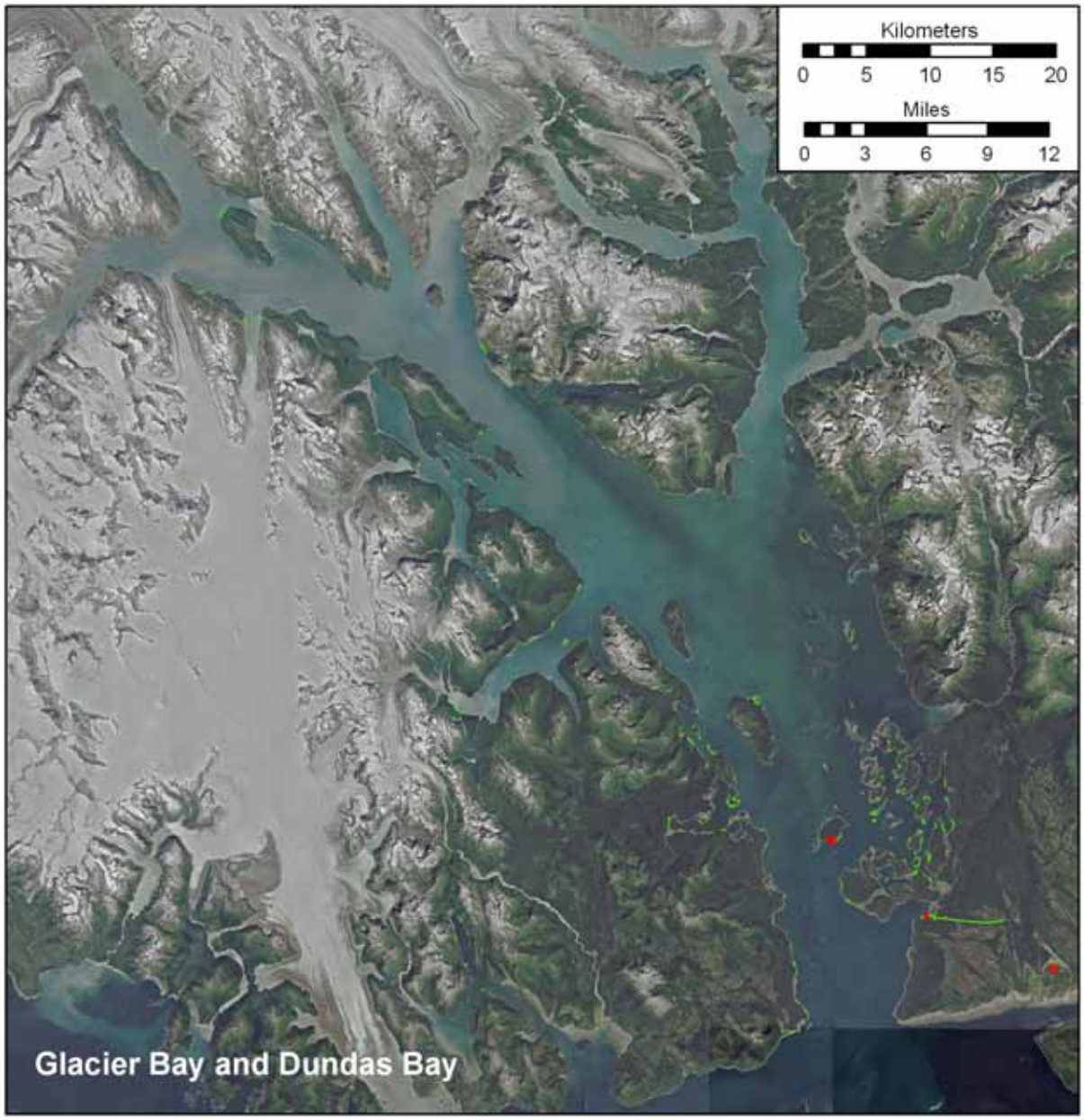
Ranunculus repens distribution in Glacier Bay in 2005



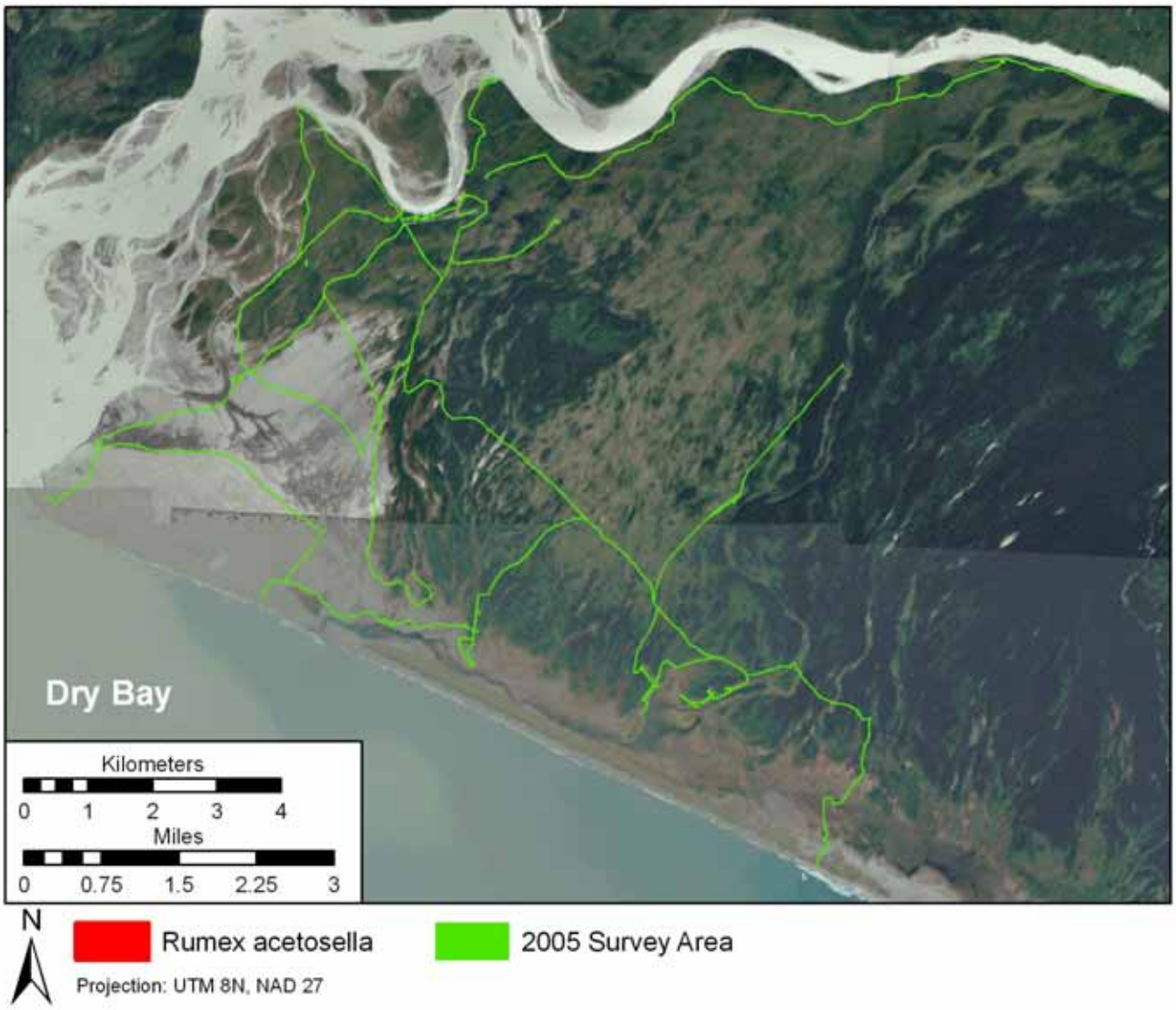
Rubus idaeus distribution in Dry Bay in 2005



