Herschel Island—Qikiqtaruk Inventory, Monitoring, and Research Program

Key Findings and Recommendations

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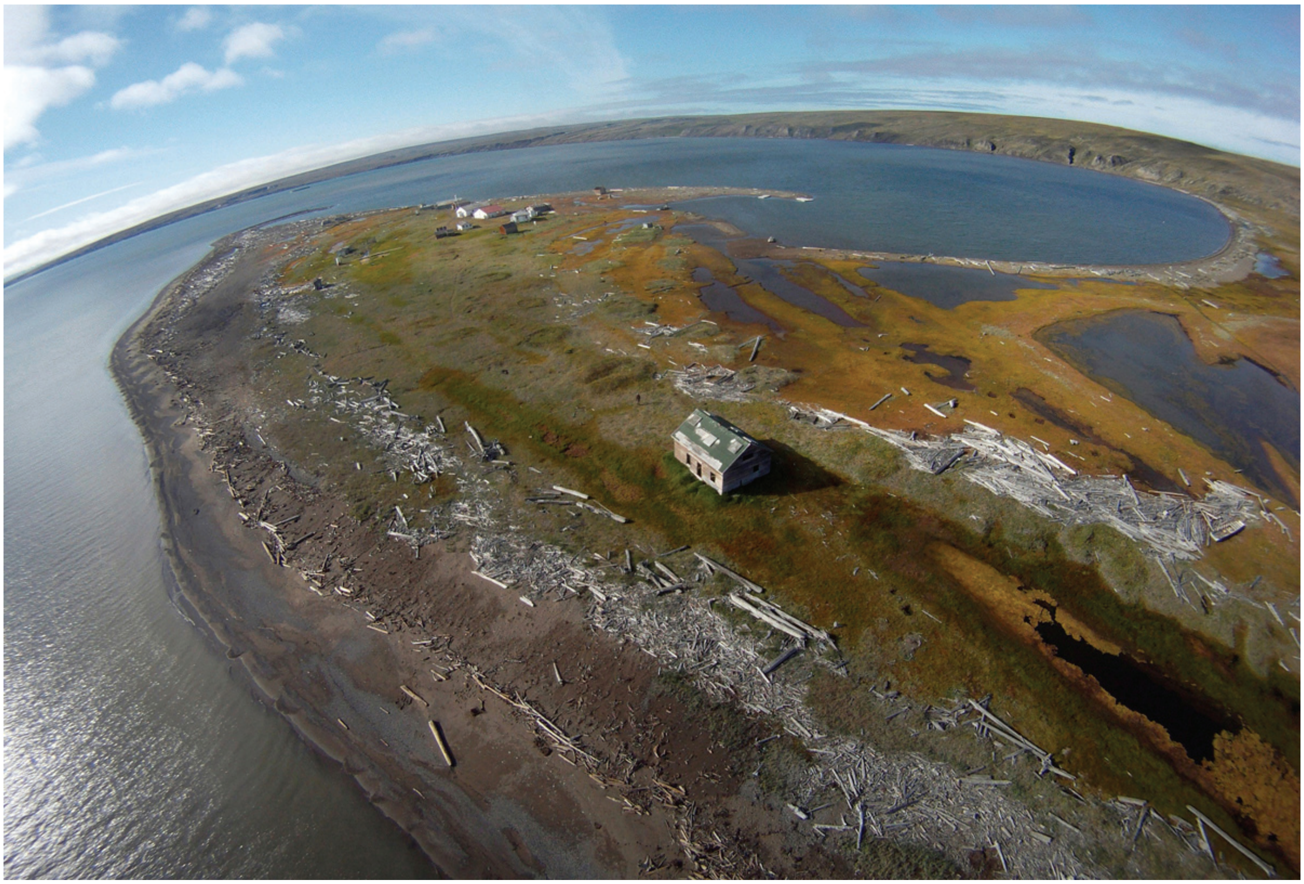

Photos (clockwise from top): An aerial view of Pauline Cove on August 24, 2011; Arctic Fox at Collinson Head on August 25, 2010; Park ranger Edward McLeod checks out a vacant Polar Bear den on June 19, 2010; A Rough-legged Hawk nest on June 19, 2010. Photos by Cameron Eckert.

Yukon Parks

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Executive Summary

The Herschel Island—Qikiqtaruk Inventory, Monitoring, and Research Program represents over two decades of work to measure and track ecological change, and impacts to the park ecosystem. The program is comprised of a suite of related projects ranging from thaw slump monitoring, breeding bird surveys, and vegetation phenology to beach landing-strip and visitor-impact monitoring. This program provides essential information to ensure the protection of park values and the maintenance of ecological integrity according to the park management plan; as well as an understanding of ecosystem function and climate change impacts at Qikiqtaruk and across the Beaufort Sea region.

Rapid environmental change is underway on Herschel Island, as highlighted through many components of this program. There are changes to permafrost; accelerated thawing and erosion through retrogressive thaw slumps; changes to vegetation with the proliferation of polargrass (*Arctagrostis latifolia*) and expansion of willows; declines in populations of several bird species, such as Ruddy Turnstone and Semipalmated Sandpiper; while the expansion of willows may be resulting in increases in shrub-dwelling species such as White-crowned Sparrow; Muskox have increased on Herschel while there is not yet a winner in the apparent competition between Arctic and Red foxes; the loss of raptor nests through coastal erosion has implications for the long-term health of these critical populations; Black Guillemots have declined significantly over 30 years though populations are currently stable; and changes in park visitation, especially with the opening of the Northwest Passage have created new challenges for park management and the protection of Herschel Island—Qikiqtaruk.

This program relies on the integrated involvement of Herschel Island rangers to ensure standardized data collection, data management, and to identify and address emerging threats to park values. As a result, the program provides exceptional capacity-building to park rangers – many of whom are young Inuvialuit who can take these skills and knowledge to further their careers and professional development. The program has for many years provided highly-valued field training to students through the STEP program – which is a unique opportunity for these students to gain work experience while learning about the natural and cultural history of Qikiqtaruk. The program provides data to graduate student degrees and researchers, national programs, and initiatives such as the newly published Herschel Island book (Burns 2012) – all of which in turn have benefits to the park. This program and associated research projects, through broad ranging field investigations of the Island's environment, have better enabled Herschel Island rangers and Yukon Parks to identify and respond to emerging issues and management challenges – which are benefits that extend beyond the collection of data and monitoring of trends.

This report provides an overview of each project, presents data summaries and key findings, and provides recommendations for the development or refinement of the program, and potential park management actions. It is intended both as a factual presentation of information, as well as a catalyst for discussion on the management of Herschel Island—Qikiqtaruk.

Contents

1. Introduction

The Herschel Island—Qikiqtaruk Inventory, Monitoring, and Research Program represents over two decades of work to measure and track ecological change, and impacts to the park ecosystem. The program has its origins in soil and vegetation mapping and inventories that were conducted in 1985 as part of the establishment of the park. Following those baseline studies, changes in the park ecosystem, particularly the vegetation, during park staff training in the summers of 1998-99; increases of one grass species, willows and lupines in a vegetation community type that covers 40% of the island were observed (Kennedy *et al.* 2001). As well, there were apparent reductions in frost action in the permafrost features associated with this vegetation community. It was clear that rapid environmental change was underway on Herschel Island and so a program of monitoring several biophysical components was established to track these long-term changes.

The program has now expanded to include a suite of related projects ranging from thaw slump monitoring, breeding bird surveys, and vegetation phenology to beach landing-strip monitoring. It is organized through a comprehensive instruction manual which is updated annually (Yukon Parks 2012). The key findings and data summaries presented here for each project may be based on different time periods depending on initiation dates and data summary periods. The program provides essential information to ensure the protection of park values and the maintenance of ecological integrity according to the park management plan; as well as an understanding of ecosystem function and climate change impacts at Qikiqtaruk and across the Beaufort Sea region. It relies on the integrated involvement of Herschel Island rangers to ensure standardized data collection, data management, and to identify and address emerging threats to park values. The program provides data to graduate student degrees and researchers such as the Arctic WOLVES project (Gauthier and Berteaux 2011), national programs such as the Canadian Tundra and Taiga Experiment (CANTTEX), and the Canadian Peregrine Falcon Survey, and initiatives such as the newly published Herschel Island book (Burns 2012). Monitoring information has also prompted new research including studies on vegetation change and coastal erosion on the Yukon's North Slope. An additional benefit of this program is that it has for many years provided highly-valued field training to students through the STEP program. This has included students from Wildlife Management Advisory Council (North Slope), the Porcupine Caribou Management Board, and Yukon Environment.

The purpose of this report is to i) provide an overview of each project which are components of the program; ii) present data summaries and key findings for each project; and, iii) provide recommendations for the development or refinement of the program, and potential park management actions.

2. Herschel Island—Qikiqtaruk Environment

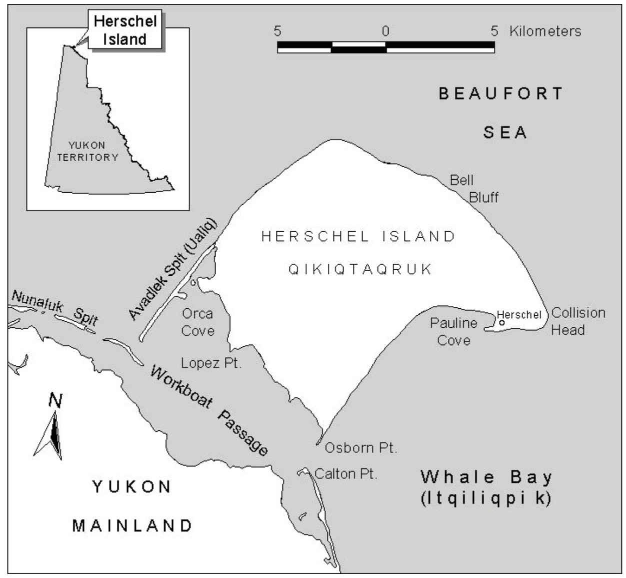

FIGURE 1. Herschel Island—Qikiqtaruk Territorial Park.

Herschel Island—Qikiqtaruk has an area of about 112 km^2 and is located in the Beaufort Sea off the Yukon's North Coast (Figure 1). It was established as a Territorial park in 1987 through the Inuvialuit Final Agreement (Indian and Northern Affairs Canada 1984). The newly published Herschel Island book provides a detailed and richly illustrated account of the natural and cultural history of the Yukon's Arctic island (Burn 2012). Herschel Island was one of the first settled sites of the Inuvialuit who call it Qikiqtaruk which means "it is island". The Inuvialuit know this land as an area rich in hunting and fishing and there is a long Inuvialuit history, discovered through extensive anthropological studies, which involves life on Herschel. The English name was given by arctic explorer Sir John Franklin in 1826 in honor of the Herschel family (Burn 2009). In 1890, this island housed a whaling community who had come to the Beaufort Sea in search of Bowhead Whales. Anglican missionaries and Royal Northwest Mounted Police (later Royal Canadian Mounted Police) followed and established themselves on the island. By 1907, the whaling era was over but the RCMP continued to use the island for breeding sled dogs until 1964.

Qikiqtaruk is part of the terminal moraine of a glacier that flowed down the Mackenzie Valley 40,000 years ago during the Wisconsin glacial period. Today the Beaufort Gyre brings warm, nutrient-rich, driftwood-laden fresh water-influenced currents to Herschel Island from the huge Mackenzie River Delta 130 km to the east.

Mammalian wildlife on the island includes Polar and Grizzly bears, Arctic and Red foxes, Porcupine Caribou, Muskoxen, Collared and Brown lemmings, Tundra Vole, Least and Short-tailed weasels, and Arctic shrew, with a few rare vagrants to the island such as Wolverine, Grey Wolf, Lynx, Pine Marten, and Arctic Ground Squirrel. Larger mammals cross over to the island from the mainland via ice bridges that form in the winter over the Beaufort. Marine mammals include Bearded and Ringed seals, (the latter of which are the most common marine mammal in the Beaufort), the Bowhead Whale (which was nearly hunted to extinction in the early 1900's), Beluga Whale, and rarely Walrus. A host of fish species inhabit the surrounding waters including Arctic cod, Arctic char, Pacific herring, and Arctic flounder. Over 100 species of birds have been seen on Herschel Island. Breeding has been confirmed for over 40 of these species to date (Eckert *et al.* 2000). There are more than 200 vascular plant species found on Herschel Island with a host of conspicuous flowering species. Research conducted in 1985 and 2000-2002 has shown increases in abundance of Polar-grass (*Arctagrostis latifolia*), prostrate willows (notably *Salix arcticus* and *S. reticulata*), and lupine (*Lupinus arcticus*) and a decrease in total lichen species (Kennedy *et al.* 2001).

3. Wildlife

3.1. Wildlife observations

Herschel Island rangers record their wildlife sightings throughout the operating season, generally mid-April to early September. Over 100 species of birds, 20 species of land mammals, and 6 species of marine mammals have been recorded over the years. Details recorded with each sighting include species, number seen, date, time, observer name(s), location, behaviour, weather, and habitat (mapped terrain unit and vegetation type). The wildlife observations database now encompasses a 23 year record of wildlife on Herschel Island. It provides an invaluable baseline understanding of a wide range of species, their seasonal patterns, habitat and terrain use, and population trends. This information is fundamental to detecting future change, especially as the climate continues to warm, ecosystems respond, and sea ice is further diminished.

The Herschel Island Management plan (Yukon Environment 2006) describes the protection of the integrity of ecosystems and wildlife as fundamental to the park's vision. Monitoring the island's wildlife through a record of observations made by park rangers enables park management that acknowledges and is responsive to this vision. The wildlife observations have provided the basis for significant research projects on Herschel Island over many years. This has included studies of Red and Arctic foxes, Polar Bears, Bowhead Whales, Collared Lemmings, Black Guillemots, birds of prey, shorebirds, and a variety of other species and aspects of Arctic ecology. As well, the data have provided valuable information for species at risk status assessments.

Key Findings

The wildlife observation database holds 6532 records spanning 23 years (1988-2010). Table 1 summarizes the number of records per year, and the high count each year for each species. Non-systematic sightings data such as these are not generally suitable for statistical trend analyses; however, the summary of high counts (Max) for each species across years does reveal trends. Species accounts (below) summarize the status of each mammal species including the total number of records and number of years seen, details on habitat, terrain, and trends, as well as any noteworthy observations. The heading for each account provides common, scientific, and Inuvialuit names.

Wolf *(Canis lupus)* – Amaguq / Amaruq. Wolf is an occasional visitor to the island (5 records; 4 years); all but one were of lone individuals. A black Wolf seen 17-20 May 2001 accounts for two records.

Arctic Fox *(Vulpes lagopus)* – Tiriganniaq. Arctic Fox likely occurs annually (94 records; 19 years). Arctic Foxes are generally present on the island when the rangers arrive in late April. At that time pairs have already found dens for breeding and rearing their young. A survey in 2008 investigated 59 fox dens of which one was occupied by reproductive Arctic Foxes, and one by reproductive Red Foxes; the low occupancy was attributed to low prey abundance that year (Reid 2009). Young foxes are seen out of the den, playing at the entrances, as early as the third week in June. High counts (3-6 animals) recorded by the rangers are in August and through September when young are out of the den and family groups are hunting. It seems likely that most foxes leave the island in winter in search of food, either on the mainland or out on the sea ice scavenging polar bear kills. However, a satellite tagged male Arctic Fox recently spent a whole year at its territory near the centre of the island. Researchers have investigated the potential displacement of Arctic Foxes by Red Foxes on the Yukon's North Slope and Herschel Island (Gallant *et al.* 2009). A complete survey of fox dens on Herschel Island in 2008 replicating surveys done in the 1980s was used to answer this question (Reid 2009). The results indicated that Red Foxes do not appear to be increasing; Arctic Foxes do not appear to be decreasing; and that Red Foxes do not appear to be taking over Arctic Fox dens (Gallant *et al.* 2009). Observations by the rangers confirm that Arctic and Red foxes are present in most years, and that neither appears to have noticeably increased or decreased.