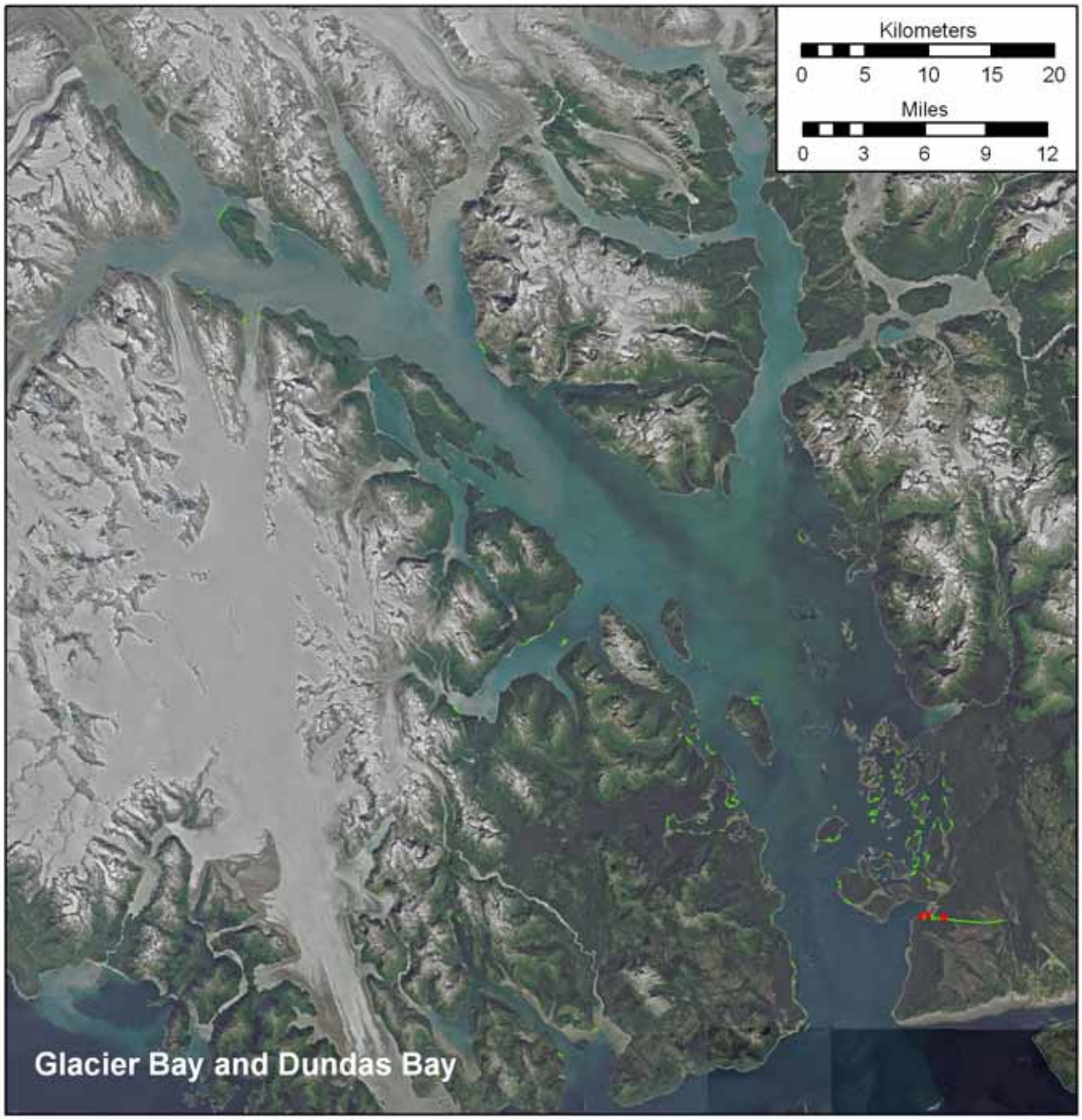
Rubus idaeus distribution in Glacier Bay in 2005



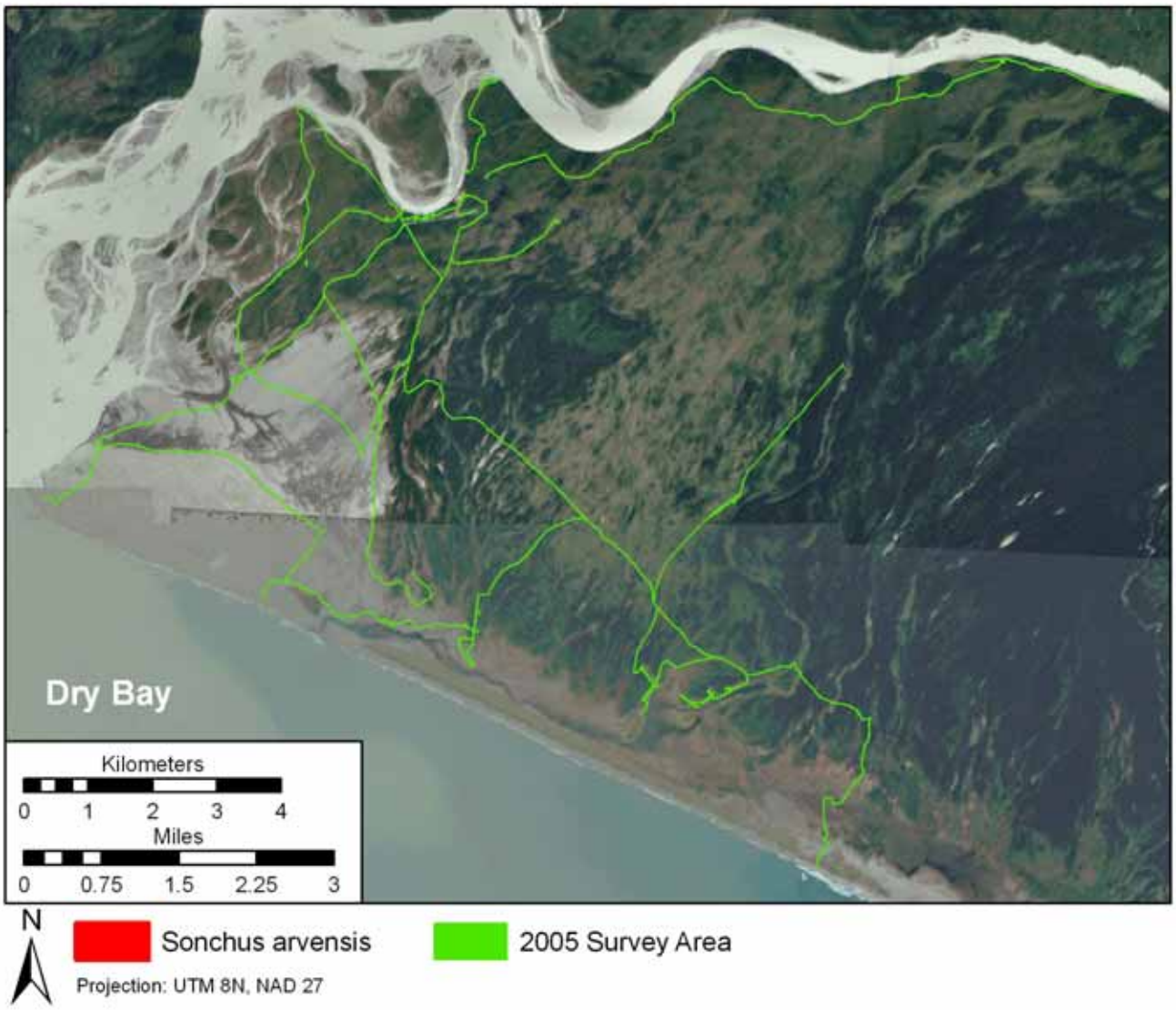
Rumex acetosella distribution in Dry Bay in 2005