Red Fox *(Vulpes vulpes)* – Kayuqtut. Red Fox occurs almost annually (100 records; 20 years). Individuals are recorded according to colouration as "red", "cross", or "silver" fox. Foxes are present on the island when the rangers arrive in late April, and observations continue into September. While Red Foxes are known to breed on Herschel Island (e.g. Gallant *et al.* 2009), observations of family groups have not been recorded by the rangers. High numbers of records in some years may result from one or two individuals being seen repeatedly near the settlement at Pauline Cove. For example, in 2005 an individual was seen on numerous days at the den site near Pauline Cove, but no reproductive activity was observed.

Grizzly Bear *(Ursus arctos)* – Aktaq / Aklak. Grizzly Bear is seen almost annually (72 records; 19 years). Most of the observations are of lone individuals wandering or feeding. There are 8 records of sows with cubs with the highest number being 3 cubs. There has been no apparent change in numbers or frequency since 1988. This information can contribute to an understanding of the status of Grizzly Bears on the North Slope (e.g. Wildlife Management Advisory Council (North Slope) and the Aklavik Hunter and Trappers Committee 2008). An apparent hybrid Polar Bear x Grizzly Bear was observed by the rangers on the North Slope mainland on 23 May 2010. This record is especially noteworthy as researchers (eg. Kelly *et al.* 2010) are becoming increasingly interested in hybridization related to rapid ecosystem change in the Arctic.

Polar Bear *(Ursus maritimus)* – Nannuit / Nanook. Polar Bears occur in small numbers at Herschel Island and are seen in most years on the sea ice or wandering near Pauline Cove looking for food. There are 28 records including 5 observations of sows with cubs or yearling cubs, with the rest pertaining to single individuals. Polar Bears are known to den on Herschel Island and in 2010 two dens were found along Bell Bluff after the bear had departed although one was still in the area on 21 April. There are significant concerns over the health of Polar Bears populations in the southern Beaufort Sea region (Regehr *et al.* 2006; Hunter *et al.* 2007). Researchers have found that cub condition and survival have declined and that nutritional limitations may be associated with changing sea-ice conditions (Rode *et al.* 2007). While the number of Polar Bears seen at Herschel Island is relatively low, the species' denning status there makes the island an important part of the bear's ecology and underscores the importance of recording signs of denning activity along with observations. There have been a number of early fall observations of Polar Bears on Herschel Island, and it seems likely that this could increase with sea ice decline as has occurred in Alaska (e.g. Schliebe *et al.* 2008). Bear awareness is a training component for park rangers and helps ensure both the protection of people as well as bears on the island. Bear awareness training for researchers should also be a condition of Park-Use Permits.

Pine Marten *(Martes martes)* – Qavviatchiat. There is one record of Pine Marten; an individual photographed at Pauline Cove on 1 May 2004.

Ermine *(Mustela erminea)* – Itiriakpuk. There are two records of Ermine or Short-tailed Weasel, both at Pauline Cove; one on 15 May 1991, and one on 20 August 2008.
Least Weasel *(Mustela nivalis)* – Tigiak / Itiriaq. The tiny Least Weasel is a fairly common but rarely seen resident species on Herschel Island. There are 5 records (4 years) spanning 5 June to 25 August. Researchers on Herschel Island found this species infrequently during lemming surveys (Reid 2009).

Mink *(Mustela vison)* – Itigiaqpait. There is one record of Mink; an individual seen at Pauline Cove on 7 July 1997.

Wolverine *(Gulo gulo)* – Qavvik / Kuvvik. Wolverine is a regular visitor to the island (17 records; 10 years). All observations are of single individuals; one seen wandering the shoreline and on the sea ice accounted for 4 records during 6 May to 24 Aug 2004.

Lynx *(Lynx* canadensis*)* – Niutuiyit / Niutuiyiq. There is one record of Lynx; an individual seen at Pauline Cove on 6 May 2010.

Moose *(Alces alces)* – Tuttuvak. Moose is an occasional visitor (6 records; 3 years). A cow with two calves seen 30 May to 11 June 1992 accounts for 3 records.

Porcupine Caribou *(Rangifer tarandus granti)* – Tuttut / Tuttu. Porcupine Caribou are the most frequently encountered large wildlife on the island (1052 records; 23 years). Small herds occur regularly from late April through August. Seasonal high counts have been fairly consistent over the years with herds ranging in size from 21 to 75 animals. The only outlier was 1990 when the highest count recorded was of just 3 animals. Herd composition generally includes bulls, cows, calves, and yearlings. In some years, the caribou calve on the island. The animals are typically observed feeding in tundra habitats, most often in *cottongrass/moss* and *Arctic willow/dryas/vetch* vegetation classes.

Muskox *(Ovibos moschatus)* – Oomingmuk / Umingmait. Muskox on the Yukon's North Slope originated from an introduction of 51 animals at Barter Island, Alaska in 1969. Muskox have been recorded irregularly on the island (119 records; 13 years), although it now appears that that this species occurs annually in increasing numbers. A lack of observations during 2002-2005 indicates that their presence on the island has been variable in the past decade. However since 2006, a relatively large herd has been present. The highest count during 1998 to 2005 was of a herd of 10 animals at Collinson Head in

1996. The population increased during 2006-2010 with a high count of 45 (37 adults, 8 young) at Collinson Head on 15 June 2008. The Wildlife Management Advisory Council (North Slope) together with the Yukon Government is working towards a Muskox management plan for the North Slope. Tracking Muskox observations at Herschel Island will provide important information for the management of this species across its range.

Lemmings, voles, and shrews. The three common small mammals on Herschel Island are Collared Lemming *Microtus oeconomus*, Tundra Vole *Dicrostonyx groenlandicus*, and Arctic Shrew *Sorex arcticus*. The vole is the species most commonly seen and recorded by the rangers as it occurs in good numbers around the settlement at Pauline Cove. The lemming is found in upland tundra areas and while common in most years, it is infrequently encountered due to its habit of hiding in the tussocks. Likewise, the shrew is rarely seen. These small mammals are a key to the island's ecology as they are prey for raptors and jaegers and therefore a fundamental part of the Arctic food web (Reid 2009). It is likely that a specific monitoring protocol (e.g. spring surveys for winter nests) would be required to effectively monitor fluctuations in lemming populations.

Bearded Seal *(Erignathus barbatus)* – Ugꞅuitch / Ooruk. The large Bearded Seal occurs regularly in small numbers after mid-June (30 records; 10 years). Individuals are seen on the sea ice and waters around the island, especially at Avadlek Spit, and occasionally one will haul out on the beach at Pauline Cove. All but one record were of single individuals; the high count being two on 28 June 1996.

Ringed Seal *(Pusa hispida)* – Natchiit. Ringed Seal likely occurs annually on the sea ice and waters around Herschel Island (132 records; 16 years). The highest numbers are recorded in early to mid June when seals lying beside their breathing holes are scattered widely across the sea ice. High counts include 400-500 on 20 June 1994; 198 on 10 June 1998; 150 on 19 June 1995; 130 on 6 June 2010; and 120 on 19 June 1994. While high numbers of Ringed Seals are recorded, the observations to date have been not been specifically standardized to monitor populations, and with this qualification no trends are apparent. Ringed Seal population trends could be effectively monitored at Herschel Island with a standardized counting protocol.

Walrus *(Odobenus rosmarus)* – Aiviq. While there are no records in the database, one of the interpretive binders from the mid-1980s and now the recently published Herschel Island book (Burns 2012) contain a photo of a Walrus on the beach at Pauline Cove in late summer or fall.

Beluga Whale *(Delphinapterus leucas)* – Qilalukkat. Beluga Whales occur annually (63 records; 18 years) from mid to late June through August. Belugas seen at Herschel are part of the Beaufort Sea population, estimated at about 20,000 individuals (Harwood *et al.* 1996), which moves from overwinter areas in the Bering Sea into the Beaufort to feed in the summer months. Pods of adults and grey juveniles are regularly seen in Thetis Bay and Pauline Cove, often quite close to shore. High counts include 60 in Workboat Passage on 4 July 1990; 30 in Thetis Bay on 28 June 1993; 30 in Thetis Bay on 25 June 1998; 30 in Pauline Cove on 10 August 1998; and 30 off the north side of the island on

26 July 2006. High counts ranging from 20 to 60 were recorded in at least 7 years from 1990 to 2010 with no apparent trends.

Bowhead Whale *(Balaena mysticetus)* – Arvirit. Bowhead Whales are seen in small numbers (29 records; 11 years) from mid July through September in the waters north and east of Herschel Island, and occasionally right in Pauline Cove. High counts include 4 on 5 August 1995; 4 on 6 September 1997 and 11 on 17 August 2010. While the numbers of Bowheads are not high, the island has played a central role in whale monitoring research in the Beaufort region. In August 2010, a joint Alaska Department of Fish and Game / Canadian Department of Fisheries and Oceans staged a Bowhead satellite tagging program from Herschel Island (Quakenbush *et al.* 2010). The whales are currently being tracked on their westward movement towards the Chukchi Sea.

Birds. Over 100 species of birds have been documented on Herschel Island (Eckert *et al.* 2000; Burns 2012). While the daily record of bird observations is not a standardized survey, it does establish a baseline inventory of the bird life on the island, and has proven valuable for detecting some conspicuous long-term population trends. This is especially relevant as numerous Arctic breeders, particularly shorebirds, are suffering dramatic population declines (Donaldson *et al.* 2000; Brown *et al.* 2001).

Ruddy Turnstone (*Arenaria interpres*). This shorebird was known as an uncommon nester and a fairly common migrant at Qikiqtaruk twenty years ago (Talarico and Mossop 1986; Eckert 1996). Rudy Turnstones were regularly observed by the rangers during 1988-1997. However, in recent years no nesting birds have been found, and the rangers have only recorded turnstones once on migration since 1997. While habitat change is underway on the island, for example, the recent proliferation of polargrass (*Arctagrostis latifolia*) (Kennedy *et al.* 2001), this would not likely account for the disappearance of nesting Ruddy Turnstones. The continent-wide declines experienced by this species (Donaldson et al. 2000; Brown *et al.* 2001) seem to have reached Herschel Island.

Rare sightings. The value of documenting the occurrence of unusual or rare species has become widely appreciated with increasing concern for climate change and its impact on species' ranges. Community members in the Mackenzie Delta region have seen numerous species well beyond their normal ranges in recent years – such as a Turkey Vulture in Fort McPherson, and a Blue Grosbeak in Inuvik. Herschel Island rangers and visiting biologists have photo-documented many of the rare birds and mammals on the island. This has included western species from Siberia and the Bering Sea region such as Whooper Swan, McKay's Bunting, Common Ringed-Plover, Wood Sandpiper, and Red-necked Stint, as well an increasing number of southern birds including Yellow-rumped and Yellow warblers, White-throated Sparrow, and Red-winged Blackbird. These observations represent early warning signs that ecosystems are changing.

TABLE 1. Total number of observations (N) and the highest single count (Max) for all terrestrial and marine mammals at Herschel Island-Qikiqtaruk Territorial Park, 1988-2010.

Species		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Grey Wolf	N	1					1								2								1	
	Max	1					1								1								2	
Arctic Fox	N	6	2		1	2	7	10	19	2	7	14		1	1		1	1	2	2	8		2	6
	Max	6	1		1	1	6	1	4	1	1	1		1	1		1	1	2	1	3		1	5
Red Fox	N		1		2	2	3		5	3	3	3		1	3	3	9	7	20	11	13	1	6	4
	Max		1		1	1	2		1	1	2	1		1	1	1	2	1	2	1	2	1	1	1
fox sp.	N	4		1																	1	1	1	
	Max	3		1																	2	1	1	
Grizzly Bear	N	5		2	3	2	2	5	1	4	4	5		4	9	2			1	1	1	4	10	7
	Max	1		4	1	1	1	1	2	3	1	1		2	2	2			1	1	1	3	3	1
Polar Bear	N	1	1		2	1	2	2			4	4			2		2		2			2		3
	Max	1	1		3	1	1	1			2	3			1		1		1			1		4
Pine Marten	N																	1						
	Max																	1						
Ermine	N				1																			
	Max				1																			
Least Weasel	N										2			1						1	1			
	Max										1			1						1	1			
weasel sp.	N		1		1					3	1													
	Max		1		1					2	1													
Mink	N										1													
	Max										1													
Wolverine	N	2			1	1	1			1		1						4			1	2	3	
	Max	1			1	1	1			1		1						1			1	1	1	
Lynx	N																							1
	Max																							1
Moose	N					3		1	2															
	Max					3		2	1															
Porcupine Caribou	N	22	5	6	13	13	32	33	38	18	16	58	11	19	38	19	53	72	116	111	160	35	80	84
	Max	40	32	3	30	24	25	27	18	40	30	75	28	60	74	38	21	75	51	40	70	49	50	40
Muskox	N				12				11	18	4	13	8	3	4					2	9	4	17	14
	Max				9				6	10	1	2	2	3	1					23	34	45	42	41

Species		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
lemming sp.	N								4	1							1					1		1
	Max								3	1							1					1		2
Tundra Vole	N							5																
	Max							1																
vole sp.	N							1	2	6	2											1		
	Max							1	3	6	1											3		
Bearded Seal	N	3				2	3	2		2	1	12					1						1	3
	Max	1				1	1	1		2	1	1					1						1	1
Ringed Seal	N	1		10	4	4	11	34	20	9	11	17					2	2		1	1	2		3
	Max	3		100	5	2	14	500	150	56	15	198					15	1		1	1	2		130
seal sp.	N	25	8	5	7	1	3	5	11	8	6	4					1				4	3	3	1
	Max	311	75	9	36	12	5	4	26	20	21	2					1				18	20	1	1
Beluga Whale	N	1	1	1	1	2	8	4	4	3	4	14					2	3	1	2	3	3		6
	Max	1	3	60	4	7	30	10	10	12	10	30					6	10	20	30	6	20		20
Bowhead Whale	N	1		1		2			4		6	6					1		1	1		1		5
	Max	1		3		2			4		4	2					2		1	1		3		11

Recommendations

- The daily record of wildlife observations should continue as a high priority of the monitoring program. It has proven to be an effective means of monitoring a wide diversity of North Slope and Beaufort Sea region species;
- Ongoing training on monitoring protocols and species identification is recommended for new rangers;
- Continue bear awareness training for new rangers, and consider bear awareness training for researchers as a condition of Park-Use Permits;
- Systematic counts at appropriate times in the season could enhance monitoring for some species. For example, Ringed Seal, Collared Lemming, and migratory birds.

3.2. Breeding bird survey

This project was initiated to systematically monitor breeding bird populations on Herschel Island (Talarico and Mossop 1986). A transect, 2.1 km in length, comprised of three sections was established around Pauline Cove and is surveyed twice in June to record breeding bird diversity and abundance. The rangers walk the three sections at an even pace while recording all species seen or heard, behaviour, and breeding evidence within about 50 metres of the survey line. The surveys are conducted on about 9 June (early), and again on about 29 June (late). In some years, just one survey was conducted.

The survey route is as follows;

- Section 1 (467m): Point A (McKenna House) to Point B (250m east of Mission House);
- Section 2 (556m): Point B to Point C (RCMP graves);
- Section 3 (1000m): Point C to beach and along beach to Point D (Simpson Point).

Key Findings

Table 2 summarizes breeding bird survey results for 65 species recorded during 1990-2012. Totals for each species are shown by Early and Late surveys. Zeros are omitted from the table to reduce clutter (i.e. a blank cell = 0); a double-dash indicates that no survey was conducted (i.e. "--" = no data). While the table includes grand totals, they can only be used to compare years where both early and late surveys were conducted.

The breeding bird survey has recorded a wide diversity of Herschel Island's breeding birds. However, this survey is best suited for detecting trends for species that commonly nest around Pauline Cove; specifically, Common Eider, Semipalmated Plover, Semipalmated Sandpiper, Baird's Sandpiper, Red-necked Phalarope, Glaucous Gull, Lapland Longspur, Snow Bunting, Savannah Sparrow, and Common and Hoary redpolls. All but two of these species do not conspicuous positive or negative trends; their populations appear stable. Semipalmated Sandpiper appears to show a slight negative trend. This species is known to be declining across its North American range (Donaldson *et al.* 2000) and will be a species to closely monitor in the coming years at Herschel Island. Most concerning is Red-necked Phalarope which has shown a pronounced decline through the 1990s; and has not been detected on a survey since 1999. These results are consistent with continent-wide declines shown by Red-necked Phalarope (Donaldson *et* *al.* 2000; Brown *et al.* 2001). Inuvialuit have also reported significant declines in Red-necked Phalarope numbers in summer along the Yukon's North Slope (Wildlife Management Advisory Council (North Slope) and Aklavik Hunter and Trappers Committee 2003).

The breeding bird survey also indicates a slight increase in White-crowned Sparrow around Pauline Cove. This shrub-nesting species was first detected on the surveys in 2009, and was subsequently recorded in 2010, and 2012. This potential increase in White-crowned Sparrow numbers corresponds to the expansion of shrubs around Pauline Cove (Myers-Smith *et al.* 2011). This could be an early indicator of habitat changes resulting in changes in local bird populations.

Recommendations

- The breeding bird survey is an effective way to monitor local breeding bird populations around Pauline Cove and should continue as a high priority of the monitoring program;
- Investigate more focused monitoring on declining species, specifically Semipalmated Sandpiper and Red-necked Phalarope;
- Continue emphasis on protecting wetland and wet tundra habitats on Herschel Island which provide nesting and migration habitat for Semipalmated Sandpiper and Red-necked Phalarope;
- Seek research collaborations to investigate the relationship between shrub-expansion and shrub-nesting species (e.g. White-crowned Sparrow);
- Annual training for rangers in bird identification skills and survey protocols will enhance the long-term strength of the results.

TABLE 2. Total number of individuals for all species recorded on early and late June breeding bird survey at Herschel Island-Qikiqtaruk Territorial Park, 1990-2012. A double dash indicates no survey was conducted, and a blank indicates zero birds were recorded.

Species	Timing	1990	1991	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Brant	early	3	--	--					2							3			--			3		11
	late				--	--							--									--		
Gr. White-fronted Goose	early		--	--	2			5		2	3						5		--	2		8	4	31
	late				--	--		2		3			--	2								--		7
Snow Goose	early		--	--								1							--					1
	late				--	--							--									--		
Canada Goose	early		--	--			2	2			7	2	1				2		--			4		20
	late				--	--					5	4	--									--		9
Tundra Swan	early		--	--													2		--					2
	late		4		--	--		2		2		3	--	1	2		2	2	2		2	--	1	23
American Wigeon	early		--	--							2	2	4						--			3		11
	late			3	--	--					12		--				23	4				--	2	44
Mallard	early		--	--				2			5	2							--					9
	late				--	--	3				4		--									--		7
Northern Shoveler	early		--	--		4		2					8						--	2		1		17
	late		2		--	--							--									--		2
Northern Pintail	early	2	--	--	7	2	12	7	19	29	51	16	7	12	5		3		--	4			4	180
	late		2	2	--	--	14	6	6	4	7	9	--	5	10				2			--	2	69
Green-winged Teal	early		--	--	2	12	4	1		2	6		1					3	--	1				32
	late			2	--	--							--									--		2
Canvasback	early		--	--		8													--					8
	late				--	--							--									--		
Lesser Scaup	early		--	--															--					
	late	1			--	--				10			--									--		11
King Eider	early		--	--															--				1	1
	late				--	--							--									--		
Common Eider	early		--	--		10	6	5	19	13	1		30	5		4	23	18	--	32	4	36	39	245
	late	16	24	13	--	--	5	30	12	15	23	8	--	3	45	6	36	22	3	1	13	--	10	285
eider sp.	early	25	--	--															--					25
	late	1			--	--							--									--		1

Species	Timing	1990	1991	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Surf Scoter	early		--	--															--					
	late			34	--	--		0		0		11	--			1	2	12				--		60
White-winged Scoter	early		--	--															--				3	3
	late				--	--	32		7		7	10	--							22		--		78
Long-tailed Duck	early		--	--		1	2								1		5		--	2				11
	late			8	--	--	0		1	4	2		--			7	2					--		24
Common Goldeneye	early		--	--															--					
	late				--	--	6						--									--		6
Common Merganser	early		--	--					1										--					1
	late				--	--				23			--									--		23
Red-breasted Merganser	early		--	--															--					
	late				--	--	1						--					1				--		2
duck sp.	early		--	--						1	5								--					6
	late				--	--							--									--		
ptarmigan sp.	early	6	--	--			1	3	2										--					12
	late				--	--							--									--		
Red-throated Loon	early		--	--			2		2	3		1		2		1	1		--	4		3		19
	late				--	--		4	1	1			--	2			1		3			--		12
Pacific Loon	early		--	--															--					
	late		2		--	--				2			--									--		4
Common Loon	early	1	--	--					1										--					2
	late				--	--					3		--									--		3
loon sp.	early		--	--														1	--					1
	late				--	--							--									--		
Osprey	early		--	--									1						--					1
	late				--	--							--									--		
Northern Harrier	early		--	--				1		1	1								--					3
	late												--									--		
Rough-legged Hawk	early		--	--		1			1	2				1					--			1		6
	late						1	1		1			--									--		3
Golden Eagle	early		--	--											1				--					1
	late												--									--		

Species	Timing	1990	1991	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Peregrine Falcon	early		--	--															--					
	late												--	1								--		1
Sandhill Crane	early		--	--		2		4		1							3		--			1		11
	late												--									--		
American Golden-Plover	early		--	--							1		1						--					2
	late								1	3			--									--		4
Semipalmated Plover	early		--	--	17				3		1			3	6		2		--	3	6		6	47
	late	27		4	--	--				4		3	--			4	5	8	1	5		--	2	63
Lesser Yellowlegs	early		--	--							1	2							--					3
	late	5			--	--							--									--		5
Whimbrel	early		--	--			1												--					1
	late				--	--							--									--		
Ruddy Turnstone	early		--	--															--					
	late	3			--	--							--									--		3
Semipalmated Sandpiper	early	15	--	--	21		11	4	1	3	4	8		1	3	1	1	6	--	7	4	8	6	104
	late		10	38	--	--	5	25	8	9	5	2	--		1	1	2	1	3	4	3	--	7	124
Western Sandpiper	early		--	--															--					
	late	7			--	--							--									--		7
Least Sandpiper	early		--	--															--					
	late				--	--							--		1					1		--		2
White-rumped Sandpiper	early		--	--															--				1	1
	late				--	--							--									--		
Baird's Sandpiper	early		--	--		5	4		14					1	2			3	--	1	6	1		37
	late		3	2	--	--	2		4				--	1		4		3	1	4		--	10	34
Pectoral Sandpiper	early		--	--															--					
	late				--	--							--					1				--		1
Long-billed Dowitcher	early		--	--															--					
	late				--	--		1			1		--									--		2
Wilson's Snipe	early		--	--									1						--					1
	late				--	--							--									--		
Red-necked Phalarope	early	6	--	--	3		9	5		2									--					25
	late	4	8	3	--	--	3						--									--		18

Species	Timing	1990	1991	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
phalarope sp.	early		--	--															--					
	late				--	--							--									--		
shorebird sp.	early		--	--		16		3				5							--	4	3			31
	late				--	--							--									--		
Pomarine Jaeger	early		--	--		4		4											--					8
	late	1			--	--							--									--		1
Long-tailed Jaeger	early	1	--	--			1	1			2	2		4	2		8	1	--		1			23
	late			5	--	--	4	6	7	3		1	--	1								--		27
Mew Gull	early		--	--															--					
	late				--	--						1	--									--		1
Herring Gull	early		--	--															--					
	late	3			--	--							--									--		3
Glaucous-winged Gull	early		--	--															--	1				1
	late				--	--							--									--		
Glaucous Gull	early	2	--	--	1	4	5	1	13	6	4	3	4	2	3	4	1	4	--			7	4	68
	late		4	5	--	--	5	11	5	3	2	7	--	1	5	9	4				4	--	1	66
Ivory Gull	early		--	--						1									--					1
	late				--	--							--									--		
gull sp.	early		--	--															--					
	late	2			--	--							--									--		2
Black Guillemot	early	33	--	--		1	2		5										--					41
	late	10	37		--	--	1	17	3	15	6	25	--		4	3	26		1	2	29	--	7	186
Snowy Owl	early		--	--															--					
	late				--	--				1		1	--									--		2
Short-eared Owl	early		--	--		1		1		3		1							--		3			9
	late				--	--							--									--		
Common Raven	early		--	--															--					
	late	1			--	--							--									--		1
Cliff Swallow	early		--	--															--					
	late	3			--	--							--									--		3
American Robin	early		--	--															--					
	late				--	--			1				--									--		1

Species	Timing	1990	1991	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
American Pipit	early		--	--															--					
	late				--	--							--								1	--	1	2
Lapland Longspur	early	23	--	--	22	12	18	9	8	8	5	11	10	15	9	8	9	12	--	15	38	15	14	261
	late	32	38	26	--	--	16	9	15	1	14	8	--	17	25	7	6	14	12	8	33	--	22	303
Smith's Longspur	early		--	--															--					
	late		2		--	--							--									--		2
Snow Bunting	early	4	--	--	6	2	3	1	8	6	3	6	1	5	1	3	3	1	--	2	8		3	66
	late	6	3	2	--	--	5	8	6	4	6	2	--	3	3	2	6	8	7	7	2	--	4	84
Savannah Sparrow	early		--	--		3			1	2		1	1	3	9			5	--			13	12	50
	late		9	1	--	--		2	9	1	2	2	--		4			8	10	11	1	--	18	78
White-crowned Sparrow	early		--	--															--	1	4		3	8
	late				--	--							--							3		--	1	4
Red-winged Blackbird	early		--	--				1										1	--					2
	late				--	--		1					--									--		1
Common Redpoll	early		--	--	2				5		5	3							--					15
	late				--	--			1	2		12	--		2	2		3	2			--		24
Hoary Redpoll	early		--	--			8								2			4	--					14
	late	4	4	4	--	--	2		1				--						2	8		--		25
redpoll sp.	early		--	--				1											--		7			8
	late				--	--							--							12		--	13	25
redpolls lumped	early		--	--	2		8	1	5		5	3			2			4	--		7			37
	late	4	4	4	--	--	2		2	2		12	--		2	2		3	4	20		--	13	74
passerine sp.	early		--	--							3			2					--	13	2			20
	late				--	--	1						--	1	1							--		3
species unknown	early		--	--	1							5	1						--	3				10
	late				--	--						1	--									--		1
TOTAL	early	121	--	--	84	88	91	60	105	85	110	71	71	56	44	24	68	59	--	97	83	104	100	1521
	late	126	152	152	--	--	106	128	88	111	99	110	--	38	103	46	115	87	49	88	91	--	101	1790
	TOTAL	247	152	152	84	88	197	188	193	196	209	181	71	94	147	70	183	146	49	185	174	104	201	3311

3.3. Raptors

This ground-based survey was initiated in 2003 to monitor nesting Peregrine Falcons and Rough-legged Hawks. Rangers walk a 10-km transect checking cliff-side nesting habitat from Pauline Cove to Bell Bluff, around Collinson Head and back to the cove. The location of active nests, and the number of eggs and chicks are recorded; as well as nests of other species which are incidentally encountered; especially, Canada and Snow geese, Common Eider, Sandhill Crane, Parasitic and Long-tailed jaegers, Snowy and Short-eared owls, American Pipit, Lapland Longspur, and Savannah Sparrow. Surveys are done twice each year; on about June 20 to check for occupancy of nest sites and to count eggs, and again on about July 26 to check for nest success and record chick numbers.

Key Findings

The large number of old nest sites on the island, combined with the tendency for active nests to completely disappear when they fall into the ocean due to erosion has created challenges for this relatively simple survey. As a result, data could only be accurately summarized for 6 years since 2003 (Table 3). In fact, one of the primary findings of this survey has been that each season a high number of active nests of Peregrine Falcon and Rough-legged Hawk fall off the cliffs due to coastal erosion. Accelerated erosion associated with climate change (e.g. Lantuit and Pollard 2004, 2008) has therefore had a negative impact on raptor nesting productivity on Herschel Island. At this time, we do not recommend specific mitigations for nest loss through erosion, such as artificial nesting platforms, to improve raptor nesting success. The navigational towers on the south side of Herschel Island are used by nesting Rough-legged Hawks, but they are also used by Common Ravens. So artificial nest platforms would almost certainly benefit ravens to the detriment of other nesting birds.

TABLE 3. Total number of nests, successful nests, and chicks for Peregrine Falcon and Rough-legged Hawk at Herschel Island, Yukon.

	2005	2006	2007	2009	2010	2012
Peregrine Falcon						
Nests	1	2	2	3	1	1
Successful nests	0	2	1	3	1	0
Chicks	0	5	3	8	3	0
Rough-legged Hawk						
Nests	4	2	4	2	4	4
Successful nests	1	1	1	1	1	1
Chicks	4	3	3	3	3	4

Recommendations

- Continue to work with rangers to identify survey challenges, refine protocols, and improve consistency of data over time;
- Identify climate change risks to nesting raptors for management plan considerations, though direct management action is not recommended at this time.

3.4. Black Guillemot population and nesting success

The Black Guillemot (*Cepphus grylle*) is a boldly coloured seabird with a circumpolar distribution. The Yukon's only nesting colony, and one of very few in the western Arctic, is on Qikiqtaruk (Sinclair *et al.* 2003; Eckert *et al.* 2006). Here the guillemots lay their eggs in nest boxes (put up in 1985-86) and crevices in the historic Anglican mission house at Pauline Cove. The colony has been monitored for population and nesting productivity since the mid-1980s, and the continuation of this work is identified as a high priority in the park management plan (Yukon Environment 2006), and the Yukon North Slope Long Term Research and Monitoring Plan (Wildlife Management Advisory (North Slope) 2000). This species' position at the top of the food chain makes it a valuable indicator of the ecological integrity of the park environment. Heightened concern about the health of the colony arose after very poor nesting success in 2003 (2 chicks) and 2004 (no chicks). The nearest Black Guillemot colony to Herschel Island, located at Point Barrow, Alaska (650 km northwest of Herschel), which has about 150 breeding pairs, also had poor productivity in 2003 and 2004 (Divoky 2005). Researchers at Point Barrow have found that nesting productivity is influenced by near-shore sea ice conditions with poor nesting success observed when the ice moves out early (Divoky 2005). The warming climate in the Arctic may well affect the long-term health of Black Guillemot populations.

Since 2005, consistent efforts have been made to count the total number of adult Black Guillemots. In 2006, the monitoring was expanded to include colour-banding of chicks. This is a safe means of individually marking birds whereby a small numbered metal band and a coloured plastic band are attached to a bird's leg. This enables tracking of yearly survival and dispersal, and enhances our understanding of factors associated with population changes. A key aspect of this monitoring is to determine if guillemots hatched on Herschel return there to breed. In other words, is the colony's population health dependent on its own nesting success?

Key Findings

Table 4 summarizes yearly totals for the Black Guillemot adult population, total number of nests, eggs, and chicks produced at Herschel Island. *Early* (mid-July) and *late* (mid- to late-August) totals for nests indicates the number of nests abandoned through the season; while totals for eggs and e*arly* (early-August) and *late* (mid- to late-August) totals for chicks indicates brood reduction through the season. August nest checks were not conducted in some years and a double-dash (--) represents missing data. The population has remained relatively stable since 2005 at 40-60 adults, though still well below the high counts recorded by Ward and co-workers (1986) nearly 30 years ago (e.g. 107 in 1984, 83 in 1985, and 90 in 1986). The number of nests and chicks produced reached a low of zero in 2004, but has since rebounded. As of 2012, the total number of nests and chicks produced do not appear significantly lower than that recorded in 1998-99, just prior to the crash of 2003-04.