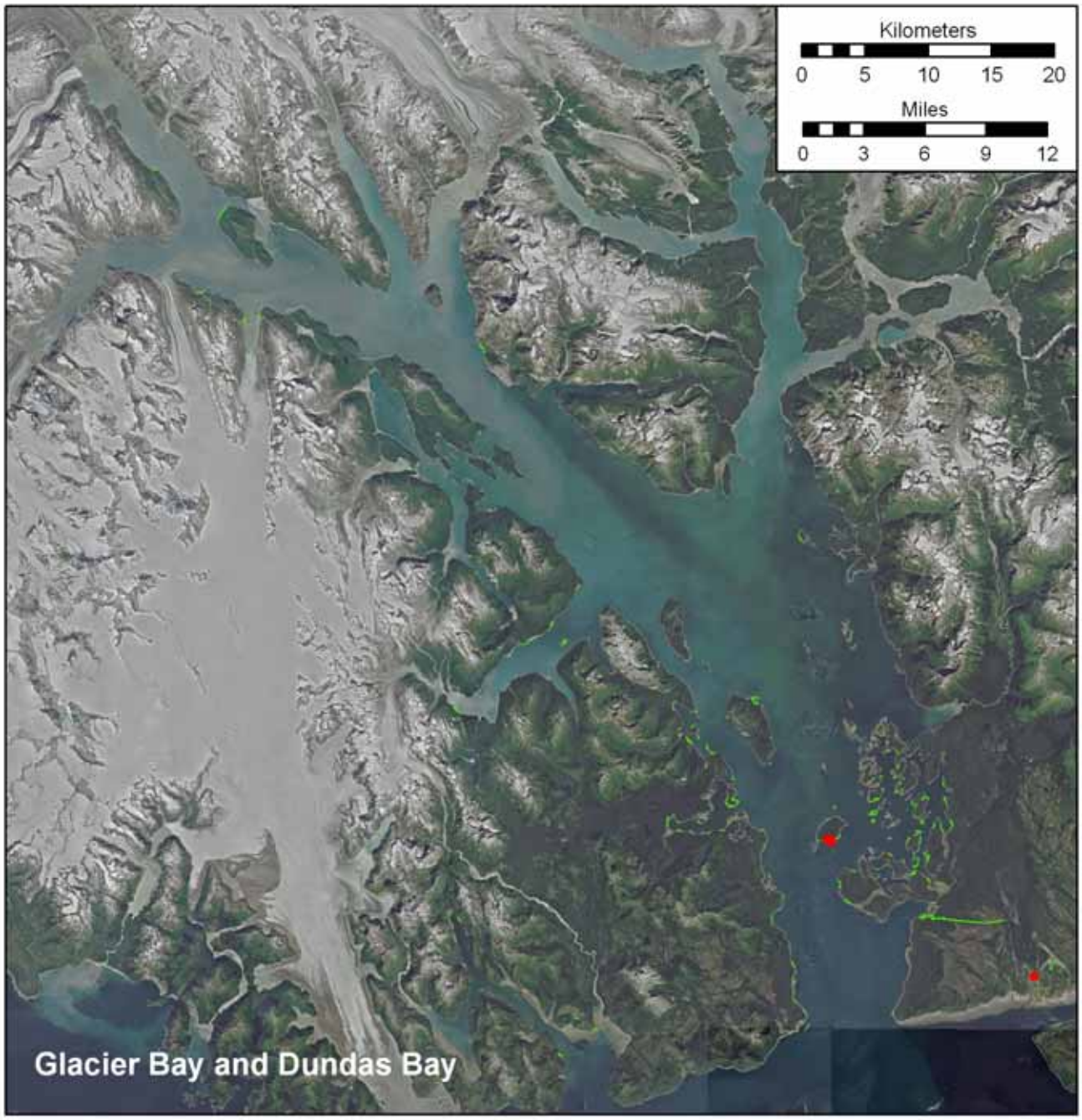
Rumex acetosella distribution in Glacier Bay in 2005



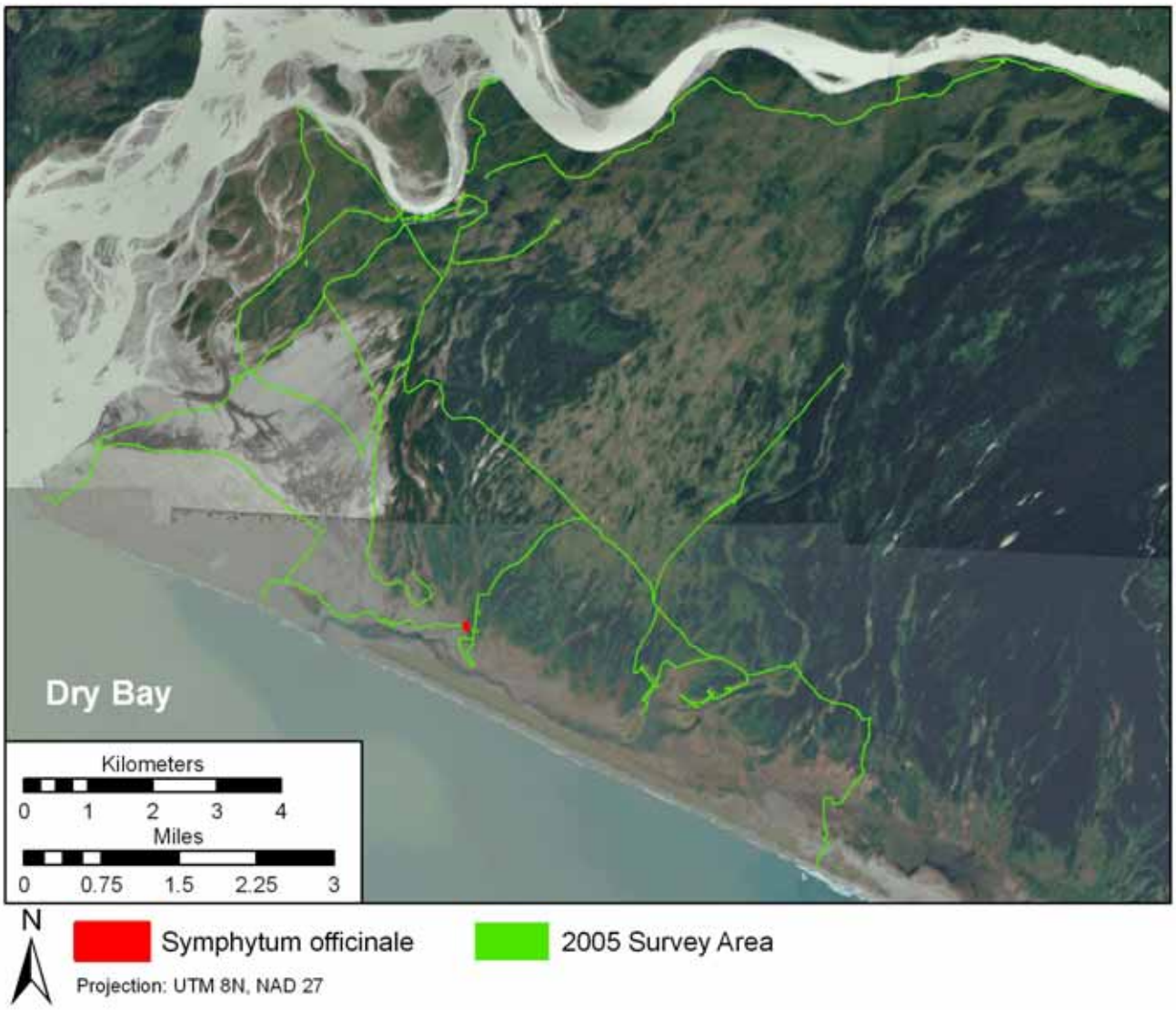
Sonchus arvensis distribution in Dry Bay in 2005



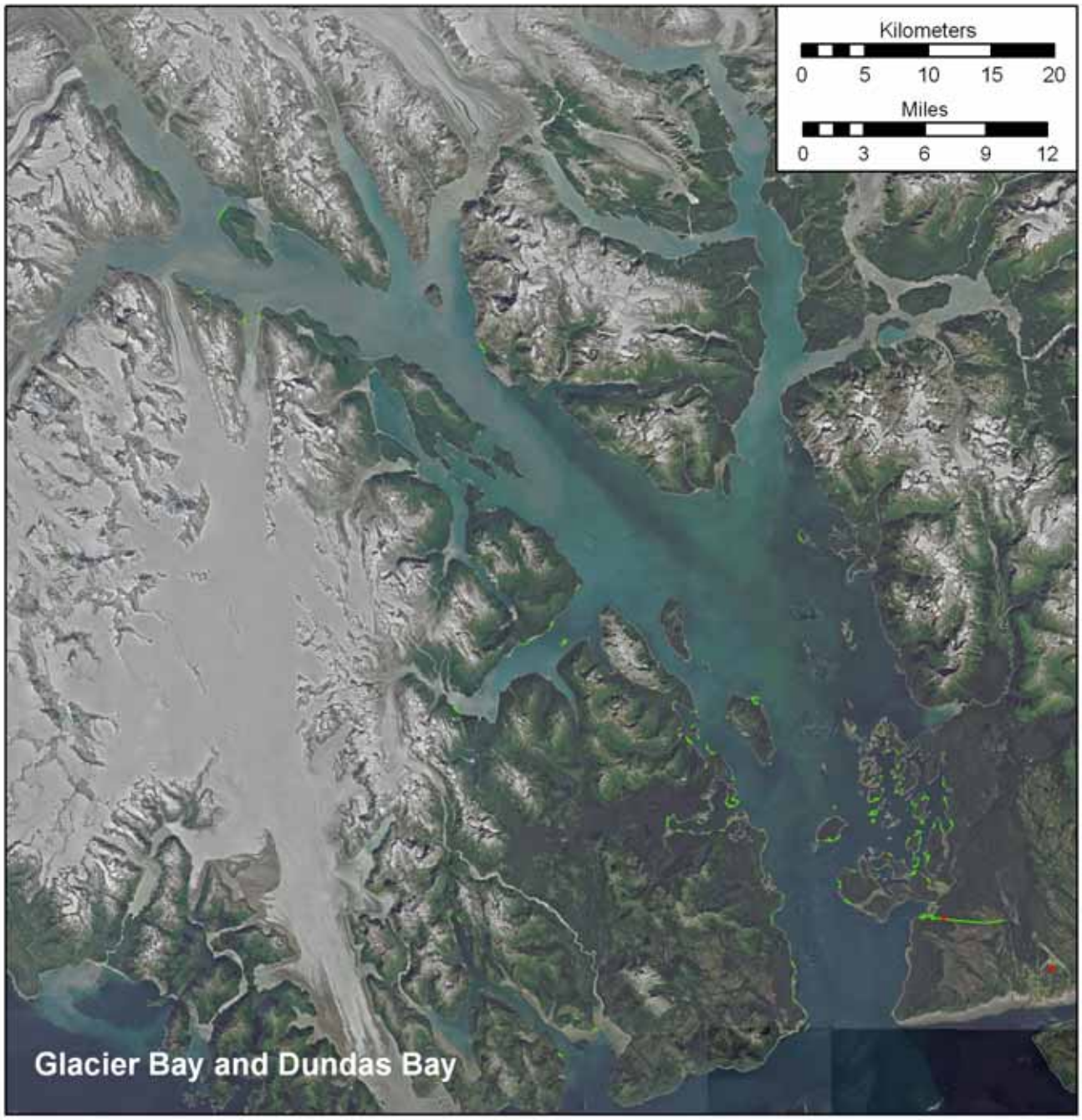
Sonchus arvensis distribution in Glacier Bay in 2005



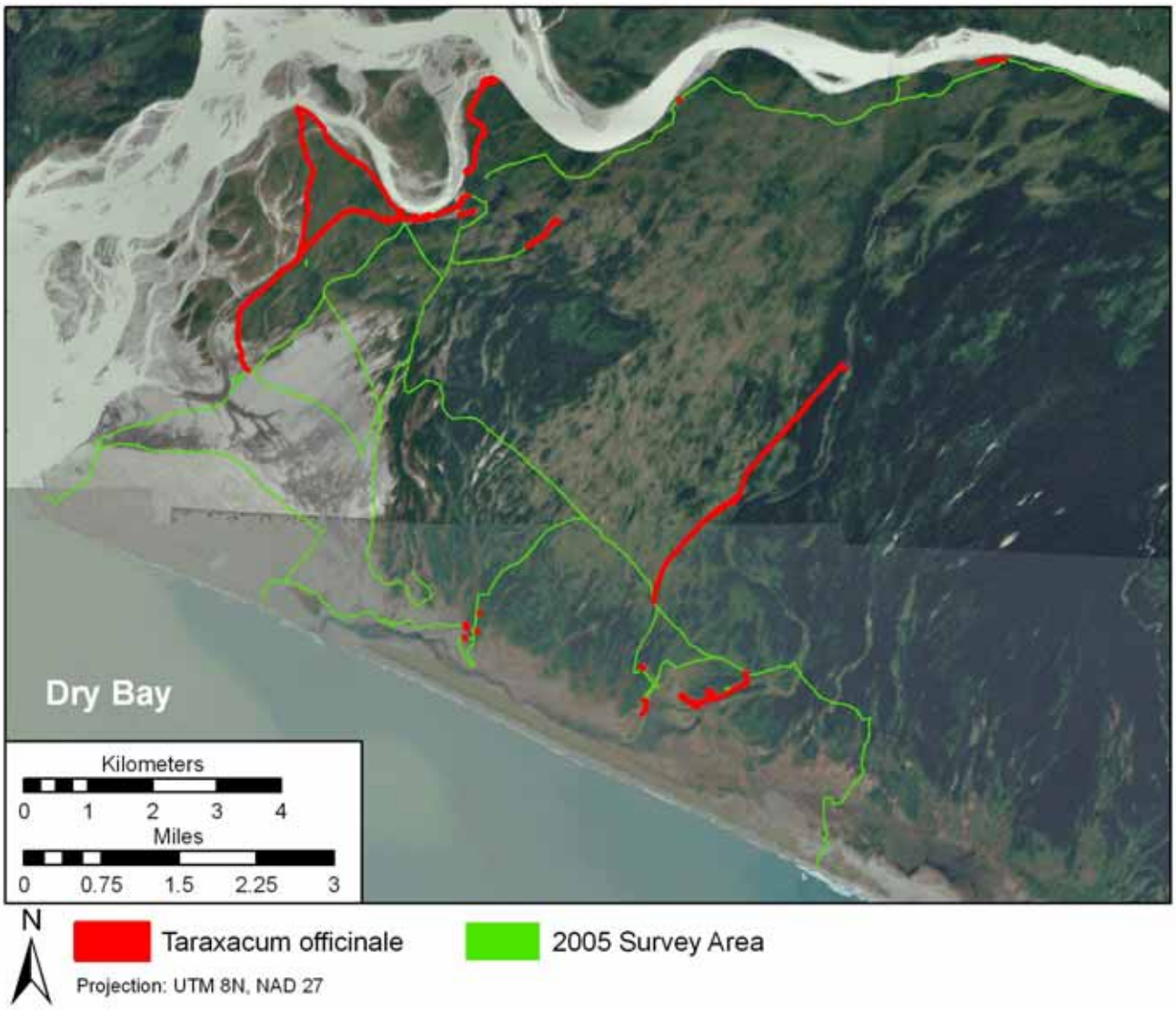
Symphytum officinale distribution in Dry Bay in 2005