What happened in 2003-2004? In 2003, the nest check on 20 June recorded 8 eggs in 7 nests, about normal for the date, but also 5 dead adult Black Guillemots which was highly unusual. On 21 August the nest check recorded 2 chicks in 2 nests, none of the eggs laid in June had hatched and there was another dead adult. This near-complete nesting failure along with 6 dead adult guillemots indicated that both nesting productivity and the health of adult birds were highly stressed. The weather records show that temperatures (0 to 6^{o}C) were cold but about normal for the date. In 2004, the nest check on 7 August recorded 13 eggs and no chicks, well past the date when chicks are expected. The nest check on 21 August recorded 13 eggs and one dead chick. It was apparent that the eggs would not hatch and likely most adults had abandoned their nests. The pattern of this nesting failure suggests that a lack of food may have been the cause whereby the adults had enough resources to lay eggs, but not enough to continue the nesting cycle. There was not a clear explanation for the failure of the colony in 2003-04, and so the monitoring was enhanced to improve monitoring of total population, year-to-year chick survival, and guillemot prey species.

TABLE 4. Black Guillemot yearly totals for adults, nests (early and late), eggs, and chicks (early and late) at Herschel Island, Yukon. Values are given for percent of nests surviving June to August, percent of eggs hatched, and percent of chicks surviving from early to late August.

		nests			eggs		chicks		
year	**adults**	**early**	**late**	**%**	**total**	**%**	**early**	**late**	**%**
1984*	107	14	--	--	--	--	--	--	--
1985*	83	23	--	--	--	--	--	--	--
1986*	90	31	--	--	--	--	--	--	--
1988	--	26	--	--	45	--	--	--	--
1992	--	36	--	--	34	--	--	--	--
1993	--	32	--	--	59	--	--	--	--
1994	--	37	--	--	46	--	--	--	--
1996	--	23	--	--	41	--	--	--	--
1997	--	19	--	--	30	--	--	--	--
1998	--	29	21	72	47	77	36	34	94
1999	--	33	18	55	50	68	34	29	85
2001	--	29	--	--	41	--	--	--	--
2002	--	16	--	--	26	--	--	--	--
2003	--	12	2	17	15	20	3	2	67
2004	--	10	0	0	14	7	1	0	0
2005	60	18	11	61	29	76	22	22	100
2006	40	12	9	75	19	68	13	13	100
2007	40	15	12	80	24	71	17	16	94
2008	40	25	17	68	41	78	32	25	78
2009	59	18	17	94	33	97	32	31	97
2010	59	22	22	100	34	100	34	29	85
2011	42	16	14	88	29	79	23	22	96
2012	52	23	20	87	41	85	35	32	91

Note: *Early* (mid-July) and *late* (mid- to late-August) totals for nests indicates the number of nests abandoned through the season; while totals for eggs combined with e*arly* (early-August) and *late* (mid- to late-August) totals for chicks indicates brood reduction through the season. Data (*) for 1984-86 are from Ward *et al.* (1986).

Nesting chronology: A survey of the colony on 21-28 July 2005 found that no eggs had yet hatched (Eckert *et al.* 2006). This was surprising since surveys in 1984 and 1985 found that hatching began in mid-July (Ward *et al.* 1986). This suggests that nesting chronology has shifted to slightly later in the season. There are very few observations of fledgling dates; in 2012, the first guillemot chick left the nest on 24 August and was seen feeding on Pauline Cove.

Banding returns: Guillemots do not generally breed in their first 3-4 years of life and so the first return of adult guillemots banded as chicks at Herschel in 2009 was right on schedule. In 2011, an adult guillemot born on the island in 2006 returned and successfully nested. These results indicate that the Black Guillemot population at Herschel depends to some extent on its own productivity. Observations over the coming years will determine the rate of return and nesting activity of the island's hatchlings.

Prey species: Since 2005, we have opportunistically observed and recorded prey species being carried by adult Black Guillemots to their nests. The most common prey are Arctic Cod (*Arctogadus glacialis*), Slender Eelblenny (*Lumpenus fabricii*), and sculpin (*Myoxocephalus* sp.); with a variety of other fish taken including Artic Lamprey (*Lethenteron japonicum*), Capelin (*Mallotus villosus*), and eelpout (*Gymnelus* sp.).

Recommendations

- Monitoring Black Guillemot population and nesting success provides a valuable indicator of park ecological integrity across ecosystems and food-chain levels and is a high priority of the monitoring program;
- The structural state of the mission house is a concern and a contingency plan is required for maintaining the nest boxes should the mission house collapse.

4. Vegetation

4.1. Vegetation permanent plots

Field inventories and soil and vegetation mapping were conducted at Herschel Island in 1985 (Smith *et al.* 1989). Fifteen years later, during ranger training in 1998-99, apparent increases in a number of plant species were noted. Further studies confirmed changes in the percent cover and frequency of occurrence for a number of species in two major vegetation communities (Kennedy *et al.* 2001; Dehn 2003). The cottongrass/tussock vegetation community showed significant increases in the percent cover of *Lupinus arcticus*, *Arctagrostis latifolia*, *Eriophorum vaginatum* and *Salix reticulate*; as well as a decrease in the percent cover of lichen. The Arctic Willow/dryas/vetch community showed significant increases in the percent cover of *Dryas* sp, *Lupinus arcticus*, *Arctagrostis latifolia*, total graminoids and total *Salix* sp.; as well as decreases in the percent cover of lichen and bare ground.

In 1999, permanent vegetation plots were established in two upland plant communities (labeled as *Herschel* and *Komakuk* units). In each vegetation community, 6m x 1m plots were randomly placed in 10 m increments along a 50 m transect which follows the 1996 ITEX manual (Molau and Molgaard 1996). Plant cover was measured within these plots using a 100-point, 1 m^2 point-frame in which all vegetation intersections from canopy to ground surface were recorded along with relative height of the canopy top. These plots were re-sampled in 2004 and 2009 and will be re-sampled every 5 years by a vegetation specialist, to monitor long-term changes in plant species cover and biomass. Data-loggers were installed at each permanent plot.

Average percent cover across the 6 plots was calculated as the total number of pins where the species was recorded divided by 600 total possible pins. Based on changes that were recorded between 1985 and 2001, we calculated percent cover for *Lupinus arcticus*, *Arctagrostis latifolia*, *Eriophorum vaginatum,* and *Salix reticulata* and total lichens in the cottongrass/tussock vegetation community.

For the Arctic Willow/dryas/vetch community, average percent cover was calculated for *Dryas integrifolia*, *Lupinus arcticus*, *Arctagrostis latifolia*, total graminoids, total *Salix* species, total lichens, and bare ground. ANOVA tests were performs to test for differences between the 3 sampling periods. For species which showed significant changes, a Tukey test was performed to show which sampling periods showed the significant change.

Key Findings

The permanent vegetation plots have shown trends during 1999-2009 (Figures 2-4). The cottongrass/tussock vegetation community showed significant increases in *Arctagrostis latifolia*; while *Eriophorum vaginatum* increased and lichens decreased but these trends were not statistically significant. The Arctic Willow/dryas/vetch vegetation community showed significant increases in percent cover of *Dryas integrifolia* and graminoid species; while there was a statistically insignificant decrease in lichens and statistically insignificant increases in the remainder of the species analyzed.

Two species of willow showed increasing trends, though the change was not statistically significant. Recent research examining vegetation change over a longer time frame has found significant increases in willows on Herschel Island (Myers-Smith *et al.* 2011). The lack of statistical significance with some trends is likely a result of the relatively short time period (10 years) of sampling. Trends may become significant over time.

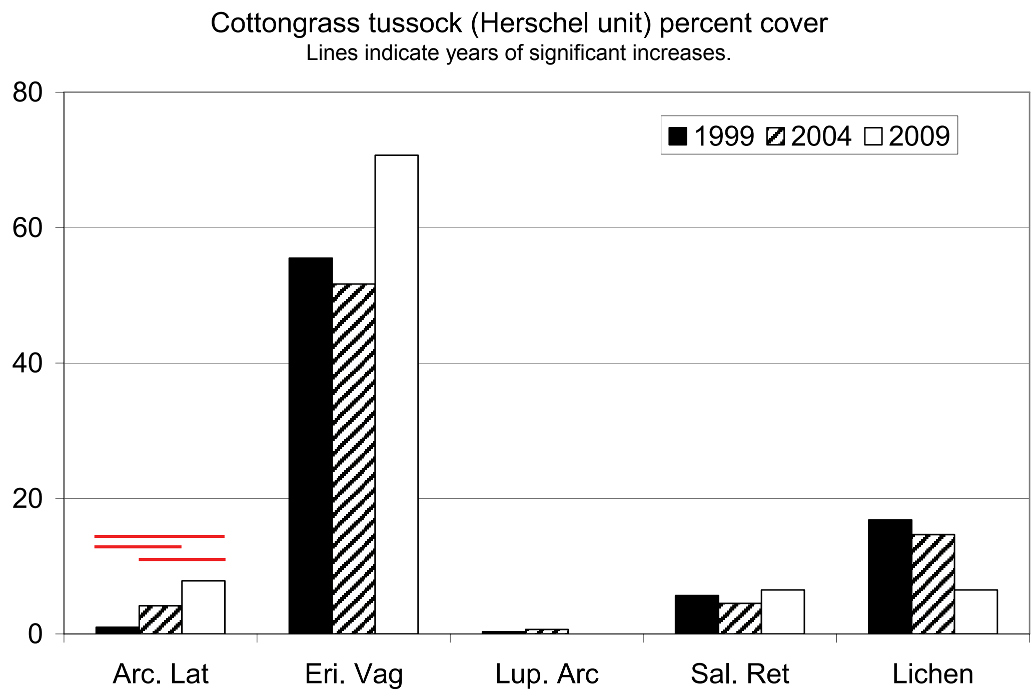

FIGURE 2. Changes in percent cover, Cottongrass Tussock vegetation community.

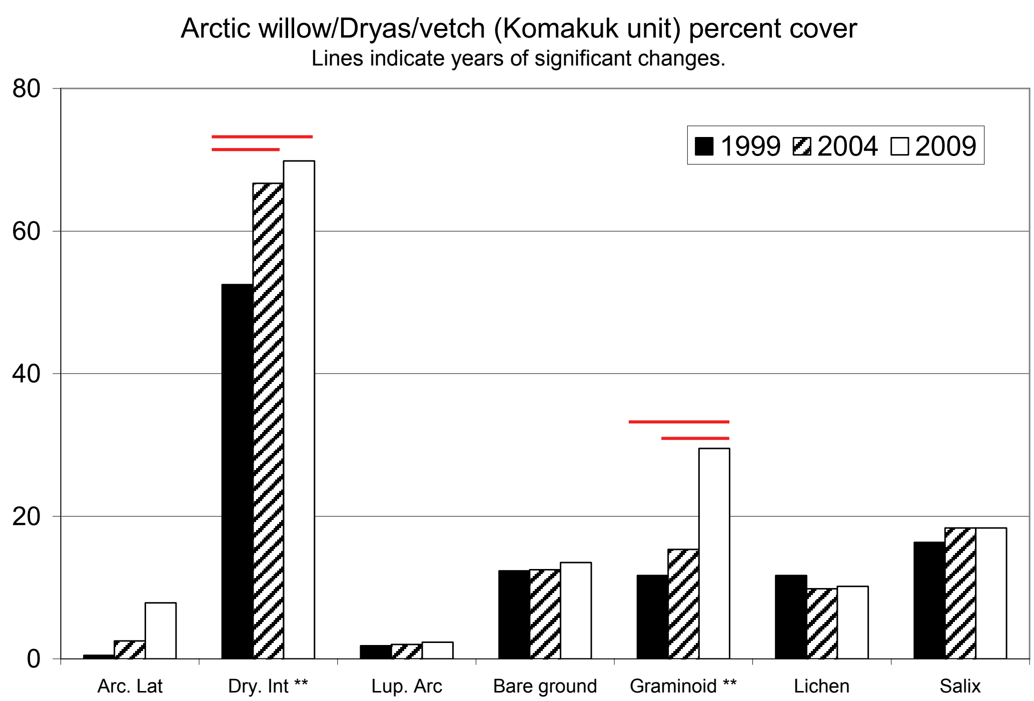

FIGURE 3. Changes in percent cover, Arctic willow/Dryas/vetch vegetation community.

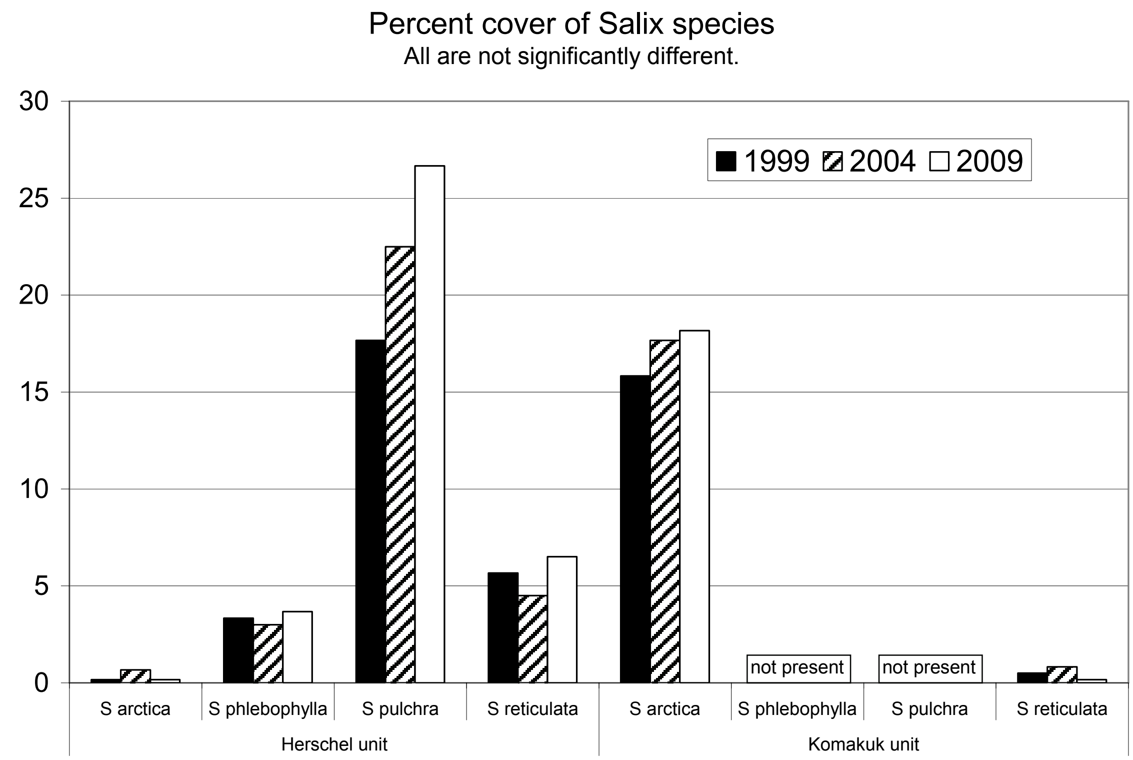

FIGURE 4. Percent cover of willow (*Salix*) species.

Recommendations

- The permanent plots have shown conspicuous trends in vegetation change during 1999-2009 and we recommend that the plots be re-sampled every 5 years – which can be done through collaborative efforts with researchers;
- Additional plant species could be considered for future monitoring within the existing plot design.

4.2. Vegetation transects

Research on long term responses of vegetation to climate have revealed patterns; for Arctic and Sub-arctic sites, plant response varies by species though temperature and the date of snowmelt generally have the largest effect on plant growth and reproduction (Bean 2005). Tundra study sites, as part of the Canadian Tundra and Taiga Experiment (CANTTEX) monitoring network, show increased moss, lichens and bryophytes over time with increased temperature. In areas with an increase in shrubs there is a loss of shade intolerant species such as lichens, mosses, and cottongrass. Plant reproductive stages are sensitive to warming however vegetative growth is not. That is, plants flower earlier giving seeds longer to mature but the plants don't extend their season. There is an overall loss of plant diversity.

Permanent transects were established on Herschel Island for common circum-Arctic species Arctic Willow (*Salix arctica*), Mountain Avens (*Dryas integrifolia*), and Cottongrass (*Eriophorum vaginatum*). The methodology follows the International Tundra Experiment (ITEX) protocols for phenology (Molau and Molgaard 1996). Individual plants, clones or tussocks are permanently marked. Response variables were chosen based on ease of measurements (Table 5), particularly for non-botanists and relevance to our anticipated questions. The data are shared with member organizations of the Canadian Tundra and Taiga Experiment (CANTTEX).

The CANTTEX system is designed to record plant productivity and growth related to long term weather patterns (climate) to compare growth between years and to compare to other CANTTEX sites. Air temperature data from the automated weather station at Pauline Cove is obtained from the Environment Canada website. Environment Canada cautions that these data have not been quality checked. The park rangers manually record numerous weather data including air temperature at Pauline Cove at least daily and we use the ranger weather data to supplement data recorded at the weather station. In addition to temperature data, we ask rangers to record sky conditions, visibility and wind information.

TABLE 5. List of measures for vegetation phenology transects.

Measure	*Dryas integrifolia*	*Eriophorum vaginatum*	*Salix arctica*
Phenology (dates)	snow free	snow free	snow free
	first color on flower buds	first flower bud	first leaf bud-burst
	first open flower	first pollen visible	first pollen visible
	last petal shed		onset of seed dispersal
	first twisting of filaments on seed heads		first yellowing of leaves
			last green leaf turning yellow
			all leaves shed
Reproductive effort	number of elongated flowers	number of mature flower heads	number of catkins
	number of un-elongated flower buds	number of undeveloped flower buds	length of catkins
Vegetative growth effort	percent cover	tussock diameter	number of growing points
	length of pedicels	length of 10 longest leaves	length of longest leaf

For all plant species, transects are checked for phenology variables every 3 days from mid-April to late-August (Table 5). The mid-season quantitative measurements are done on or near 15 July every year. In 1999, tussock diameter was measured in one dimension only. Starting in 2002, tussock diameter was measured in 2 dimensions and the average of both measurements was used for each tussock.

Key Findings

Environment Canada weather data: Environment Canada shares daily weather data for the Herschel Island station for 1899 to 1905, 1974 and 1975, and 1994 to current (Table 6). Daily data (as opposed to hourly data) were used here because the dataset contains mean, maximum and minimum temperatures (Figure 5). There are substantial data gaps in the data, presumably due to weather station malfunctions. Data points for 11 entire months were censured if there were 15 or fewer data points in a month (1904: Sep, Oct, 2004: Sep, Oct, 2005: Jan, Mar, Apr, 2006: Jan, Apr, 2009: Apr, Dec). For 9 of these months, all recorded data were censured. For Apr 2009, temperatures only and for Dec 2009, temperatures and precipitation data were censured. Data were completely missing for 2007 and 2008. Growing Degree Days (GDD) is defined as the degrees in temperature above a daily mean of $+5^{o}C$ (Figure 6). For example a daily mean temperature of +4°C is zero. A daily mean temperature of +8°C is three. Missing data precluded calculation of any GDD values for 1974, 1975 and 1994, and maximum and last GDD's for 1904 and 2004.

For all analyses, in addition to the general caution from Environment Canada, the data prior to 1994 should be considered with great caution due to technology improvements in the past 100 years. The mean and standard errors were calculated by year for all quantitative measurements. Mean dates were calculated for all phenology measurements. Simple ANOVA models were run to test for significant differences between years. There is no trend in the Growing Degree Days for the Environment Canada data.

TABLE 6. Environment Canada weather station - monthly means of daily mean temperature (degrees Celsius) for Herschel Island—Qikiqtaruk Territorial Park, 1899-2009.

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ALL
1899	-28.2	-31.3	-25.2	-18.6	-5.7	4.7	8.2	6.2	-0.9	-8.7	-19.9	-25.3	-11.9
1900	-30.4	-28.0	-22.0	-15.8	-8.2	2.9	6.0	3.6	1.1	-10.3	-18.8	-27.5	-12.3
1901	-29.6	-26.3	-31.0	-17.7	-9.2	1.3	7.3	5.0	1.1	-8.2	-20.3	-24.7	-13.0
1902	-31.0	-22.2	-31.1	-17.6	-6.2	3.8	8.4	7.5	1.8	-2.7	-20.9	-24.5	-11.7
1903	-28.8	-24.0	-19.4	-17.0	-7.3	2.4	5.3	5.3	-0.6	-14.2	-22.6	-24.4	-12.1
1904	-30.3	-26.5	-19.2	-14.9	-4.6	1.1	7.0	4.5			-24.6	-26.7	-13.3
1905	-19.3	-25.1	-24.5	-17.3	-6.2	2.8	6.2	4.2	-5.5	-11.5	-16.5	-29.2	-11.8
1974							5.6	4.5	1.2				
1975	-32.2	-26.9	-22.2							-11.6			
1994								7.8	0.3	-6.8	-19.9	-22.1	
1995	-22.3	-22.9	-25.2	-11.3	-0.8	3.7	8.6	6.1	4.2	-6.4	-17.5	-24.4	-9.1
1996	-22.0	-23.3	-18.5	-16.8	-4.1	3.7	8.8	3.5	-2.6	-14.6	-16.1	-20.5	-10.1
1997	-23.8	-24.6	-24.5	-13.5	-4.2	4.0	8.9	10.5	4.5	-7.0	-10.3	-22.5	-8.3
1998	-27.2	-23.7	-16.2	-5.8	-0.5	7.5	15.1	16.2					
1999							7.7	7.2	2.3	-8.2	-17.8	-24.2	
2000	-30.4	-28.0	-22.0	-15.8	-8.2	2.9	6.0	3.6	1.1	-10.3	-18.8	-27.5	-12.3
2001	-29.6	-26.3	-31.0	-17.7	-9.2	1.3	7.3	5.0	1.1	-8.2	-20.3	-24.7	-13.0
2002	-31.0	-22.2	-31.1	-17.6	-6.2	3.8	8.4	7.5	1.8	-2.7	-20.9	-24.5	-11.6
2003	-28.8	-24.0	-19.4	-17.0	-7.3	2.4	5.3	5.3	-0.6	-14.2	-22.6	-24.4	-12.1
2004	-30.3	-26.5	-19.2	-14.9	-4.6	1.1	7.0	4.5			-24.6	-26.7	-13.3
2005					-3.4	2.2	5.2	7.3	2.1	-5.9	-21.4	-18.0	
2006					-1.7	5.1	8.5	7.6	4.8	-3.6	-17.1	-16.2	
2007													
2008													
2009					-3.9	2.7	8.1	6.1	2.3	-3.3	-18.5		
ALL	-28.0	-25.4	-23.6	-15.6	-5.3	3.1	7.6	6.2	1.0	-8.4	-19.4	-24.2	-10.3

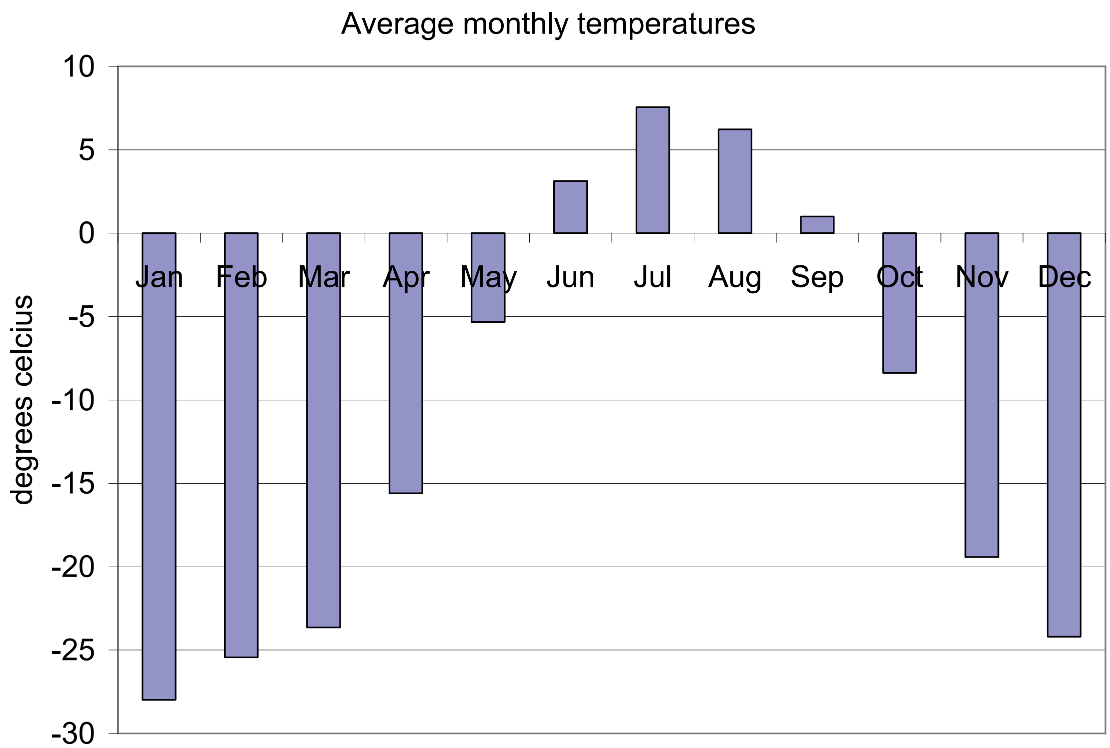

FIGURE 5. Average monthly temperatures, 1899 to 1905, 1974, 1975, 1994 to 2009.

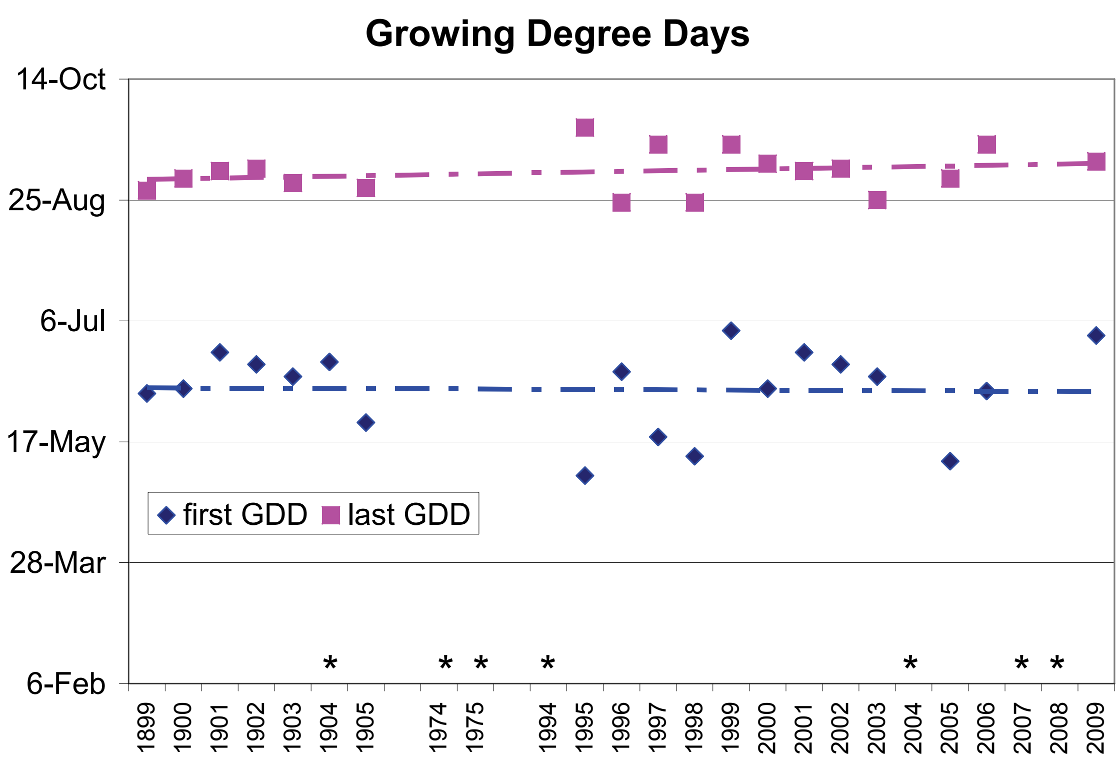

FIGURE 6. First and last Growing Degree Days, 1899 to 2009, showing trend lines.

Phenology measures: Figures 7-9 present values for all phenology measurements. All measurements except *Eriophorum vaginatum* P2 (date of appearance of first flower bud) were significantly different from each other. 2005 was an early snow melt and a warm year for *Dryas* and *Eriophorum* but not for *Salix*. There was little effect to the early year for *Eriophorum* however counter intuitively, 3 of 4 phenology measures for *Dryas* were delayed. We've rarely documented *Salix* P6 (last green leaf turning yellow) and P7 (date all leaves dead) because the park closes before these events occur. This lack of senescence data is not an uncommon situation for ITEX / CANTTEX sites.

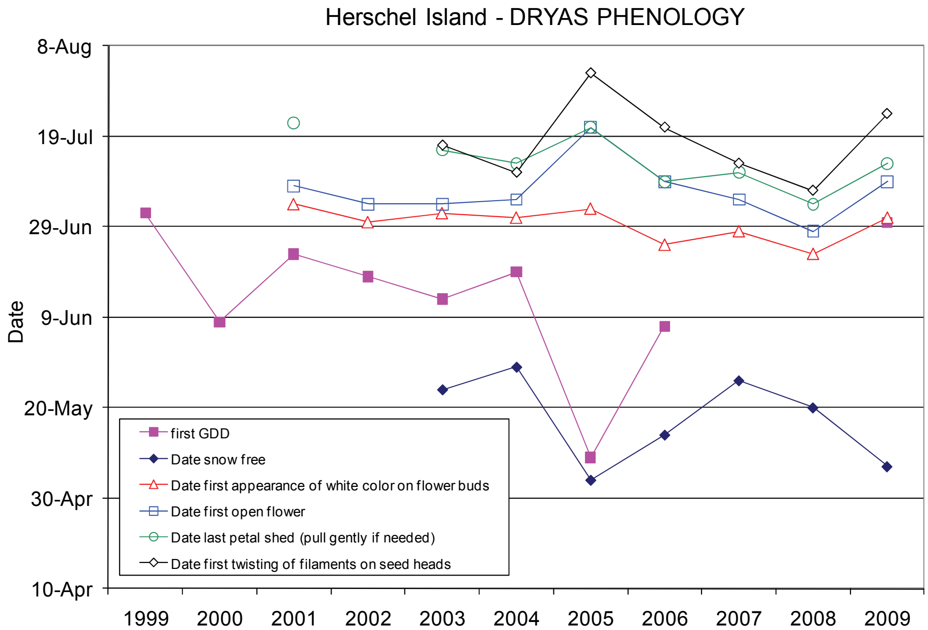

FIGURE 7. Dryas phenology measurements.