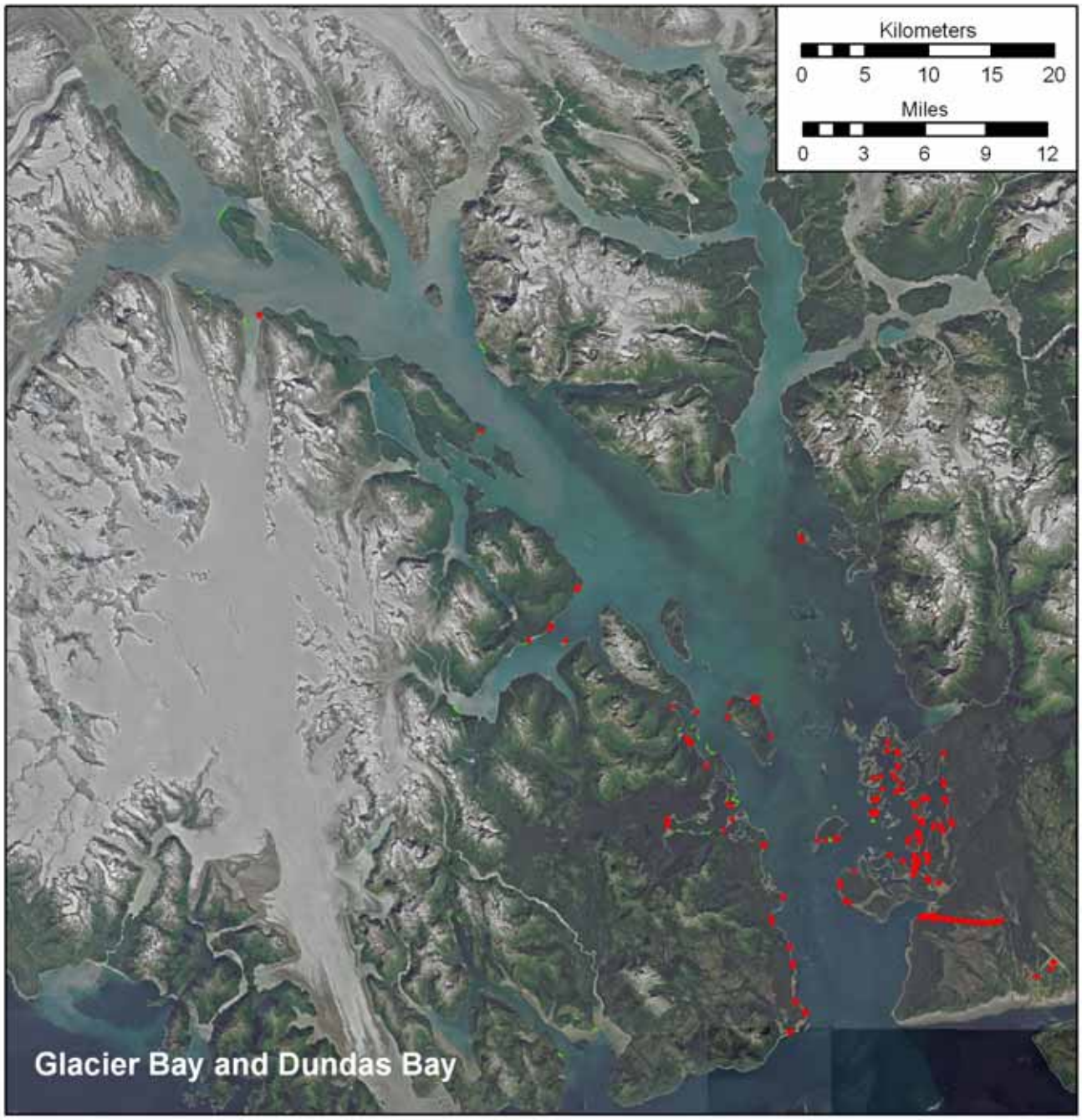
Symphytum officinale distribution in Glacier Bay in 2005



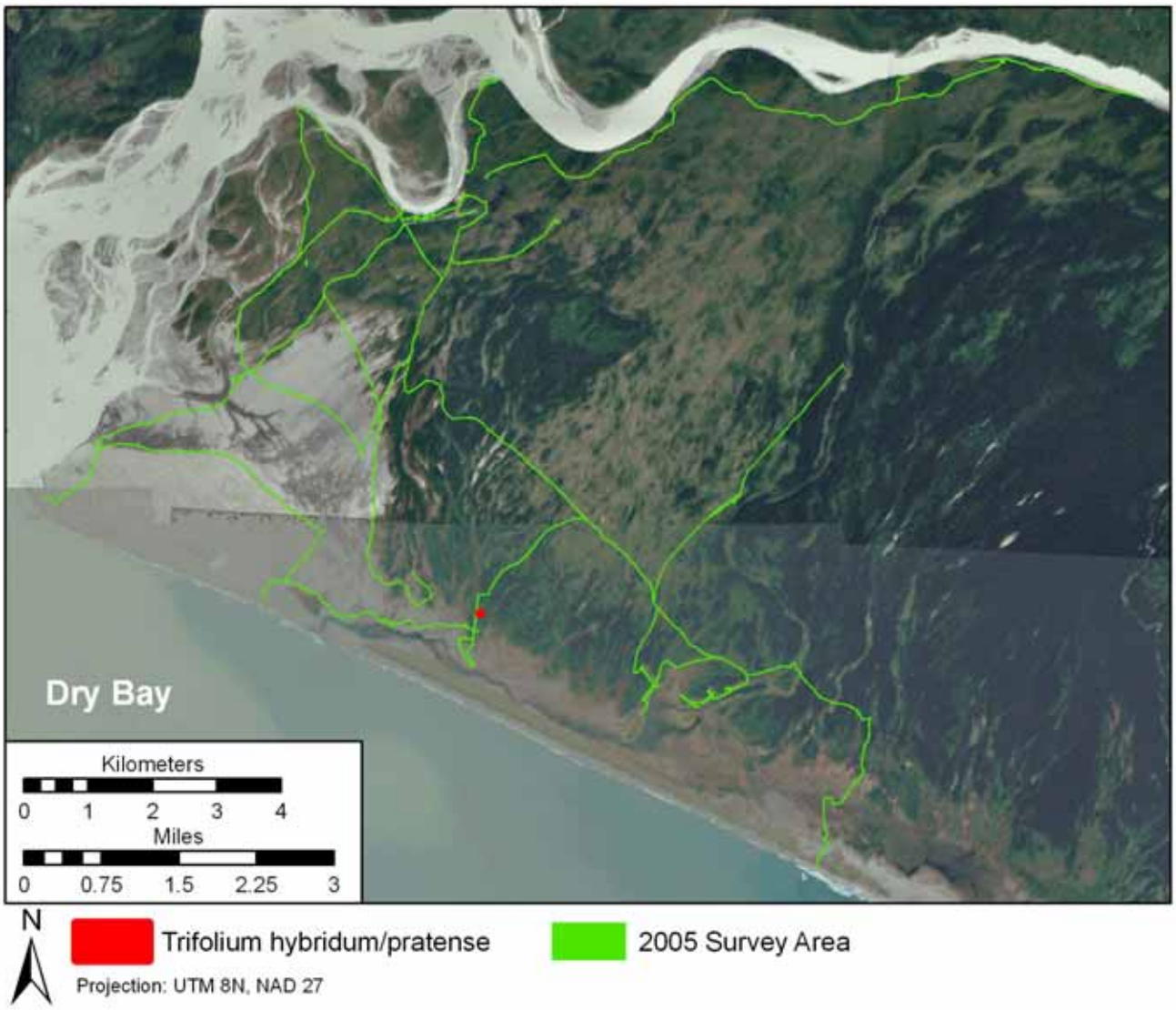
***Taraxacum officinale* ssp*. officinale* distribution in Dry Bay in 2005**