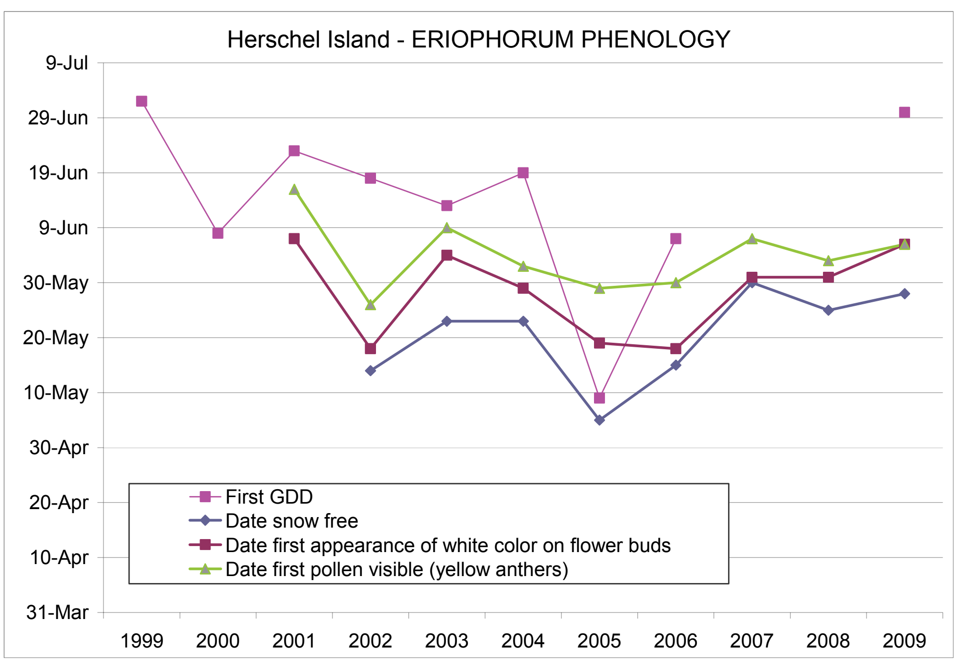

FIGURE 8. Eriophorum phenology measurements.

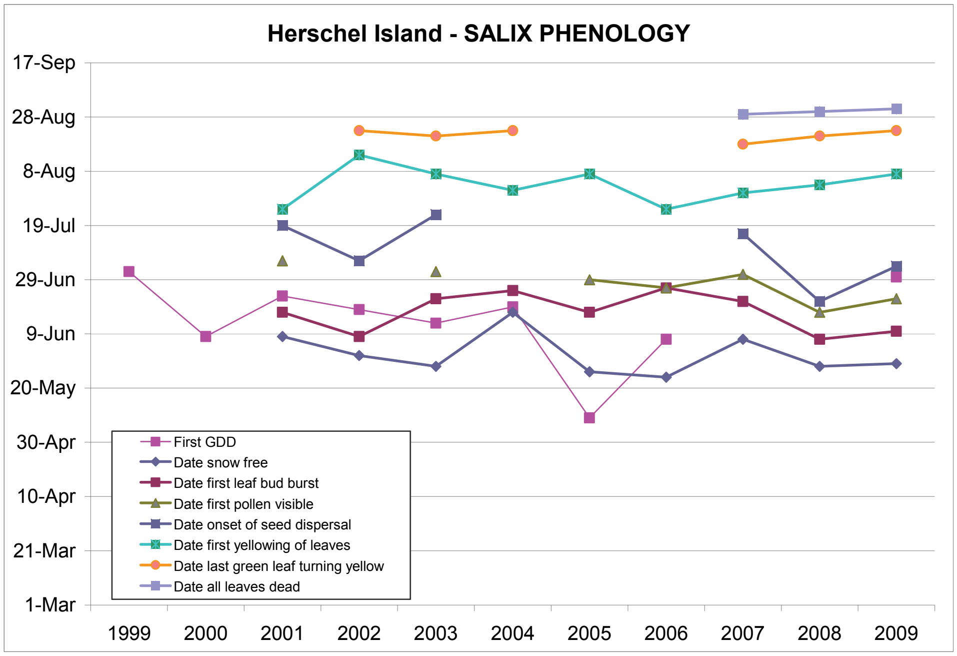

FIGURE 9. Salix phenology measurements.

Quantitative measures: Figures 10-12 present quantitative measurements for phenology plots. All measurements were significantly different from each other. The early melt of 2005 had no effect on the mid season quantitative measurements. For *Dryas*, there were 4 years of relatively few elongated (mature) flower heads but this does not seem to be statistically related to anything we measured.

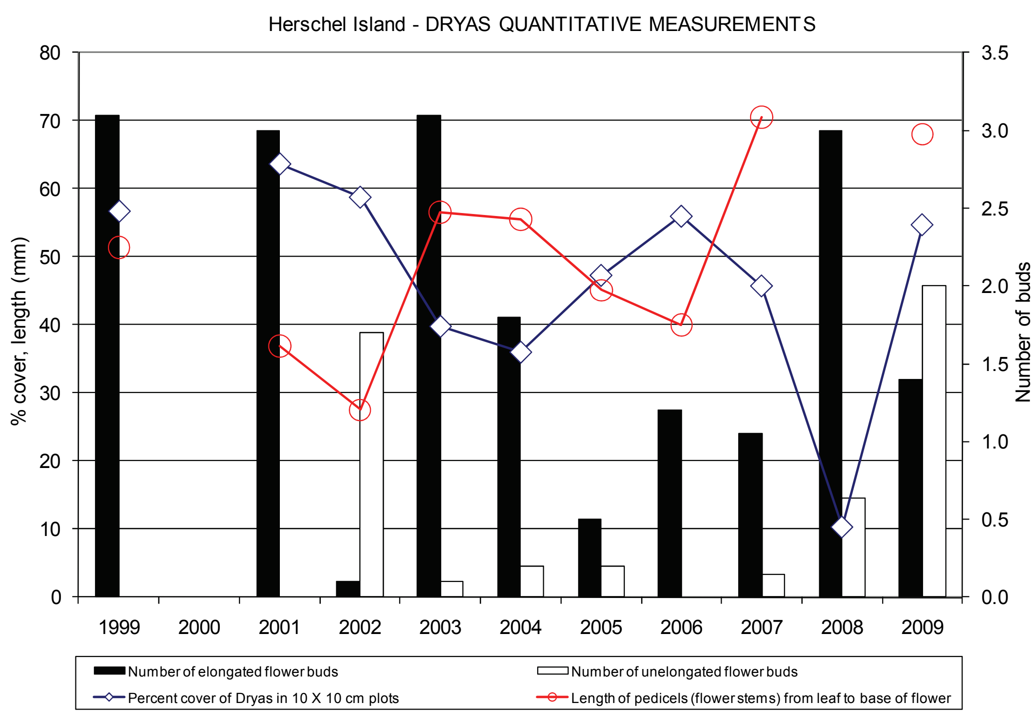

FIGURE 10. All Dryas quantitative measurements.

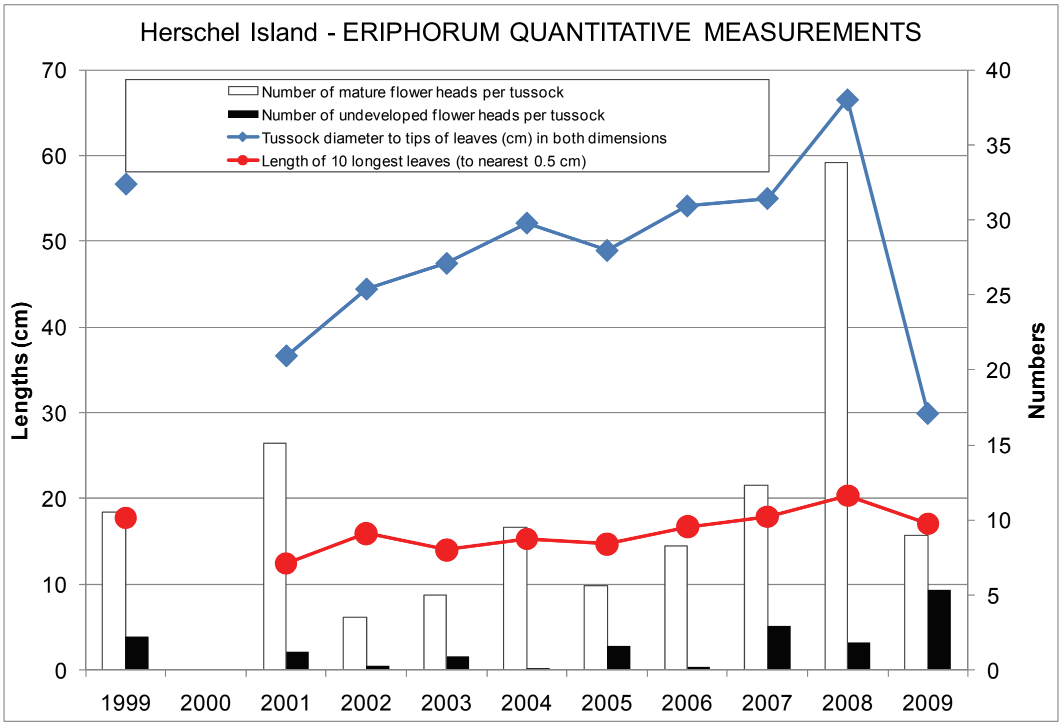

FIGURE 11. All Eriophorum quantitative measurements.

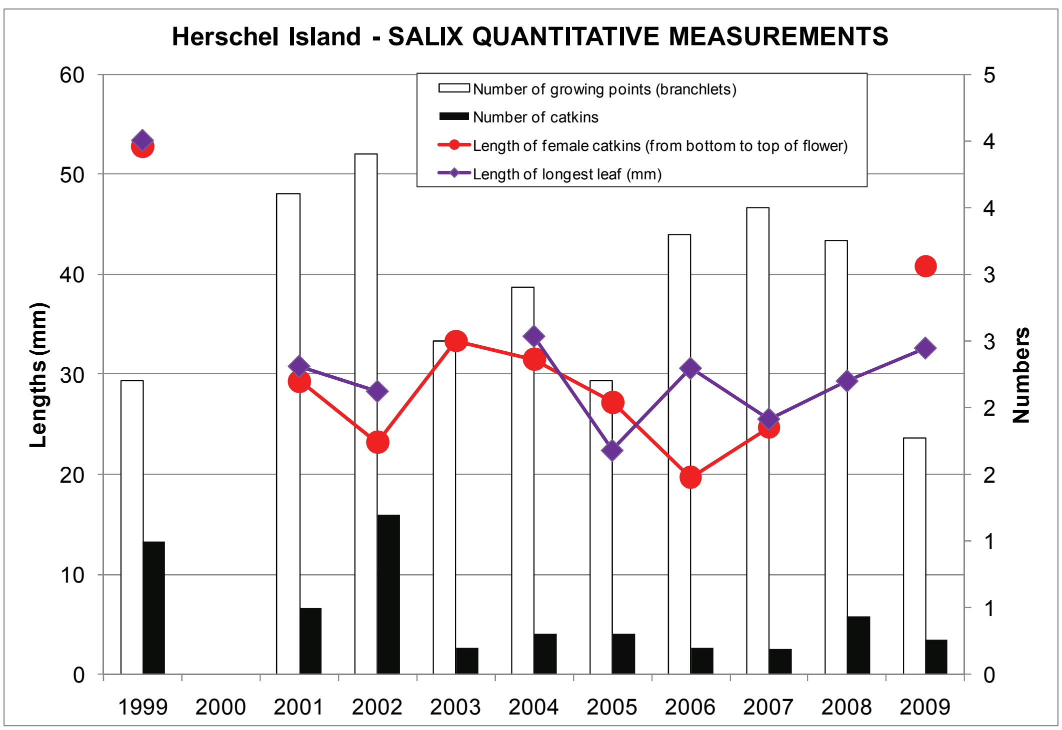

FIGURE12. All Salix quantitative measurements.

Recommendations

- Vegetation changes are significant between years. However, the 10 years of data collected have not yet indicated a statistically significant relationship between vegetation change and temperature. We expect that significant trends could emerge over the next 10 years and recommend that the monitoring be continued;
- Weather station malfunctions are fairly common. This is problematic particularly if the station fails early in the calendar year and is not repaired before May, preventing us from calculating Growing Degree Days. We recommend then that rangers record daily minimum and maximum temperatures as part of their weather observations. Another option is to deploy a fully automated weather station for Herschel similar to ones established in Tombstone Park.

5. Abiotic

5.1. Active Layer temperature

The active layer refers to the ground between the surface and permafrost. Changes to the active layer through climate change have profound implications to vegetation change on the island. The depth of the active layer was recorded during the baseline vegetation and terrain work in the mid to late 1980's. Monitoring of soil temperatures at two permanent vegetation plots began in 1999. The Arctic willow/Dryas/vetch community was named *Komakuk*, and the Cottongrass vegetation community was named *Herschel*. Two HOBO data-loggers were installed on 18 July 1999 and programmed to record the temperature at 20, 50, 100, and 150 cm depths at 6 hour intervals.

Key Findings

The harsh environment and curious wildlife of Herschel Island presented significant challenges to maintaining functioning data-loggers. For example, the *Komakuk* vegetation plot lost its 20 cm sensor which was pulled deeper into the ground in the first year. This was not an issue in the *Herschel* vegetation plot as permafrost is closer to the ground surface therefore the sensors were installed at shallow depths only. In 2006, the *Komakuk* data-logger disappeared and was subsequently replaced, though the new unit did not record data during September 2007 to April 2008. The data-logger disappeared again, and was subsequently replaced. The *Herschel* data-logger failed during the winters of 1999/2000 and 2000/2001. Each summer the data-logger was replaced. On 3 November 2001, the data-logger apparently malfunctioned and the 50 cm sensor appeared to be offset; the temperatures recorded rose abruptly by roughly 25.78^{o}C. The relative temperatures appeared plausible so a correction of 25.78^{o}C was applied to the temperature values from 3 November until 15 May 2002 when recorded values became too variable to consider. A similar situation arose on 5 November 2002 and a correction of 21.94^{o}C was used. In both years, the 20 cm sensor seemed unaffected by these anomalies so uncorrected temperatures were used. The *Herschel* data-logger was destroyed in 2004. Another borehole was drilled in 2006 and a new logger was installed with sensors at 10, 20 50 and 100 cm. That logger disappeared again in 2009 and it has not since been replaced.

Despite the challenges of maintaining data-loggers, the following results present ground temperature data for the two vegetation plots;

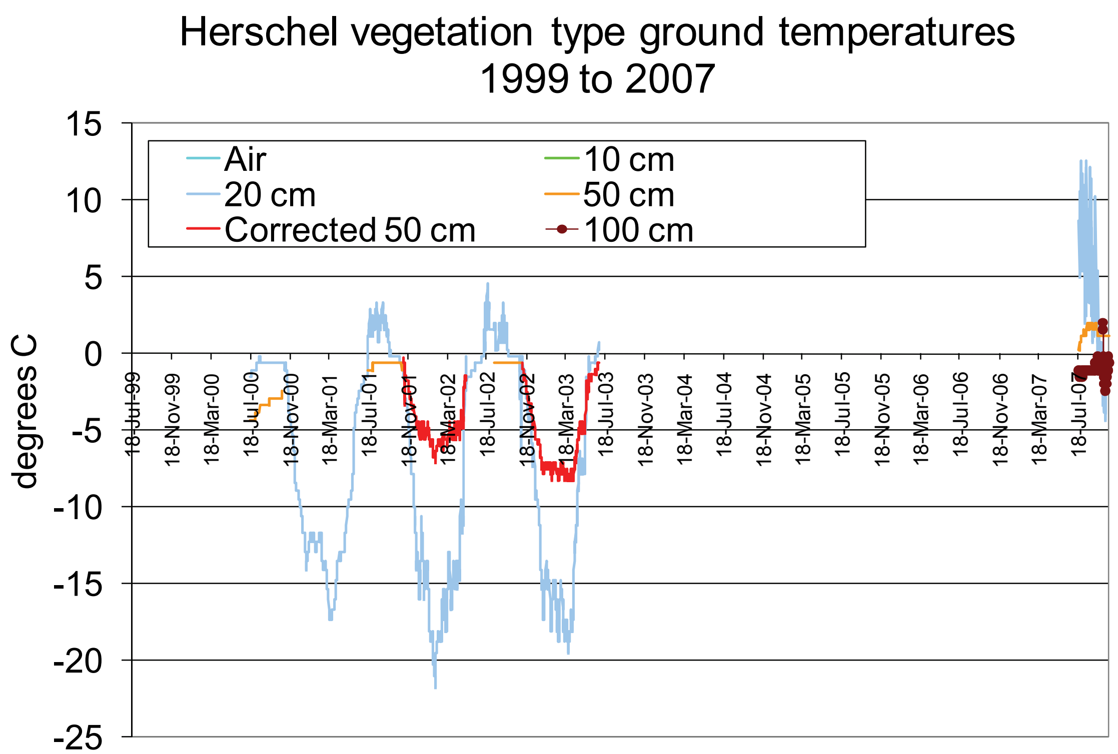

FIGURE 13. *Herschel* vegetation plot ground temperatures (degrees Celsius).