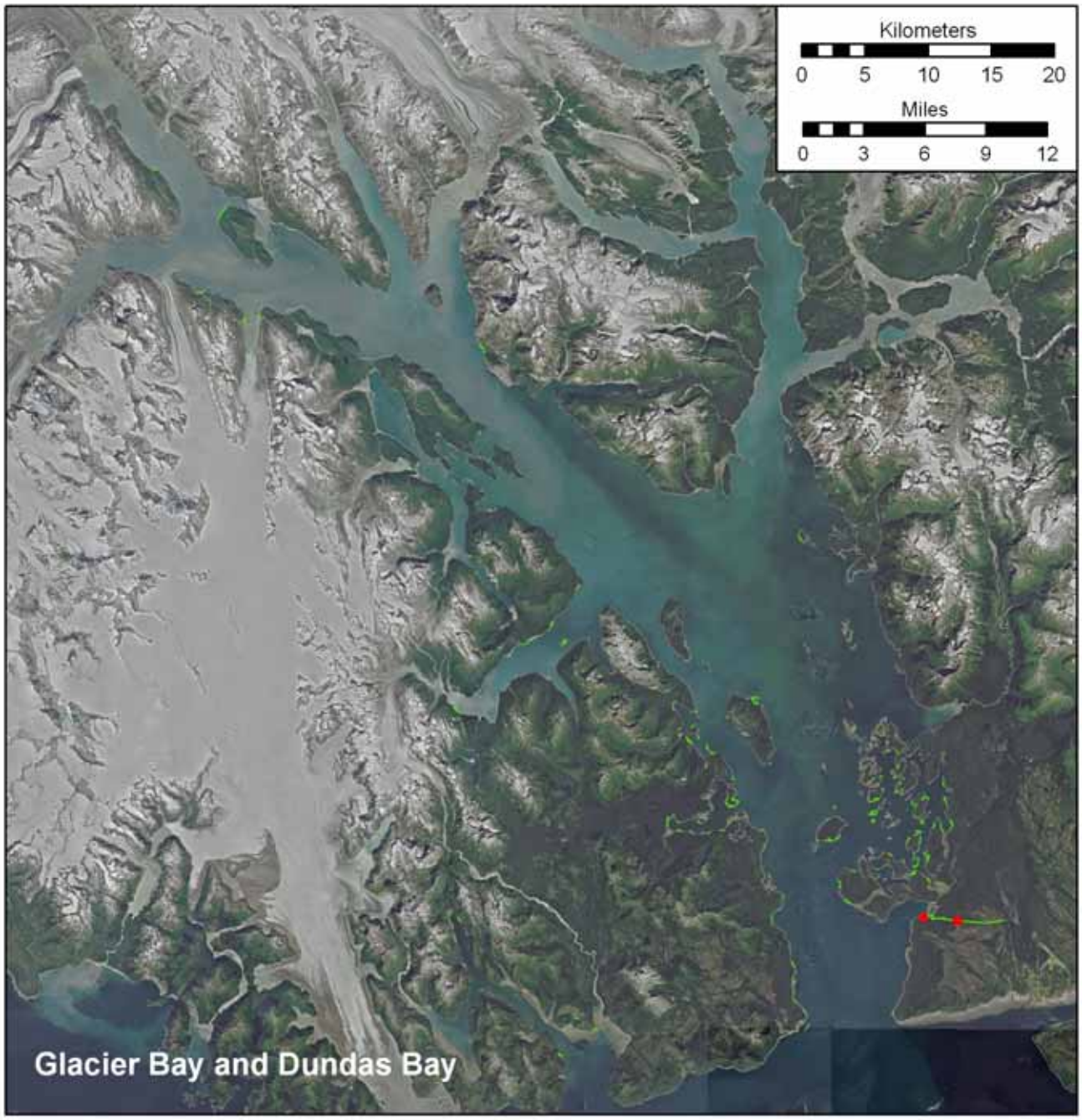
***Taraxacum officinale* ssp*. officinale* distribution in Glacier Bay in 2005**