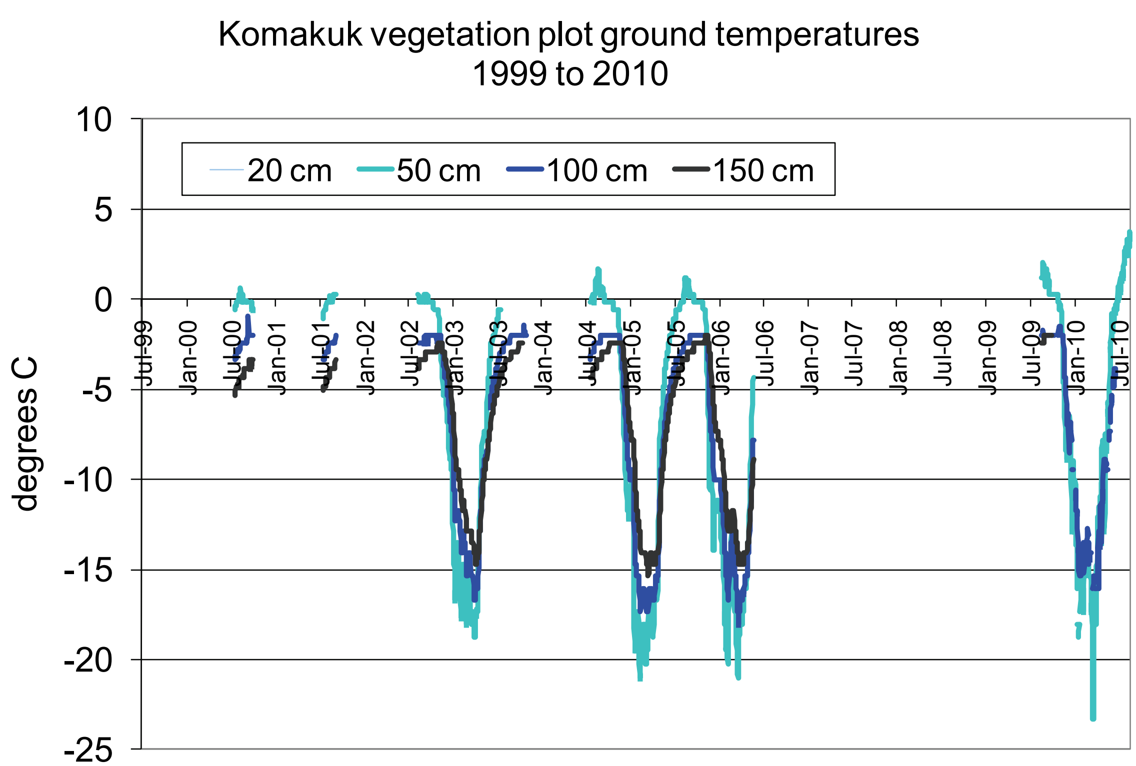

FIGURE 14. *Komakuk* vegetation type ground temperatures (degrees Celsius).

Recommendations

- Changes to the active layer resulting from climate change have profound implications to vegetation cover and many aspects of the island's ecology; and we therefore recommend that monitoring of the active layer continues;
- The maintenance of consistently function data-loggers has been a significant challenge to this project. We therefore recommend seeking alternate means of maintaining data-loggers, particularly through collaborations with researchers.

5.2. Deep permafrost temperature

Dr. Chris Burn of Carleton University is monitoring permafrost temperatures using three boreholes established in different years. The deepest sensor is place 42 meters below the ground surface, well into permanently frozen ground. Soil temperature changes at these depths will signal long-term changes in the thermal regime of the island's soil environment. At a relatively shallow borehole, sensors are placed at 2, 3, 4, and 5 meter depths. Temperatures are recorded on a data-logger. Two deeper boreholes are measured manually at least twice per year (July and March / April). At the 15 meter deep borehole, sensors are placed at 1, 2, 3, 4, 5, 7, 10, 12 and 15 meter depths. At the 45 meter borehole, sensors are placed at 12, 16, 20, 24, 28, 32, 36, 40 and 42 meter depths. Data are recorded as resistance measures and are converted into temperatures.

Key Findings

Figure 15 shows ground temperatures at various depths, 2001-2008.

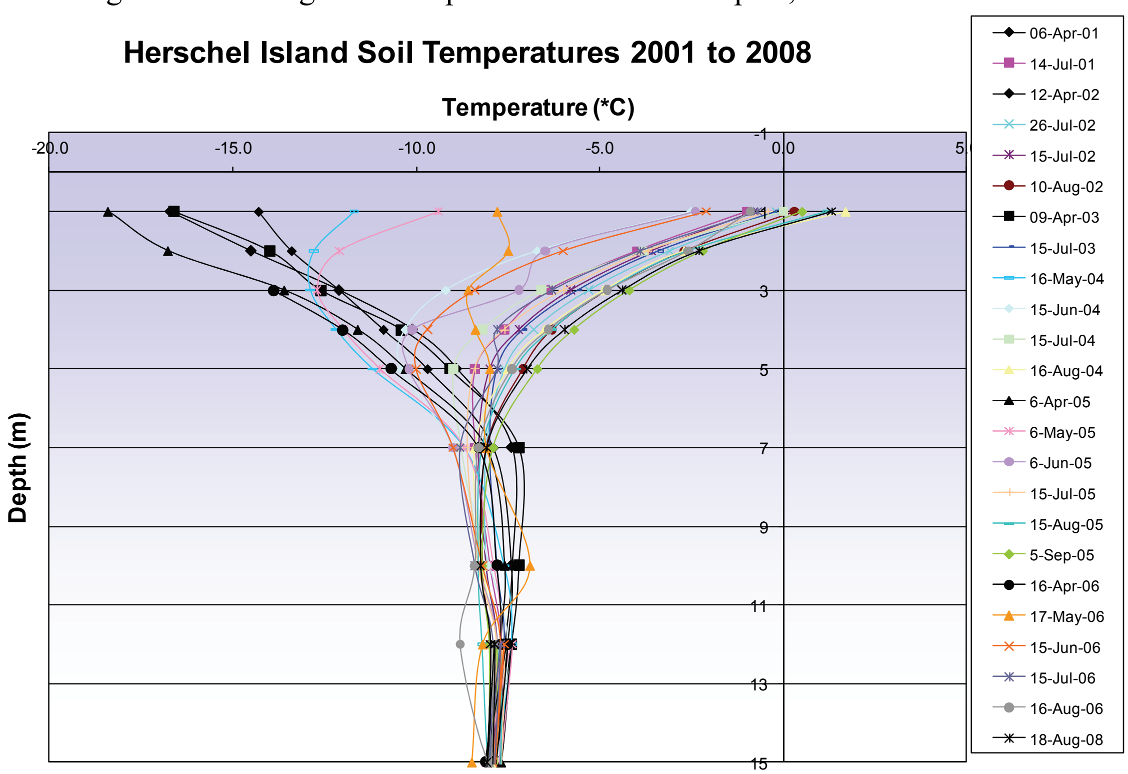

FIGURE 15. Herschel Island ground temperatures (degrees Celsius) to 43 meters deep.

Recommendations

- Deep permafrost temperature monitoring is a good example of Yukon Parks working collaboratively with scientific researchers to monitor aspects of the island's biophysical environment. We recommend that this project continues, and that Yukon Parks expands collaborative relationships with colleges, universities, and other research institutions.

5.3. Thaw slump growth

The retrogressive thaw slumps on Herschel Island are among the largest in the world. They are a unique feature that has attracted the attention of researchers and been a focus on climate-change related monitoring. Herschel Island rangers and community members have observed that the thaw slump activity on Herschel Island seems to be expanding and accelerating. This has been the focus of research by Dr. Wayne Pollard of McGill University, and Dr. Hugues Lantuit of the Alfred Wegener Institute for Polar and Marine Research (e.g. Lantuit and Pollard 2004, 2008). In 2005, park rangers began monitoring two large slumps, known as the Big Slump and the Ice-Valley Slump, along Pauline Cove. A set of distance measurements are recorded across each slump to track their growth. Measurements are taken in late August when the slump activity has decreased or ceased for the year and the edges are a bit more stable. Lines roughly parallel to the slope run up on each side of the slump. At pre-determined intervals along each line, the distance from the line to the edge of the slump is measured to the nearest centimeter. Measurements at each point are guided by a pair of spikes inserted perpendicular to the growth of the slump. After one year of measurements, we also installed spikes along the top of each slump to measure expansion of the slump up the slope. As the slumps grow, the lines will expand to encompass the slump. The design allows us to calculate an index of the surface area of thaw slumps each year but does not document depth of the slump which would give us volume of the slumped area. Surface area can then be "mapped" and calculated on the computer to estimate growth rates over time. We consider the "mapped" slumps indices because they are distorted due to different slopes along the different measurement lines.

Key Findings

The Big Slump was 9,143 m^2 (Figure 16) and the Ice Valley slump was 793 m^2 (Figure 17) when they were first measured in 2005. The Big Slump was not measured in 2006 therefore the measurement in 2007 includes the growth for both years (Figure 17; Table 7). The ranger's weather data were used to estimate the total Thawing Degree Days during the season for 2007-2008; and despite the small sample size, it appears that there is a relationship between Thawing Degree Days and slump growth (Figure 18).

TABLE 7. Total slump size (m^2) by year, with the increase in area (m^2) shown in brackets.

year	Big Slump	Ice Valley
2005	9143	793
2006	--	1029 (236)
2007	14614 (5471)	1990 (961)
2008	17312 (2698)	--
2009	17583 (271)	--

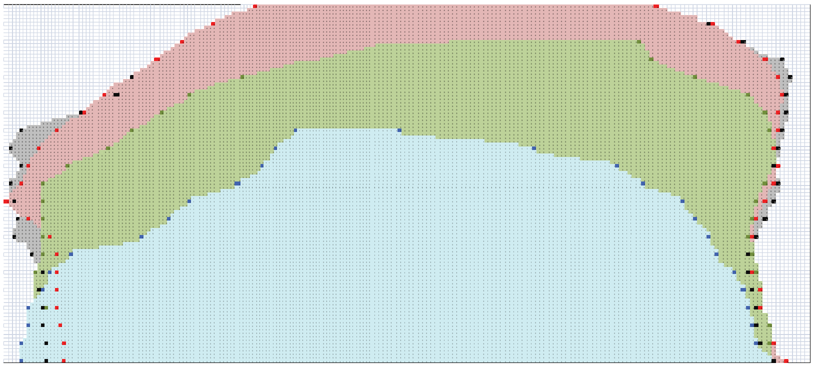

FIGURE 16. Big Slump measurements 2005 to 2009. Area by year = 2005 (blue), 2007 (yellow), 2008 (pink), and 2009 (grey).

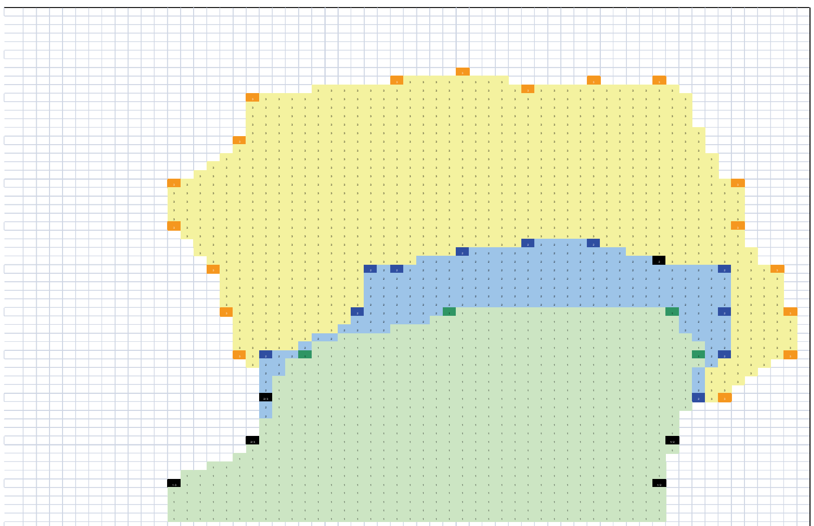

FIGURE 17. Ice Valley slump measurements 2005 to 2007. Area by year = 2005 (green), 2006 (blue), 2007 (yellow).

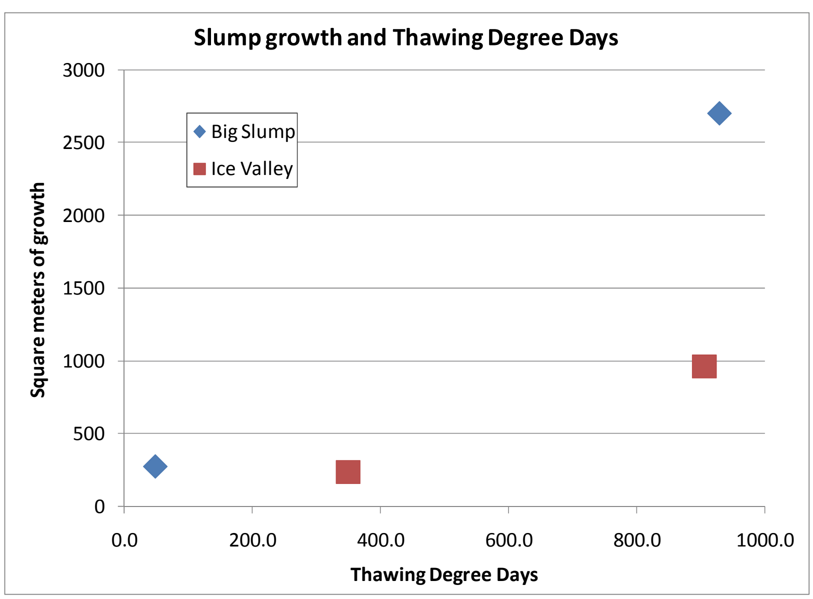

FIGURE 18. Slump growth and Thawing Degree Days.

Recommendations

- Yukon Parks should continue to encourage research focused on the thaw slumps at Herschel Island. This includes comprehensive studies by Dr. Wayne Pollard of McGill University; and Dr. Hugues Lantuit of the Alfred Wegener Institute for Polar and Marine Research;
- The simple method of monitoring slumps employed by the rangers has confirmed that retrogressive thaw slumps on Herschel Island are indeed growing at a rapid rate. So much so that the rate of growth can exceed the ability of the rangers to manually map the slumps; as the erosion quickly engulfed the marking sticks. Therefore, we recommend working with researchers to determine the most effective means of monitoring the slumps in the long term. Given the challenges of field measurements, it may be possible to get the same information using GPS tracks or satellite imagery.

5.4. Snow depth & ground temperature

A snow depth transect, 720 metres in length, was established by Dr. Chris Burn of Carleton University to document the relationships between snow cover, soil temperature, and vegetation (Burn 2004). The transect consists of 10 stations with data-loggers in a line from the settlement area to the tower on Collinson Head. Rangers measure snow depth along the transect in April, and the depth of permafrost at each station in August; while Dr. Burn downloads the temperature data-loggers and periodically measures vegetation plots along the transect to record species composition and biomass. Vegetation and soil temperature characteristics will be summarized relative to the snow depth and density at these sites. This work complements snow depth monitoring conducted by Environment Yukon at sites along the Dempster Highway and across the North Slope.

Key Findings

Burn (2004) found that the average temperature of permafrost at Collinson Head is -8^{o}C, while the near-surface ground temperature for 2003-04 at sites along the transect varied from -9^{o}C to -5^{o}C, depending on snow depth. Further, ground temperatures at depth (42.5m) suggest the permafrost on Herschel has warmed by 1.5 to 2^{o}C. Burn (2004) reports that in the valley, the early and deep snow prevented freeze-back of the active layer until late December, while at the other sites, with less snow, the active layer had frozen by mid-November. In summer, the ground temperatures at the sites along the transect are similar, so it is the winter conditions that separate them out. Burn (2004) concludes that these data demonstrate the importance of the snow cover to ground temperatures, and, therefore, suggest the significance of changes in snow cover as part of climate change. Further, the observations are of regional significance because there are no other data indicating the range of near-surface ground temperatures that may be observed due to natural variation at present.