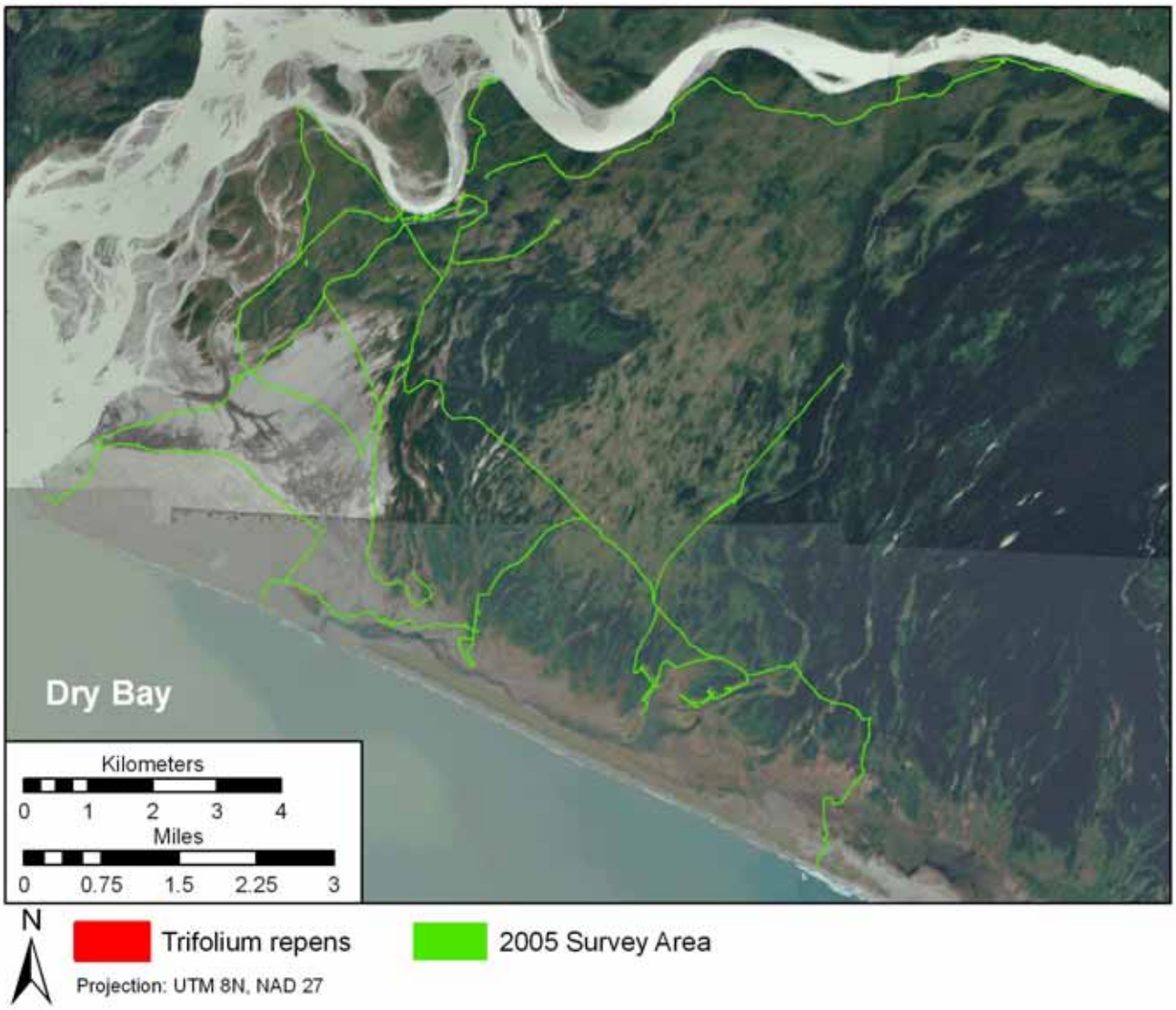
Trifolium hybridum/pratense distribution in Dry Bay in 2005



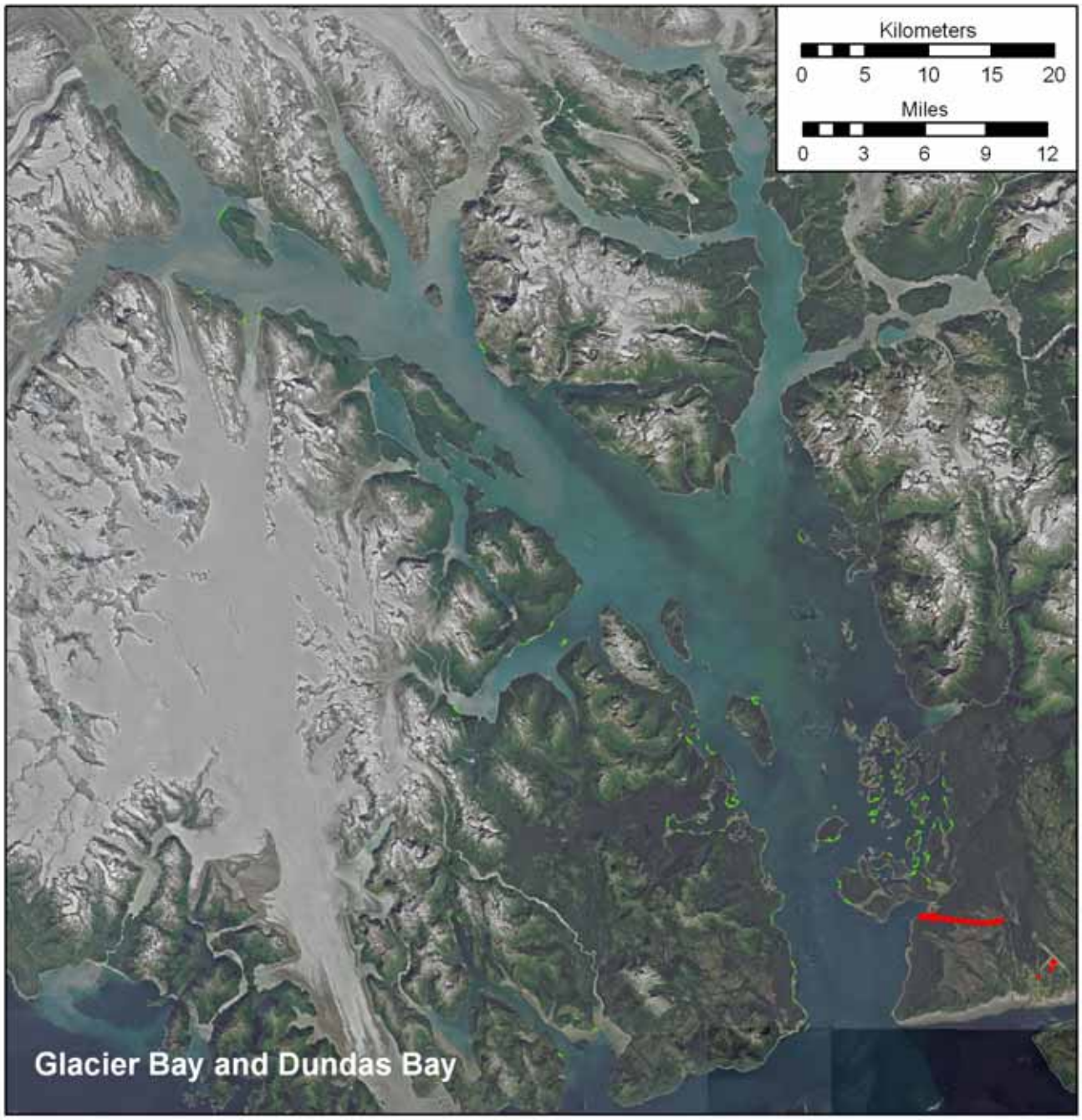
***Trifolium hybridum/pratense* distribution in Glacier Bay in 2005**