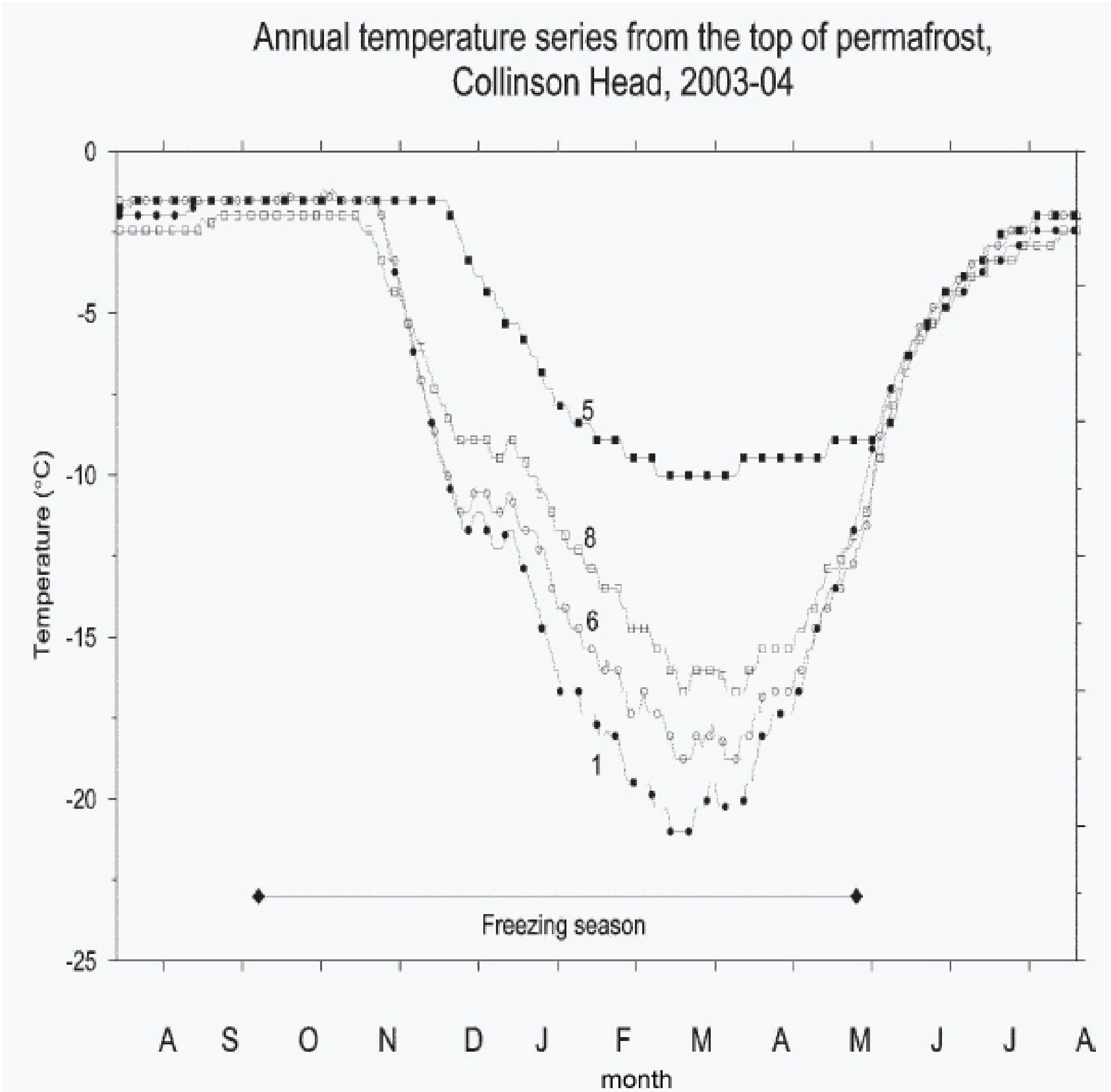

FIGURE 19. Temperatures at four sites along the transect, indicating the impact of variations in snow cover on ground temperatures over the winter. Note that in summer, temperatures at the sites are similar. But they may be substantially different in winter due to the insulating effect of snow cover (from Burn 2004).

Recommendations

- We recommend the continuation of this project which has established key baseline data on ground temperature and the influence of snow depth on Herschel Island; which are critical variables in understanding and predicting the potential impacts of climate change;
- This work illustrates how productive collaborations between researchers and park rangers can greatly enhance the monitoring program. We recommend that rangers continue to work with the researchers involved to ensure the long-term continuation and development of the project.

6. Human Use

6.1. Park visitors

Managing visitors to Herschel Island by Yukon Parks is an important aspect of park planning, management, and the protection of park values. Park rangers record the number and type of visitor which is key information for providing services and assessing potential negative impacts by park visitors. These data are gathered through overnight camping permits which are required for visitors; the island guest book which records day-use or cruise ship visitors; and the trappers' cabin guest book.

Key Findings

These data are summarized each year in the annual park operations report by Richard Gordon, senior park ranger. The first cruise ship visited Herschel Island in 2002, and since then cruise ship visitors have made up a substantial portion of day-use visitors. Researchers also comprise a large proportion of visitors. In recent years, Yukon Parks has required that researchers be as self-sufficient as possible in order to minimize their use of park resources (e.g. water, wood).

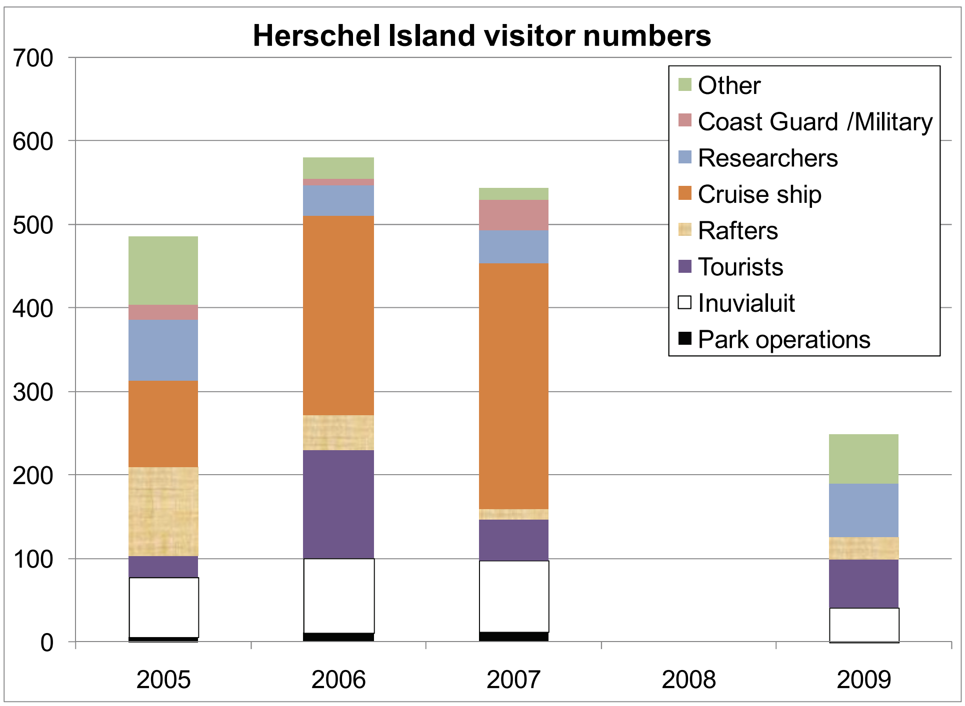

FIGURE 21. Herschel Island—Qikiqtaruk Territorial Park visitor numbers.

Recommendations

- We recommend that Herschel visitor data be integrated into park visitor databases from other Yukon parks to facilitate data management and reporting;
- Given the high proportion of cruise ship visitors and that this upward trend is expected to continue, these data point to the necessity of a strategy for cruise ship visitation to Herschel Island;

- Yukon Parks should continue to work directly with the researchers to ensure productive collaborations that do not impact on park resources or values;
- Continue to share these data with Yukon College whereby summaries are produced and posted on the Arctic Borderlands Ecological Knowledge Co-op site; http://www.taiga.net/coop/indics/overflts_her.html.

6.2. Aircraft landings and overflights

This project records aircraft activity on and over Herschel Island. Wildlife can be sensitive to aircraft disturbance so monitoring this indicator helps identify potential impacts. Measurements of aircraft activity related to industrial development or tourism can be used as a measure of human activities in an area. Fixed-wing landing in the wilderness area of the park is not allowed. A Park-Use Permit is required for helicopter landings, with appropriate conditions to ensure that the parklands and wildlife are protected to the greatest extent possible. Yukon Parks will continue to promote the use of float-equipped aircraft and will ensure that the number of tundra-tired aircraft landings on the beach is kept to a minimum level wherever possible. The minimum flight altitude of 610 metres as recommended by the Environmental Impact Screening Committee (2012) will be requested for island over-flights, with exceptions for researchers made under Park-Use Permit conditions. The rangers record all landings and over-flights by aircraft type and purpose of flight (e.g. shift change, researchers, Canada Customs, etc).

Key Findings

These data are summarized in the annual park operations report by Richard Gordon, senior park ranger. During 2005-09, park operations accounted for 30-40% of landings, while researchers accounted for 25-45% of landings.

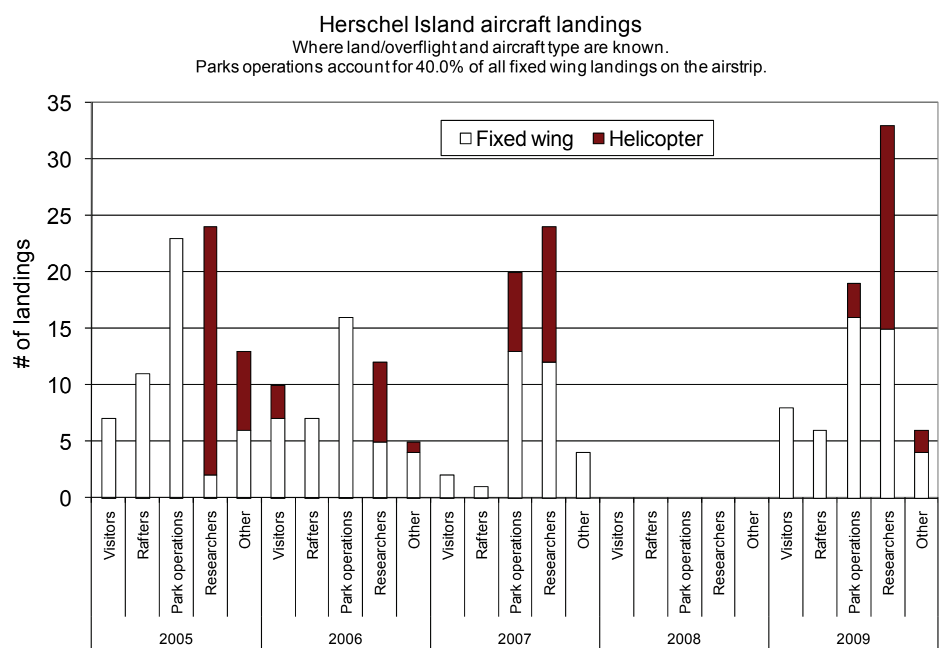

FIGURE 20. Aircraft landings and over-flights by type during 2005-2009.

Recommendations

- Yukon Parks is responsible for issuing Park-Use Permits for aircraft activity associated with Herschel Island, and as such has an obligation to track that activity. This project should continue as it enables Yukon Parks to respond to aircraft-related issues or concerns should they arise;
- Continue to share these data with Yukon College, whereby summaries are produced and posted on the Arctic Borderlands Ecological Knowledge Co-op site; http://www.taiga.net/coop/indics/overflts_her.html.

6.3. Beach landing-strip monitoring

The beach landing-strip at Pauline Cove provides operational support to rangers and researchers; and is also important for other visitors and tourists. The strip is used by Twin Otters out of Inuvik for transporting large loads or more than 3 passengers to the island. However, it is not a maintained or approved airstrip and the role of the park is limited to providing updates on the status of the strip and, when possible, clearing loose debris and driftwood from the beach. The judgment as to whether or not to use the strip resides with the air charter companies. The two main issues that have arisen in recent years with respect to the landing-strip that prompt its inclusion in the monitoring program are; i) the potential impact of the landing-strip on plants and wildlife; and ii) the status of the landing-strip in terms of safe take-offs and landings (eg. moisture, surface, debris, width, and length). This project responds to the Park Management Plan (Yukon Environment 2006) which calls for the monitoring of impacts associated with the use of the beach landing-strip. Observations of plant and wildlife use of the landing-strip area will be used to minimize the potential impacts of landing-strip use on the ecosystem.

Monitoring the physical status of the landing-strip provides aircraft charter companies with current information on the length, width, moisture, debris, and surface state of the strip. As well, this information will also be used to track the changing status of the airstrip over the years, and guide future management direction.

Key Findings

While a number of bird species are known to nest along the beach landing-strip, the Semipalmated Plover is the only one that regularly on the ground right on the strip. Fortunately, all the nests to date have been off to the side of the landing-strip. The rangers have marked the nests and guided planes to ensure that nests are not disturbed. This is the approach recommended in the program manual (Yukon Parks 2012), and to date it has been successful.

In 2007, the configuration of the beach landing-strip was dramatically altered by fall storms. Extremely hard work by the rangers reconfigured the landing-strip in a way that made it useable again and did not damage habitat or disturb wildlife. Since then, rangers have monitored the physical condition of the strip and that information is provided directly to pilots so that they can make decisions about landing on the island.

Recommendations

- Continue landing-strip monitoring with the emphasis on protecting birds and habitat, and providing current conditions to air charter companies;
- Maintain the good communication between the rangers in the field, the park office in Inuvik, and the air charter companies.

6.4. Cruise ship visitors

Managing cruise ship visitors in a safe and effective manner is a growing challenge to Herschel Island Park management. Cruise ship visitor group sizes range from 60-120 people which can disturb sensitive habitat, wildlife, as well as cultural and historical features. Current measures to avoid these impacts include; on-board orientation and impact-minimization briefing provided by park rangers prior to passengers disembarking; limiting the number of visitors allowed on the island at one time; encouraging tour operators to adhere to a appropriate codes of conduct; and increasing the educational material available to operators and tourists.

Key Findings

During 2002-2005, impact monitoring for cruise ship visits was initiated to assess the effects of large groups on trails and vegetation. This work determined that impacts to existing permanent trails (e.g. increased trail width) were not as severe as the damage to vegetation not associated with trails. This is because visitors are not necessarily using existing trails.

In 2012, sensitive wetland and wet tundra habitats not specifically associated with trails around the Pauline Cove settlement area were monitored during August cruise ship visits. These areas were observed before and after cruise ship visits, with the result being that park staff observed conspicuous foot-traffic impacts (ie. new trails) in sensitive habitats. In particular, there was a notable trail developing to the whalers' graves, and many foot paths across the coastal marsh. It is not yet known if these are short-term impacts with quick recovery, or long-term lasting impacts; or what effect group size and frequency have on these impacts.

Recommendations

- Continue to develop monitoring both in terms of assessing impacts, and recording cruise ship data. This will further enable management of the growing number of cruise ship visitors to the island; and provide key information to the development of a cruise ship strategy for the park.

7. Park Operations

7.1. Supplies and maintenance

While not technically part of the inventory, monitoring, and research program, the monitoring manual (Yukon Parks 2012) provides data sheets to record annual use of water, wood, propane, gas, as well as snowmachine maintenance, and shipping & receiving. This information is used to assess visitor capacity and plan operational budgets. The information is summarized in the annual park operations report by Richard Gordon, senior park ranger.

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