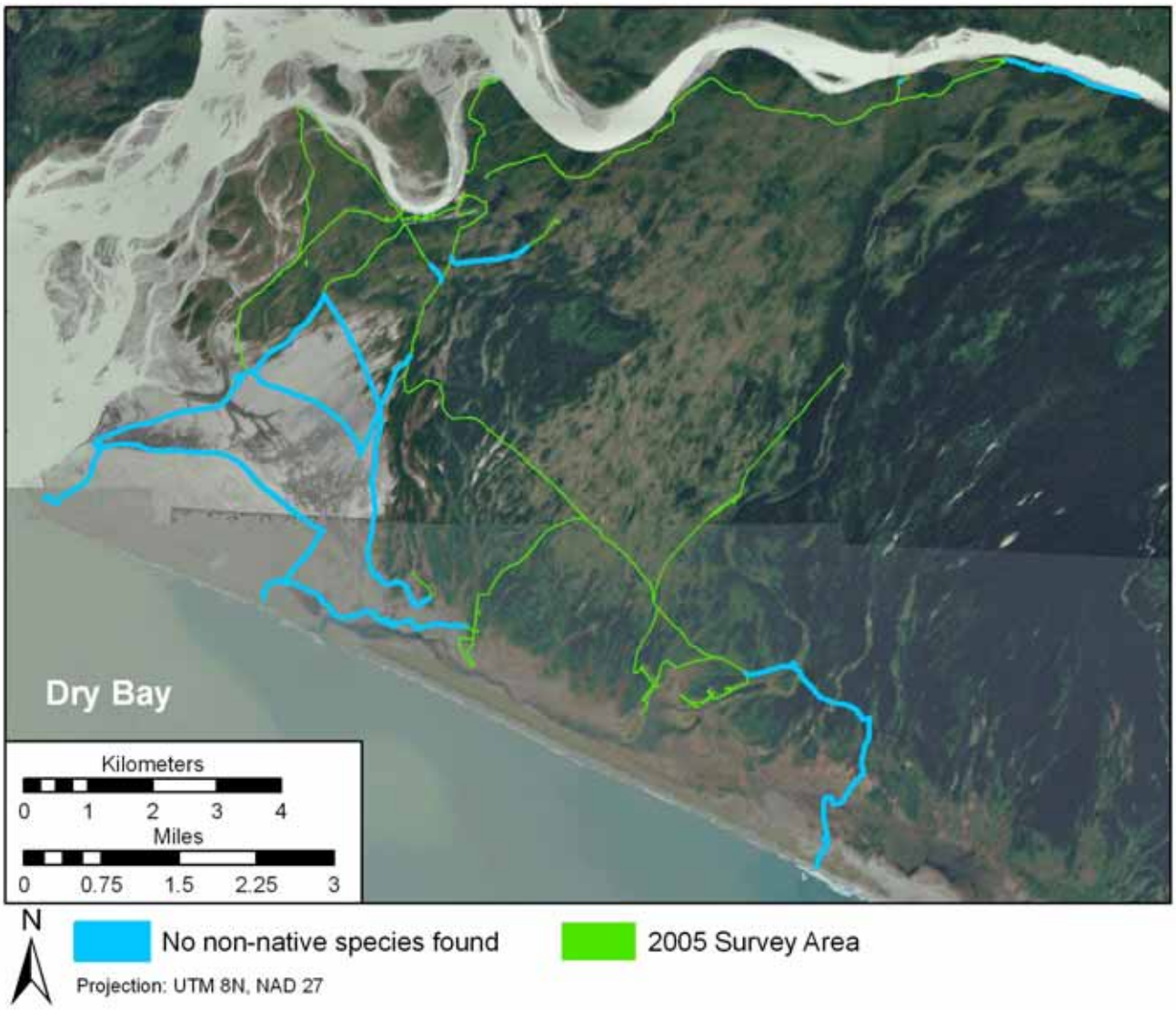
Trifolium repens distribution in Dry Bay in 2005



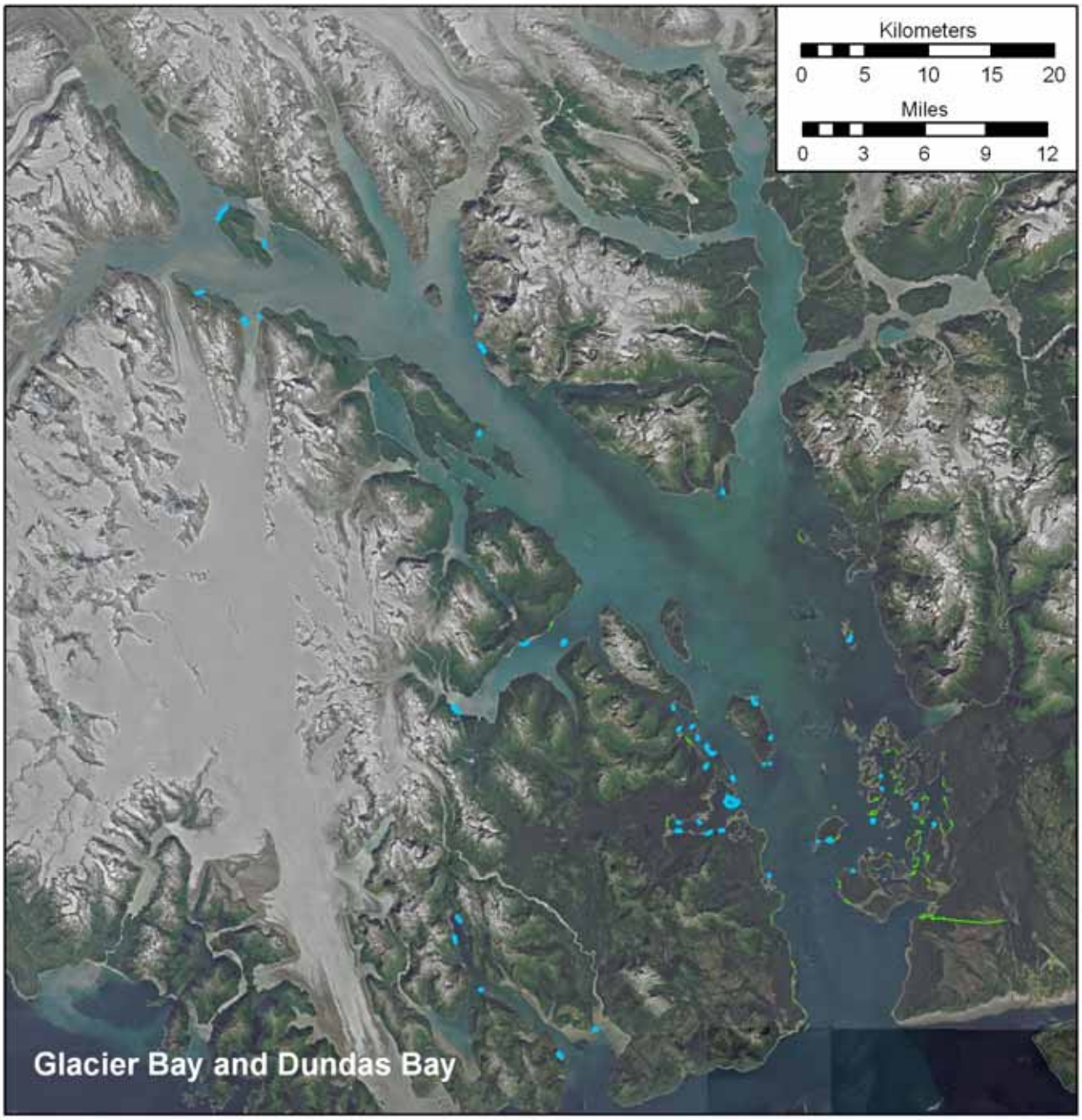
Trifolium repens distribution in Glacier Bay in 2005



Areas without Non-Native Species in Dry Bay in 2005



Areas without Non-Native Species in Glacier Bay in 2005



Appendix C – Species biographies of select species prepared by the Alaska Natural Heritage Program

All documents from:
http://akweeds.uaa.alaska.edu/akweeds_ranking_geo.htm

Achillea millefolium var. millefolium
Bromus inermis ssp. *inermis*
Hieracium aurantiacum
Hordeum jubatum
Leucanthemum vulgare
Linaria vulgaris
Matricaria discoidea
Phalaris arundinacea
Plantago major
Ranunculus repens
Ranunculus acris
Sonchus arvensis ssp. *uliginosus*
Sorbus aucuparia
Tanacetum vulgare
Taraxacum officinale
Trifolium hybridum
Trifolium repens